THE MICROCOSM:

THE ORGAN OF THE

Substantial Philosophy.

DEVOTED TO THE DISCOVERIES, THEORIES, AND INVESTIGATIONS OF MODERN SCIENCE, AND THEIR BEARINGS UPON THE RELIGIOUS THOUGHT OF THE AGE.

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PROF. TAIT ON FORCE.

A. Wilford Hall, Ph. D., LL. D.:

DEAR DOCTOR,—I have secured a copy of a lecture on "Force" by the distinguished savant, Prof. P. G. Tait, F. R. S., of the University of Edinburgh. As his views represent the most advanced scientific thought on this subject, and are now generally accepted as correct, and as your views on this subject differ so materially from those of Prof. Tait, in the interest of truth I respectfully request that you would benefit the readers of THE MICROCOSM with a crucial analysis of the views set forth below, which, without reproducing the whole lecture, represent the characteristics and peculiar features of the same.

The following are the salient paragraphs of his lecture:

"We read constantly of the so-called 'Physical Forces'—heat, light, electricity, etc.,—of the 'Correlation of the Physical Forces'—of the 'Persistence or Conservation of Force.' To an accurate man of science all this is simply error and confusion."

"Perhaps no scientific English word has been so much abused as the word 'force.' We hear of 'accelerating force,' 'moving force,' 'centrifugal force,' 'living force,' 'projectile force,' 'centripetal force,' and what not. Yet, as William Hopkins, the greatest of Cambridge teachers, used to tell us, 'force is force,' *i. e.*, there is but one idea denoted by the word, and all force is of one kind, whether it be due to gravity, magnetism, or electricity. This, alone, serves to give a preliminary hint that (as I shall presently endeavor to make clear to you) there is probably no such *thing* as force at all! That it is, in fact, merely a convenient expression for a certain 'rate.' If any one should imagine that 'three per cent.' is a sum of money he will soon be grievously undeceived. 'Three per cent.' means no more nor less than the vulgar fraction $\frac{3}{100}$. True the '*three per cent.*' usually means something very substantial—but there the term is not a scientific one."

"Heat, whatever it may be, is SOMETHING which can be transferred from one portion of matter to another; the consideration of temperatures is virtually that of the mere CONDITIONS which determine whether or not there shall be a transfer of heat, and in which direction the transfer is to take place. Bear this carefully in mind, because it has most important analogies to the results we meet with in considering the nature of force."

"It has been definitely established by modern science that ***heat, though not material,*** has *objective existence in as complete a sense as matter has.*"

"We may state once for all, that our conviction of the objective reality of matter is based mainly upon the fact, *discovered solely by experiment,* that we cannot in the slightest degree alter its quantity. We cannot destroy, nor can we produce, even the smallest portion of matter. But reason requires us to be consistent in our logic; and thus, if we find anything else in the physical world whose quantity we cannot alter, we are bound to admit it to have objective reality as truly as matter has, however strong our senses may predispose us against the concession. Heat, therefore, as well as light, sound, electric currents, etc., though not forms of matter, must be looked upon as real as matter, simply because they have been found to be forms of energy—which in all its constant mutations satisfies the test which we adopt as conclusive of the reality of matter. We shall find that this test fails when applied to force."

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"But you must again be most carefully warned to distinguish between heat and the mere sensation of warmth; just as you distinguish between the motion of a cudgel and the pain produced by the blow. The one is the *thing* to be measured, the other is only the more or less imperfect reading or indication given by the instrument with which we attempt to measure it in terms of some one of its effects. So that when your muscular sense impresses on you the notion that you are exerting force, as in pushing or pulling, you ought to be very cautious in forming a judgment as to what is really going on; and you ought to demand much further evidence before admitting the objective reality of force." . . . .

"'Some people are in the habit of confounding force with momentum. No one having sound ideas of even elementary mathematics would be guilty of this or any similar monstrosity. He would as soon, as Hopkins used to say, measure heights in acres, or arable land in cubic miles." . . . .

"The mathematician expresses this distinction at once by saying that momentum is the time-integral of force, because force is the rate of change of momentum." . . . .

"Whatever force may be, there is no such thing as centrifugal force; and accelerating force is not a physical idea at all. But that which is denoted by the term living force, though it has absolutely no right to be called force, is something as real as matter itself. . . . . The third law of motion Newton first shows to hold for ordinary pressure, tensions, attractions, impacts, etc.; that is, for *forces* exerted on one another by two bodies, or their time-integrals. And when he says—'If any one presses a stone with his finger, his finger is pressed with an equal and opposite force by the stone,' we begin to suspect that force is a mere name—a convenient abstraction—not an objective reality."

"Pull one end of a long rope, the other fixed, you can produce a practically *infinite* amount of force, for there is stress across every section throughout the whole length of the rope. Press upon a movable piston in the side of a vessel full of fluid, you produce a practically infinite amount of force, for across every ideal section of the liquid a pressure per square inch is produced equal to that which you applied to the piston. Let go the rope, or cease to press on the piston, and all this practically infinite amount of force is gone."

"When the distance between two bodies is doubled, their mutual attraction falls off to one-fourth of what it formerly was. Faraday seriously set to work to determine what became of the three-fourths which have disappeared, but all his skill was insufficient to give him any result. Faraday's insight was so profound that we cannot assert that something may not yet be discovered by such experiments; but it will assuredly not be a conservation of force."

"Newton says: '*If the action of an agent be measured by the product of its force into its velocity; and if, similarly, the reaction of the resistance be measured by the velocities of its several parts into their several forces, whether these arise from friction, cohesion, weight, or acceleration—action and reaction in all combinations of machines will be equal and opposite.*'"

"The actions and reactions which are here stated to be equal and opposite, are no longer simple forces, but are *products* of forces into their velocities; *i. e.*, they are what are now called *rates of doing work;* the time-rate of increase, or the increase per second of a very tangible and real SOMETHING—for the measurement of which rate Watt introduced the practical unit of a *horse-power*, or the rate at which an agent works when it lifts 33,000 pounds one foot high per minute against the earth's attraction.

"Now, think of the difference between raising a hundred weight and endeavoring to raise a ton. With a moderate exertion you can raise the hundred weight a few feet, *and in its descent it might be employed to drive machinery, or to do some other species of work;* but tug as you please you will not be able to lift the ton, and therefore, after all your exertion, it will not be capable of doing any work by descending again.

"Thus it appears that *force* is a mere name; and that the *product of a force into the displacement of its point of application* has an objective existence. [Even those who are so metaphysical as not to see that the product of a *mere name* into a *displacement* can have objective existence, may perhaps see that the quotient of a horse-power by a velocity is not likely to be more than a mere name.] In fact,

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modern science shows us that force is merely a convenient term employed for the present (very usefully), to shorten what would otherwise be cumbrous expressions; but it is not to be regarded as a *thing* any more than the bank *rate of interest* (be it two, two and a half or three per cent.,) is to be looked upon as a sum of money, or that the birth-rate of a country is to be looked upon as the actual group of children born in a year." . . . .

"In fact, a simple mathematical operation shows us that it is precisely the same thing to say:

"*The horse-power of an agent, or amount of work done by the agent in each second, is the product of the force into the average velocity of the agent;* and to say, *Force is the rate at which an agent does work per unit of length.*"

"Following a hint given by Young, we now employ the term ENERGY to signify the power of doing work, in *whatever* that power may consist. . . . .

"The conception of kinetic energy is a very simple one, at least when visible motion alone is involved. And from motion of visible masses to those motions of the particles of bodies whose energy we call heat, is by no means a very difficult mental transition. Mark, however, that heat is not the mere motions, but the energy of these motions—a very different thing, for heat and kinetic energy in general are no more '*modes of motion*' than potential energy of every kind (including that of unfired gunpowder) is a '*mode of rest!*' In fact, a '*mode of motion*' is, if the word motion be used in its ordinary sense, purely kinematical, not physical:—and if motion be used in Newton's sense, it refers to momentum, not to energy."

"The conception of potential energy, however, is not by any means so easy or direct. In fact, the apparently direct testimony of our muscular sense to the existence of force, makes it at first much easier for us to conceive of force than of potential energy. *Why* two masses of matter possess potential energy when separated—in virtue of which they are conveniently said to attract one another—is still one of the most obscure problems in physics."

Hoping you will examine into the above views and answer in your usual analytical manner,

I am yours very cordially,

HENRY A. MOTT.

REMARKS ON THE FOREGOING BY THE EDITOR.

Dr. Mott has our thanks for calling attention to this discussion of *force* by the eminent Prof. Tait. We like to present our readers with the views of great writers, especially with those which relate to physical science, as they are well calculated, even if not correct, to suggest the necessity for explanations of various matters that might otherwise remain obscure. But in this present case, we must confess to a degree of surprise and disappointment at the barrenness of definite ideas in the midst of so much apparently confident elaboration and matured critical thought. We dislike to say this at the very start, on entering upon the analysis of a paper from a great scholar and scientist which aims to discuss so important a subject in such a critical manner. Particularly were we disappointed, after reading Dr. Mott's introductory remarks, that "his views represent the most advanced scientific thought on this subject, and are now generally accepted as correct." After reading the extracts through the second time with the utmost care, we stopped and seriously asked ourself the question, what *are* these "views" which thus represent the most advanced scientific thought, and which are now generally accepted as correct? For the life of us we could not see any definite or settled *views* on the subject discussed worthy of the name of "advanced scientific thought." We saw, as we will try to make the reader also see, a vast amount of confused, incoherent, half-evolved and half-contradictory statements, with only one or two well-defined and clearly expressed scientific propositions that one could put his finger on and say, *there is a real scientific idea.*

If there is one thing more than another which we abominate in scientific discussion, it is obscurity or want of definiteness in a writer who is trying to present what he apparently believes to be new. We invariably conclude that such writer either has no well-defined, clear-cut ideas on the matter he is discussing, or else that his command of appropriate terms, in which to convey his thoughts,

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is mightily deficient. We would rather be guilty of downright plagiarism than to be justly chargeable with obscurity and the jumbling of ideas in the discussion of a scientific subject. If by these hints we are doing injustice to Prof. Tait, we freely beg his, Dr. Mott's, and the reader's, pardon. The sequel, however, will show. We owe a duty to our readers in these discussions which comes first in the category of our obligations, and however unpleasant it may be to criticise unfavorably the published views of a great and prominent writer, our duty, as a journalist, stands paramount to the mere conventional claims of courtesy. Will the reader therefore re-examine the extracts as given by Dr. Mott, and then see if our conclusions and criticisms are, or are not, too severe?

Now, we ask in the first place, what possible reason could Prof. Tait have for this vehement and almost ill-natured crusade against the use of the term *force?* It would almost seem as if he had recently had a personal controversy with some other professor on the question of force, in which he had been worsted, and thus been led inadvertently to oppose the use of that term, as not appropriate for scientific purposes, and that some sharp point of the controversy had so fastened itself in his memory that when he took up his pen to write his lecture he could not forego whaling his adversary indirectly by expressing his dislike for that repugnant term, *force.* But whatever the motive which induced this remarkable opposition to a short, euphonious, well-understood, and most appropriate English word, the Professor gives nothing whatever as a substitute, except it be indirectly the term *energy.* But what is the difference which word is employed, so you only understand as the dictionaries define it, *force* to be *energy*, and *vice versa?* Why, then, should he call force "a mere name—a convenient abstraction?" If the influence or power which a magnet exerts over a piece of iron at a distance is called the *force* of the magnet, or the *energy* of the magnet, or the *influence* of the magnet, what is the difference? Really, for a scientific writer to waste pages of a book to oppose the one or the other, when we all understand the meaning intended to be conveyed by these words, is downright quibbling and waste of time unworthy of a professorship in a great university. To discuss the question of what *force*, or *energy* is, whence it comes, its nature and character, and how its various manifestations are caused to address themselves to our sensuous observation, would be legitimate and important matters to consider in our scientific investigations; but mere quibbling about the use of a term which by common consent and the use of all vocabularies, fairly conveys an understood idea, is going backward instead of representing "advanced science."

But for this fight about a mere word, Prof. Tait appears, from one or two vague hints, to be on the right track. Taking light, heat, sound, electricity, gravity, magnetism, etc., as *forces* of nature in the common acceptation of that term, and the Professor seems to regard them as real entities; and yet by wildly concluding that there is no such thing as conservation of force, or correlation of force, and that "to an accurate man of science all this is simple error and confusion," he loses all the benefits of his embryo ideas about the entitative nature of force, or energy, which he at times virtually admits.

Suppose we drop quibbling about the mere meaning of the word *force,* and admit that if a rose by any other name would smell as sweet, still, as all must concede, it is just as well to call it a *rose* for the sake of old associations as to learn a new name for it, and we will then have no difficulty in understanding the correlation of force, convertibility of force, or conservation of force, especially if *force,* or *energy,* if you prefer it, be regarded as a real thing, a substantial, though immaterial existence, as viewed in the light of the Substantial Philosophy.

If we regard all possible manifestations of the physical forces as substantial emanations from one universal fountain of force, and which fountain reaches back, merges into, and blends with the correlated fountain of vital and mental force which gives active power and capability to the physical forces, then all mystery about the correlation, convertibility, or conservation of force will disappear from any well-balanced mind, even as "an accurate man of science." Could Prof. Tait accept *force,* in whatever form it is manifested, whether as light, heat, sound, electricity, cohesion, gravity, magnetism, or what not, as but a substantial transformation out of the primordial force-element constituting the fountain from which every form of force emanates through means appointed in nature, and

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which then travels, each by its own peculiar law of radiation or conduction, as ordained by the intelligent Author of all things, his mind would at once clear itself of all its obscurity on the subject, and the whole discussion would be relieved of the contradictory phases in which his want of definite ideas has so unfortunately involved it. He would then instantly be enabled to grasp the idea that, as all the forces are but different substantial forms of the one substantial force-element of nature, it is the simplest thing in philosophy to see mentally that sound-force, heat-force, light-force, or electric-force, after it has served the purpose of its manifestation and use, by no means ceases to exist, though we no longer observe it, but as real substance it falls back into the force-element, whence it came, and where it is conserved for future want and supply, and where it is necessarily correlated with, and may be converted into any other form of force. No view of nature or her laws but that of Substantialism, as here set forth, can ever make the idea of the conservation, correlation, or convertibility of force anything but an incoherent and unintelligible farrago. In the light of the new philosophy all forms of force are objective things or entities, and not mere "modes of motion" of material particles. This truth Prof. Tait at times seems to accept. And as all force emanates from the one fountain or force-element, and as this fountain is necessarily and inseparably connected with the still more refined, elevated, and sublimed fountain of vital and intelligent force, as the First Cause of all things visible and invisible, material and immaterial in the universe, it is plain to see, by aid of a truly philosophical vision, how this force-element is intimately correlated to God as the fountain of vital and mental force, and also how every one of the manifestations of physical force are and must of necessity be correlated one to another, since they are primordially but one essence, and in the forms of force thus emanate from the same fountain of physical energy. Is not this plain? Is there the slightest confusion of ideas or the most indirect self-contradiction in all this teaching of the Substantial Philosophy? Why should there be any ambiguity, since it has nothing to cover up, nothing to conceal or obscure, but everything to open out and expose to the clear sunlight of the most rigid scientific investigation, as every consistent philosophy should? Indeed, while Prof. Tait insists in one paragraph that *all force is one*, in another paragraph he proposes to prove that "there is no such thing as force at all!" He admits that the attraction of one body by another is "one of the most obscure problems in physics." And yet, by denying the existence of any such thing as force at all, he obscures the idea of attraction still more, and would, could he have his way, prevent all possible solution of the mystery. The attractive force which acts between two bodies is not a whit more obscure than any other problem where the action of an invisible, immaterial force is involved, or where the energy is exerted through a substantial connection beyond the observation of man's senses. But how much of the obscurity and mystery here complained of disappears when we focus the light of Substantialism upon the problem, and conclude, as we must do, that by no possibility can the magnet attract the armature unless a real, substantial objective emanation, or force, connect the two bodies thus drawn together. Accept this commonsense view of the intangible entities of nature, and discard the impossible, irrational conception that it is the motion of the molecules of the magnet that causes the distant pull, and, although all mystery of the operation may not be cleared up, so much of it is explained that we can well afford to wait for the future solution which will surely be brought about in the final consummation and universal acceptance of the Substantial Philosophy.

Let us now endeavor to untangle, or at least look into, a few of Prof. Tait's obscurities, and thus try to help him out of the difficulties he has raised by his incoherent and useless war upon the term *force*. He says, "no scientific English word has been so much abused as the word force." We deny his charge, if we except his own unnecessary and abusive attack upon that word. He then presents "accelerating force" as one example of this abuse, and in another place he denies that there is "any such thing as centrifugal force," and says that "accelerating force is not a physical idea at all." But the truth is, there is not the slightest coherence or reason in this scientific scolding, and it but goes to confirm our first suspicion, that his opposition to the use of the word has all come from an unfortunate controversial disagreement with some other scientist. Why should

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he object to "centrifugal force" when it is simply well understood as that form or direction of mechanical energy which tends to drive the surface of a revolving body off on a tangent? Surely some force or energy must carry the drops of water away from a rapidly revolving grindstone, or they would not go.

That a force, which in revolving bodies tends to a tangent, is properly and philologically termed "centrifugal," being from the center, should be self-evident to a beginner in science. It does seem strange that an eminent professor of physics could so quibble about a mere distinction without a difference. And what is "accelerating force" but the accumulation of force or mechanical energy in a moving body which tends to carry it faster and faster.

As an illustration, take the falling stone. Gravity exerts a certain amount of force upon it during the first inch of fall. Now if gravity should cease at the end of the inch, the stone would keep on falling, but without acceleration, by virtue of its *momentum*, as it is usually termed, which really signifies nothing more nor less than the gravital *force* which is stored up in the stone by that first inch of downward pull. Gravity, however, does not stop at this first inch of pull, but adds just as much more gravital force during the second inch; these two quantities of force combined, and now both stored up in the stone, increase the stone's velocity, or accelerate its motion, and the same continues on, because new portions of gravital force are continually being added to the stone to produce this acceleration, or continual increase of velocity. What more appropriate language, in the name of reason, could be used than to call this constant addition of force (that produces acceleration,) "accelerating force"? Had a child raised this pointless and pitiable objection, we might have had patience with it.

The true explanation of *momentum*, here for the first time hinted, and which, by the way, has thus been incidentally utilized, will prove in the future to be of importance to science, inasmuch as it straightens out another tangle of Prof. Tait's confused reasoning in connection with this uncalled-for denial of "accelerating force." He says: "Some people are in the habit of confounding force with momentum." Such a blunder he calls a "monstrosity." No careful reasoner, however, could do so except in the original and beautiful manner just presented, namely, as *stored-up force*, and this no previous writer has done. In a recent editorial we showed that the property of *elasticity*, instead of being a *force*, as nearly everybody believes, was simply the condition or quality of a body by which mechanical force, or energy, could be *stored up* within it for the purpose of restoring the body to its original form after distortion. This was just as true, as well as new, in science as the point we have here made, that the momentum of a body can be nothing else than the stored-up force which gave to it the original impetus. If we mistake not, this must strike every careful thinker in physics as a most important scientific discrimination. To illustrate: The force, or energy, of the exploding powder does not by any means cease acting on the ball as it emerges from the mouth of the cannon, or otherwise the ball would then stop; but it continues on with the ball, stored up in it to the end of its journey, as proved when it strikes a tree at a distance. What but stored-up force, or mechanical energy, could knock that tree to splinters? But this stored-up force, by common consent, receives the name of *momentum*. In fact, momentum, hitherto unexplained, is thus made clear. Suppose, as a further illustration, that during every ten feet of the ball's travel, after leaving the gun, it should receive another and equal impetus of force from exploding powder, each adding another velocity, and each new addition of force being stored up in the ball like the first, thus augmenting its momentum, does a great professor of physics need to be told that such accumulating force, which produces the accelerating velocity of the ball, may properly be called "accelerating force"? Why, then, we ask again, this purposeless scientific scolding at well-understood terms, without even pretending to substitute others more appropriate?

One of the best evidences of a sound scientific reasoner who understands his subject, is the use of appropriate illustrations by which to convey and enforce his ideas. The attentive reader cannot fail, however, to observe, all the way through these paragraphs, a total disregard to the applicability of his comparisons. What possible analogy or similarity, for instance, can there be between the idea of measuring of arable lands in cubic miles, or the measuring of heights in acres, and

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this most common-sense view of momentum as the force or mechanical energy which starts the body into motion stored up to keep it in motion? He tells us that this comparison was made use of by Prof. Hopkins, one of the best teachers of Cambridge University. We confess we do not admire Prof. Hopkins as a lucid teacher. But even the measuring of heights in acres or arable lands in cubic miles is by no means an impossibility in point of fact. Had Prof. Hopkins lived in the Alleghany regions of Pennsylvania he would have learned that the number of acres in a square mile depends very much on the height of the various hills it contains; and had he lived in the prairies of Illinois he would have known that the value of its lands often turned upon the cubic miles of its arable soil for future use, a great difference being made if it is one foot or six feet deep! He also quotes Prof. Hopkins as proof that his own idea of force, as really nothing at all but a name, must be correct. That greatest teacher of Cambridge was in the habit of declaring to his students that "Force is force"! We have tried to imagine the benefit that pupils in physical science would probably derive from such comprehensive instruction under such an eminent teacher; but as Prof. Tyndall says about atmospheric sound-waves, "imagination retires baffled." Prof. Tait, after this clear explanation by Prof. Hopkins of what force is, adds his own interpretation of its probable meaning: "*i. e.* there is but one idea denoted by the word, and all force is of one kind whether it be due to gravity, magnetism, or electricity. This alone seems to give a preliminary hint that (as I shall presently endeavor to make clear to you) *there is probably no such thing as force at all!*"

Well, a professor of physics who proposes to "make clear" that there is "no such thing as force at all," after quoting and indorsing the "preliminary hint" that "force is force," ought to stand a good chance in competition with "the greatest of Cambridge teachers." Let us try to follow him and see how he makes it clear that there is "no such thing as force at all," after admitting in the same sentence that "*all force is of one kind.*" How "all" of nothing "at all" can be of "one kind," we shall thus try to learn.

To prove that force is nothing, or that there is "no such thing as force at all," after much similar confusion of ideas, he gives it in the language of the mathematician as "the *rate of change* of momentum," because "momentum is the time-integral of *force.*" Not to discuss the lucidity of this statement, let us consider the idea that *force* is a "*rate of change,*" even when "there is no such thing as force at all." To prove this proposition he goes on to compare it to the bank rate of interest on money deposited. Is this rate of interest, three per cent., or three dollars per annum on each hundred dollars deposited, nothing at all? Is it "a mere name—a convenient abstraction—not an objective reality," and is it true that there is "no such thing as a *rate of interest* at all"?

His ideas of money are unique, to say the least, and his entire discussion of the question of capital and interest is about the most confused part of his lecture. He says: "If any one should imagine that *three per cent.* is a *sum of money*, he will soon be grievously undeceived. *Three per cent.* means no more nor less than the vulgar fraction $\frac{3}{100}$"! And who does not know that $\frac{3}{100}$ of \$100 on interest, is "a sum of money" exactly amounting to \$3 in cash? But the assumption, that the *rate* of interest, $\frac{3}{100}$, or \$3 earned by \$100 in one year, could represent *force*, of which there was "no such thing at all," seems to have flashed on the Professor's mind as soon as he had uttered it, as involving too puerile an absurdity to let stand, so he tries to fix it by adding: "True, the *three per cent. usually means something very substantial, but there the term is not a scientific one*"!

And this is a specimen of "the most advanced scientific thought"! Why did not Prof. Tait stop long enough to give us the "scientific" use of the term $\frac{3}{100}$, if it does not convey a *substantial* idea equivalent to a *sum of money?* And why should he insist upon a "scientific" use of a term here, when he was devoting the bulk of his lecture to repudiating the scientific use of the term *force?*

What could have put it into Prof. Tait's head to insist upon force as "the rate at which an agent does work," as he so strenuously urges, is one of the mysteries of his incoherent teaching. Why, instead of being a *rate* at which work is done, *force* is the very *agent* or *power* or *energy* which, through proper appliances, does the work, while the rate of execution simply signifies the amount of work accomplished in a given time. The *rate* of performance never means the *force* or

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energy or *agent* which does the work. The rate of bank-interest is the same precisely. It means simply the annual amount of actual work done—of actual money which a given sum deposited in bank earns or works out by thus being put into useful employment—while the *force* or *agent* which does this rate of work, and secures this substantial result, is the very original sum of money as the power thus put on interest or put to work.

Prof. Tait seems not to have formed the first correct conception of ordinary monetary affairs. Instead of making the money on deposit in the bank the *agent* or *force* which yields the *rate of interest*, as earnings of the deposit, he makes the rate of interest, and the force or agent which produces it, one and the same thing. And yet he makes this rate of interest, as his unintelligible equivalent of *force, nothing at all but "a mere name—a convenient abstraction,"* though it amounts to $3 in cash every year on each $100 deposited in bank! A professor in a great university who can reason thus disjointedly and irrationally, deserves a public reprimand, and should then be compelled to take a course in elementary scientific studies before again writing for the public.

But after all this confusion about *force* as being a *rate*, and about its being nothing at all but a mere name, or a convenient abstraction, the Professor does really seem to touch bottom in his reference to Faraday's efforts to determine what becomes of the force of attraction between two bodies as they are separated farther and farther from each other. If the attraction of the two bodies is the force by which they are drawn together, as Faraday plainly taught, and as Prof. Tait seems to concede, then the force is clearly not the rate at which they approach or at which their motion is accelerated, since the force or agent which causes their approach is manifestly the attraction itself. What trifling with plain English words would it be to make the agent or force which does the work of drawing the bodies together nothing but the *rate* at which the work or drawing is done! Yet the bulk of the lecture of Prof. Tait, instead of presenting clear instruction on the nature of force, such as the mind can grasp as intellectual food, deals in this confused indefiniteness of expressions, which, though it may have been clear to him, it certainly is anything but clear to the ordinary reader.

Even Faraday himself seemed to fail in finding a solution of his difficulty about the decrease of attraction as the two bodies receded from each other, owing solely to his not understanding the true nature and operation of force. If he could have grasped the fact, as set forth so clearly in the Substantial Philosophy, that two bodies are attracted by the substantial rays of gravity passing out from each in all directions, analogous to the substantial rays of light from a candle, and which could be seen with eyes suitably constructed, he would at once have been able to see mentally what became of this great percentage of lost energy or attracting force. By the well-known law of squared-distance-inverse it is plain that fewer and fewer of these substantial rays of gravity, radiating in straight lines in all directions, would reciprocally touch the two bodies as they removed farther and farther apart, while all the rest of the rays from each body, not touching, would pass off into vacant space without affecting either body, though not by any means to be lost or annihilated, but to return into the universal fountain of force, there to be conserved in God's order of things for correlation, convertibility, and remanifestation in other or similar forms of energy. This is the very thing the Substantial Philosophy teaches, and which Prof. Tait denies by saying that when it is explained "it will surely not be a conservation of force." The substantial explanation here given would have beautifully solved Faraday's difficulty, and could Prof. Tait now stop scolding about the term "force" long enough to look into the Substantial Philosophy, he would have his mind cleared of all its fog on the subject, and there would be nothing left in his way of coming out a ringing Substantialist.

One of the most unsatisfactory peculiarities about Prof. Tait's style of reasoning, is that he masses difficulties against the term *force*, not seeming to reflect that these very difficulties bear with equal effect against any other word or form of expression he may substitute for that term. He seems, like a young polemical aspirant in a debating school, eager for honor as well as for smashing things generally, and for the sake of temporary triumph not caring if half his blows rebound against his own head. Take his reference to the pulling at one end of a rope.

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He says that, according to the received notion, "you can *produce a practically infinite amount of force*, for there is stress across every section throughout the whole length of the rope." Now why, as a great teacher in a great institution of learning, does Prof. Tait launch out such apparent difficulties against *force* (and the same in the case of a cask of water with a closely-fitting piston) when they apply the same precisely against the term *energy*, or *pressure*, or *tension*, or *expansion*, or any other word he may dare to substitute? How useless is such an attack on *force* when he knew he could not answer it himself, as he had put it, taking any word he might select, for there is surely some word in his vocabulary which means what common mortals understand by *force*. Will he say that by pressing a piston into a closed cask of water with one pound of energy or pressure he "produces an infinite amount of energy or pressure," because that single pound takes an infinite number of directions? He surely believes in *energy* and *pressure*, and why does he not therefore run amuck at some of his own scientific terms, and see how they will stand the shock? Iconoclastic objectors to other folks' views should be peremptorily forced to explain how their own views, if they have any, make the matter any better, or else be spanked into silence. When we hurl our difficulties at the wave-theory of sound, we are always found ready and willing to show that no such difficulties or objections lie against the substantial theory. Let Prof. Tait be compelled to do the same, and he will soon modestly begin to let up in his bootless crusade against the excellent little word *force*.

The Professor ignores force as only an abstraction, a mere name, a nothing *at all*, in fact, because he does not know what becomes of a hundred pounds of it when he lifts that amount at a ton mass without moving it! Does he know what becomes of a hundred pounds of *energy* or muscular *power* at a similar effort? Possibly he might grasp the elementary conception, with a little dispassionate effort, that when he exerts a hundred pounds of upward pressure at the ton weight without stirring it, this force or energy, while he is lifting, is simply expended and stored up in neutralizing just one hundred pounds of gravital force which is acting on the weight in the opposite direction; and that if twenty men should lift each a hundred pounds they would thereby neutralize the whole ton of gravital force, and thus would cause the ton weight to rise. If this "abstraction" is too heavy for him, let him do a little intellectual training by first reflecting that the ton mass would absolutely have no weight at all but for that invisible, immaterial, substantial, objective entity, called the *force of gravity*, which Faraday was so bewildered about, and which Prof. Tait concluded could not surely be conserved.

But as stars sometimes twinkle through the interstices of the cloudiest atmosphere, we have an occasional scientific scintillation even from this mass of confused ideas. Indeed, he almost seems at one point virtually to take back all the naughty things he had been provoked to say against *force*, by selecting *heat*—a "scientific" term meaning one of the acknowledged *forces* of nature—and making it an actual, substantial, objective *entity*. It is really as encouraging as it is surprising to fall in with one such sensible and philosophical statement in the midst of so much intellectual pi. "Heat," he says, "whatever it may be, is *something* which can be transferred from one portion of matter to another." Suppose heat to be a *force*—then what? The sentence here quoted sounds very much like the utterance of a veritable substantialist, and but for his unfortunate misunderstanding about the word *force*, there is no visible reason why he was not, when he made that statement concerning heat, on the high road to Substantialism. For example, what better Substantialism has ever been published in this magazine than the following?

"It has been definitely established by modern science that *heat* [one of the natural *forces*], *though not material, has an objective existence in as complete a sense as matter has*"!

Such a truthful averment about *heat*, one of the physical forces, as a real "something," would be equally applicable to every other recognized force of nature. Cannot *electricity* be transferred from one material body to another, and has it not an existence as real and objective as has the tree which it shivers into kindling-wood? Cannot *magnetism* be transferred from one material body to another, and does not the piece of steel itself become a magnet on this principle of transference when brought within a magnetic atmosphere? Is not this force

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or energy which radiates from the poles of a magnet in all directions, and which lifts the distant armature in opposition to gravity, a veritable, objective existence, as much as the armature which it lifts, or the steel magnet which lifts it? Cannot *sound* be transferred from the vibrating chord to the prong of a distant unison tuning-fork, and thus throw it into corresponding motion by its substantial, sympathetic action; and is not this "something" which accomplishes a visible mechanical result as real an objective existence as is the instrument thus made to respond? And if these forces of nature are all proved to be objective existences, by the very test which Prof. Tait applies to heat as a real "something," how natural, then, and consistent is the Substantial Philosophy, and how easy is it for acceptance, since it makes every natural force, including the vital, mental, and spiritual forces, an objective existence as real and substantial as is matter itself.

But it would not seem to do for the professor to continue this magnificent line of thought without some additional confusion and cloudiness of ideas interspersed. He learnedly undertakes to explain to the reader the process by which we have found out that *heat*, or any other form of energy, is an objective existence as much as matter. We have learned it, he says, because we have found out by experiment that *matter* cannot be altered or reduced in its quantity in the slightest degree; and hence we conclude that it must have an objective existence. And further, as we also find by experiment, he continues, that heat cannot be altered or reduced in quantity, but only transferred to other bodies, or converted into other forms of energy, we rationally infer also, that heat, though not matter, has as much an objective existence as has matter itself. To a superficial reader this reasoning appears intensely and even severely logical; but weaker scientific nonsense was never put into the same number of words, even if it did issue from the University of Edinburgh, and if the reader will keep his face straight long enough, we will prove it.

How can we go to work experimenting on a mass of matter to find out that it cannot be reduced in quantity in order to know that it has an objective existence, unless we first know that it exists objectively, and unless we know what its quantity is which we are trying to reduce? How, in the name of science, can we know what its quantity is, so as to learn by experiment that such quantity is unaltered after experiment, unless we first know that the matter has an objective existence as a real entity? According to this specimen of "advanced scientific thought," you take a quantity of matter which you do not yet know to exist, and as you cannot know of its existence until your experiment proves that its quantity cannot be altered, you cannot, of course, have any conception of its quantity before the attempted reduction commences. But after experimenting sufficiently you thereby learn, first, that its quantity has not been reduced in the least, without knowing what its quantity was prior to beginning the test, since you did not yet know of its existence; and finally you learn of the existence of the matter itself upon which you have been experimenting, and thus find out its original quantity, by finding out that its quantity, of which you knew nothing, had not been lessened. Such is a specimen of this profound reasoning about force which Dr. Mott assures us is "now generally accepted as correct." Clearly, so far from knowing that matter exists by first experimenting with its unknown quantity to find out if such quantity can be altered, and thus learn of its existence, we first know that the matter has a real objective existence by our sensuous and conscious observation, and we know what its quantity is in the same manner, by weighing or otherwise measuring it and observing the result; and by the same sensuous, or conscious, observation, aided by reason, we know that heat and other forces of nature have a real objective existence by what they do, and by what we observe concerning them. We surely do not have to wait to experiment with heat, as Prof. Tait urges, and first find out that its quantity cannot be altered, before we know that heat exists, or know the quantity we are trying to reduce. According to the reasoning of Prof. Tait, we neither know that matter or force exists, or has any quantity whatever, until we have first experimented on its unknown quantity to see if it can be reduced, and have in this way determined its unknown existence to learn if it really has any quantity.

But we must not be too exacting with this great scientist, especially when in the midst of so much confusion he can make such a valuable admission for the

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Substantial Philosophy as that *heat*. an immaterial force, is a "*something*" as real and objective as matter itself. Indeed, as we read further we find he does not stop with *heat*, but actually carries the principles of Substantialism almost as far as its most outspoken advocates could desire, by the remark: "*Heat*, **therefore, as well as *light*, *sound*, *electric currents*, etc., though not forms of matter, must be looked upon as real as matter, simply because they have been found to be forms of energy,"**—in other words *forms of force*, since the common word *force* is just as good as his substitute. In fact, it is quite common now for scientific writers to use these two words interchangeably as convenience suggests, or to avoid tautology. Why, then, this needless jangle about one of these two words when, by avoiding it, he could have saved himself from an unfortunate bewilderment of ideas which now bids fair to make him notorious?

From a careful study of his lecture, it is evident that Prof. Tait had been reading the Substantial Philosophy, though perhaps not with sufficient care to receive the full benefits of its teaching. If he had not seen and read it, how are we to account for the term "sound" having been included among the natural forces or forms of energy?—substantial entities having as real an objective existence as matter itself—a truth never admitted by a great scientist before the "Problem of Human Life" was published. The truth is, the University of Edinburgh, through its leading physicist, has substantially indorsed the central tenet of the Substantial Philosophy as based on physical science, and as taught in the various volumes of THE MICROCOSM. It thus accepts the substantial existence of "sound" as well as of light, heat, electricity, etc., as objective entities, and as real as material bodies themselves. That great university, therefore, with one of the foremost physicists of Europe at its head, has clearly abandoned the wave-theory of sound, and also the undulatory theory of light and heat, with the waves of ether on which it rests, thus clasping hands across the Atlantic Ocean with the MICROCOSM PUBLISHING COMPANY in dealing a death-blow at the whole modern mode-of-motion philosophy!

What a pity that Prof. Tait, with his great reputation as a physicist in one of the first universities of the world, and with all his scientific lore to aid him, had not more largely profited by studying the Substantial Philosophy after having adopted, as he has done, its principal features of sound, light, heat, and electricity as objective entities! When he took up the "Problem" or THE MICROCOSM (for he certainly has been reading one or the other), he should have foregone his personal grievances about a mere word, and sent for our entire series of books, and thus been prepared to make himself thoroughly familiar with the principles of which he had obtained such a hopeful smattering. What a pity, after having become substantially a Substantialist, he should have thrown away so splendid an opportunity for revolutionizing Great Britain within the next six months, or a year at farthest, and of thus establishing the Substantial Philosophy permanently in the Queen's Dominions. But he foolishly preferred a petty contention over the word *force*, and thus narrowly escaped an immortality that is never offered to man but once in a lifetime.

At any rate, the friends of Substantialism throughout the world can well congratulate themselves that the keynote of their great philosophy has been authoritatively echoed from one of the first universities in the land, and by one of the world's leading physicists; and while we thus congratulate each other, let us fervently hope that these good-natured criticisms which we have been compelled to make on this "force" argument may not provoke the distinguished professor to waste more ink and paper by pitching into the Substantial Philosophy, after having adopted and used it, as he was some way provoked to do, in the case of the unfortunate little word *force*.

THE FUTURE OF SUBSTANTIALISM.—No. 1.

BY REV. J. I. SWANDER, A. M.

We have just received instruction from the managers of THE MICROCOSM to prepare a paper upon the above subject for the opening number of Volume V. The editorial authorities seem to have been blissfully oblivious to the fact that it

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is much easier to select the text than to preach the sermon. They have, therefore, placed upon our shoulders a burden too grievous to be borne with an angelic smile of ready acquiescence. But having learned obedience as a child, we shall endeavor to continue its practice through the laborious responsibilities of our advancing years. Fortunately, we have not been asked to don the prophet's robe, but only to exorcise our memory, and relate our experience of things to come; and if we, in this reversed retrospection, should forget to recollect some things correctly, the sin should not be laid at the door of the printer, but charged up against the writer himself, who, having been placed under marching orders, is presumptuous enough to horoscope the substantial zodiac, consult the invisible stars in their courses, read the predictions of the passing night and herald the blessings of the coming day.

The Substantial Philosophy has not yet passed through the first decade of its existence, and is, therefore, still in the formative period of its history. Not that its essential principles are undergoing any change. Such an admission would be in conflict with the immutable nature of truth, as well as disadvantageous to those who are called to advance and advocate its claims in the world. Truth makes its march of progress, not to a higher perfection of itself, but toward its more perfect apprehension by those to whom it gradually reveals its hidden treasures. In this way truth, having an essence of its own, incarnates itself in the Substantial Elements of the human mind and spirit, becomes conscious of its own being, and finally appears in the form of a correct and established theory to utter its beatitudes upon the mount, and pour its benedictions upon the people of the plains below.

It matters but little whether Substantialism is at this time to be regarded and spoken of as an hypothesis, theory, or a system of philosophy. A learned friend has written to us: "The new philosophy *may become* an acknowledged system in the course of time, but at present the question may properly be asked whether it is more than an hypothesis." Very well. We lose nothing by admitting, if necessary, all that is claimed in the above. The advocates of the substantial hypothesis, if indeed it be nothing more than an hypothesis, are in proud possession of unquestionable facts and conclusive demonstrations of its correctness in all its essential parts. In the non-possession and contradiction of such radical facts it were better to-day for some of the old theories and systems had they never been born to exist in their monstrous unscientific deformity than to offend this sound and symmetrical little one that believes in the immaterial forces of creation which, under God, are constantly moving the chariot-wheels of the material universe.

In science, the *germ* of truth is worth more than the century-plant of error. Even a living dog is better than the carcass of something foolishly supposed to have been a lion. The embryonic principle that approached Sir Isaac Newton in the falling apple, though wrapped for awhile in the swaddling-clothes of an hypothesis and laid in the manger of an unpopular theory, gradually arose to general recognition and power as something of more value to science than all the old astronomical treasures of Egypt. Yes, gentlemen, we have no objection that you look upon Substantialism as an hypothesis; but, mark our word, the hypothesis of to-day will be the central theory and illumining sun in the regenerated science of to-morrow. Give us the acorn, with its immaterial germ of a giant oak, and you may have all the fully-developed mushrooms, cabbage-palmettos and lifeless trunks of your materialistic forest.

Let all lovers of truth who are willing to follow its leadings through evil, as well as good report, not do themselves the great wrong to conclude that Substantialism is not worthy of their entire confidence, because, forsooth, it doth not yet fully appear what it shall be when that which is perfect is come. Neither should the increasing number of believers in the Substantial Philosophy be any less enthusiastic in its advocacy because it has not yet been fully formulated. The time is fast coming when its high rank in the family of philosophies will be generally acknowledged, and when, as the center of the world's admiration, the royal child shall receive the insignia of its intrinsic worth. Even in the bulrushes of the Nile, Moses was a "proper child," and therefore the coming man and lawgiver for a nation from whom, according to the flesh, Christ came. And Christ himself, instead of springing, like a full-fledged mythical Minerva from the head

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of Jupiter, into his highest attainable perfection, "increased in wisdom, stature and favor with God and man." So, too, with Christianity, as the substantial presence of the glorified Christ in the world. He is a very poor reader of church history, and a very shallow student of its philosophy who sees Christianity's highest attainable perfection either in Primitive religion, the Church of Rome, or modern Protestantism. While nothing can transcend the limits of its own type and pattern, it is everywhere God's law that the old and more defective develops the want and prepares the way for the new and more perfect. For this reason we are not disposed to make fun of the wave-theory of sound. In consideration of its negative service to the cause of science, we are in favor of giving it a decent burial. Dr. Hall may differ from us in our assertion that Substantialism comes from materialism in the sense somewhat analogous to that in which Christianity sprung from Judaism, and Protestantism from Rome. Thus the principle of Substantialism was always present in the organic constitution of the world's life, but could not attain to actual birth until the fullness of the time had arrived. Upon the arrival of that appointed day it came to emancipate the world from the then prevailing law of materialism. It has already accomplished much as an earnest of the purchased inheritance. Less mythical and more mighty than Hercules, it has reached from its cradle to grapple with the dragon of unscientific fraud. It has brought its calcium light to bear upon those Evolution theories known as "Spontaneous Generation," "Ontogeny," "Philogeny," "Pangenesis," and "Gemmules," in such a way as to completely unmask their false pretensions. It has laid bare many of the ridiculous fallacies involved in the current theory of acoustics. It has pointed out a simple yet sovereign remedy for the deepest malady that now afflicts the general family of sciences; and it has accomplished all these initial results under the reign of a persecution and suffering not worthy to be compared with the glory that shall be revealed in the triumphal march of its future.

The future of the Substantial Philosophy is neither a matter of prophecy nor conjecture. It is something to be anticipated according to the law of life in history, and the sure workings of its plastic power. When we are once acquainted with the root there is no prophecy in predicting both the coming and the quality of the fruit. Even the form of the fruit is predetermined by the norm of the root. Only to a limited extent is such form subject to modification from without. All life constantly struggles toward the realization of its ideal. This ideal is not a mere subjective concept in fancy of something that has no existence outside of the mind, but a veritable substantial pattern of the thing to come in outward form. That which is to be has been. The objective ideal is a reality. Essence is more real than form, because it is molder and master of the form. It is so in religion. The Christianity of the Middle Ages made many centuries of ridiculous ecclesiasticism by trying to legislate law into life. Much of our statutory Protestantism is doing little better. Let modern theologians and materialistic mound-builders in philosophy profit by their examples. Let them catch a glimpse of the power of the world to come, and with uncovered heads do proper homage to those invisible forces which, under God, create their own forms in the material universe. This we propose to do with Substantialism. It needs no outer mold in which to cast its coming form—it will admit of none. In that particular, it will take care of itself. It came not to be ministered unto, but to minister unto the wants of the scientific world. Who can declare its generation, or adequately portray the part it is to play in the coming, closing scenes of time's great theater? If it is to take rank with other distinct sciences, it should be defined as *the Science of Force.* Chemical professors are talking and writing about the generation, conservation, transmission and persistency of force. Very well; but whence and what is it? Is it really nothing more than the result of favorable combinations in matter? Is mental force nothing more than molecular motion or effervescence from a few pounds of pulpy matter stuffed into a human skull? All who wish to escape the odium of being known as such materialists must either acknowledge the substantial nature of the immaterial in being, or fly for protection into the region and shadow of—nothing. This region has its existence in some of our current theories, and its capital is the city of refuge for much infidelity in science. There is no other alternative. Any theory of force whose genesis is not traceable to

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matter, or whose claims are not based upon a recognition of the immaterial substances of God's creation, must start in the desert of lean abstractions and end in the wilderness of logical and laughable absurdity. It is time, therefore, for all serious scientific inquirers after the symmetrical wholeness of the truth to pause and ask themselves whether there is not an imperative demand for such a distinct branch of study to round out the curriculum in the great university of God.

When the necessity for such a new science shall have been generally conceded the point reached may be emphasized as a *period* in the world's intellectual progress. Substantialism will then receive an ovation worthy both of the principle that it involves and the blessings that it will impart to the family of man as it moves forward in its grand march to victory. What a broad field is opening for the display of its power and the distribution of its benefits to all the lovers of truth! Passing through the wilderness of scholastic chemistry, it will complete its thorough "examination of the present theory of force and energy," as already indicated by the preparatory papers of Dr. Mott. In this line of inquiry it will look a little more carefully into the chemical laws of affinity, cohesion and repulsion, and show that some things hitherto treated as the properties of matter are really the proprietors thereof. Continuing its well-begun work in the domain of physics, it will perfect the new theory of sound and formulate its truths for the general instruction of the laity in the rudiments of scientific righteousness. Entering into the domain of optics, it will pour new rays upon the subject of light, recall Huygens and Newton to the witness stand, and submit a few questions by way of cross-examination concerning corpuscular emissions of luminous matter, ethereal jelly and the old undulatory theory in general. It will also examine farther into the presumptuous assumptions that gravity, magnetism, electricity, and heat are not substantial entities and forces of nature. Encouraged with its grand achievements in the lower departments of being, it will direct its efforts toward heaven, and with a hush of reverence, standing the scientific gates ajar, it will enable man to look into the laboratory of Almighty God, where the handiwork of the visible creation is made of things that do not appear. It will continue to march its invincible forces into the realm of mind, lay peaceable siege to the capital of intellectual empire, climb up into the highest dome of finite thought, examine more thoroughly the substantial structure of the human soul and demonstrate its constitutional power to survive the dissolution of its material environments. Neither shall the pent-up Utica of sublunary things contract its powers. Persevering in its searches to find out all that science can know of God, it will conduct its disciples up into the newly discovered observatory of the sidereal heavens, permit them to gaze through a telescope radically different from any previously pointed toward the skies, and direct their most devout efforts to ascertain the place of the more immediate presence of Him who evolves the stars like sparks from his own substantial being, and sends them as scintillations of his personal glory around the central throne of his boundless empire.

PAUL'S PARADOX; BECOMING WISE BY FIRST BECOMING A FOOL.

A SERMON BY REV. T. WILLISTON, M. A.

"If any man among you seemeth to be wise in this world, let him become a fool that he may be wise."—1 Cor. iii. 18.

Before explaining this paradox of Paul's, it may be useful to notice the different senses in which the words *wise* and *wisdom* are used in the Scriptures. When Bezaleel and other builders of the tabernacle are spoken of as men in whom the Lord "had put wisdom," it is simply meant that he had endowed them with much mechanical skill and ingenuity. When Christ said to the twelve, "Be ye wise as serpents," his meaning was, be cautious and wary, or on the lookout against danger. In adopting a sagacious expedient for his support the unjust steward is said to have "done wisely;" that is, to have acted *shrewdly*. When it is said that "the children of this world are in their generation wiser than the children of light," the meaning is, not that they are wiser in the highest or best sense, but that, in proportion to the magnitude of the objects aimed at,

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they prosecute their worldly schemes with more earnestness and zeal than Christians manifest in striving to make their "calling and election sure." To the attainments of men in such things as science and philosophy, as well as to the subtle artifices with which they prosecute their various designs, the Bible applies the words, "man's wisdom," or "the wisdom of this world." But when Solomon says, "Wisdom is the principal thing, therefore get wisdom," he exhorts men to acquire "the wisdom that is from above," and the very beginning and essence of which consists in "the fear of the Lord."

It is in two very dissimilar senses that, in my text, Paul uses the word "wise," and it is in a very peculiar sense that he uses the word "fool." Let us first see how very unlike are the senses of the word *wise*, as twice used by Paul, or, in other words, what Paul means by one's being "wise in this world," and then submitting to a certain process in order "that he may be wise." To get the full force of the passage before us, let us institute a comparison between the two kinds of wisdom that Paul here refers to. Let us place them side by side, inspect them narrowly, see in what respects they differ, and which of the two we had better seek to possess. We will first inquire *what it is* to be "wise in this world." What is the aim of the worldly-wise, and what are the methods they usually employ in executing their designs? The object they invariably aim at is the attainment of some perishable earthly good, and the promotion thereby of their own happiness; and it never rises higher. The good sought by them is different in different individuals, but it is invariably good of a worldly kind, and self-interest is uniformly their prompting motive in seeking it. With one set of persons *money* is the object which with tireless toil they seek to acquire. With another class it is the fame and the emoluments connected with office and exalted station. With another it is the celebrity that is gained by authorship, or by military prowess, or by brilliant literary and scientific achievements. With still another the object aimed at is self-indulgence and sensual gratification. The objects of pursuit vary as do the tastes of the different classes, but self-gratification and self-advancement is the governing motive in each.

Not only are the aims and efforts of the worldly-wise directed exclusively to earthly objects, but they are usually very sagacious in the selection of means for effecting their designs. What, for example, could be more wise, in a worldly sense, than the plan resorted to by Absalom when, with eye on his father's throne and the nation's applause, he stationed himself by the roadside, and said to every aggrieved Israelite, "O that I were made judge in the land, that every man which hath any suit or cause might come unto me, and I would do him justice!" Worldly wisdom was admirably exemplified by this flattering demagogue, and by it he "stole the hearts of the men of Israel." And as he was not conscientious in respect to the character of the means he resorted to, but was guileful and insincere, so it usually is with worldly men in the use of means. If to the mere worldling flattery, or fraud, or prevarication seem to be the surest means of rendering his enterprise successful, he will not usually hesitate to employ them. To secure for themselves office and honor, political demagogues have in every age resorted to substantially the same obsequiousness and the same pseudo-patriotism that Absalom did. And what is true of the unscrupulous demagogue is to a greater or less extent true of the worldly-wise, in all the varied pursuits of life.

Having seen what is implied in being "wise in this world," let us now see what that *other kind of wisdom* is, which Paul exhorts the worldling to get by becoming a fool. In its very *nature* this wisdom differs from that, for while *that* is "earthly, sensual, devilish," *this* "is from above," or has its origin in the heart of God, and is as pure as its divine Author. Instead of aiming at the attainment of some purely secular and perishable benefit, this wisdom seeks a good that is spiritual and ever-enduring. Instead of having self-interest for its governing motive, it rises above self, and is swayed by a desire for the glory of God and for the general good. While the worldling's field of vision embraces only "the things which are seen," that of the truly wise takes in all worlds and all duration. With the Bible for his telescope, he fixes his eye on things unseen and eternal. While "God is not in all the thoughts" of the worldly-wise, the language of him that is truly wise is, "I meditate on all thy works, I muse on the work of thy hands." As he surveys the doings of the Most High, whether it be in the kingdom of Nat-

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ure, Providence, or Redemption, he is filled with awe and adoration, and he finds himself exclaiming, "O the depth of the riches both of the wisdom and knowledge of God!" Every feature in the character and government of Jehovah is alike gratifying. That "God is love" rejoices him, and so it does that, to the wicked, "our God is a consuming fire." He is as glad to hear God say that he "will by no means clear the guilty," or say, "Vengeance is mine, I will repay," as he is to learn that the Lord "delighteth in mercy," and "will abundantly pardon" every sinner that truly forsakes his evil ways. Once this man was "wise in this world," and wise in his own estimation, but now he is "a new creature," and though he is deemed a fool by some of his old associates, the All-Wise God pronounces him a fool no longer.

We have seen that there is a wide, a radical difference between the two kinds of wisdom that Paul names in my text, and we come now to consider what he means by one's "becoming a fool" in order "that he may be wise." Would Paul have us understand by these words, that if one has made large attainments in human science, or if his mind has been greatly expanded by education, he must cease to feel any interest in science, or cease to make any advances therein, if he would become spiritually wise? Does he mean that learning and piety cannot co-exist in one and the same person? By no means. The wisdom that Paul would have men obtain is no enemy to learning and science. So far from being their enemy, it is their warm and sincere friend. Religion woos and welcomes Science to her side as an ally, an efficient colleague, a cordial supporter. What then can the apostle mean by so strange a paradox as having one become wise by first becoming a fool? To this question more than one reply may be made, and yet each be a correct one. One meaning that Paul *may* have had is this: By deserting the ranks of your former companions in sin, you may be despised and deemed a fool by them, and you must *consent to be a fool in their estimation,* in order to your being wise in the sight of God. It is no very unusual thing for one to be sneered at, or even hated, if he breaks away from Satan's ranks and goes boldly over to the Lord's side. Said Jesus to his disciples, "Because ye are *not of the world* . . . . therefore the world hateth you." It has been the lot of many a Christian to be reproached, scorned, and persecuted, because he was no longer "*of* the world." To become wise in the highest sense a worldling must cease to be a worldling, must cease to have the same aims, the same governing motives, and the same methods of fulfilling his aims that worldlings have; yet it is obvious that so great a change as this would by some of the worldly-wise be regarded as *becoming a fool.* "Well," the apostle would say, "if this is to be or become a fool, become one, that you may be wise."

Paul's meaning, however, in the words "let him become a fool," we are far from having exhausted, even if the above supposition was a part of his meaning. He well knew that "knowledge puffeth up," that the "wise in this world" are prone to pride themselves in their real or supposed pre-eminence in intellect or knowledge, and that this pre-eminence, and its accompanying pride of intellect, often become a serious obstruction—yea, in many cases a fatal barrier—in the way of men's salvation. Impressed with this fact, it was doubtless Paul's intention, in the clause referred to, to warn the worldly-wise against that snare of the devil which consists in the speculations of an unsanctified philosophy, and in the intellectual pride generated thereby. It was as though the apostle had said, "He that would become 'wise unto salvation' must cease to make an idol of learning and earthly wisdom, however profound." He must become sensible that the largest attainments in science and philosophy, if not associated with the love of God, are but a feeder of human pride, and can never make their possessor happy. As compared with the wisdom that God imparts, he must regard "man's wisdom" as well-nigh worthless, and if human attainments have puffed him up, or caused him to despise the crucified One, he must feel his own littleness and unworthiness, and must in his own estimation "become a fool." It was not the apostle's aim to have men undervalue science, or any earthly thing that is truly useful, but he would have them prize purity of heart and the divine approbation far more. And as for that "wisdom of this world" which "God hath made foolish," Paul would have men *become fools,* as it were, by exchanging it for the wisdom that confers permanent joy, and that is as enduring as the throne of God.

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In view of the immeasurable superiority in value of "the wisdom that is from above" to "the wisdom of this world," need we wonder that God pronounces that man a fool who scorns or heeds not Wisdom's entreaties and admonitions? As a fitting close of this interview, my hearers, let us listen to a few of Wisdom's own words—words of tender entreaty on the one hand, and of solemn warning or awful denunciation on the other. Hear her as she says, "Happy is the man that findeth wisdom" . . . . for "all things thou canst desire are not to be compared unto her. Length of days is in her right hand, and in her left hand riches and honor." "If thou criest after knowledge, and liftest up thy voice for understanding; if thou seekest her as silver, and searchest for her as for hid treasures, then shalt thou understand the fear of the Lord, and find the knowledge of God." "How long, ye simple ones, will ye love simplicity? . . . . Turn you at my reproof: behold, I will pour out my Spirit unto you, I will make known my words unto you." Such are some of Wisdom's urgent invitations, and what language could be more tender or persuasive than hers? Alas, that it should ever have been necessary for her to become severe, and to address any of our race in such words as these: "Because I have called, and ye refused; I have stretched out my hand, and no man regarded; but ye have set at naught all my counsel, and would none of my reproof: I also will laugh at your calamity, I will mock when your fear cometh . . . . when distress and anguish cometh upon you. Then shall they call upon me, but I will not answer; they shall seek me early, but they shall not find me. For that they hated knowledge, and did not choose the fear of the Lord . . . . Therefore shall they eat of the fruit of their own way, and be filled with their own devices." God forbid that I, or any of you whom I am addressing, should, on a dying bed or at Christ's bar, hear Wisdom say, "Because I have called, and ye refused . . . . I also will laugh at your calamity, and will mock when . . . . distress and anguish cometh upon you. You shall call upon me *then*, but I will not answer". *To-day*, my hearers, Wisdom is saying, "Seek ye the Lord while he may be found, call ye upon him while he is near." "*To-day*, if ye will hear his voice, harden not your hearts." Let us beware lest we make a part of that hopeless number to whom she will by and by say, "Then shall they call upon me, but I will not answer; they shall seek me early, but they shall not find me"!

WHAT IS LIFE?

BY HENRY A. MOTT, PH. D., F. C. S.

"Nothing is needed but matter and the forces inherent in it, to account for all the life that is found on the earth, of every kind."[1]

Such is the teaching of the science of to-day. Life, according to this view, being only one mode in which the universal force inherent in matter shows itself. or, as Barker[2] puts it, "Life is now universally regarded as a phenomenon of matter, and hence, of course, as having no separate existence."

The word "life" is used in two distinct senses; the one metaphysical, the other physiological. The former, synonymous with mind and soul, at least in the higher animals, has been evolved from human consciousness; the later has arisen from a more or less careful investigation of the phenomena of living beings. "It need scarcely be said," says Barker, "that it is in the sense last mentioned that the word 'life' is used in science. The conception represents simply the sum of the phenomena exhibited by a living being."

Without accepting the above views as correct, or rejecting the same as incorrect, let us investigate the subject carefully, consistently and logically, and see where the investigation will lead us, and what conclusion we will arrive at.

To discover the nature of life, to find out what life really is, it would be folly to compare the perfection of living matter—a human being—with some non-living or inorganic substance, such as a brick, for example; for, as Prof. Orton[3] has said, "That only is essential to life which is common to all forms of life.

[1] "Origin of Life."—Hollick, p. 27. [2] *Pop. Sci. Monthly*, vol. xvii., p. 751.—Geo. F. Barker.
[3] "Comparative Zoology," p. 13—1876.

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Our brains, stomach, liver, hands and feet are luxuries. They are necessary to make us human but not living beings."

It will be necessary for us to consider, then, the simplest being which possesses life, and such are the little apparently homogeneous specks of protoplasm constituting the group *Monera*, which *are claimed* to be entirely destitute of structure. In the fresh waters in the neighborhood of Jena minute lumps of protoplasm were discovered by Haeckel, which, on being microscopically examined, were seen to have no constant form, their outlines being in a state of perpetual change caused by the protrusion from various parts of their surface of broad lobes and thick finger-like projections, which, after remaining visible for a time, would be withdrawn, to make their appearance again on some other part of the surface. To this little mass of protoplasm Haeckel has given the name *Protamœba primitiva*. These little lumps, about one-thousandth of an inch in diameter, resembling a speck of jelly, multiply by spontaneous division into two pieces, which, on becoming independent, increase in size and acquire all the characteristics of the parent.

From this illustration, it will be seen that "reproduction is a form of nutrition and a growth of the individual to a size beyond that belonging to it as an individual, so that a part is thus elevated into a (new) whole." The monera, then, up to the present time has not been shown to have a structure, or, in other words, it has not been shown to be organized, or to have a nucleus, investing membrane or parts.

After being acted on by chemical and other agencies, it is *assumed* that the monad becomes hardened on the surface, or a membrane forms, then afterward by osmose, a nucleus and granules in the interior, and so becomes a true cell, the first *real organism*.

The vegetable cell has usually two concentric coverings—cell-wall and primordial utricle. In animal cells the former is wanting, the membrane representing the utricle. As a general fact, also, animal cells are smaller than vegetable cells. Their size[4] varies greatly, but they are generally invisible to the naked eye, ranging from $\frac{1}{500}$ to $\frac{1}{10000}$ of an inch in diameter. About four thousand of the smallest would be required to cover the dot put over the letter *i* in writing.

All animal and vegetable structure is but the multiplication of the cell as a unit, and the whole life of the plant or animal is that of the cells which compose it, and in them or by them all its vital processes are carried on.[5]

The cell, then, can be regarded as the basis of our physiological idea of the elementary organism; but in the animal, as well as in the plant, neither cell-wall nor nucleus is an essential constituent of the cell, inasmuch as bodies which are unquestionably the equivalent of cells—"true morphological units"—may be mere masses of protoplasm devoid alike of cell-wall or nucleus. For the whole living world, then, the primary and a mental form of life is merely an individual mass of protoplasm in which no further structure is discernible. For this reason, protoplasm has been called the "universal concomitant of every phenomena of life." Life being inseparable from this substance, but dormant unless excited by some external stimulant, such as heat, light, electricity, food, water and oxygen.

Although we have seen that the life of the plant, as well as of the animal, is protoplasm, and that the protoplasm of the plant and that of the animal bear the closest resemblance, yet plants can manufacture protoplasm out of lifeless matter, whereas animals are obliged to procure it ready-made, and hence, in the end, depend on plants. "Without plants," says Orton, "animals would perish; without animals, plants had no need to be." "The[6] food of a plant is a matter whose energy is all expended—is a fallen weight. But the plant organism receives it, exposes it to the sun's rays, and in a way mysterious to us converts the actual energy of the sunlight into potential energy within it." It is for this reason that life has been termed "bottled-sunshine."

The principal food of the plant consists of carbon united with oxygen to form carbonic acid, hydrogen united with oxygen to form water, and nitrogen united with hydrogen to form ammonia. These elements, thus united, which in themselves are perfectly lifeless, the plant is able to convert into living protoplasm.

[4] "Comp. Anat."—Orton, p. 32.
[5] See "Was Man Created?"—Mott, p. 21.
[6] "Correlation of Vital and Phys. Forces."—Barker, p. 51.

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"Plants are," says Huxley,[7] "the accumulators of the power which animals distribute and disperse." Boussingault found long since that peas sown in pure sand, moistened with distilled water, and fed by the air, obtained all the carbon necessary for their development, flowering and fructification. Here we see a plant which not only maintains its vigor on these few substances, but grows until it has increased a million-fold, or a million million-fold, the quantity of protoplasm it originally possessed, and the protoplasm exhibits the phenomena of life. This, and other proof, led M. Dumas to say: "From the loftiest point of view, and in connection with the physics of the globe, it would be imperative on us to say that in so far as their truly organic elements are concerned, plants and animals are the offspring of the air."

Schleiden,[8] speaking of the haymakers of Switzerland and the Tyrol, says: "He mows his definite amount of grass every year on the Alps, inaccessible to cattle, and gives not back the smallest quantity of organic substance to the soil. Whence comes the hay if not from the atmosphere?"

It has been seen, then, that plants can manufacture protoplasm, a faculty which animals are not possessed of; they at best can only convert dead protoplasm into living protoplasm.

In what manner, then, does this matter—protoplasm—possessing the phenomena of life, differ from inorganic matter, or in what manner does living matter differ from matter not living?

The physical consistence of protoplasm varies with the amount of water with which it is combined, from the solid form in which we find it in the dormant state to the thin, watery state in which it occurs in the leaves of valisneria.

As to its composition, chemistry can as yet give but scanty information; it can tell that it is composed of carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorus, and it can tell the percentage of each element, but it cannot give more than a formula that will express it as a whole, giving no information as to the nature of the numerous albuminoid substances which probably compose it.

Edward Cope,[9] in his article on Comparative Anatomy, gives the formula for protoplasm (as a whole) $C_{24}\ H_{17}\ N_3\ O_8 + S$ and P (in small quantities under some circumstances). It is therefore, he says, a nitryl of cellulose: $C_{24}\ H_{20}\ O_2 + 3\ NH_3$—. This, however, is purely a speculation, for living protoplasm has never been made artificially, and, in fact, all analyses are of dead protoplasm. Synthetical chemistry has produced numerous organic substances, constituents of the plant and the animal, but none of them are animated or living substance; in fact they are just as dead as if they were not made at all.

It was proper, in considering the question "What is Life?" to consider the simplest form of matter giving evidence of life, and this we have done by considering the protoplasm of the monera, a form of life which is so low down that the scientist is unable to state whether it is animal or vegetable life—and yet what knowledge have we gained by so doing in respect to the nature of life? The fact still remains that this living matter is different from non-living matter—different in one most important respect—it is continually undergoing change—taking in new matter, decomposing it, adding such portions to itself as are necessary for development, and expelling the remainder—in fact, it is perpetually changing, yet always preserving its identity.

Dead matter can be made to grow, such as crystals, but the growth is external, in living matter the growth is internal, and only after decomposition of the food.

It is claimed that the forces which are at work on the one side are at work on the other, and that the phenomena of life are all dependent upon the working of the same physical and chemical forces as those which are active in the rest of the world, and it is also claimed that the terms "vitality" and "vital force," whilst *convenient* expressions to denote the cause of certain groups of natural operations, as the names "electricity" and "electrical force," are used to denote others; but if the name implies that either "electricity" or "vitality" is an entity, playing the part of a sufficient cause of electrical or vital phenomena, they become absurd assumption. As Huxley[10] has said—"A mass of living protoplasm is simply a

[7] "Physical Basis of Life."—Huxley.
[8] "Biography of a Plant."
[9] Johnson Ency. Article, Comp. Anatomy.
[10] "Anatomy of Invertebrate Animals."

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machine of great complexity, the total result of the work of which, or its vital phenomena, depends on the one hand upon its construction, and on the other upon the energy supplied to it; and to speak of 'vitality' as anything but the names of a series of operations is as if one should talk of the 'horologity' of a clock."

Huxley,[11] speaking of the formation of water by the passage of an electrical current through hydrogen and oxygen, and the formation of ice by the reduction of temperature, says:

"We do not assume that a something called 'aquosity' entered into and took possession of the oxide of hydrogen as soon as it was formed, and then guided the aqueous particles to their places in the facets of the crystal or amongst the leaflets of the hoar-frost. On the contrary we live in the hope and in the faith that by the advance of molecular physics we shall by and by be able to see our way as clearly from the constitution of water to the properties of water, as we are able to deduce the operations of a watch from the form of its parts and the manner in which they are put together.

"Is the case in any way changed when carbonic acid, water and ammonia disappear, and in their place, under the influence of *pre-existing living protoplasm,*[12] an equivalent weight of the matter of life makes its appearance? It is true that there is no sort of parity between the properties of the components and the properties of the resultant, but neither was there in the case of water. It is also true that what I have spoken of as the influence of pre-existing living matter is something quite intelligible, but does anybody quite comprehend the *modus operandi* of an electric spark, which traverses a mixture of oxygen and hydrogen? What justification is there, then, for the assumption of the existence in the living matter of a something which has no representative or correlative in the not living matter which gave rise to it? What philosophical status has 'vitality' than 'aquosity'?

"If the properties of water may be properly said to result from the nature and disposition of its molecules, I can find no intelligible ground for refusing to say that the properties of protoplasm result from the nature and disposition of its molecules."

Let us examine this opinion of Huxley and see what value should be attached to it. "When insisting," says Stirling,[13] "on attributing to protoplasm the qualities it possessed, because of its chemical and physical structure, if it was for chemical and physical structure that we attribute to water *its* qualities, he has simply forgotten the addition to protoplasm of a third structure that can be only named organic. 'If the phenomena exhibited by water are its properties, so are those presented by protoplasm, living or dead, its properties.' When Mr. Huxley speaks thus, exactly so we may answer—'living or dead!' That alternative is simply slipped in and passed; but it is in that alternative that the whole matter lies. Chemically, dead protoplasm is to Mr. Huxley quite as good as living protoplasm. As a sample of the article, he is quite content with dead protoplasm, and even swallows it, he says, in the shape of bread, lobster, mutton, etc., with all the satisfactory results to be desired. Still, as concerns the argument, it must be pointed out that it is only these that can be placed on the same level as water; and that living protoplasm is not only unlike water, but it is unlike dead protoplasm. Living protoplasm, namely, is identical with dead protoplasm only so far as its chemistry is concerned (if even so much as that); and it is quite evident, consequently, that difference between the two cannot depend on that in which they are identical—cannot depend on chemistry. Life, then, is no affair of chemical and physical structure, and must find its explanation in something else."

"There are certainly different states of water, as ice and steam; but the relation of the solid to the liquid, or of either to the vapor, surely offers no analogy to the relation of protoplasm dead, to protoplasm alive. That relation is not an analogy but an antithesis, the antithesis of antitheses. In it, in fact, we are in presence of the one incommunicable gulf—the gulf of all gulfs—that gulf which Mr. Huxley's protoplasm is as powerless to efface as any other expedient that has ever been suggested since the eyes of man first looked into it—the mighty gulf between death and life."

[11] "Physical Basis of Life," pp. 24 and 25. [12] The italics are the writer's.
[13] No. 3, University Series.—James H. Stirling, p. 118.

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"The Germans, the most advanced and innovating of them, directly avow that there is present in the cell 'an architectonic principle that has not yet been detected.' In pronouncing protoplasm capable of active or vital movements they do by that refer, they admit also, to an immaterial force, and they ascribe the processes exhibited by protoplasm—in so many words—not to the molecules, but to organization and life. It is remarked by Kant that 'the reason of the specific mode of existence of every part of a living body lies in the whole, whilst with dead masses each part bears this reason within itself'; and this indeed is how the two worlds are differentiated. A drop of water, once formed, is then passive forever, susceptible to influence but indifferent to influence, and what influence reaches it is wholly from without. It may be added to, it may be subtracted from; but infinitely apathetic quantitatively, it is qualitatively independent. It is indifferent to its own physical parts. It is without contractility, without alimentation, without reproduction, without specific function. Not so the cell, in which the parts are dependent on the whole, and the whole on the parts; which has its activity and *raison d'etre* within, which manifests all the powers which we have described water to want, and which requires for its continuance conditions of which water is independent."

Water is not ice, nor is either steam for all the chemical identity that exists—ought we then to make nothing of the *difference?* Not so; we ask a reason for the difference, we demand an antecedent that shall render the consequent intelligible. The chemistry of oxygen and hydrogen is not enough in explanation of the threefold form; and by the very necessity of the facts we are driven to the addition of heat.

It is precisely so with protoplasm in its twofold form. The chemistry remaining the same in each (if it really does so), we are compelled to seek elsewhere a reason for the difference of living from dead protoplasm.[14]

"In protoplasm," says Stirling, "even the lowest, then, but much more conspicuously in the highest, there is in addition to the molecular force, another force unsignalized by Mr. Huxley—the force of vital organization."

It may be proper to mention here that Schultze, Brucke and Kuhne, three great German histologists, hold that it is only in cells that protoplasm exists. Hollick says, "Once let matter assume the organized form and what we call life begins at once." The fact is, that what is now assumed to be a mere homogeneous mass of living matter, without structure and without parts, as in the case of the monera—may be shown on closer investigation to be organized. For we know of no higher form of life without organization, and when once the organization is injured life disappears.

As Kuhne has said: "To-day we believe that we see" such or such fact, "but know not that further improvements in the means of observation will not reveal what is assumed for certainty to be only illusion."

We find an infinite number of cells, in the animal and vegetable world, which differ infinitely from one another, and must have so differed from the start. There must therefore be an infinite number of different kinds of protoplasm in the infinitely different plants and animals, in each of which its own protoplasm but produces its own kind, and is uninterchangeable with that of the rest.[15]

In the human body we have nerve-protoplasm, brain-protoplasm, bone-protoplasm, muscle-protoplasm, and protoplasm of all the tissues, no one of which but produces only its own kind, and is uninterchangeable with the rest.

(To be concluded in the next number.)

THE PHOTOGRAPHING OF SOUND-WAVES.—Many paragraphs are going the rounds of the press referring to the fact that sound-waves have been photographed, and much confusion of ideas exists upon these various announcements. Next month the editor will explain the mystery in a set paper on that subject, so that readers of THE MICROCOSM need have no further trouble asking us for an explanation of the apparently impossible feat. It turns out to be a very simple process as soon as we come to find out what is really meant in the announcement.

[14] See "As Regards Protoplasm."—J. H. Stirling, p. 117.

[15] Stirling, ibid, p. 99.

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THE PHILOSOPHY OF POVERTY: ITS CAUSE AND CURE.—No. 3.

BY PROF. H. S. SCHELL, A. M.

In the closing numbers of the fourth volume of our greatly prized MICROCOSM I took occasion to exhibit some of the baleful effects of that oppressive poverty which is found in all civilized nations, but never among savage tribes, in reducing to a wretchedness almost beyond the power of language to describe, vast multitudes of the human family—that poverty which has converted a fair and beautiful earth, a magnificent world—on beholding which, as it emerged in pristine grandeur from the bosom of chaotic night, "the morning stars sang together and all the sons of God shouted for joy"—a world built and bountifully furnished by God for his yet unborn sons and daughters—into a sad abode, a place of torment, an embryonic hell for a large majority of them; and I have shown that this crushing poverty is caused by the monopoly of the soil by the few but powerful—that soil which God gave *without money* and *without price*, for the *free* use of *all;* and that by means of this usurpation, thirty millions of the descendants of the fathers of the Revolution are deprived of that for the attainment of which those fathers pledged "their lives, their fortunes and their sacred honor"; and though many millions of acres of this broad domain are now uncultivated and ready for the occupancy of their descendants, they are prevented by this cruel and unjust monopoly from using them. I have shown that by the power the ownership of land gives, they who hold it are enabled to demand in rent for its use, and to appropriate all that their fellow countrymen can earn save bare necessities, thus entailing upon them lives of slavish toil, poverty, anxiety, and an ignorance which engenders crime, intemperance, and vice of every kind; and having suggested a radical, practical and complete remedy, I now, as this magazine is *religio-scientific* in its mission, with a view of warning those who are perpetrating this wrong of the danger they incur in trampling upon the rights of their fellow men, feel at liberty, at the expense of a slight digression, to quote, with a few remarks of my own, some passages of Scripture bearing upon the subject.

The first may be found in the twenty-fifth chapter of the Gospel as recorded by St. Matthew, where the Saviour says, when describing the scenes of the great judgment day, "Then shall the king say also unto them on the left hand, Depart from me, ye cursed, into everlasting fire, prepared for the devil and his angels; for I was an hungered, and ye gave me no meat; I was thirsty and ye gave me no drink; I was a stranger, and ye took me not in; naked, and ye clothed me not; sick, and in prison, and ye visited me not." When the condemned, apparently astonished, affirmed that they were not aware of having thus neglected the king, he replied: "Inasmuch as ye did it not to one of the least of these, *my brethren,* ye did it not to *me*"; and then the wondrous fact was elicited that these suffering and neglected people were the king's brethren. Think of it—brethren and sisters of the Lord God Almighty; the King of kings, and Lord of lords—brethren and sisters of the mighty God who built and upholds this vast, this magnificent universe; no wonder that they who neglected to assist them when in such trouble and affliction were cursed and sentenced to depart into everlasting fire, in company with the devil and his angels. If this is to be the fate of those who merely *neglect* to assist the poor, what must be in store for those who rob them of their birthright, and thus make them poor?

The next quotation is found in the sixteenth chapter of Luke, where the Saviour says, in speaking of a certain rich man who had been clothed in purple and fine linen, and had fared sumptuously every day, that "in hell he lifted up his eyes, being in torment." The Saviour does not state why he was sent to hell, but the context instructs us that it was because he neglected to help Lazarus, a beggar, who lay before his door starving, and desiring to be fed even with the crumbs which fell from his table. This poor man, besides being destitute of food, was covered with sores, and so ragged that the *dogs,* seeing the sores through the rents of his tattered garments, and apparently sympathizing with him in his forlorn condition, endeavored to alleviate his distress by lapping them with their tongues.

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Here, again, we see that this rich man was not condemned to hell for robbing and oppressing the poor, but merely for neglecting to *help* one of them when in misery; and the question again arises, what will be the fate of those who not only neglect to relieve their fellow men when in distress, but who bring that distress upon them?

The third quotation is from the eighteenth chapter of Luke, where the Saviour says: "It is easier for a camel to go through a needle's eye than for a rich man to enter the kingdom of God"; and when his disciples expressed astonishment at the remark, he added, "With men this is impossible, but with God all things are possible," intimating that it required the exertion of Almighty power to effect the entrance of a rich man into the kingdom of God. It is well for those interested that the disciples did express their astonishment, otherwise the amendment to the Saviour's first remark might not have been made. I do not for a moment suppose that God ever condemns a rich man merely because he is rich, or that, by any means, all rich men are condemned, for some there are, and have been, like our lamented Peter Cooper, but those only who acquire their wealth dishonestly, or who practice a systematic course of oppression in depriving the poor of just wages for their labor when it is unnecessary, or charging them rent for, or keeping from them, the use of land which God designed they should have *free* in order to gain a support; or endeavoring to enhance the price of provisions, or of any of the necessities of life, by speculating in them; or charging double or treble rates for the transportation of such necessities; or imposing heavy and unnecessary tariffs and taxes; or contracting, expanding, or otherwise manipulating the currency of the country so that the rich become richer at the expense of their fellow men; or taking advantage of men's pecuniary distress by charging them exorbitant interest; or accepting or offering bribes with a view of influencing legislation; or by means of any one or of all the devices by which Satan and civilization have contrived to make for the poor a place of torment of this fair earth. Those who acquire wealth in any of these ways are, I think, the "rich" to whom the Saviour referred when he made the remarks I have quoted.

During the sweltering heat of many days of the past summer hundreds of thousands of the poor of this city who dwell in tenement houses, ten, twenty, and sometimes thirty families in each, suffered very much, and every day fifty or more of their infants or young children died, and the moans of the bereaved mothers and the sobs of the brothers and sisters were hourly heard from one or another of these so-called homes. Do they who defraud the poor by exorbitant rents, stinted wages, or pawnbrokers' interest, thus dooming them to such misery, and who, in the heat of summer, live in ease and luxury on the proceeds of their gains at the watering-places, or among the mountains, or at other summer resorts, or cruise in their elegant yachts, realize that *they* may be the murderers of these children by reducing their parents to a poverty which compels them to live in the foul air of such abodes, and if so, will be held responsible for the loss of their young lives? Do they realize that that Saviour who, when on earth, took such little children in his arms and blessed them, will, by and by, say to their murderers, "Depart from me, ye cursed, into everlasting fire"?

This vast material universe is sustained and governed by the power of God manifested through inflexible law, and the moral universe is no less governed and upheld by infallible and inflexible law, one of its grandest attributes being *Justice*, and the acme of *its* triumph is, "With what measure ye mete it shall be measured to you again."

I feel convinced that in my former papers I have shown that the primary and fundamental cause of the misery existing in the civilized world, and which takes its root in poverty, is the absolute ownership of the public domain by individuals, and that this is the giant wrong which in this country is depriving thirty millions of the descendants of the heroes of the Revolution of the land, the free use of which is theirs by *right* of *birth*. That portion of our population who claim to own it, aver that they have a legal and absolute title to its possession, not only for the present, but for *all* time, thus claiming the right to rob the yet unborn, and their title-deeds do, in fact, give them that right. Let us for a moment attempt to trace their title, and ascertain, if possible, to what result their claim leads. It came chiefly from the kings of Spain, England, France and Holland, who by force

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took it from the Indians, and then these kings, believing perhaps that they had a perfect right to do so, granted the land to their favorites; these sold it to those who again sold it, and it has been sold and re-sold until it has come into possession of our landlords. Now, if the titles the kings gave are good, they, or those from whom they got them, must have received their titles from God, the maker and original owner of the land, which, for the sake of argument, we will for the present admit. The question now arises: By what authority did God, after he had deeded to others his land, allow thirty millions of people, not the descendants of those who own the land, to be born upon it? Here he sends thirty million paupers into the country to feed upon land which does not belong to him, and gives them nothing whatever when they come; no food or the means of getting any; not a spot of land to live upon; no place where they can erect even a hut; no wood with which to build the hut; no place where they can lie down and sleep, and makes them entirely dependent upon the charity of those who own the land. And yet, this is not all. What right has he to permit his sun to burn up the pastures of these people who own the land, as he sometimes does, or to flood the meadows with his rain when the farmers are gathering their hay; to destroy with his frost the blossoms of the peach and apple trees, or to allow his locusts, caterpillars, weevil and potato-bug to blast their crops? What right has he to strike their houses or barns with his lightning, to devastate the land with his tornadoes, or upheave it by his earthquakes? Is this right? Is this justice either to the landlords or to his intruders? Is this doing as he would be done by?

Here we see to what result the claim to the ownership of the land leads—to blasphemy against God.

This single argument, though possibly irreverent, but without such intention, independent of any other, it appears to me, proves conclusively that there can be no just claim to the absolute ownership of land, as it is not only an attempt to deprive man, but even God, of his rights, and gives the holders power to drive all others away from it, or to oppress them by heavy charges for rent if they wish, or by circumstances are compelled, to reside upon it. Besides, it accuses God of great cruelty in allowing his creatures existence without making any provision for their maintenance, or even giving them a place on which to live.

In this country there are between two and three millions of families who own nearly all the land, and thus have the legal right to drive the other eight or nine million families out of it, and be sustained in the act by the courts, and by the military power. A very large majority of these families, however, occupy merely their homesteads and live quiet and industrious lives, being honorable members of the communities in which they reside, and of which they form a part; but the rest have got the land they hold for the purpose of speculating in it—that is, gaining wealth, not by their own industry, but by appropriating to their use the earnings of their fellow men. These are the landlords who are keeping the thirty millions of our people from the enjoyment of their birthright, depriving them, besides millions of our adopted citizens, of the use of the land which is necessary to their very existence, or charging such rents as impoverishes them, and who will be held responsible for this gigantic wrong.

Rents for dwellings, stores, warehouses, factories, offices, shops, etc., in this city are so enormous that employers are often compelled to reduce the wages or salaries of their help almost to the starving point, as in most cases it takes nearly all the profits of their business to pay their rents and support their families; and thousands of widows who struggle, almost against hope, to gain a bare support for themselves and children by keeping boarding or lodging houses, are driven nearly to despair by the heavy rents they are charged, and every day some of them are turned, with their furniture, into the streets for the non-payment of rent; and it is not alone the rent of the buildings, but of the land upon which they stand, which in many instances is five times as valuable as the buildings, and the rent charged for the use of it is in that proportion. The owners of these are the landlords that rob all classes, and cause seven-eighths of the failures of business men, and the poverty, intemperance, vice, and all kinds of crime and misery that exist—these are the men who force hard-working, honest citizens to live in cramped apartments amid fetid, poisonous air, sending thousands of their children yearly to premature graves, and who, themselves, spend their time in summer in idleness

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and pleasure; but another "summer resort" is waiting for them, and their only hope of escape is to stop at once charging one cent except the land tax for the use of their lots, and be content with a fair interest for the use of their buildings.

This rent extortion exists in every city, and in every section of the whole country, and landlords should stop it, if for no other reasons than those named, and the time is not far distant when those reasons will be found eminently cogent.

The great Father has given all an equal right to the use of the earth; but for one class, and that by far the least in number, to monopolize it at the expense of the rest by forcing them to pay rents that reduce them to poverty, is an outrage and a crime of inconceivable magnitude; they might as well monopolize the sunlight, air, and water, and compel the rest to pay them for their use or die. To shoot down a man for the purpose of getting his money is barbarous, but what shall we think of him who tortures the man night and day, year after year, and not only the man, but his wife and children, to get money from him? and they do so who deprive him by extortion of the free use of the land his Maker gave him for his support. Is it any wonder that the Saviour said of those who get wealthy by such means, that it is easier for a camel to go through the eye of a needle than for a rich man to enter the kingdom of God?

Land speculators as a rule, I have no doubt, think they have a right and are at liberty to speculate in land as much as they please; but when we see to what disastrous results it leads, what misery flows from it, we know, and they should know, that it is wrong, for it is a blow at the very existence of life, and, in any event, slavery is its fruit. Speculation in breadstuffs or in any of the necessities of life, carries with it, as a compensation, the fact that most of the speculators fail, and consequently those articles fall as often below as they rise above their true value.

Private ownership of land by speculators keeps millions from the use of it because they have no money to buy it, and compels them to seek employment in other occupations, and their number being already enormous, and constantly increasing, competition for opportunities to labor ensues, and as a consequence, wages sink to the minimum on which the industrious can exist. If, on the contrary, land was free, no charge being made for its use except the necessary taxation, millions would take farms, and these would employ millions more, and the labor market being thus relieved, wages would rise, production would wonderfully increase, as all the workers would be employed, and all would earn and receive sufficient to live in comfort and lay by for old age. This is "a consummation devoutly to be wished," and to contribute an atomic trifle toward its accomplishment I write these papers, and for no other reason whatever.

The aggregate of our taxation at present amounts to not less than two thousand millions of dollars annually, and should not be over one-fourth of that sum. This vast amount is made up of three hundred and fifty millions taken by the federal government in duties on imports and internal revenue taxes, both of which should be abolished; twelve hundred millions taken as rent by landholders for land alone without improvements, and at least $450,000,000 (of which New York City alone pays $34,000,000) by state, county and city taxation, all of which is paid by the industrious classes. Is it any wonder that poverty stalks through the land; that everywhere our merchants and manufacturers are in trouble; that hundreds of thousands of industrious men (over two millions at present) are constantly out of employment, their families suffering, and that, too, in a land capable of supporting in comfort a population equal to that of the whole globe? Now, if we abolish all this taxation, and place all taxes necessary on bare land in city, village and country, we relieve labor of the whole of taxation, for a tax on bare land is paid by nature. The Creator is very kind, and he designed that the earth should furnish us not only with a luxurious support, but also with the means of paying our taxes, and these can be paid from nature's surplusage. As an illustration, suppose a farmer sows say five bushels of wheat and sells a hundred, which he obtained from the five, the proceeds will remunerate him for the cost of the seed and labor and afford him the handsome profit of at least one hundred per cent. and a surplus besides. Let him pay his taxes out of the surplus.

With business men in cities and villages it would be the same; a good business location will enable a merchant to sell far more goods, and, consequently,

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make much more money, than a poor, out-of-the-way location. Let him credit the land with even one-fifth the advantage its location gives him, and it will pay his tax.

Our country is increasing in wealth, but not very rapidly at present, but the more riches the industrious classes produce the poorer they become, as the wealth is mostly absorbed by the landlords, who take it in extravagant rent, and it exhibits itself in elegant dwellings, costly equipages, rich furniture, fine paintings, magnificent yachts and in ostentation and extravagance of every kind, all afforded by the constant increase of the value of land, and as a result higher rents; so the *harder* men work and the more they produce, the *poorer* and more dependent they become.

This state of things conclusively proves that the absolute ownership of the soil by individuals is the result of a hellish scheme, invented by Satan and worked up by civilization, for there is no wrong that was ever perpetrated upon the race that equals it in enormity.

Every new invention which is calculated to produce wealth and lighten labor, instead of being a blessing to the industrious classes is converted into a curse, and their labor becomes more onerous and their wages less, for rent absorbs the fruits of their toil. Why is it that in New York hundreds of lots containing less than one-sixteenth of an acre, scarcely large enough for a chicken pasture for one hen and her brood, can be let, independent of the rent of any building upon them, for $10,000 a year; yes, in some cases for $15,000? It's merely because the Erie Canal, steamboat, steam engine, railroad, cotton-gin, steam grain elevator, steam plow, reaper, thrasher, the telegraph, sewing machine, and other labor-saving and wealth-producing constructions or inventions have been made or introduced, for without these the city would have had scarcely one-fifth its present population. These have vastly increased the productions of the country, as well as its internal and foreign commerce, and consequently room must be obtained for the storage and sale of these productions, and for vessels to convey them abroad, besides for the residences of the vast army of workers who handle them, and for shops and stores of all kinds to supply them with food, clothing, etc., and the greater demand there is for room—land—the more landlords charge for the use of it, and they thus, without doing any work themselves, are enabled to appropriate a large proportion of the profits which labor, and the capital which assisted it, has earned, and wages, as well as interest on capital, are kept down. Is not this proven by the enormous rents they charge for the use of these lots? Besides this imposition on the industrious classes, there is the fact that every labor-saving machine, or other invention to lessen toil and increase production, does away, to a considerable extent, with the necessity of manual labor, and thus with the introduction of each new one, many are thrown out of employment. These constantly increase in number, and having no access to free land, and no money with which to buy land, fierce competition for employment ensues, and men being willing to work for almost nothing rather than starve, wages grow lower and lower as rent rises higher and higher; the rich become richer and richer, the poor become poorer and poorer, and the moans of the mother and the cries of her starving, ragged, and freezing children are heard in the land, and hell and the landlords rejoice, but the angels of God weep.

As a single illustration of the way in which one of the greatest labor-saving blessings that was ever bestowed upon the human race is turned into a curse, I name the Sewing Machine. A woman with a sewing machine can do the work of ten without it. Does she get ten times the pay? Is her labor lighter than when she sewed by hand? She produces ten times the wealth she did before; is she richer than she was then? No! her labor is greater; her poverty deeper; if she operates the machine with her feet, the labor is much increased; if steam is used, she is worked almost to death by her efforts to keep the material moving in its proper place under the needle; her wages may in some cases be a trifle higher, but her room-rent is *doubled* and her food costs one-fourth more than it did, for the landlord has got her butcher and baker, her grocer and shoemaker by the throat, and they are compelled to charge her, as well as all their customers, a portion not only of their store-rent, but of the rent of their dwellings. Here is an exhibit of what the sewing machine has done for women who are obliged to use it as a means

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of support, and it is a sample of the effects of every other labor-saving and wealth-producing machine or device, every one of which should be blessings to the industrious classes in lightening their toil, increasing their pay, and lessening their hours of work, and would be but for the monopoly of the land, which enables the landlord to raise his rents as fast as it is needed, and thus he absorbs the profits of industry at the expense of the labor and of the capital which produced them.

This state of things will continue, unless the land is recovered, until the dawn of the resurrection morn, not only in this country, but in every country in which the public domain is held as private property, and where is it not so held except among savage tribes, who, uncontaminated by civilization, know little of poverty, and who have too much sense to permit a wrong so monstrous to exist in their communities; and all other schemes for the abolition of poverty and the disenthrallment of the industrious classes will be tried in vain, and will not affect them an iota while the monopoly of the land is suffered to continue; for if each and all succeeded, the landlords, by means of the power which the ownership of the land upon which all must live and work gives them, could and would so raise rents as to cause such an advance in the price of all the necessities of life as would absorb all the laborer could earn, save enough to keep him from nakedness, starvation, and too much cold, even if his wages were advanced to double or treble what they now are; consequently, all even successful efforts in any direction, except for the recovery of the land, would accrue to the sole benefit of the landlords, and all such efforts for its recovery would accrue to the benefit of all except the landlords, who have the power to be, and are the oppressors of all classes, from the highest to the lowest. This is the record of history from time immemorial, and they that are wise will heed it and act accordingly.

THE TERRA-LUNA CHARIOT.

A. Wilford Hall, Ph.D., LL.D.

Dear Sir,—You have drawn the linchpin from a wheel in the chariot that courses the annual and lunar cycles, to show that it "wabbled" the wrong way, and needed a little tightening up to make the theory agree with the facts. Might not your regulator be pressed a little farther to fortify and guard some outposts that might seem to be exposed? I simply call your attention to it for your consideration.

You present as a self-evident fact, that the moon, being one-eightieth the size of the earth, would, by its attraction, draw the earth one-eightieth of its distance (240,000 miles) toward itself, thus bringing the earth 3000 miles from its normal position in its orbit, and on the side toward the moon, instead of from it, as the popular theory requires. You also admit that if the moon were double its present size, it would pull the earth twice as far—that is, 6000 miles from its normal position in its orbit and center of motion.

Just at this point Fancy plumes her wing for a longer flight, and peering into the cycles upon which the Terra-Luna Chariot is careering, beholds with inquisitive eye the earth crowding 6000 miles nearer to its plethoric companion, Miss Luna, now double her normal size, and is tempted to press the question: If the moon, double its present size, draws the earth double the distance, would a moon eighty times the present size draw it eighty times as far—that is, the whole 240,000 miles? And what would be the relative position of the earth and moon? Being of equal size, would they be together? Or would they be mutually revolving around each other? If so, at what point did "gravitation turn the other way," and push them apart? Or did centrifugal force step in, and act as that "rigid bar," to pry them apart, and not allow them to crowd each other as their chariot whirls along in its monthly and annual cycles?

These are questions that might be asked, and I just turn the inquisitive Fancy over to the editor, to be instructed in the defense of these outposts, or to be spanked for her inquisitiveness, as the case may demand.

G. R. Hand.

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REPLY TO THE FOREGOING BY THE EDITOR.

WE are glad that Prof. Hand has suggested these pertinent difficulties on the moon problem, as they are well calculated to put to a thorough test the true theory of the relative positions and motions of earth and moon, whatever that theory may be, while they are just as certain, when closely examined, to expose the fallacy of the false theory. No single real fact in astronomy will fail to harmonize and agree perfectly with every other fact or true theory known to that branch of science; nor will any such true theory disagree with any hypothetical fact that may be supposed to occur among the heavenly bodies. Therefore, the suppositions of Prof. Hand, though they will most likely never occur, are subjects of legitimate inquiry for testing the truth or fallacy of the two opposing theories. Let us therefore proceed carefully to examine our new departure concerning the relations of the earth and moon to their common center of motion, in the light of these supposed enlargements of the moon.

Suppose the moon, by its one-eightieth attraction, to have drawn the earth out from its normal position 3000 miles, and that it maintains it there as they both circle around that position as their common center of motion, and both of them on the same side of it, as we insist is their actual position and their relation to each other.

Now to simplify the problem, let us suppose the earth and moon not traveling around the sun at all, but that the earth is quiescent in space, uninfluenced by any other attracting body at the time the moon appears in its orbit as we now find it. Of course it is known to every beginner in astronomy that the moon (one-eightieth the size of the earth) is diverted into its circular orbit by the constant attractive pull of the earth upon it, thus drawing it into a curved line from its straight or tangential course, which it would take and keep but for this pull of the earth. The moon, in turn, as it swings around the earth must necessarily pull the earth with one-eightieth as much force out from its *quiescent position*, first in a very small circle around it, corresponding to the larger circle of the moon, but increasing spirally in size and keeping the earth in exact line between the attracting moon and this original quiescent position, till finally the earth shall attain a local orbit, around this center, of 6000 miles in diameter, having been pulled out toward the moon 3000 miles, which, with its maintenance in that circle, represents the full capacity of the moon's one-eightieth attraction. Is not this plain?

We of course totally repudiate the present notion of astronomers, that while the earth is thus being pulled out and carried around in its little circle alone by the moon's attraction, it can, by any possibility, fall back of the line of this attraction; but, on the contrary, that it must, in the nature of things, and by every law of mechanics known to man, keep in that line and necessarily between the moon and the original quiescent position of the earth, around which, as the common center of motion, both bodies travel. A more prodigious and grotesque absurdity was never suggested in mechanics than that the earth, *depending alone for its motion upon the moon's pull*, could fall back of that pull, and incline to get around on the opposite side of the center from which the moon alone had pulled it, unless some other attracting body should interfere. Clearly the moon, while constantly swinging around that old center of motion, would not and could not remove the earth farther out from it than it could maintain it in line with it, and nothing short of astronomical lunacy, it seems to us, could cause any man of a mechanical turn of mind to adhere to this "falling-back" notion of astronomy after his attention had once been called to its self-evident fallacy.

That question, however, need not be argued further here, as neither Prof. Newcomb nor Prof. Young, the two foremost astronomers in this country, dares to attempt to give one mechanical reason for this claimed "falling back" as taught in the present theory, after having been repeatedly urged to do so by Dr. Mott.

We now come to Prof. Hand's difficulties: If the moon, with the motion, and in the relation to the earth, here described, were instantly to be doubled in size, it would not only pull the earth out spirally as before, say, 3000 miles farther toward itself than it is now, but the moon would necessarily, at the same time, increase the size of its own orbit in like proportion; that is, instead of remaining 240,000 miles from the common center of motion, as at present, it would vastly augment that distance. Why? Simply because, with its present projectile velocity, and with double its size, the present mass and attraction of the earth could not divert such an enlarged moon so abruptly from its tangent as it does now, and the consequence would be that the moon, by its increased weight, would assume nearer a tangential line, and thus enlarge its orbit by this very inability of the earth not so easily to overcome its projectile momentum. In this manner every additional enlargement of the moon that should occur would proportionately enlarge its orbit around that old common center of motion, while the earth in like manner would proportionately be drawn farther and farther out toward the constantly enlarging orbit of the moon, thus increasing also the size of the earth's inner orbit, while both earth and moon would retain their present relation to each other, both swinging around in line with, and on the same side of, their common center of motion, the same as they did at the start.

Finally, should the moon be increased in size to that of the earth, as Prof. Hand supposes, it would pull the earth out, say, a distance of 240,000 miles from its original quiescent position, or to where the moon is now, while the moon, by its increased mass and correspondingly greater tangential momentum, would in turn have attained an orbit, say, of twice its present size, or at a distance of 480,000 miles from the earth's old quiescent center around which both bodies, at the start, began to revolve. In this relation to each other the two equal bodies (instead of revolving around each other or coming together) would simply continue to circle in a radial line with and around the original quiescent position of the earth, and both necessarily on the same side of it, separated by about the distances we have named. We do not, of course, pretend to calculate exact distances, as that is not the aim or scope of our work. As a scientific discoverer, we are merely presenting general principles by which heavenly bodies must be controlled, and under which they must travel according to the laws of motion and of reciprocal attraction. We leave it for mathematicians of the future to work out the details of these exact positions and distances.

But having thus presented, in answer to Prof. Hand's queries, what cannot, as we think, fail to strike every philosophical and mechanical mind as the only possible result of the supposed enlargements of the moon, let us now proceed to show how utterly destructive these supposed enlargements must be to the theory which begins by putting the earth on the wrong side of the common center of motion, or, which is the same thing, by putting the common center of motion between the earth and the moon, as it is now claimed to be by astronomers. Suppose that by some inexplicable means, which no astronomer can make intelligible, the earth, after being drawn out from its normal position by the moon's attraction, did actually fall behind farther and farther, till finally it had lost half a month and found itself 3000 miles from its original position, and on the opposite side of it from the moon. Suppose, to oblige astronomy, we admit the moon and earth to be now in that relation to each other and to their common center of motion, as astronomy insists, and that they are revolving around that center on opposite sides of it and in opposite directions. Then suppose the moon, as Prof. Hand suggests, to be instantly doubled in size; there is not an intelligent and unbiased astronomer in the world who would not agree that the additional attraction of such added mass would at once pull the earth across the present center of motion, carrying it 6000 miles to the opposite side and directly toward the moon. How could an astronomer doubt such a result, when Prof. Newcomb admitted in his correspondence with Dr. Mott that the moon, placed in its orbit as at present, would pull the earth out 3000 miles toward it, though he insisted that by some means, which he did not attempt to explain, the earth would commence falling back of the moon's line of attraction, till it would finally lose half a month or half a circuit, as we have so often described. Clearly, then, and indisputably, as soon as the moon is enlarged the earth must move *toward* it, directly across the center of motion and not in the *opposite direction*, unless the enlarged moon actually repels instead of attracts the earth. According to the present system of astronomy the center of motion, as the common center of gravity of the moon and earth, would have to remain stationary, and the earth, after having been drawn toward the moon, would be compelled in

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some way to get located 3000 miles farther away from such center of motion than it is now, still opposite to the moon, whatever round-about course it might take to get there, in order that both bodies might revolve in their present style around their common center of gravity in accordance with theory. Manifestly, if we are right, and if the doubled moon would first draw the earth across the present center of motion toward it a distance of 9000 miles, or 6000 miles beyond the center, then the same mysterious process of falling back, as occurred at first according to Prof. Newcomb, would have to be repeated on a larger scale in order finally to get the earth back again on the opposite side of the common center of gravity and motion, and 3000 miles farther away from it than it was before!

But what would be more impossible in the practical operation of the present theory is this: If the moon were doubled in size, it must of necessity, as we have already shown, vastly enlarge its own orbit by its increased momentum under its present projectile velocity, and this increased distance from the earth (even if the earth should get no farther away) must weaken its attraction of the moon and its power to divert it from its tangent, thus again adding to the moon's increase of distance, etc. But it is a fatal fact, according to the present theory, that the moon would not only get farther away from the earth by thus enlarging its own orbit, but the earth by some means must recede in the opposite direction to a corresponding distance, *in order that the common center of gravity, as their center of motion, may retain its proper quiescent position where it is now!* Then this new increase of the earth's distance would again decrease its pull of the moon from its tangent, thereby allowing the moon again to increase its orbit by its less restrained momentum, which would again require the earth to go still farther away in the other direction in order to readjust its distance from the quiescent common center of gravity, which would again lessen its attraction upon the moon, allowing it again to increase its orbit by its less restricted momentum, and so on, back and forth, continuously augmenting the moon's orbit and distance by the weakening of the earth's attraction, which would likewise be continuously weakened on the moon by the earth's necessary increase of distance to keep it adjusted to the quiescent center of gravity, etc., etc., etc. Thus one single increase in the size of the moon, with the earth, as now claimed, on the opposite side of their common center of motion, would necessarily act and counteract back and forth, first on the moon, increasing its orbit by increased momentum, then on the earth increasing its distance the other way to adjust it to their common center of gravity, just as we have explained it, getting them constantly farther and farther apart, till finally they would leave each other entirely, if there is a grain of truth or consistency in the present theory of the relation of moon and earth to their common center of motion!

Nay, we need not base our argument, so destructive to the present theory, upon the hypothetical enlargement of the moon as supposed by Prof. Hand. We have only to look at the received theory as it is now taught to reach the very same fatal result: When the moon was placed in its orbit and had pulled the earth out 3000 miles, it is plain that if the earth by any means should get away 6000 miles, or 3000 on the opposite side of the common center of motion, it would weaken, to that extent, its pull of the moon from its tangent, which, as we have shown, would allow the moon by its released momentum, to enlarge its orbit to a corresponding extent. This, of course, would require the earth to move still farther away to adjust its proper distance in relation to the common center of gravity, which would again weaken its attraction of the moon, allowing it again to increase its orbit, thus making it again necessary for the earth to move on still farther to keep up its adjustment, etc., etc. The truth is, and no man can deny it, this very original error of the current theory, of getting the earth 6000 miles farther away from the moon than the place to which it had been first attracted, and on the opposite side of the quiescent center of gravity and motion, necessarily involves this very gradual and continuous separation of the two bodies till they would finally part company entirely! No astronomer living can make the least answer to this argument.

It is perfectly plain, therefore, in the light of this analysis, that no mechanical theory can keep the earth and moon revolving about a common center of motion in a permanent relation to it and to each other and at permanent distances apart,

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except the theory we have had the pleasure of announcing and explaining, namely, the retaining of the earth on the same side of the center of motion to which the moon first attracted it as is agreed by common consent. To remove the earth 3000 miles to the opposite side of such center of motion, after it had been attracted 3000 miles toward the moon, would be, as we have seen, to destroy the relation of earth and moon entirely, and finally to separate them forever.

In conclusion, if the scientific reader wishes to see the culmination of the absurdity of the present theory, let him try to analyze it after hypothetically enlarging the moon to the size of the earth, as supposed by Prof. Hand. He will first see the moon shooting off into a new orbit, about 480,000 miles from the present common center of motion, owing to its present projectile force rendering it impossible for the earth, only of the same size, to divert it any more abruptly. He would also see the earth following by the moon's attraction, a distance of 240,000 miles more or less, but commencing to "fall back," according to original habit, but without any mechanical cause or reason for so doing, till finally the earth would find itself away on the opposite side of the old center of motion, a distance of 960,000 miles from the moon! Such a distance of separation, which the present theory would unavoidably require, would of course so weaken the hold of the earth upon the moon, as almost to let it free, and under such weak diverting force its momentum and projectile force, still unabated, would necessarily carry it into another still vastly enlarged orbit, which, in turn, would necessitate the earth's removal the same distance the other way in order again to adjust it, as before, to their common center of gravity, in this way still farther weakening its pull of the moon from its tangent, thus letting the big satellite go under its original projectile velocity, till very soon this constant increase of the moon's orbit from the lessening of the earth's attraction by reason of increased distance, and this constant increase of the earth's distance by the continually recurring necessity of its adjustment to the stationary common center of gravity would, as before shown, separate the two orbs entirely, letting each pass off into space in a straight line. *Reductio ad absurdum!*

In contrast with this disastrous and monstrous nonsense, necessarily involved in the present theory of astronomy, we proudly and triumphantly oppose our own beautiful theory for the explanation of all possible difficulties and objections, and where every result or deduction is in perfect harmony with reason and philosophy, with the principles of mechanics, and with the laws of motion, inertia, momentum, and reciprocal attraction. So plain and rational are the explanations based on this new theory that they require no special scientific training to comprehend them, and Dr. Mott assures us that so easy is our view to be understood that a little girl eight years old had no difficulty in comprehending it, while the theory as taught in astronomy is totally incomprehensible not only by himself but by every scientific man he had conversed with about it. Which theory, then, we ask, in the light of these facts and the explanations we have here given, is probably the correct view? This is the question which appeals to young students whose minds are free from the prejudices instilled by long study of the textbooks. These are the minds to which new discoveries in science naturally appeal for an unbiased hearing, and these are the investigators to whom, with the utmost confidence, we submit our cause.

THE MARCH OF MIND.

BY CALVIN RANKIN.

It would be an almost impossible and certainly a profitless task to attempt to record the progress of intellect through its many different stages, and to mention the obstacles which have arisen hydra-headed on every side to impede that progress; but in view of the great advancement in the intelligence of the masses of the present day as compared with the past ages, it may not be time nor labor wasted to briefly note a few of the causes which have chiefly contributed to this advancement, and its corresponding increase in the general happiness of mankind. In tracing the spirit of progress in regard to mind and knowledge, we cannot help

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but be forcibly impressed by the overruling hand of an all-wise God in bringing good out of evil, and in making the blind and wicked passions of men redound to his own honor and glory!

And yet it has taken ages and ages of suffering and bloodshed to bring man's intellect to its present plane of perfection, and the march of mind has been a slow and steady one, marked by no great leaps toward the goal to be gained, but surely and persistently plodding on, now laying siege to some castle of bigotry, and again overturning some stronghold of ignorance. Even as late as two hundred years ago the belief in witches in this country was almost universal, and innocent men and women, for the most part persons of far superior intellect to those by whom they were condemned, were sacrificed upon the altar of ignorant superstition, having been declared to be in league with Satan and his angels. There has recently been dedicated, in the town of Danvers, Mass., formerly part of the town of Salem, a monument in commemoration of Rebecca Nourse, hanged as a witch two centuries ago on the prosecuting testimony of a minister of the Word of God! Though sad to contemplate, this is conclusive evidence, even if long delayed, of the progress of human intelligence, that we now put up a monument for one for whom our forefathers had erected a gallows! But we need not look so far back for the results of an ancient barbarism and ignorance. It is but a few years ago that the soil of our country was crimsoned with the life-blood of thousands and thousands of her best sons, who had laid down their lives in vindication of the cause of freedom and equal rights. The strife was long and bitter, but our country came out of it purged and clean, and slavery, that horrible ulcer which had been eating into the very heart and battening upon the very life of civilization, was a thing of the past.

In Europe during the middle ages, the then prevailing system of feudalism, the tendency of which was to strengthen and elevate the position of those in power, and to degrade the mass of the people to a condition worse than that of brutes, did much to pave the way for a great advance toward civilization. In no era in the history of the world have the poorer classes been so barbarously treated as under the operation of the feudal system, and this resulted in the adoption of measures the ultimate outcome of which was its overthrow, although in some countries its evil influences are felt even at the present day. It is a well-known fact that the lowest forms of animal life, when forced into a corner from which there is no escape, will turn upon their oppressors; and the people, treated with less consideration than is usually shown to the defenseless cur that roams our streets, and goaded to desperation by their inhuman treatment, at last had their senses quickened and their intellect awakened to the betterment of their condition. When once the passions of mankind are aroused, the tyrants' sway and power are swept aside and trampled under foot as easily as a child's play-house of cards. For a long time had the vassals submitted to the will of their lords; but after a while the first faint glimmering light of learning began to infuse itself into their hitherto beclouded minds, and they were no longer satisfied to be mere automatons, controlling all their actions, and thoughts even, to suit the caprice of others; for the higher destinies of humanity were being gradually unfolded to them. The Great Commander had issued the order to march, and the armies of the world had buckled on the impregnable armor of equal rights, and started on their long journey through the arid and sandy deserts of superstition and ignorance, with the hope of some day reaching the smiling and fertile valleys of knowledge and happiness.

The next great educator of the people was the art of printing, which, although in all probability practiced to some slight extent by the Chinese, as early as the sixth century, awaited the inventive genius of a Gutenberg to give it the impetus by which the means of acquiring knowledge were soon multiplied to an almost limitless extent. Then, almost contemporary with this last-named boon to mankind, entered another factor, which without doubt had a greater influence than all the others combined in bringing about a state of higher enlightenment. This was the Reformation, that glorious religious movement of the sixteenth century, which split in twain the Latin Catholic Church, and resulted in the establishment of various Protestant denominations, and for which it would appear that all prior movements and inventions had but prepared the way, being simply "reformers be-

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fore the Reformation." Superstition and bigotry began to be stripped of their blind-faith covering, and the brightness of the sun of truth appeared in all its effulgent glory, and scattered to the four winds the lowering clouds which for ages had enchained the mind, and feelings, and affections of man. So sweet, so pure, so noble a religion as that of Christ's, dispensing hope and consolation, holding out to all the right of religious and civil liberty, could not help but make converts and find disciples amongst men who for so long had been bound and in bondage to principles of passion and prejudice. For it struck at the very heart of these, making plain and palpable their absurdity and impotence.

Men now began to know their rights and to maintain them, and the privileged few of the higher classes were compelled to share with their fellow-men the power which they had hitherto arrogated to themselves. The consolidation of power and privileges in the hands of the nobles was no longer tolerated, and the participation in those things which related to their government and laws, which before had been refused them, became one of the characteristics of a more enlightened people. Their rights were now held sacred, where hitherto they had been treated with contempt. As a consequence, commerce increased, trade expanded, and a spirit of emulation and legitimate rivalry arose which contributed still further to the advancement and progress of mind, and which have gone on steadily increasing until now wealth and industry are linked hand in hand, and trade and commerce form the honor and glory of all nations.

The effect of these and many other causes has been extended into our own days, and is continually at work. The impetus which mind has thus received is still urging it forward, and there are now no barriers which can impede or delay its onward movements. He who started it on its course has not yet cried halt, and who can picture to himself where it yet may reach? With all our ponderous machinery and unlimited facilities for bringing the fruits of the minds and hands of our great thinkers and inventors to the knowledge of the whole world, with our command of the ever-ready electricity, whereby two continents may clasp hands over three thousand miles of space and whisper in each other's ears, and with all the new scientific and practical discoveries and inventions that still from day to day are added to our resources, are we not justified in thinking that the end is not yet—that mind is still on the march? At any rate, who will be presumptuous enough to set a limit to its progress, or say to it "Thus far shalt thou go, and no farther"?

THE CHEMISTRY OF WHAT WE EAT.

BY HENRY A. MOTT, PH. D., F. C. S.

Eggs.

The egg must be looked upon more or less as a typical food, as it contains, in connection with the shell, all the ingredients necessary for the development of the young animal. During the process of incubation, the shell of the egg is gradually absorbed by the process of growth until it becomes as thin as a sheet of paper.

The shell, which is composed of carbonate of lime, is penetrated by numerous minute pores, which permit the air to pass through to the young animal in the process of hatching. It is on account of these pores permitting the air to pass through that eggs become stale and rotten when kept for any considerable time.

There is no fresh egg known, whether of bird or reptile, which would not be food for a hungry man.

The flavor of the egg differs with its source and is considerably influenced by the character of food the animal has.

The large egg of the sea-gull is much stronger than that of the duck, and both of these than that of the common fowl or plover. The egg of the turtle is often eaten with relish.

The egg of the domestic hen is, however, most universally used as food.

The weight of the ordinary fowl's egg is 1½ to 2 ounces, whilst that of the

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duck is 2 to 3 ounces, of the sea-gull and turkey 3 to 4 ounces, and of the goose 4 to 6 ounces.

All eggs have a similarity of composition—they consist of a shell inclosing a white portion consisting of nearly pure albumen and water, and a yelk consisting of albumen, oils, sulphur and water.

An egg weighing 1¾ ounces consists of 120 grains of carbon and 17¾ grains of nitrogen, or 15.25 per cent. of carbon and 2 per cent. of nitrogen.

The composition of a hen's egg, as given by Lawes and Gilbert, is as follows:

Fresh weight	1.8	ounces.
Dry "	.45	"
Fat	.198	"
Mineral matter	.025	"
Nitrogen	.036	"
Carbon	.275	"
Or in per cent.,		
Water	70.00	per cent.
Dry matter	30.00	"
	100.00	per cent.
Dry fat	11.00	"
Albuminous substances	17.60	"
Mineral matter	1.40	"
	30.00	per cent.
Nitrogen	2.00	"
Carbon	17.52	"
Or carbon and nitrogen, reckoned as carbon	20.56	"

The shell of the egg weighs about 100 grains, so that an egg consists of:

Shell, 10 parts	Carbonate of lime		
Yelk, 30 parts	Nitrogenous matter	16.00	per cent.
	Fatty "	30.70	"
	Saline "	1.30	"
	Water	52.00	"
		100.00	per cent.
White, 60 parts	Nitrogenous matter	20.40	"
	Fatty "	—	
	Saline "	1.60	"
	Water	78.00	"
Total, 100 parts		100.00	per cent.

The yelk or yolk of the egg does not contain as much water as the white, and is a kind of yellow emulsion. The fatty matter exists as a kind of emulsion in the albuminous portion, as it is held in suspension; the albuminous portion is called vitelline, as it constitutes a slight modification of the white of the egg. The albumen in the white exists in a dissolved state inclosed within very thin-walled cells.

The yelk is inclosed in a membrane or bag. Being lighter than the white, it floats to that portion of the egg which is uppermost, but is kept in position between the two extremities by two processes of inspissated albumen, called chalazæ, which pass and are attached—one to either end of the egg.

Fresh eggs are readily distinguished from stale ones by their translucency when held up to the light, and it is on this principle that egg-testers have been founded. A fresh egg will sink in a solution of ten per cent. of salt in water, a stale egg will swim, whilst a bad egg will float in pure water. By this simple test a fresh egg can be readily distinguished. When a fresh egg is plunged into a considerable amount of boiling water it is very apt to break, owing to the sudden expansion of the contents. A stale egg is not so apt to break in this way on account of the air which has replaced the evaporated fluid admitting easily of compression.

THE EGG AS A FOOD.

The egg contains about the same amount of water as butcher's meat, amounting, as the analysis shows, to about three-quarters of its whole weight; it contains, however, more fat than beef, and in this respect is only equaled by pork and eels in the common kinds of food. The albumen or white of the egg alone is very constipating, but when eaten in connection with fat this tendency is counteracted. Hence eggs and bacon or ham has always been a popular and wholesome dish.

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The egg is very deficient in carbonaceous matter, for calculated as starch, it is only in the proportion of 1.75 to 1 of nitrogenous. Eggs therefore consort also with oil in salads and with all kinds of farinaceous matters in puddings.

The oil in the yelk is separated in Russia and used for medicinal purposes; it was also formerly used for the painters' art before the discovery of oil colors.

Fresh eggs are eaten by invalids without first being cooked, and in this condition they are very readily digested, and often when all other food refuses to stay on the stomach. a raw egg will be digested and supply a great deal of nutriment.

When taken raw, the contents of the egg is either sucked out of the shell through a small hole or drank after breaking the egg into a glass.

Invalids sometimes only eat the yelk of the egg on account of its flavor and digestibility.

In most all culinary preparations it is customary to separate the white from the yelk and use them separately.

Eggs are often taken raw in drinks, such as sherry-flip or cider-flip; by this means they are rendered more agreeable to the palate as also more digestible.

Eggs should not be used with milk unless in a cooked form, as in puddings, for it is very doubtful if raw eggs and milk are not better fitted to hinder than to promote digestion.

There are numerous ways of cooking as well as serving eggs; it will hardly be necessary to consider them all, the more common methods will be touched upon only.

Boiled Eggs.—Eggs are boiled in water for varying lengths of time according to the taste of the consumer; they are not, however, equally digestible. A soft-boiled egg digesting very readily, whilst a hard-boiled egg requires as much time to digest as mutton, that is to say, about three to four hours.

The proper way to boil eggs is undoubtedly to put them in cold water in a tin vessel which is surrounded by water in another vessel. When the water has boiled in the outer vessel from six to seven minutes, the eggs are sufficiently cooked. The white of the egg should be soft and flaky and not entirely opaque by the consolidation of the albumen. Eggs cooked in this manner digest readily in comparison to hard-boiled eggs. Poached eggs are quite digestible and present a pleasant method of consuming them.

The omelet is a very common way of serving eggs, but if the egg is not sufficiently beaten before it is mixed with milk to be cooked by dry heat, it is heavy and more or less indigestible. A light omelet is however digestible. Shirred eggs or eggs cooked in small pottery dishes, which have been previously heated, before the egg is added, and then further cooked, form a very pleasant dish, provided sufficient butter, pepper and salt have been introduced in the dish before adding the eggs.

The egg, therefore, in its compact state, and in connection with the nutriment it contains, is a very valuable article of food. To keep eggs any length of time, the pores in the shell must be closed so as to prevent air from entering. This is accomplished by keeping eggs in lard or in an envelope of paraffine. They are more commonly kept in bulk by placing them in lime or lime water in a dark room; the principal objection to this is, that the shells become brittle, which renders them difficult of transportation, and they often break in the process of boiling. Still, this is the method usually adopted.

CAMPING TOUR TO THE YO-SEMITE VALLEY AND CALAVERAS BIG TREES.—No. 11.

BY PROF. I. L. KEPHART, D. D.

After the fatiguing climb to Glacier Point, all felt weary and sore; hence we slept later than usual on the morning of July 10th, and the forenoon of that day was spent in making preparations for our departure. Everything in readiness, and dinner over, following the custom of other campers, we tacked up a board on the great oak under which we had slept and ate and sung, bearing our names and the date of our visit, and over it a big horse-shoe, "for good luck," (?) and then,

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with reluctance, we bid this part of the valley adieu. Going down to the hotels, we stopped for some time, visiting again the Art Gallery, the Curiosity and Cabinet Shops, procured a few more stereoscopic views and mementoes, and then dropping down to the base of El Capitan, we went into camp on the banks of the rippling, sparkling rivulet that comes dashing down from Ribbon Falls, sometimes called Maiden's Tears. Near this point the Big Oak Flat Road begins to make its wonderful ascent out of the valley, and here we had resolved to spend the night, so as to begin to climb the mountain the following morning.

But, reader, imagine the sublimity of the presence in which we were encamped. Within three hundred yards of our wagon was the base of the mighty El Capitan. This is a monster mountain-rock that projects from the north wall of the valley, and towers up, up, up, 3300 feet, almost perpendicularly! It is one stupendous, solid granite rock; not a seam or crack to be seen in all its broad towering face! No one can form a conception of its massiveness without seeing it. You stand at its base! You lean back and look up, up, up, until your neck aches; and the view overwhelms you with a sense of your own insignificance. Speaking to your own heart, you involuntarily exclaim, What am I? an atom, a feeble worm, a speck of frailty. El Capitan is immense, immovable, permanent as the everlasting hills! A peculiar feeling comes over you! You seem to be awed into insignificance by a sublime presence! But, suddenly, the thought occurs, "I can *think*—El Capitan cannot! I am a sentient being; I can, from this mighty presence, look up to and revere, admire, love and adore the Infinite Creator, who laid the foundations of this monster stone and placed it here; but *El Capitan is only a rock!*"

You walk backward and take a more distant view. You see the apparently dwarfed shrubbery clinging to its edges near its summit, like mere specks in the sky; but you are assured by those who have been up to the top that they are stately pines that tower in height more than one hundred feet. Such is El Capitan, or "The Captain." There are other rocks surrounding this valley that attain to a greater height, but none that so impress the beholder with a sense of massiveness. The Three Brothers, that stand only a short distance east of the Captain, and are so related to each other as to suggest the idea of mountains playing leap-frog, rise to the height of 3830 feet, but they in no way impress one as does the massiveness of El Capitan.

Respecting this rock and the South Dome, the Indians had quite a fascinating legend, which will be interesting to the reader. They believed South Dome to be the home of *Tis-sa-ack*, the good spirit of the valley; and that, in a far distant age, this valley was the home of the children of the sun. Here they lived peacefully under the guardianship of their great chief, *Tu-toch-ah-nu-lah*, who dwelt upon the rock, El Capitan, known to them under the name of their chief. Stationed here, he saw at a glance all that his people were doing. Swifter on foot than the elk, he herded the wild deer as if they were sheep. He roused the bear from his mountain cave that the young people might hunt him. From the crest of the rock he prayed to the Great Spirit, and the soft rains descended upon the corn in the valley. The smoke of his pipe curled up into the air, and the warm sunshine streamed through it and ripened the golden crops for the women to gather. When he laughed, the river rippled with smiles; when he sighed, the swaying pines repeated the plaint. When he spoke, the voice of the cataract was hushed into silence; when his shout of triumph arose over the bear he had slain, it was repeated by every echo, and rolled like a thunder peal from mountain to mountain. His form was straight as an arrow and elastic as a bow. His foot outstripped the red deer, and the glance of his eye was like the lightning's flash.

But one morning, while hunting, a bright vision dawned upon him of a lovely maiden sitting alone, on the very summit of South Dome. Unlike the nymphs of his tribe, she was not wreathed in tresses black as night, nor was the gleam of darkness in her eyes; but down her back fell the long golden hair like a stream of sunshine. Her brow was pale with the beauty of the moonlight; her eyes were blue as the mountains in the hour of twilight. Her little feet shone like the snow-crests on the pine woods of winter; she had small cloud-like wings drooping from her marble shoulders; her voice murmured sweetly and softly, like the tones of the nightbird of the forest.

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"Tu-toch-ah-nu-lah!" she whispered, and was gone. From crag to crag, over gorge and chasm, rushed the impetuous chief in pursuit of the aerial beauty; but, lo! her snow-white wings had conveyed her to the unknown land, and Tu-toch-ah-nu-lah saw her no more.

Day after day did the young chief wander among the mountains seeking her. Day after day did he lay sweet acorns and fragrant flowers upon her dome. Once his eye caught her footstep, light as the fall of a snowflake on a river. Once he caught a glimpse of her form, and a tender glance from her radiant eyes. But he was speechless before her; nor ever did her sweet tones fall upon his expectant ear. So passionate was his love for Tis-sa-ack, so absorbed was he in his dreams and thoughts of the beautiful maiden, that he forgot his people; and the rains ceased to descend, and the valley became athirst, and the crops withered where they stood; the beautiful flowers bent their heads and died; the winds lost their power, and ceased to cool the valley; the waters passed away, and the green leaves faded into brown. Nothing of this was seen by Tu-toch-ah-nu-lah, for his eyes were wholly fixed on the vision of the mountains. But Tis-sa-ack saw it, and saw with sorrow; and kneeling on the gray rock of the dome, she prayed the Great Spirit that he would again give to the people the bright flowers and delicate grasses, the leafy trees, and the savory acorns.

Then, in a moment, the great dome on which she knelt was cloven asunder, and through the gorge thus opened rushed the melting snows from the Sierra Nevada into the channel of the River of Mercy; and the rocks that simultaneously fell from the mountain banked up so much of the waters as were sufficient to fill the Mirror Lake. Then, indeed, the scene was changed. The birds wetted their wings in the rills and pools, and burst into joyful song; the grasses spread stealthily over the gladdened soil; the flowers received a new life, which they poured out in grateful fragrance; the golden corn sprung up in its abundance; and the merry wind aroused a thousand slumbering echoes. But in the convulsion which had inaugurated this transformation, the maiden had disappeared forever; and since then the half-dome bears her name—*Tis-sa-ack*—among the Indians, in grateful recognition of her love for their people. Every morning and evening the sun lifts from or lays his rosy mouth upon the summit; and all around the margin of the lake bloom myriads of white violets, the memorials of the snow-feathers dropped from Tis-sa-ack's wings as she flew away.

When Tu-toch-ah-nu-lah discovered that she would be seen no more, he abandoned his rocky fastness; and, with a bold hand, carving the outline of his head and form on the face of the rock that still (among the Indians) bears his name (but by the whites has been christened El Capitan or Captain), a thousand feet above the valley, he went in search of the lost one. On reaching the other side of the ravine, a feeling of deep melancholy fell upon him. Unwilling to quit it, he sat down, gazing far away toward the sunset, whither, as he believed, his Tis-sa-ack had bent her flight.

And as he sat, his grief weighed heavily upon his heart, and he ceased to have motion or life in his blood. Slowly he changed into stone; and the voiceless, breathless, lifeless figure may still be seen by every visitor to the Yo-semite, looking afar off to the land of the sunset, in wistful inquiry for the loved and lost. Such is the legend. In it we have a striking indication of the religious belief of the Indians, as well as some statements that point to a belief upon their part that this wonderful valley was, in part at least, formed suddenly by some mighty convulsion in the earth's crust.

Five hundred yards to the north of where we were encamped, and northeast of El Capitan, is Ribbon Falls, sometimes called Maiden's Tears. Here the water comes leaping, sliding and plunging down in a series of alternating cataracts, cascades and slides, making, in all, a fall of 3300 feet. This is the highest fall in the valley; but as much of the descent is made in slides down the steep face of the rock, rather than in vertical leaps, and as the quantity of water is comparatively small, making a stream in the valley about five feet wide and four inches deep, these falls are not so noted.

Having arranged our camp for the night, the Professor and I took a stroll through this part of the valley, he going quite up to the foot of the Bridle Veil Falls and filling a bottle with the sparkling water, to carry along home; and

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both of us going up to the foot of the Ribbon Falls. Returning to camp, we ate supper, and put all things in readiness for an early start out of the valley the next morning.

A refreshing night's sleep, a hearty breakfast, and at an early hour we were on the road climbing the immense steeps as the road winds along the north wall of the valley, intent on passing the most laborious part of the "climb" before the heat of the sun became oppressive. As our load was much lighter than when we entered the valley, and our horses fresh, we made good time. The Professor, walking, drove the team, and I, with the gun on my shoulder, "footed it" up the wonderful zig-zag steep. Oh, what a climb it was! How we and the horses did perspire! Often we halted, turned around and cast last lingering looks at that stupendous picture of Nature's painting spread out below! By 9.30 A. M., we have arrived at *Prospect Point*, more familiarly known as "O, My!" Here we stop a few moments to take a farewell gaze into that wonderful valley with its vast precipitous walls of gleaming granite, with its colossal pines and firs, its beautiful ferns and flowers, its singing birds, barking squirrels, and speckled trout; its murmuring brooks, its balmy breezes, its roaring cascades, and its thundering, booming cataracts! We stand, we gaze in silence for a moment, and then, waving our handkerchiefs to the enchanting scene, we exclaim, "Farewell Yo-semite, *Farewell*; thank God we have lived to gaze upon thy indescribable wonders!" And, so saying, the word is given; patient, faithful Jake and Daisy lean forward in their harness, the wagon moves on, and we can but feel sad that the rarest feast of mortal vision for us is ended.

THE STRIDULATING LOCUST AGAIN.

A Scientific Argument for Immortality.

BY THE EDITOR.

The argument based on the stridulating locust as presented against the wave-theory of sound in the July number of The Microcosm, vol. iv., p. 318, has proved, as we expected and predicted, to be entirely unanswerable. We stated distinctly, when first presenting the argument, our belief that no power of man could gainsay it, or save the wave-theory from destruction at its hands, if no other consideration could be presented, and we further predicted that no reputable scientist would venture to controvert its force. Since the argument was first published, we have taken pains to open correspondence with several acute scientific men in different sections of this country and some in Europe, urging them to oblige us by making any conceivable reply by which to weaken its force, if it lay in their power to do so. The result is, two points only have been raised as possibly bearing against it, both of which we will state and then answer. But before doing so, let us briefly re-state the argument itself, since many of the readers of the present volume have not seen the previous volumes of The Microcosm.

The argument, in the fewest words possible, is this: The wave-theory teaches that sound consists alone of *air-pulses*, or of *condensations and rarefactions* sent off from a vibrating instrument; and hence the greater the atmospheric agitation, that is, the more intensified the condensations and rarefactions, the greater must necessarily be the volume of the sound produced. Now it is a fact easily observed and verified, that a locust in stridulating does not produce one-tenth the tremor or vibratory motion, and consequently not one-tenth the disturbance of the air that a powerfully bowed or struck tuning-fork produces; yet the tuning-fork held in the fingers with its ten-fold greater pulse-making effect, or disturbing action upon the air, cannot be heard a distance of six feet away in a still room, while the insect, with only one-tenth the pulse-making power and consequent motion of the air, is distinctly heard a mile in all directions. The conclusion drawn from this is irresistible, namely, *that sound cannot consist of air-waves or atmospheric pulses at all!* The final conclusion is, that sound must be an objective something, such as one of the substantial forces of nature, analogous to electric currents, and consequently that any atmospheric tremors or pulses, which are known to accom-

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pany sound, can constitute no part of the sound itself, but must be merely incidental to its generation, just as tremors may incidentally accompany electric discharges from the motion of the dynamo-machine, without such tremulous motion constituting any portion of the electricity itself.

This is the latest argument based upon the stridulating locust against the current doctrine of acoustics—the one which we have repeatedly invited physicists to answer, if in their power to do so, but which we absolutely knew at the time they could not do. Some may think it *boastful* in us thus to reiterate so strongly what we believe to be invulnerable in our arguments, and helpless weakness in the advocates of the wave-theory. Ordinarily such would be the case. But the new departures in science, upon which the Substantial Philosophy is based, are so radical and startling in their announcement to the scientific world, that a tame and merely commonplace presentation of the matter would scarcely arrest the attention of the reader. We may have erred in our judgment, but we have believed from the start that the revolutionary and all-sweeping nature of the case brought us under the injunction to "cry aloud and spare not," even if temporarily it should subject us to the charge of egotism. The near future, we feel assured, will make it right, and that it will cheerfully condone the manner for the sake of the substantial results. Such being our humble apology, we proceed in our own way in accomplishing the work of our mission.

The only attempted answer to the above argument in response to our correspondence consists in the two points raised, as just hinted, and lest they might come up some time in the future as an offset to its crushing force, and thus tend to puzzle the minds of inexperienced substantialists, we here leave the record of rejoinder perfect. The attempted answers to the argument are as follows:

1. The reason why the locust produces so great a volume of sound with so little vibration, is, that its body consists of a highly *resonant case* or *sound-board,* like that of a violin, harp, or piano, only on a small scale.

2. The reason why the tuning-fork produces so little sound with so great a vibratory motion, is, that the two prongs tend to cause *interference* in their condensations and rarefactions, thus greatly weakening their disturbing action or pulse-effect upon the air.

These two attempts at answering our argument now constitute the only hope of the wave-theory, and both of them we had in our mind when originally presenting the argument, as we distinctly stated to Dr. Mott at the time, pronouncing them the probable straws at which the drowning theory would clutch. Let us now mercilessly snatch from it these straws, and thus leave it to sink out of sight.

1. The body of the locust, as we now assert, does not constitute a "resonant case," or "sound-board," at all, by which to augment the tone of the locust. Let us proceed to demonstrate it: We recently went into the country where these stridulating locusts abound, on purpose to secure one, and by which effectually to silence this very attempt at answering our argument, and we are glad to say that we were fortunate enough to accomplish our purpose. We now have before us on our desk, as we write, a *bona fide* stridulating locust whose sound, just before being captured, had filled and surcharged a mass of air equivalent to four cubic miles. Here, now, is the incontrovertible experiment which settles the question of the "resonant-case" assumption. We struck a tuning-fork against its pad, causing it to sound, and then held the stem firmly against the back of the locust, but, just as we expected, not the slightest perceptible augmentation of the sound was produced. The same result was obtained by holding the stem of the fork against any and all parts of the insect's body, no resonant increase being perceptible by the most careful observation, and holding the sounding fork close to the ear, as changes were made. This single fact totally annihilates the first part of our correspondent's answer. Indeed, had he exercised his reasoning faculties, he would have seen that, however perfect the resonant quality of the locust's body might have been, it was altogether too small to produce any sensible augmentation of its own sound, as may be readily determined by employing a piece of highly resonant dry spruce of the same size as the locust for experiment with the fork. Hence it follows, that this insect radiates its enormous volume of sound without the slightest aid from the resonant character of its body, except so far as its sonorous property forms the unknown basis of its substantial sound-producing power. It is

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thus conclusively demonstrated that the sound of this insect does not consist of air-waves, since there is no vibration produced adequate to, or commensurate with, such a purely mechanical result, by which the four cubic miles of air, weighing 20,000,000 tons, can be condensed and rarefied, heated and cooled 440 times a second by a mere insect, as the wave-theory teaches.

2. The supposed *interference* of the condensations and rarefactions sent off from the two prongs of the tuning-fork, as constituting the second answer, breaks down even more signally than the first, since a *single string* stretched over a rigid bar of iron, till it gives the pitch of the locust, *can be heard no farther than can the tuning-fork!* As no interference is possible in the case of a single string, according to the wave-theory, the air must receive the full effects of its vibrations, and of its condensations and rarefactions. Why is it then, if sounds consist alone of these condensed atmospheric pulses, that this vibrating string, which sends off a hundred times more powerful air-waves than can the vibrating body of the diminutive insect, cannot be heard six feet away in a still room, while the locust, with one hundred times less vibration and less effect on the air, can be heard a mile in all directions? Come, gentlemen of the wave-theory side of the house, speak out and let your *voice* be heard, even if you cannot let your *light* shine. We beg of you not to conclude that you have no *voice* because we have demonstrated that your air-wave theory is all nonsense. You can talk, and you know it, even if there is but little *substance* in what you say. Then tell us why it is that this powerfully stretched string, without any interference of its so-called air-waves to weaken its effect, cannot produce a volume of sound that will sensibly fill a radius of six feet around it, while the vibrating body of this trifling insect, producing fully one hundred times less effect upon the air, actually generates, as shown by pure geometrical measurement, 80,000,000 times the volume of tone that can be produced by its superior pulse-producing competitor!

The argument thus brought to an overwhelming culmination appeals to the common sense as well as the consciences of the physical professors of our colleges and universities throughout this land. Either they are at this very time wretchedly misleading and misdirecting the minds of their tens of thousands of students, in still teaching them the impossibilities of the current theory of sound, or else we are monstrously deceived and deceiving others in insisting upon such arguments as the one here presented, as all-sufficient reasons for repudiating that theory as the most arrant nonsense, unworthy even of the dark ages of science.

Upon the total fallacy of the wave-theory of sound, as the key to all the other forces of nature, now depend the truth and perpetuity of the Substantial Philosophy. We frankly and defiantly stipulate here, that if wave-theorists will meet and set aside this single argument against their theory, or show how the theory can possibly be true in the face of the facts therein massed, then will they have overturned Substantialism root and branch, and they will henceforth and forever be relieved from all further molestation by its troublesome founder. Will they undertake the contract and thus, if successful, rid the scientific world of a pest, which we frankly acknowledge ourself to be, if what we are teaching as the Substantial Philosophy be not in the direct line of the infallible principles of science? We do not ask it tantalizingly, but we do inquire, nevertheless, if eminent physicists of the present decade of the nineteenth century can really care so little for their future scientific reputations that they can afford to be pointed to and laughed at by rising investigators as the learned fossils who had not genius enough to see even after it was explained to them, the crushing force of this locust argument, and that it has alone totally killed the wave-theory of sound? We ask this personal question for their sakes, not for ours; for, so far as we are individually concerned, boasting or no boasting, the matter is a foregone conclusion, and the question of the truth or fallacy of the wave-theory has already been definitely settled by the totally silenced and spiked batteries of the opposition. Unless some formal as well as formidable attempt shall be made by leading physicists to neutralize the effect of this locust-and-tuning-fork argument, there is not a judicial mind in Christendom, that pretends to even a smattering of scientific lore, that would not decide the case peremptorily against the wave-theory. And with the wave-theory judicially pronounced null and void, nothing remains but Substantialism, with all that the term implies, both here and hereafter—both for time and for eternity.

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And now we embrace the opportunity, before concluding this paper, of saying a few affectionate words to those friends of our work who accept the general principles of the Substantial Philosophy, but who do not see the importance, or rather necessity, of so persistently harping upon the unscientific character of the wave-theory of sound, as we are doing in THE MICROCOSM. They evidently do not see, as we claim to do, that upon the incorrectness of that theory depends the possible immortality of man, because, as we hold, upon the incorrectness of that single scientific theory depends the substantial or ontitative nature of all physical force, in whatever manifested form; and upon the substantial nature of the physical forces, such as heat, light, sound, electricity, cohesion, magnetism, gravity, etc., depends, logically and unavoidably the substantial or entitative nature of vital, mental, and spiritual force according to Substantialism, upon which also manifestly and admittedly depends our personal and conscious existence after death. For assuredly, unless the vital and mental powers are as really substantial as is the body itself, instead of being the mere motion of material molecules, they can have no personal or entitative existence after the dissolution of soul and body at death. The very premise of a continued existence of anything involves, of necessity, its substantiality, whether it consist of material or immaterial substance; and the very premise of the insubstantial or non-entitative nature of one single force or phenomenon-producing cause, inevitably involves the absolute non-substantiality or nonentity of all force, of whatever kind or character in nature, and thus the nonentity of the human soul. As Pope says of a concatenation:

"Tenth or ten-thousandth breaks the chain alike."

Prove one single link in the chain of the natural forces, or one single form of energy which produces a phenomenon, causes a sensation, moves a body, or accomplishes any observable result, to be a mere mode of motion and not a substantial, objective existence, and every link in the chain of physical, vital, and mental force is severed. The whole line of links dissolves, with less cohesiveness than a rope of sand. Life, as we have so often shown, with such a single missing link of continuity, can be nothing but mere molecular motion; soul, mind, and spirit can be nothing but the insubstantial phenomena of matter, as Haeckel and Huxley so logically insist from the standpoint of physical science as taught in all our Christian colleges. And if man, according to the science of the schools, is only constituted of matter and material phenomena, then manifestly life is less, even, than an evanescent, vapory breath; future existence is not even a well-matured dream; immortality is a visionary sham; hope of heaven a cruel delusion, and death, verily, ends all.

We beg, therefore, of the thoughtful reader to pause and consider well before deriding this crusade against the wave-theory, as the absolute key to the situation, since upon the triumphant success of this campaign, and upon it alone, depends the truth of the Substantial Philosophy as the pivotal scientific basis upon which man's personal immortality turns. The wave-theory of sound, as now universally taught, we claim also to be the key to the situation, because it was this admitted doctrine (so manifest on its face as never to have been called in question) that sound was but the motion of the material particles of the air, which first led to the invention of a material, gelatinous *ether*, filling all space, but inconceivably attenuated, by which the theories of light and heat, as but undulatory modes of motion, could be framed and made feasible; and from these it was but an easy step of ratiocination to conclude, as has Sir William Thomson, that magnetism, electricity, and gravity are but the vibratory motion of material molecules; and then a still easier, and quite as logical a step for Haeckel and Huxley to take, as they have boldly done, in assuming that the soul, life, and mind of man are nothing but the infinitesimal movements of the brain and nerve molecules "placed together in a complex and most varied manner." How natural, then, and how consistent that the Substantial Philosophy, in attempting to evolve a scientific, philosophical, and natural basis on which to rest the immortality of man, and by which scientifically to corroborate the fundamental truths of the Christian Religion, should lay its ax at the very root of the upas tree of materialism by striking a fatal blow, if possible, at the first and representative undulatory doctrine taught as science, and from which the whole brood of serpentine theories had their rise!

Hence, in the logical necessity of the case, we could not help seeing intui-

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tively that so long as the sound-theory maintained its impregnable position as one force which is nothing but an acknowledged mode of motion, it was but visionary and puerile to conceive of the possibility of founding a universal system of scientific doctrine such as that now set forth in the Substantial Philosophy. What folly to waste our time and aim our blows at light, or heat, or gravity, or magnetism, or electricity, as modes of motion, and thus try to break their force, with this air-wave Mordecai the Jew sitting provokingly at the king's gate!

In the dead hours of night, as we lay in sleepless contemplation of the mighty problem to be worked out, by which God could be manifested through nature, science, and philosophy as he never had been manifested before, and by which true religion, in the evolved light of such scientific truth, could assume a position in scholasticism that it had never before sustained, something whispered to us (and we well remember the time, more than a decade since), as almost with an audible voice: "Lay your ax at the root of the materialistic tree by striking at the primordial undulatory monster of the scientific deep, and God will direct your blows." We gave heed to the admonition of this still, small voice, and, blindly at first (being almost entirely ignorant of the principles of physical science), commenced dealing our blows at the wave-theory of sound as the Malakoff which rears its mighty tower at the entrance of the harbor to protect the Sevastopol of materialism.

Before, however, printing a line on the subject of our contemplated assault upon the mode-of-motion philosophy of physical science, we held a number of long private interviews with a very learned materialistic doctor, with whom we were on the most intimate terms of personal friendship. In reply to our questions, as the subject began to open itself out, he declared unhesitatingly that if the wave-theory could be overturned, then sound could, in the nature of things, be nothing else than an immaterial substance of some kind, and this once proved, the other forces of nature would follow unavoidably as substantial or objective existences; and he added with emphasis, that, with the physical forces, including sound, shown to be substantial there was not a materialist on earth who would not abandon his doctrine at once and admit life, soul, mind, or spirit to be as entitative or real as is the corporeal body it inhabits.

But after this frank avowment, and with a look of pity for the delusion under which he believed we were laboring, in thinking it possible to overturn the wave-theory of sound, and thus revolutionize physical science, and thereby to found the broad philosophy of Substantialism, he led us to his magnificent library and took down a score or more of massive scientific volumes, including those of Tyndall, Helmholtz, Haeckel, Huxley, Darwin, Spencer and many others, and said to us with a half derisive smile: "You see here the contract you have taken in attempting the overturn of the wave-theory of sound; if that theory can be broken down then all these volumes are not worth the paper they are written on, except to expose the ignorance of their authors, and with them will be rendered null and void more than one half of this valuable library of scientific books!" He then proceeded strongly to urge us to reconsider and abandon our bootless undertaking as certain to end disastrously what little reputation we had as a sound scientific thinker. "But if you will go on," he derisively continued, "I am one of the consulting physicians of the Bloomingdale Asylum, and will try to use my influence in making it as comfortable for you there as possible!" We soon thereafter left him, though we have endeavored since to keep him posted in the progress of substantial events by occasionally sending him a copy of THE MICROCOSM. How he now feels about the invulnerability of the wave-theory of sound, or how he now regards the healthfulness of the Bloomingdale Insane Asylum as a place of residence for scientific cranks, we have a little curiosity to know. At any rate, for the sake of old-time friendship, we will see that he gets a marked copy of this number, so that he may have the pleasure of trying his skill on our locust-and-tuning-fork argument if he likes.

Finally, let every beginner in the study of Substantialism think on these things, and remember that materialistic writers only assume the non-substantial nature of the soul from the conceded non-substantial nature of the physical forces, as taught in all our schools, with sound-force lying at their base as the representative so-called mode of motion.

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We have thus dwelt somewhat lengthily here upon this phase of the Substantial Philosophy, as an explanatory apology for the prominence given to the sound discussion in this magazine, in order that young substantialists may not stumble in reading THE MICROCOSM and thoughtlessly ask, as too many older believers in the new philosophy are led to ask: "Why this incessant hammering at the wave-theory of sound, as if it had much to do with science or anything to do with religion?" Such young substantialists must not fail to remember that although the wave-theory of sound is already "twice dead and plucked up by the roots," so far as scientific facts, reasoning, and arguments are concerned, yet it is a fact for which, surely, we are not to blame, that probably not one scientific thinker in one hundred, in this country, has yet heard the news that the current theory of acoustics has been seriously attacked, nor has any conception of a rational reason therefor. This is a great country, and it takes a good many MICROCOSMS to cover it, though we have tried to do so by sending out hundreds of thousands of them. Still it is the imperative need that the Organ of the Substantial Philosophy should never let up in its revolutionary crusade against this foundation theory of false science, till not one scientific man in the civilized world shall have a reasonable excuse for withholding his assent to Substantialism.

LET US PREPARE FOR THE NEW UNIVERSITY.

BY THE EDITOR.

It is now a foregone conclusion that the University of Substantialism is to be built and started into operation without unnecessary delay. The enterprise has been vigorously taken in hand by a few of the leading Substantialists of the country, who have not only put their shoulders to the wheel by declaring that it shall be accomplished, but money has already been subscribed for partly meeting the contingent expenses of organizing the institution, and also for putting an efficient agent into the field to solicit donations, as well as to solicit competitive propositions from various towns and cities, with reference to inducements to secure the permanent location of the University.

It is well known that a university, fully equipped for work and manned for carrying it forward, located in any growing town or city, ambitious for a rapid increase of its municipal prosperity, will pay such a town or city in a few years many times the cost both of the site and of the buildings required, in the increased value of its real estate. Several towns in the West and South, as we learn from one of the active friends of the new movement, are now offering inducements of this kind with a view of securing the location of a college or university in their immediate vicinity. It is of importance, therefore, that any town or city desiring to secure such advantages as here named, should communicate as early as possible with Dr. Henry A. Mott, Corresponding Secretary and Managing Editor of THE MICROCOSM, at this office.

We are also pleased to announce that already donations of apparatus and appliances, including cabinets of specimens, books, etc., to the amount of thirty or forty thousand dollars, have been voluntarily proposed, as soon as the university buildings shall be in readiness to receive them. We state these things thus early, and in the very incipiency of the movement, as a hint to the friends of Substantialism everywhere to ask themselves the question whether their own hearts do not cordially indorse the plan of establishing such a home for the Substantial Philosophy, by which its power for doing good may be centralized, and its great revolutionary principles may the better be matured and formulated for the benefit of mankind. And when asking themselves this question, let them further inquire whether they may not have some means that can be spared financially to help forward a cause so meritorious as placing the Substantial Philosophy in a formal attitude for doing good. Any suggestions, looking to contingent donations, either immediate or remote, will help to strengthen the hands and gladden the hearts of those now earnestly engaging in this work.

The reception given to the foreshadowing announcement of the Substantial

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University in last month's MICROCOSM is well calculated to send encouragement and cheer to those who are already preparing to devote their lives to its interests, and so far as we have had time, up to this writing, of hearing from our readers, the proposition for a university, based on Substantialism as its chief corner-stone, is hailed with delight.

The length of time necessary for getting such an institution of learning into full operation, about which several have inquired, will depend largely upon the liberal spirit of its friends, and the substantial manner in which they may volunteer to assist in the work of its founding. Information more directly bearing on this inquiry can better be furnished in a subsequent number of THE MICROCOSM after the plans for the details of its establishment have been more fully matured.

From the enthusiasm already aroused in those who have read last month's announcement (which every reader should examine if he has not already done so), and from the earnest spirit evinced by those now planning for the organization, there is no reason to believe that more than two years at farthest will have elapsed before the University of Substantialism will be ready to marshal her forces for the noble work of the scientific and philosophical regeneration of the world. And when it does open for work, we have every reason to look for such numbers of applications for the matriculation of students that there will not probably be room enough in the university buildings to receive them. We are already hearing from ministers and other substantialists who are anxious that their sons and daughters shall have a place in the first session of that institution, and one man writes: "I have two sons and two daughters, all four of whom shall, if I live, enjoy the benefits of an education in the University of Substantialism." A record of all such intimations will be duly kept.

We believe that we hazard nothing in predicting that the institution here proposed, for radiating the principles of the new philosophy to all portions of the civilized world, is destined, in the very nature of its mission and purpose, to become historic as no other university has ever become. The curriculum of Substantialism will form of itself an inducement for the attendance of the bright young men and women of this nation, of a more captivating and exciting character than has ever before been announced by a similar institution of learning. The intellectual activity which is now so marked among all classes of advanced thinkers, the marvelous discoveries in science, mechanics, and the arts, which have so signally characterized two or three of the last preceding decades, and the ominous foreshadowings of revolutionary events which the wise men of the East are predicting as so imminent, all point to the present as the opportune moment for unfurling the banner of the University of Substantialism as the virtual fulfillment of these prophecies. That the times are ripe for the planting of this philosophy in an educational soil of its own, where it may take ready root and grow almost spontaneously, till its spreading branches, perennial foliage, rich blossoms and golden fruit shall combine to bless not only every state of this Union, but through these states reach the whole civilized world, is a proposition which the friends of Substantialism do not hesitate for one moment to believe most firmly. That an imperative duty is thereby devolved upon every such loyal friend of the cause to aid to the extent of his means in starting the revolutionary movement, is equally a part of the faith which has been delivered to the Substantial saints. How they are to apply their shoulders to the best advantage, in causing this wheel of Substantialism to revolve with the greatest possible velocity, and thus to grind out the greatest possible amount of truth, with the least possible modicum of error, will be a matter for future deliberation and announcement by the leading movers in the enterprise in convention assembled.

One thing, however, is a *sine qua non* to the widest possible usefulness of this university, and that is, that every friend of the Substantial cause shall at once begin a course of intellectual preparation for grasping the meaning, appreciating the importance, and comprehending the wide-reaching scope of this revolutionizing system of religio-philosophical doctrine, by storing the mind with its principles, in anticipation of the personal part each Substantialist is expected to play in the near future, whether as one of the working force within the halls and class-rooms of the university colleges, or as an active missionary in the country at

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large for directing the steps of wayfaring students to the sheltering asylum where their every intellectual want may be supplied. To this end, and to best facilitate such mental qualification for true workers in the Lord's great vineyard of Substantialism, we can only admonish every friend of the cause: study the principles of the new philosophy thoroughly, make them a part of yourself, let no problem or objection be too difficult for your ready solution, and so shall you always be prepared to give to every man that asketh a reason for the hope that is in you with meekness and fear.

SOMETHING OUT OF NOTHING.

New York, September 12, 1885.

DEAR DR. HALL:

Your argument in reply to Dr. Stone in the September MICROCOSM has thrown a flood of light on the subject of Creation. Clearly, if Dr. Stone's view is correct, *nothing* must be the exact equivalent of an entity, as you have logically insisted. If I were able to "frame" a house out of *nothing,* as the worlds were supposed by Dr. Stone to be "*framed* by the word of God," even if I possessed infinite power, I should regard *nothing* as a good enough *entity* for all practical purposes of material construction. The very fact that God must be immanent or present in nature, in order to sustain it, according to the faith of most Christians, and the very fact that without the immaterial force of cohesion, as you have shown, all material bodies would at once disappear, is sufficient proof that it is through and by means of the physical forces that God's presence is made manifest in nature. And if God is actually present in nature, and controls it through the immaterial force-element in its various manifested forms, there is nothing illogical or irreverent in supposing that this same immaterial element was the original portion of God's exterior essence out of which the worlds were made. How natural, then, is Paul's statement that the worlds were "framed" of *things* that *do not appear,* or in other words, of the "*invisible things of Him.*" Heb. xi. 3; Rom. i. 20.

The argument advanced by you in reply to the Rev. Dr. Barr, of Philadelphia, as printed in the "Problem of Human Life," at page 52, is one of the strongest scriptural arguments against the *nothing* theory yet presented, and I cannot imagine how any one would attempt to answer it, namely, that the "*Word* was *God,*" and the "*Word was made flesh.*" As the flesh of Christ was literally *material,* it is plain that God did, at least in one instance, himself change into *matter,* and it is equally true that the mere flesh of Christ, after its creation, was no more a part of God than is the flesh of any other person. Then the argument is overwhelming, if *God* as the *Word,* could be made into *material flesh,* dare we assert that God as the *Word* could not be made into a material *World* or a material universe? It is also very plain that in the creation of Adam the soul or spiritual part came direct from God, as a part of his own spiritual essence, and by which man was made in the image of God. Is it likely that God made one half of Adam out of his own essential being, and that the other half (or that out of which it was made) came from nothing? Is it not more probable that the whole man, soul, body and spirit, came directly or indirectly from the substantial being of God? Would it not be well for those who advocate the *nothing* hypothesis to stop raising trivial objections long enough to answer a few of your strong arguments?

Query,—If God was in the habit of making *things* out of *nothing,* why did he change his plan and make Adam's body out of the *dust of the earth?* Why did he not consistently adhere to his uniform process and make Adam's body out of *nothing?* If it was actually necessary for God to use some previously existing substance out of which to make so *small a thing* as Adam's body, is it at all likely that he could make larger things such as *worlds,* out of *nothing?*

ROBERT ROGERS.

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EDITORS' TABLE.

WHY WE HEAR NO SOUND FROM A VACUUM.

If the wave-theory be not true, why is it that a bell, rung in an exhausted receiver, is not heard by persons in a room near it? This question is frequently asked by correspondents, and we have several times answered it in THE MICROCOSM. (See volume 3, page 61.) Let us briefly explain it again.

To illustrate: Suppose a small insulated dynamo-machine running by spring-power in a perfect vacuum, and generating electricity—why is it that no electricity is observed outside of the exhausted receiver? Every scientist would answer, because there is no conducting medium connecting the electric generator with the outside. This is exactly the answer in the case of sound. The air in the receiver, when not exhausted, is the sound-conductor from the otherwise insulated bell. If the receiver is full of air the sound through it reaches the sides of the receiver, and through the receiver connects with the external air. But if the receiver is exhausted of air and the shank of the bell is set in the board bottom of the receiver, it will be observed that the sound will be heard outside the same exactly as if the receiver had not been exhausted—the board serving as an all-sufficient conductor, and probably augmenting the sound by resonance.

There is a difference in the forces of nature, some requiring conductors and some not. While sound and electricity always require conducting media, light, magnetism and gravity require no conductor whatever, but will radiate and act with equal force through a vacuum as through air or the most favorable medium. Heat, on the contrary, while acting independently of all media, will act stronger through a suitable medium than through a vacuum.

It thus turns out to be no proof in favor of the wave-theory of sound, because sonorous pulses need a conducting medium, either air or something else, any more than it proves the truth of a wave-theory of electricity because electric pulses will not travel without some sort of a conductor suited to its law of transmission, radiation, or diffusion.

Some few of our subscribers, when sending in their names for renewal, have inclosed \$1.00, with the request to send the magazine to their address for one year. The subscription price is \$2.00 per year, or \$1.00 for six months; and to all those who have unthinkingly sent one dollar for the year, the magazine will be forwarded for six months. We merely mention this so that those who have not as yet made themselves acquainted with the change in price will know when their subscriptions expire.

AN OCULAR VIEW OF THE SOUL.

Much discussion has recently been going the rounds of the press concerning a report, apparently quite well authenticated, that one Mr. Holland, of Nebraska, had actually invented a microscope by which he could see, and also exhibit to others, the human soul, as it leaves the body of a person at death. We have read a dozen or more attempted replies to Mr. Holland's alleged discovery, by which to show that the whole thing is probably a hoax. But not one of these critics hits the true reason why there can be nothing in the pretended discovery, and that is, that *the soul is an immaterial substance, and in the very nature of things cannot be seen by means of material lenses.*

The following from the Philadelphia *Public Ledger* speaks for itself:

To the Editor of The Public Ledger:

I saw in our morning papers yesterday, a short article, and in the yesterday's *Public Ledger* a fuller account, of an alleged discovery in regard to the human soul by a pseudo Mr. Holland, of Lincoln, Neb., claiming that the soul is an exact counterpart of the physical body. I cannot see how Mr. Holland can claim to be the discoverer of the theory of the "dual man," when Dr. A. Wilford Hall advances this identical theory and treats it at length in his "Problem of Human Life," a book which has been before the public for some years. Then Mr. Holland's real discovery lies in the *apparatus* by means of which this "inner man" may be seen.

Dr. Hall is now editing THE MICROCOSM, a religio-scientific magazine, and those who wish to investigate this important subject should address him at No. 23 Park Row, New York City, and procure a copy of the "Problem of Human Life," which, in my humble judgment, is the ablest and most wonderful book of the century. Very respectfully,

L. CLAY KILBY.

We send the initial number of the fifth volume of THE MICROCOSM to all our old subscribers, whether they have renewed their subscriptions or not, so that those who have not as yet sent in their names for renewal may see the magazine in its improved form, and determine whether or not they care to be without it. We have used our very best efforts to make it worthy of the patronage we fervently believe it will receive, and hope to enter in our subscription books the names of every one of our old readers.

OUR LIFE-SUBSCRIBERS.

In answer to many inquiries on the subject, we would say, that all life-subscribers will regularly receive their magazines, notwithstanding the increased cost and price of the same. To balance this additional cost of THE MICROCOSM, for which no extra charge is made, it might be the pretty thing on the part of life-subscribers, could they do so, to send in the names of a few new subscribers with the money for the same. Such reciprocity will be duly appreciated.

THE PAMPHLET ON SUBSTANTIALISM.

Some time ago we proposed through this magazine to get out a pamphlet of about seventy-five pages, more or less, on the Substantial Philosophy, if enough pledges could be obtained from our readers to take copies sufficient to cover the cost of the edition. We subsequently received pledges for about 1500 copies in all—not nearly enough to meet the first cost of the edition, including composition, electrotype plates, paper, printing, binding, postage, etc. We were very anxious to get out the pamphlet and to put it into circulation, by scattering it broadcast through the land, alone for the good it was destined to accomplish. But we were then unable to do what we so much desired, and what we knew to be of so much benefit to the world at the present crisis in the progress of Substantialism.

But now, seeing the manifest importance of extending the influence of the Substantial Philosophy, in view of the founding of the forthcoming University of Substantialism, the publication of this pamphlet can no longer be delayed, and we earnestly hope that enough friends of the cause will be ready and willing to order copies sufficient in number to meet the first cost of the work.

The labor of compiling it will at once commence under the editor's supervision, and as soon as that can be completed, the pamphlet will be issued. The names of all those who have heretofore subscribed are duly recorded in our books, and we do hope and trust that hundreds of others will at once feel induced to send on their names, ordering from ten to twenty, or a hundred copies each, either to sell, loan, or give to those willing to become informed on this all-absorbing question. Due notice will be given through this magazine as soon as the pamphlet is ready.

AN ADVISORY BOARD.

After due consideration by the friends of Substantialism who have taken in hand the founding a University as a home for the New Philosophy, it was decided that a preliminary organization of an Advisory Board would be needed to look after the contingent expenses, while the regular work of

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founding the institution was in progress. To this end the Advisory Board has been duly organized, of which Rev. F. Hamlin, of Peekskill, N. Y., is President; Henry A. Mott, Ph. D., F. C. S., of New York, is Secretary; and Rev. J. J. Smith, D. D., of Paterson, N. J., is Treasurer. This Board will soon issue an important circular to the friends of the New University enterprise throughout the world. All desiring to receive a copy of the circular can address the Secretary, Dr. Mott, at this office.

MODERN SCIENCE.

A few days ago a Boston girl who has been attending the School of Philosophy at Concord, arrived at Brooklyn on a visit to a seminary chum. After canvassing thoroughly the fun and gum drops that made up their education in the seat of learning at which their early scholastic efforts were made, the Brooklyn girl began to inquire into the nature of the Concord entertainment.

"And so you are taking lessons in philosophy. How do you like it?"

"Oh! it's perfectly lovely. It's about science, you know, and we all just dote on science."

"It must be nice. What is it about?"

"It's about molecules as much as anything else, and molecules are just too awfully nice for anything. If there's anything I really enjoy its molecules."

"Tell me about them, my dear. What are molecules?"

"Oh, molecules. They are little wee things, and it takes ever so many of them. They are splendid things! Do you know there ain't anything but what's got molecules in it. And Mr. Cook is just as sweet as he can be, and Mr. Emerson, too. They explain everything so beautifully."

"How I'd like to go there!" said the Brooklyn girl enviously.

"You'd enjoy it ever so much. They teach protoplasm, too, and if there is any one thing perfectly heavenly it's protoplasm. I really don't know which I like best, protoplasm or molecules."

"Tell me about protoplasm. I know I should adore it."

"'Deed you would. It's just too sweet to live. You know it's about how things get started, or something of that kind. You ought to hear Mr. Emerson tell about it. It would stir your very soul. The first time he explained about protoplasm, there wasn't a dry eye in the house. We named our hats after him. This is an Emerson hat. You see the ribbon is drawn over the crown and caught with a buckle and a bunch of flowers. Then you turn up this side with a spray of forget-me-nots. Ain't it just too sweet? All the girls in the school have them."

"How exquisitely lovely! Tell me some more science."

"Oh, I almost forgot about differentiation. I am really and truly in love with differentiation. It is different from molecules and protoplasm, but it's every bit as nice. And Mr. Cook! You should hear him go on about it! I really believe he's perfectly bound up in it. This is the Cook scarf. All the girls wear them, and we named them after him just on account of the interest he takes in differentiation."

"What is it, anyway?"

"This is mull, trimmed with Languedoc lace——"

"I don't mean that—the other."

"Oh, differentiation! Ain't it sweet? It's got something to do with species. It's the way you tell one hat from another, so you'll know what is becoming. And we learn about ascidians, too. They are the divinest things! I am absolutely enraptured with ascidians. If I only had an ascidian of my own I would not ask for anything else in the world."

"What do they look like, dear? Did you ever see one?" asked the Brooklyn girl, deeply interested.

"Oh, no; nobody ever saw one except Mr. Emerson and Mr. Cook, but they're something like an oyster with a reticule hung on its belt. I think they are just heavenly!"

"Do you learn anything else beside all these?"

"Oh, yes! We learn about common philosophy and logic, and those common things like metaphysics, but the girls don't care anything about those. We are just in ecstasies over differentiation and molecules, and Mr. Cook and protoplasm, and ascidians and Mr. Emerson, and I really don't see why they put in those vulgar branches. If anybody besides Mr. Cook and Mr. Emerson had done it, we should have told him to his face that he was too terribly awfully mean."

And the Brooklyn girl went to bed that night in the dumps, because fortune had not vouchsafed her the advantages enjoyed by her friend, while the Boston girl dreamed of seeing an ascidian chasing a molecule over a differentiation back fence with a club, for telling a protoplasm that his youngest sister had so many freckles on her nose that it made her squint-eyed.

MICROCOSMIC DEBRIS.

—Some of the French papers speak of the new explosive called miners' powder as much preferable in certain respects to the nitro-glycerine compounds. It resembles ordinary gunpowder, but with the difference that chlorate of potash is used as the oxidizing agent instead of saltpeter. Carbon is supplied in an organic form, and the preparation is very simple. A given weight of chlorate of potash is dissolved in water, and a quantity of sawdust or bran equal in weight to the chlorate of potash is stirred into the liquid, the mass being then allowed to dry. The sawdust powder, however, though cheap, is less safe to prepare and handle than that made of bran, as resin, which is very likely to be present in small quantities in the sawdust, forms, with chlorate of potash, a compound which detonates on being suddenly disturbed. This new powder possesses, weight for weight, about twice the power of ordinary gunpowder.

—The *Lancet* lately gave a dreadful picture of the unsanitary plight of Windsor. It entirely agrees with the report made by a special agent of the *Builder* fourteen years ago, and is confirmed by a well-known Windsor clergyman, who writes: "In South Place in this town there are forty-two houses with a population varying from 170 to 210. To these forty-two houses there are fourteen closets, all without water. Ten of these houses have no 'backs,' no sinks, no closets. All are without water. There are in these ten houses just fifty people without the common decencies of life." The medical officer admits all this, but adds: "I do not feel justified in condemning these houses as unfit for habitation." Such is royal Windsor. No wonder the prince consort got his typhoid there.

—The Koh-i-noor, the Queen's celebrated diamond, was committed by the East India Board to the care of John, afterward Lord, Lawrence. He dropped it into his waistcoat pocket and thought no more about it. He went home, changed his clothes for dinner, and threw the waistcoat aside. Some time after a message came from the Queen to the Governor-general, Lord Dalhousie, ordering the diamond to be at once sent home. Lawrence turned to his brother Henry at the Board and said, "Send it at once." "Why, you have it," said his brother. Lawrence was terror-stricken. It was fortunately found still in the pocket. It is now preserved in Windsor Castle, but a model of the gem is kept in the jewel-room of the Tower.

—The correspondent of a London paper, who visited the imperial train which conveyed the Czar of Russia to his meeting with the Emperor Franz Josef, thus describes it: "It contained bedrooms, bath-rooms, and dining-rooms, besides saloons and boudoirs, and all these were furnished with wonderful luxury. The room of the two young princes, for

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it was a regular room, was upholstered in violet leather of a new and lovely shade. Everywhere were easy-chairs and the softest of sofas. In the emperor's private saloon was an ikon, with a lamp burning before it, and on the table lay the newspapers which his majesty had been reading."

—The merry little mosquito has arrived in Dublin. The interesting tourist from this side had already turned up in London, evidently with the notion of staying. He is reported at opposite outskirts. Ever since the memorable day, some seven years since, when the first intruder of his race waylaid an Irish M. P. in Piccadilly, the bloodthirsty insect has not only lurked around London, but has considerably increased and multiplied, though it is doubted whether he will ever prove formidable. His development there promises to form a curious chapter of natural history.

—The contents of the State Library at Monaco are being catalogued by a well-known French savant, who has discovered there a mass of correspondence of immense historical value. There are many documents of the greatest interest, as well as some 20,000 letters, including many written by successive Kings of France, and by Richelieu, Mazarin, Catherine de Medicis, Louvois, Colbert, and Montaigne.

—The University College Hospital is a foremost London medical institution. The charter forbids the introduction of religion in any form into the institution. Lately the nurses in the wards have been a religious sisterhood, sanctioned by the Church of England; but there is now a movement to exclude them, on the ground that their employment is a violation of the anti-religious proviso.

—The historic town of Concord, Mass., celebrated its 250th anniversary on Sept. 12.

Kind Words.

We believe Dr. Swander will forgive us the liberty we take in quoting two or three sentences from a private letter sent us on receipt of the last number of Volume IV., as follows:

"The September MICROCOSM is to hand, and it is an excellent number. Who is Robert Rogers? His contribution is splendid—among the best. He seems to be a rising star in the galaxy of Substantialism. Give him my congratulations. I thank you for your crushing editorial on Dr. Stone's 'nothing.' It is really one of your best, and it did me good. It opened the door to let in new light for me upon that feature of the subject. It will strengthen the brethren generally. I wonder what Dr. Stone will do? What can he do but to acknowledge that you are right; and he will do it, mark my word. His 'metallic or mineral God' has been ground to theistic powder. I thank you for that editorial. There is no power in the world to set aside such invincible logic. Dr. Mott's paper is good. I expect great things from him," etc.

Lovington, Ills., Sept. 2, 1885.

MICROCOSM PUBLISHING CO.

Inclosed find blank with full directions and subscription for Volume V. I am confident that the increase of subscription price will bring with it more than a corresponding increase of mental and moral riches to all its readers. The project for the founding of a University of Substantialism is glorious. I would like to help carry bricks and mortar for the walls of its buildings, and esteem it more of an honor than to hold a professorship in some of our colleges where students are stuffed with *insubstantial stuff*, rather than trained to delve in the realms of thought and investigation for themselves. Success to every *Substantial* undertaking!

Yours truly, J. R. SUTHERLAND.

S. E. Smith, of Binghamton, N. Y., in a very kind letter, says:

"I have just finished reading the last MICROCOSM of the fourth volume, and think the two articles by Dr. Mott for this and last month alone worth the price of the entire volume. I have all the volumes of THE MICROCOSM, together with the 'Problem,' and consider them jewels of great price."

Answers to Correspondents.

J. W. L.—The word "expired," stamped on outside wrapper, will inform you when your subscription runs out.

J. DORCHESTER.—We cannot enter your name on our subscription books under the arrangement you desire, but if you wish to pay for the magazine monthly you can order it through any newsdealer, or send twenty cents to our office, and it will be mailed to you.

CHARLES WHEELER.—Our inducements to those getting up clubs appear on second page of cover. We are not at present inclined to accept your offer.

New Publications.

It is with pleasure that we call attention to a new book of sermons by Rev. T. Williston, M. A., now on the press, and to be ready for sale by the time this notice meets the reader's eye. Mr. Williston is our old contributor, and who has written many important expository articles for this magazine, as our readers are well aware. One of his short sermons, as a specimen from his forthcoming book, will be found in the present number of THE MICROCOSM. As a writer of sermons Mr. Williston has few if any equals. In confirmation of this statement we need only refer to the fact that in a recent competitive trial for a $25 prize, offered by Funk & Wagnalls, publishers, of this city, for the best short sermon, Mr. Williston was the winner of the prize against 142 able competitors. He also received a $100 prize for an essay some years ago in Boston. These facts stamp him as a writer of unusual ability. The book will be sent, post-paid, on receipt of the price, 75 cents, by the author, from his residence, Ashland, N. Y.

We have just received a magnificent copy of Dante's "Vision; or, Hell, Purgatory and Paradise," containing the life of Dante and chronological view of his age, with copious notes, and latest additions. The character of this work is so well known that nothing need be said about it. The book appears in a new and peculiarly attractive style of binding, Russia back and corners, with marbled sides and edges, and at its price is a marvel of cheapness. It contains over one hundred and thirty full-page illustrations by Gustave Dore; 600 pp., price $3.50. HURST & CO., 122 Nassau Street, New York.

A REMARKABLE BOOK OF POEMS.—We have seldom seen a book of original poems that compares for sweetness and purity of rhythmical composition and pathetic sentiment, with "Marmondale and Other Poems," by Mr. Sheldon S. Baker, of Saratoga Springs, N. Y. Mr. Baker can justly aspire to a front rank as a poet, and has already made his mark in this volume. Price $1.25.

Articles Left Over.

Still we have to apologize for the non-appearance of several valuable papers from our contributors, some of which were announced last month. The reason is that in preparing the first number of the new volume in its enlarged form, the publishers drew upon the editors for more material than expected, thus with the larger and more legible type occupying rather more space than was anticipated. These matters, however, will hereafter adjust themselves so as, we trust, to render justice and satisfaction to all parties concerned. Contributors will therefore be patient with us till the new volume gets into its regular groove.

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The Microcosm.

November, 1885.

THE FUTURE OF SUBSTANTIALISM.—No. 2.

BY REV. J. I. SWANDER, A. M., D. D.

Any philosophy that can destroy a theory older and more popular than the Christian religion has substantial force enough in its vigorous constitution to advance itself into favorable recognition throughout the learned world. Having cleared and secured its own right-of-way through the black forests of unscientific fallacies, and having engineered the building of its own iron road, Substantialism now claims to be the trunk-line of philosophic truth. Neither is its claim any more courageous than consistent. Its testimonials are found in the work already accomplished. Not only has the road been built and ballasted, but its general managers are even now already engaged in shipping rich cargoes of newly discovered commodities to all the established stations along its beneficent route. Gentlemen, don't you hear the mighty thunderings of the invisible engine, and the musical rumblings of the wheels of Substantial commerce? If not, the fault must be your own. The really deaf are only they who will not hear. Do you say that the claims of the new philosophy are contrary to the testimony of the senses? We answer that they are neither dependent upon such testimony, nor contrary thereto. As the claims of the Christian religion, like its objective entities, do not rest upon the exercise of subjective faith, nor upon its consequent comforting assurance, so with the claims and objective realities of the invisible entities of nature. Testimony, allowable and valuable in the lower, is not always admissible in the higher courts, by the wise rules and rulings of the superior bench. If, then, for the want of *such* tests in proof of its genuineness, the gospel of our philosophy be hid, it is hid to them that are lost in the meshes of materialism: in whom the God of mere matter hath blinded the minds of them which believe not in the invisible and yet most fairly and fully authenticated entities of the universe.

O that the scientific world might realize that the night of materialistic darkness is far spent, and that the day of Substantial light is at hand! With or without such knowledge and recognition, the fact remains the same. Substantialism has doffed its swaddling clothes, and is now upon its feet as a veritable system of philosophy. The grammar of its future will have but little use for the subjunctive mode. If used at all, it will be to predicate a contingency not belonging to the subject of the principal proposition. Neither is there room in its vocabulary for the term "hypothesis" in the sense of its common acceptation. Not for one moment can the name "philosophy," in its broadest signification, be rightfully withheld from the harmonious collection of facts, phenomena and logical deductions, which was obliged to annihilate a universally accepted theory of science in order to lay its foundation-stone on solid rock. Ordinarily such a collection of facts, phenomena and deductions, depending entirely upon their harmonious consistency for acceptance, might, at best, be held as only a tentative theory; but when such systematized collection or arrangement was not only entirely congruous in accounting for all the phenomena involved, but which, in order to crown its work, was also obliged to destroy one of the best-established theories in physical science, nothing but educated ignorance and narrow bigotry can refuse its admission to the family of philosophies. And whether now admitted or rejected, it will make but little difference in the near future's unfolding years. Conscious of

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the revolutionary work already accomplished, it will not condescend to "bow the suppliant knee that thrift may follow fawning"; but standing erect in the majesty of its intrinsic worth, the vigor of its symmetrical constitution, and the beauty of its admirable proportions, it will thunder with authority at the feeble gates of stubborn scholasticism, until the learned world will be glad to own and honor and utilize the only system of philosophy that can strike the fetters of fallacy from its limbs and bring it to the light and liberty of a more enduring substance.

We repeat, therefore, that Substantialism can be confined within the compass of an hypothesis no more than it can be measured by the definition of a mere science. *It is a philosophy*—THE philosophy of the world and for the world. Its primary mission is to deal with the question of being, as that which underlies all science, and enters into all philosophy. That which Aristotle dreamed of as the "first philosophy" is, in these last days, to be studied and known and applied as the philosophy of the absolute, so far as human reason may have the power to comprehend the absolute in its deep impulses and in the ever-expanding circles of its unlimited domain. This bold claim must not be confounded with the respective claims of other theories whose fragments strew the highway of all past philosophic research and inquiry. Descartes, in his theory of substance, thought that he had gotten down to the bed-rock of truth; yet, with all the vigor of an intellect that placed him in advance of his age, he barely penetrated the cuticle of the question which he attempted to solve. Besides, the fragmentary truths which he did announce were comparatively of no lasting benefit to applied and practical science. His lightning was only seen in its flashes above the clouds. It was so vividly brilliant that it could not exist in closer contact with the practical affairs of the earth. Leibnitz dreamed of pre-existent force, thought of eternal harmony in the universe, projected his doctrine of substance, and formulated his theory of the monads. Others have advanced different theories, ranging all the way from the most ethereal idealism to the outward material crust of creation, and yet there is nothing upon record worthy to be compared with the harmonious collection of facts, phenomena, and logical deductions now known by its founder and intelligent friends, and soon to be known and read of all unprejudiced scholarly men as *The Substantial Philosophy.*

Why should the heathen rage, and the people imagine a vain thing because God in his providence has "taken the wise in their own craftiness" by placing a king upon the holy hill of science? Is it not time for the star to appear above the birthplace of something better than anything now offered in the *Talmudic* traditions of scholastic materialism? The hitherto dissatisfied yearnings and searchings of earnest intellects demand something better. The glory of the truth calls for something more true in many of the prevailing theories of men. In fact the diversified fields of science require nothing short of a holy catholic philosophy, just as really as the diversified families of the earth and the divergent races of men need a holy catholic religion to bring them convergingly back to their original moorings, and conduct them thence to the port of their proper destiny. Substantialism is catholic in its constitution. Its catholicity consists in its universal adaptability to every proper department of human knowledge, and every legitimate inquiry of the human mind after the nature of things, from the point where they originate in the Personal Author of their being on to the ultimate goal of their wisely and beneficently ordained destiny. Sustaining this relation to the absolute, the general, and the ultimate, no narrow latitude can contract its powers. It is for science and for religion; for reason and for faith; for time and for eternity; for the solution of the problem of human life, here and hereafter. In reverential imitation of the Incarnate Truth, its mission is to bless all the nations of the earth. Not merely among, but above other systems of philosophy, it came to correct the faults and supply the wants of others. Its corpuscular emissions will unstop the ears of the deaf, and the scintillations of its substantial light will fall as healing rays upon the eyeballs of the blind. Like Joseph, after being persecuted, stripped, sold, banished, imprisoned, tempted and slandered by all the amorous hags in Potiphar's house, it will still retain its virtue, rise by its own invisible force of character into the highest place of earthly power, bind the princes of scholasticism at pleasure, teach its senators wisdom, and furnish the corn of truth for its envious, famishing and beggarly brothers.

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Moreover, Substantialism has a higher mission than merely to bring other theories and systems out of the materialistic wilderness in which for more than forty years they have murmured and meandered in their fruitless attempts to reach the scientific land of promise. Its face is turned toward "the Jerusalem which is above." Among all the vestal virgins that wait upon the Creator in the grand temple of creation, it stands nearest to the most sacred fires that burn upon the holy altar of the Christian religion. Its last scope and purpose, as well as its greatest glory, is to serve in the "more perfect tabernacle not made with hands." Ministering thus in the sanctuary of our holy religion, it will demonstrate in every prayer and sermon that the command of God for man to believe in the invisible entities and verities of the Gospel is no exception to his general mandate continually uttered and echoed in every province of nature, and throughout every realm of his expansive universe. Serving thus at the altar of the Christian's God, the Substantial Philosophy sustains a more immediate and intimate relation to the "world without end," and ministers more directly and beneficially to the deepest wants and yearning of the human spirit than anything yet offered either in the current teachings of science or the prevailing subjective theories of undulatory religion. It is able to show by "many infallible proofs," cited from every province of creation, that while religion is above rationalism its claims are no less rational than divine. This is the reason why "The Problem of Human Life" and THE MICROCOSM are sought after and studied with a thoughtful and devotional relish that knows no parallel in the history of uninspired books. Uninspired? *They* are not without inspiration. To all intents and for all purposes within the providential scope of their glorious mission, they are inspired of Heaven with the holy spirit of a rich and radical truth, not previously revealed to the children of men. No wonder, therefore, that Substantialism approaches man with no ordinary power, and addresses him at the central point of his being where the vital and connecting link of his personality holds him in peculiar and blessed relation to the God of heaven and the imperishable bliss of an endless hereafter. This is the reason why thousands are either standing upon the tip-toe of anxiety, or marshaling into line at the first tappings of the Substantial drum. This, too, is the reason why the new philosophy is gathering strength and marching forward with a sweep of power that no prejudice can resist. Let the good work go forward with the impetus of its own constitutional impulse, accelerated by the momentum of its own progress, stimulated by the beneficence of its own achievements, until it shall be glorified in the universal vindication of its radical and revolutionary claims. The 25,000 converts, who are now willing to stand up before all the world and be counted, are merely the first-fruits of that abundant harvest which is to be gathered from the whitening fields until empty idealism, on the one hand, and bold materialism, upon the other, shall burn the gods of their ridiculous idolatry, and hasten to worship with admiration and respect before the superlative truth of *The Substantial Philosophy*.

(*Continued from page* 21.)

WHAT IS LIFE?

BY HENRY A. MOTT, PH. D., F. C. S.

Briefly reviewing the ground we have gone over, we have seen that the science of to-day teaches that when carbon, hydrogen, nitrogen and oxygen are combined in a particular way, protoplasm is the result, and that this compound body exhibits the phenomena of life; also that wherever life is manifested there must be protoplasm.

By this view life is claimed to be the product or effect of organization, and not the principle or cause of organization. Herbert Spencer defines life as "The definite combination of heterogeneous changes, both simultaneous and successive, in correspondence with external co-existences and sequences." This definition Drysdale[1] has pointed out to be defective, because it does not limit the changes of

[1] "Protoplasmic Theory of Life." London, 1874, p. 176.

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which it speaks to one specifically constituted substance now known as protoplasm (bioplasm).

Democritus and the other atomists accounted for the whole phenomenal universe on the *supposition* that the different kinds of matter are made up of the most variously arranged ultimate particles or *atoms*. These atoms differing from one another in size, shape, and weight, were nevertheless thought to be *indivisible*. They were supposed by Democritus[2] to be able to group and arrange themselves, and so form the various material substances which exist by virtue of these inherent tendencies. Nothing but predestination or "blind necessity" could therefore be assigned by Democritus as the active cause of the continual mutation taking place in the material world. Such a spiritless conception of the universe was however resisted by Anaxagoras. He, too, like his predecessors, believed that in the ordinary course of things nothing was created and nothing was destroyed—there was only a continual flux and mutation. But the necessity of a moving force, hitherto almost neglected, was fully realized by him.

Anaxagoras had an idea of a world-forming intelligence (νοῦς) that was absolutely separated and free from matter, and that acted on design,[3] and he endowed this νοῦς with the attribute of thinking. As in the case of organized beings more especially, we have the presence of the matter-moving νοῦς which, as animating soul, is immanent in all living beings (plants, animals, men), but in different degrees of amount and power. In this way we see that he made it the business of the νοῦς to dispose of all things, each in accordance with its own nature, into a universe that shall comprehend within it the most manifold forms of existence, and to enter into, and identify itself with, this universe as the power of individual vitality. Thus was initiated the ancient pantheistic notion of a general soul or spirit pervading all things. The ancients, then, looked upon the spirit or the "animating principle" of any living thing as an integral part of the general "soul of nature."

Paracelsus and his followers, on the contrary, in the sixteenth century, regarded the "vital principle" as an entity or self-existent something altogether independent and peculiar. This distinct vital principle was presumed to preside over the processes of nutrition, and was known by the name Archæus. Von Helmont, the disciple of Paracelsus, sought to explain all the phenomena of life by the occurrence of chemical changes in the organism taking place under the guidance of this distinct spiritual entity or "Archæus," whose place of abode was the cardiac-orifice of the stomach. The "Archæus" of Von Helmont, however, was only one, though the chief, of many "vital spirits" which were allotted severally to each organ of the body.

In modern times, as already stated, life is looked upon as the consequence rather than the cause of organization. And scientists, after showing the correlation of the physical forces—that is to say, their mutual convertibility—endeavor to show the correlation between the vital and physical forces. Other scientists, while admitting the correlation of the forces, contend that there is such a thing as a peculiar "vital force," a something which finds no place amongst the circle of correlated energies.

Dr. Lionel Beale, for instance, says:[4] "In order to account for the facts, I conceive that some directing agency of a kind *peculiar to the living world* exists in association with every particle of living matter, which, in some hitherto unexplained manner, affects temporarily its elements, and determines the precise changes which are to take place when the living matter again comes under the influence of certain external conditions." It is therefore argued that in order to bring about this metamorphosis of the physical forces, which is to give rise to the various manifestations of vegetable and animal life, there must be needed some force inherent in the organism as a whole, and in every part of its structure. That this force or power, although independent of the correlated series, is *the* vital force—that which conditions or transforms the physical forces, in order that they may give rise to the most varied vital phenomena. The Duke of Argyll, considering the problem as to what is life, says:[5] "Because a particular substance called 'protoplasm'

[1] See "The Beginnings of Life," Vol. I, p. 56.—Bastain.
[2] Schwegler's "Handbook of the History of Philosophy," translated by Stirling, p. 28.
[4] "Protoplasm," 2d ed., p. 119.—Beale.
[5] "The Unity of Nature," pp. 34–44.

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is found to be present in all living organisms, an endeavor follows to get rid of life as a separate conception, and to reduce it to the physical property of this material. The fallacy involved in this endeavor needs no other exposure than the fact that, as the appearance and the composition of this material is the same whether it be dead or living, the protoplasm of which such transcendental properties are affirmed has always to be described as 'living' protoplasm. But no light can be thrown upon the facts by telling us that life is a property of that which lives. . . . We cannot suppose life to be a substance [material] supported by another. Neither can we suppose it to be like a chemical element in combination with another. It seems rather like a force of energy which first works up the inorganic materials into the form of protoplasm, and then continues to exert itself through that combination when achieved. . . .

"It is common now to speak of things widely separated in rank and function as being 'the same,' only 'differentiated' or 'variously conditioned.' In these, and in all similar cases, the differences which are unseen, or which, if seen, are set aside, are often of infinitely greater importance than the similarities which are selected as the characteristics chiefly worthy of regard.

"If, for example, in the albumen of an egg there be no discernible differences, either of structure or of chemical composition, but if, nevertheless, by the mere application of a little heat, part of it is 'differentiated' into blood, another part of it into flesh, another part of it into bones, another part of it into feathers, and the whole into one perfect organic structure, it is clear that any purely chemical definition of this albumen, or any purely mechanical definition of it, would not merely fail of being complete, but would absolutely pass by and pass over the one essential characteristic of vitality which makes it what it is and determines what it is to be in the system of Nature.

"Let us always remember that the more perfect may be the apparent identity between two things which afterward become widely different, the greater must be the power and value of those invisible distinctions—of those unseen factors—which determine the subsequent divergence. . . .

"We know enough of those agencies to be sure that they are agencies which do, indeed, determine both arrangement and composition, but do not themselves consist in either. . . .

"It is upon something else than composition, and upon something else than structure, that those vast differences ultimately depend which separate so widely between living things in rank, in function and in power. And although we cannot tell what that something is—although science does not as yet even tend to explain what the directive agencies are or how they work—one thing, at least, is plain: that if a very few elementary substances can enter into an untold variety of combinations, and by virtue of this variety can be made to play a vast variety of parts, this result can only be attained by a system of material adjustments as immense as the variety it produces, as minute as the differences on which it depends, and as centralized in direction as the order and harmony of its results."

Dr. Drysdale says in so many words: No matter how complex the protoplasmic molecule may be, its atoms are still nothing but matter, and must share its propeities for good or evil, and among the rest *inertia*. Hence it cannot change its state of motion, nor rest without the influence of some force from without. True spontaneity of movement is, therefore, just as impossible to it as to what we call dead matter. . . . So we are compelled to admit the existence of an exciting cause in the form of some force from without to give the initial impulse in all vital actions. This is the stimulus. Surely such a stimulus can only be translated to mean the soul.

Prof. Joseph Cook* defines life "as the invisible, individual, co-ordinating cause directing the forces involved in the production and activity of any organism possessing individuality." And Prof. Cook makes the distinction between vitality, life and soul, as follows: A single cell may have vitality; the individual organism to which the cell belongs has life; and that organism, if possessed of self-consciousness and of the power of self-direction, has soul. Hahnemann was a vitalist; he believed in the existence of that mysterious power in whose action indirectly upon the tissues of the organism all the manifestations of vitality origi-

* "Boston Monday Lectures—Biology," p. 141.

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nate. In his essay[7] he expresses himself as follows: "What life is can only be inferred from its phenomenal manifestations; no conception of it can be formed by any metaphysical speculation *à priori;* what life is, in its actual, essential nature, can never be ascertained or even guessed at by mortals.

"Life cannot be compared to anything in nature save to itself alone; neither to a piece of clockwork, nor to an hydraulic machine, nor to chemical processes, nor to decompositions and recompositions of gases, nor in short to anything destitute of life.

"Human life is in no respect regulated by physical laws, which only obtain among inorganic substances. The material substances of which the living organism is composed do not follow the laws to which inanimate material substances are subject; they are regulated by the laws peculiar to vitality alone; they are themselves animated just as the whole system is animated. Here a nameless, fundamental power reigns omnipotent, which suspends all tendency of the material constituents of the body to obey the laws of gravitation, of fermentation, putrefaction, etc., and renders these constituents subordinate to the wonderful laws of life alone; in other words, maintains them in a condition of sensibility and activity necessary to the preservation of the living whole, a condition almost spiritually dynamic."

"In[8] the healthy condition of man, the immaterial vital principle which animates the material body, exercises an absolute sway and maintains all its parts in the most admirable order and harmony, both of sensation and action, so that our indwelling rational spirit may freely employ these living, healthy organs for the superior purposes of our existence. The material organism deprived of its vital principle is incapable of sensation, action or self-preservation, (it is then dead, and subjected to the physical laws of the external world; it suffers decay, and is again resolved into its constituent elements.) It is the immaterial, vital principle only, animating the former in its healthy and morbid condition, that imparts to it all sensation and enables it to perform its functions."

Hermann Lotze, one of the greatest philosophers, holds that the unity of consciousness is a fact absolutely incontrovertible and absolutely inexplicable, on the theory that our bodies are woven by a complexity of physical arrangements and physical forces, having no co-ordinating presiding power over them all.

I know that there is a co-ordinating presiding power somewhere in me. I am I. I am one. Whence the sense of a unity of consciousness, if we are made up according to Spencer's idea, or Huxley's, of infinitely multiplex molecular mechanisms? We have the idea of a presiding power that makes each man one individuality from top to toe. How do we get it? It must have a sufficient cause. To this hour no man has explained the unity of consciousness in consistency with the mechanical theory of life.[9]

The great opposition to admitting the existence of a special vital-force arises from the definition or meaning given to force, or more properly the manner in which the forces of nature are accounted for.

Forces, according to modern science, are not considered as separable entities. They are considered as merely modes, affections, properties—call it what you will—of matter; and, therefore, necessarily vary with the molecular states of matter.

The notion that such a force as "vital force" does exist, is claimed to be based on no evidence, it being merely a postulate; and the supposition that it exists and that it acts, is supposed to be totally adverse to the general doctrine of the correlation of the forces.

When it is stated that "life"[10] is a result of organization, it is not necessarily meant of an organization which is capable of being discovered by means of our microscope—rather, of a molecular organization, in the sense of a peculiarly complex and unstable collocation of the component atoms of the matter displaying life, which may exist to perfection, after its own fashion, even in what appears to be the perfectly structureless jelly-mass constituting one of the Protamœbæ of Prof. Haeckel.

The philosophy of Substantialism considers the forces of nature in opposi-

[7] "Spirit of the Homeopathic Doctrine." [8] "Organon of Medicine," p. 99.
[9] See Lotze's greatest work, *Mikrokosmus.*—Leipzig, 1869, Vol. I, Book 3, Chap. 1.
[10] See "Beg. of Life."—Bastain, p. 69, Vol. I.

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tion to the modern philosophy as entities, having objective existence and emanating and being sustained or constantly being put forth from and by the Omnipotent Being.

The modern philosophy has no need of an Omnipotent Being, its main and sole object being to account for all the phenomena of nature on a purely materialistic basis.

In the first place it is *assumed* that matter is composed of molecules, and these in turn of atoms, and that the molecules of bodies are continually in motion, they being separated from each other two hundred times their diameter. When they vibrate rapidly, heat is produced, or the body gets heated; when they vibrate slowly the body becomes reduced in temperature.

In the first place the accounting for the production of heat in this way is based on an assumption, and that is that matter is composed of molecules.

The molecule has never been seen, never been isolated, its existence is based on pure speculation, formulated for the benefit and advancement of materialism.

Much value, however, has been derived by the assumption of the existence of molecules, especially in chemistry, the same as has been derived by the use of the symbols x and y so often employed in mathematics, but the belief in their existence should be discarded so soon as their usefulness in the deduction of certain problems has expired. This is no idle opinion, but it is the opinion entertained by some of the most distinguished scientists, among whom may be mentioned Prof. Cook of Harvard and Prof. Mattieu Williams of England.

Prof. Cook[11] says in reference to the atomic theory: "Beautiful and consistent as it appears [it] is only a temporary expedient for representing the facts of chemistry to the mind. Although in the present state of the science it gives absolute essential aid both to investigation and study, I have the conviction that it is a temporary scaffolding around the imperfect building which will be removed as soon as its usefulness is passed."

Prof. Williams[12] says: "The atoms invented by Dalton for the purpose of explaining the demonstrated laws of chemical combination performed this function admirably and had great educational value, so long as their purely imaginary origin was kept in view; but when such atoms are treated as facts and physical dogmas are based upon the assumption of their existence, they become dangerous physical superstitions."

Prof. Caunizzano,[13] speaking of the atomistic theory, says that some of the followers of the modern school push their faith to the borders of fanaticism—"they often speak on molecular subjects with as much dogmatic assurance as though they had actually realized the ingenious fiction of Laplace, and had constructed a microscope by which they could detect the molecule and count the number of its constituent atoms."

If then matter be not composed of molecules and atoms—then away goes the materialistic theory that the forces of nature are but modes of motion, affections of matter and not real objective entities.

By experiment, matter has been shown to be indestructible, its quantity unalterable, and from these facts we are convinced of the objective reality of matter. "Reason," says Prof. Tait, "requires us to be consistent in our logic, and thus if we find anything else in the physical world whose quantity we cannot alter, we are bound to admit it to have objective reality as truly as matter has, however strongly our senses may predispose us against the concession." "Heat, though not material, has objective existence in as complete a sense as matter has."

This is the view of pure Substantialism, which considers the forces of nature as objective existences, substantial but immaterial in their nature.

The Substantial Philosophy then is "that system of doctrine which recognizes every force or form of energy in nature, whether physical, vital, or mental, by which any effect or phenomenon is produced within the reach of our sensuous or rational observation *as a substantial entity* or real objective thing."

Heat, light, magnetism, electricity, life, mind, soul, and spirit, are real objective entities, substantial things.

It is difficult for one to see how an educated man can be anything else than a

[11] "The New Chemistry," p. 103, 1876. [12] *Quar. Jour. Sci.*, 1876. [13] *Gazetta Italiane*, No. 1, Jan., 1876.

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believer in the existence of a vital organism, to which this perishable physical organism serves as a connecting link, and a means of objective manifestation.

"The material organism," says Hempel,[14] connects man with physical nature; of itself it is dead. The spiritual organism to which the former serves as a vehicle or instrument for vital manifestations, connects man with the spiritual world, which is the only living world, the grand esse, the world of essential substances, which, by their action upon material nature, achieve an unceasing creation, and develop and perpetuate nature's individualities.

It is not sufficient to say that the material organism is animated by a soul; the soul would not be capable of carrying on the functions of vitality without the aid of an intermediate organism, which, by means of the nervous system, controls the physical organs for the performance of the complex movements and purposes the sum of which constitutes life manifested in act.

If the chemist is unable to discover any trace of the spiritual-dynamic organism in his crucibles and retort, it is because this organism is by its nature beyond the reach of chemical re-agents. A denial of this vital organism by chemical physiologists for no better reason than because perceptible traces of it are beyond the limits of the microscope or the resources of the laboratory, implies a degree of mental obtuseness or perversity of which no clear-headed man should ever render himself guilty.

The Substantial Philosophy clearly teaches the duality of man—an immaterial as well as a material body—the immaterial dictating to the material, and governing it in every action. So when death comes, it only comes to the material body, leaving the immaterial body the exact counterpart of the material to live forever—recognizing the immaterial as the real in nature.

The materialistic assumption that the life of the soul ends with the life of the body, is perhaps the most colossal instance of baseless assumption that is known to the history of philosophy. No evidence for it can be alleged beyond the familiar fact that during the present life we know Soul only in its association with Body, and therefore cannot discover disembodied soul without dying ourselves. This fact must always prevent us from obtaining *direct evidence* for the belief in the soul's survival. But, as Fiske has said, "the entire absence of testimony does not raise a negative presumption, except in cases where testimony is accessible."

"The existence of a single soul or congeries of psychical phenomena, unaccompanied by a material body, would be evidence sufficient to demonstrate this hypothesis. But in the nature of things, even were there a million such souls round about us, we could not become aware of the existence of one of them; for we have no organ or faculty for the perception of soul apart from the material structure and activities in which it has been manifested throughout the whole course of our experience. Even our own self-consciousness involves the consciousness of ourselves as partly material bodies."

In the words of Giordano Bruno: "A spirit exists in all things, and no body is so small but contains a part of the divine substance within itself by which it is animated."

As Goethe has said, "I am fully convinced that our spirit is a being of a nature quite indestructible, and that its activity continues from eternity to eternity." Hence, we arrive at the sublime idea, since we can in no other way account for the ultimate cause of anything, that it is God's spirit which pervades and sustains all nature. By this admission we are not led to say with Haeckel, "There is no God but force," but rather as Dr. McCosh has said, "There is no force but God."

I know of no more suitable way to close this article than to reproduce the following beautiful lines to be found in Fleetwood's "Life of Christ":

"God hath a being, and that you may see
In the fold of the flower, the leaf of the tree,
In the sun of the noonday, the star of the night,
In the storm-cloud of darkness, in the rainbow of light,
In the wave of the ocean, the furrow of land,
In the mountain of granite, the atom of sand.
Turn where ye may, from the sky to the sod,
Where can ye gaze that ye see not a God?"

[14] "Sci. of Homeopathy."—Hempel, p. 48.

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"SOMETHING OUT OF NOTHING."

BY REV. J. W. ROBERTS.

In THE MICROCOSM for January, 1883, the writer presented some views on this subject, and advanced some arguments in support of those views, which have never been answered. The leading thought of that article is that God created the visible and invisible universe out of his own substance, and not out of nothing. Dr. Stone's objections to this idea presented in the September MICROCOSM, 1885, and so conclusively answered by Dr. Hall, have led to some additional reflections on the subject, which are, in part, presented in this paper. Let the reader refer to the article of January, 1883, and then pursue the theme along the thread of analogy as now unfolded.

That something can be produced out of nothing is a scientific impossibility; but theologians have found it convenient to place God above all science and all law, in a sense, as the Author of both science and law; and, properly understood, there can be no objection to this estimate of God's character and attributes. But at the same time it must be borne in mind that God cannot contradict himself, or do anything contrary to his infinite perfection; and as he has stamped upon all creation this infallible law, which is fundamental to all scientific research, is not the conclusion rational, is it not inevitable, that he has not departed from this primal law in the "workmanship of his own hands"? What conclusion can be more logical than this, or better accord with the divine perfections of him whose impress is stamped upon all he has made?

If in any case God departs from what appears to be a *universal and all-pervading principle of his government and economy,* it devolves upon those who set up the claim for this departure *to bring forward the evidence in proof of such deflection on the part of the Deity.* In other words *the "burden of proof" rests with those who raise the exception,* and not with those who follow the analogy. The advocates of something out of nothing will please take notice of this well-established law of evidence, and govern themselves accordingly.

Let us now calmly look at some of the analogies which are found all about us and within us. Take the fragrant flower, which sends out its perfume on the populous as well as the desert air. That perfume, invisible to the eye, and only conceivable by one of the five senses, can be gathered and condensed into a merchantable commodity, and become almost an essential adjunct to a lady's toilet. The "insensible perspiration" of our bodies, unrecognizable by any and all of the unaided senses, is yet a verity, and by suitable apparatus and appliances may be condensed into visible vapor and water. These material examples can be multiplied indefinitely; but we only give examples to establish the principle, and pass on to the realm of mind.

Analogous to the insensible perspiration of the body, and the odor of the flower, is an emanation from the mind which surrounds, envelops, and pervades it as the aureole of the painter or the corona of the astronomer, and which, though entirely beyond the grasp of any of the physical senses, is perceived by the mind of another in a positive and sensible manner. As soon as one mind comes within the sphere of this radiating influence of another mind, *it feels the impress of that influence.* Hence, *first impressions,* instantaneously made when coming in contact with strangers. These impressions are wrought upon the mind without any aid from reason or observation. They are intuitive. Impression is the proper term to express their character, for they are *impressed* upon the mind, as the seal makes its imprint upon the soft wax. We cannot tell why a first impression is favorable or unfavorable. Reason and observation may not coincide with it—nay, these may even be opposed to it; and yet it is there, and very difficult, if not impossible, to shake off. As a rule, "all other things being equal" and normal, *these impressions are correct.* It is mind acting upon mind directly, by a most subtile law of intercommunication, as yet only recognized and not understood, but as real as that which draws a material body toward the center of attraction. It is not necessary to dwell upon this fact. The attractions and repulsions we daily experience in our intercourse with men amply demonstrate the existence of this attribute of mind.

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These impressions are *real.* They shape our conduct. They form the basis of our loves and friendships. They are the outpost sentinels to warn us of danger; and we do well to heed them.

Take another example. A speaker will thrill a whole audience by that which, for want of a better term, is called his "magnetic power." Another man might utter the same words and repeat the same gestures without any visible effect. What is this subtile force? It is not in the words, gestures, manner or matter of the speaker, but *inheres in himself.* Yet it is a *reality,* as the wonderful effect it produces upon his auditors amply testifies. The same endowment in kind makes a Napoleon, a Wellington, or a Grant at the head of an army. It is the magnetism of mind upon mind which gives a soldier confidence in his commander, and makes him invincible, quite as much as the able planning of a campaign that secures victory.

Without multiplying illustrations let the facts speak. If these astonishing results are a part of our daily experience, and are written upon the pages of history over and again, showing the wonderful capabilities of finite man, what must be the conclusion when we reach up to contemplate the might of the one infinite Jehovah? If man can condense the subtile perfume of the flower, or the invisible output from his own body, into visible and tangible material entities; if the subtile effluence of creative minds is written upon the tablets of our living souls and upon the records of time, so that we scarcely dare place limits upon the wide outreach of acts and results on the part of finite beings, how must our conception of possibilities expand as we lift our thoughts to the ETERNAL I AM, whose powers and resources are only limited by his own perfections!

If the condensed perfume upon the toilet-case of the lady is no part of the flower or the chemist who gathered and compacted the delicate aroma, why should the earth or the sun be a part of God, even if they are condensed out of the emanations which proceed from himself? Or, if the drops of water condensed from insensible perspiration are no part of the man, why may not God use what goes forth from himself in the accomplishment of his wise purposes?

It is conceded that all comparisons of the finite with the infinite are imperfect, and hence the conclusions may not be strictly logical, because the premises are not identical; but the difference in capacity far more than balances the discrepancy in premises; and the purpose of this line of argument is to show that the law of analogy runs through all God's works, and is this: *That the visible is brought from the invisible; that the invisible is always something and never nothing;* that this law is indelibly stamped upon all creation as God's own impress, and as God cannot be inconsistent with himself, that, therefore, the universe was not made of nothing, which would be a departure from all that God has revealed of himself, and consequently a mark of mutability on his part—of improvement upon himself, which is unthinkable.

But the argument drawn from the influence of mind upon mind, and mind upon matter, as exhibited daily and hourly about us, is probably more nearly akin to the operations of the Divine Mind than illustrations drawn from material things alone. The cases cited of the effects produced when mind comes in contact with mind are in point. So the construction of a building or any piece of mechanism or machinery. The thing made is first wrought out in the mind, then given shape by the hands. But always something comes out of something and not from nothing. Thought becomes mind-food for others besides the thinker; but the thinker is not the other man, though his thoughts, proceeding out from himself, built up that other's mental powers. Dr. Stone surely does not believe that, because the thoughts he gives to his congregation from Sabbath to Sabbath tend to make them better, that therefore his hearers have become a part of himself. Why, then, should the *effect* of God's workmanship upon that which is constantly proceeding from himself be and remain an integral part of that Self? There is neither logic nor analogy in such a conclusion. If man with his circumscribed powers can accomplish so much, what may not God do?

But this argument of unity and analogy with all God's plans is strengthened from the consideration that *the visible is remanded back to the invisible its primordial condition, when dissolution takes place.* It is a law of nature that all things *find their level,* or return to their original estate, if at any time they have been

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brought out of it. It is needless to cite examples, for this universal law is written upon the whole face of nature. Thus both ends of the argument in this case meet in the same conclusion, and interlocking them, render that conclusion practically impregnable. It is logically safe to consider the existence of this great principle or law of the universe established in the reason and analogy of things and the immutable character of the Creator; and so it is pleasant to find confirmation of these views in the revelation God has made of himself to his creature man. The Apostle Paul, the deepest of all the inspired writers, seems clearly to have comprehended the great truth herein set forth, as we gather from the following passages in his writings:

"For OF *him*, through him and to him *are all* things." Rom. xi. 36. "But to us there is but one God, the Father, *of whom are all things*," etc. 1 Cor. viii. 6. "For as the woman is of the man, so is the man by the woman, but *all things of God.*" 1 Cor. xi. 2. Similar passages occur in other portions of his epistles, but these will suffice for the present. Notice the last: As the woman came from *man* and not from *nothing*, so *all things come from God*, not from *nothing*.

As we thus find reason, science and revelation beautifully harmonizing in this great and fundamental doctrine that out of nothing something cannot come, let us, with more than our wonted reverence, feel ourselves in the presence of Him *of whom, by whom, and in whom, all things consist*, who now and forever shall remain *all and in all*, the one Source of all things, visible and invisible, to whom be the glory forever.

PROF. O. N. ROOD ON SOUND.

AN IMPORTANT ACOUSTICAL PROBLEM SOLVED.

BY THE EDITOR.

One of the ablest and clearest exponents of the wave-theory of sound living is O. N. Rood, Professor of Physics in Columbia College, this city. Indeed, after reading every treatise on sound within our reach, we are convinced that Prof. Rood stands pre-eminently ahead of all, even of both Tyndall and Mayer, for conciseness and perspicacity, and especially for felicity of expression in the elucidation of his subject. The wave-theory, at best, involves so much complexity and intricateness that it is marvelous that any man can find the language necessary to present its nice points of distinction to the comprehension even of the most profoundly scientific mind. But Prof. Rood is equal to the task, and does possess that happy faculty of making even this incongruous theory understandable. But in making it intelligible, as to what is intended to be taught by it, he by no means succeeds in making its teachings appear rational, consistent, or possible as scientific truth. In fact, the very perspicacity and conciseness which he manages to bring to bear upon its mysterious inconsistencies, by aid of his remarkably analytical powers, only tend the more glaringly to exhibit its defects and impossibilities as a true theory of science, just as the clearer rays of the electric light show defects in a delicate etching which common gas would not reveal.

We have just read with care his lecture on the "Mysteries of the Voice and Ear," and were intensely entertained by the elegance of his diction and the general versatility of his treatment of the subject, especially reading, as we naturally did, in the light of our own published remonstrances against the current doctrines of acoustics. Firmly as we are convinced of the total fallacy of the wave-theory of sound, we nevertheless read his treatise entirely free from prejudice, and even with a strong desire to find, if possible, something solid in the current view upon which the mind could base a logical deduction in its favor. But we aver, that at every turn of the exposition of the argument not one phenomenon appeared half as reasonable, viewed in the light of "atmospheric condensations and rarefactions," as under the calcium rays of the Substantial Philosophy.

Much that he presented in his lecture was beautifully true, viewed in the light of any possible theory, since it was simply a statement of facts and phenomena patent to every careful scientific experimenter. But whenever the eminent

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lecturer verged upon the special work of illustrating and vindicating the wave-theory, it was manifest with confirming clearness that the discussion lacked the true light of Substantialism necessary to keep it clear of the fatal shoals, snags, and quicksands so easily encountered in presenting the details of present acoustical science.

We shall not here attempt a general review of his lecture, as that would be impracticable in so brief a space as a magazine editorial. We will only attempt a careful examination of a single phase of the discussion which, *par excellence*, embraces the very gist of the wave-theory, and upon which, perhaps more than upon any other single aspect of the subject, depends the truth or falsity of the whole present doctrine of acoustics. We refer to the so-called law of *sound-wave interference*, so clearly illustrated by the well-known interference observed in water-waves.

Of course there was nothing new in what Prof. Rood taught upon this phase of the discussion, since the same doctrine of interference, by which two sounds may produce silence, has been taught by all writers on acoustics, almost if not quite from the time of Pythagoras down to the lectures of Prof. Tyndall. The value of Prof. Rood's statement of the law and its operations consisted in his original manner of treating the argument, and the plausible method he adopted of proving it true. Suffice it to say, that the whole law of sound-interference, or the assumption that two sounds can produce silence, so far as facts are concerned, depends on a few mistaken phenomena superficially observed by acousticians, and which (for want of the light of the substantial view of all force, including sound-force, for the first time presented in the "Problem of Human Life") have never been possible to be explained by the advocates of the wave-theory.

But such mistaken facts do not constitute their main proof that two sounds can travel in such relation to each other as to cause interference and consequent silence. The main strength of the supposed law consists in the analogy existing between water-waves and air-waves, or air-pulses—that is, assuming the theory that sound is constituted of "atmospheric condensations and rarefactions," to be true. Clearly, if this theory be correct, then two equal systems of such supposed sound-waves, traveling together half a wave-length apart, so that the crests or condensations of one system will fall into the furrows or rarefactions of the other system, must, by every law of mechanics or principle of science, neutralize each other, since there can be no condensing of the air by one system when at the very place of such condensing tendency an equal mechanical rarefaction is taking place. Hence, as sound consists alone of such "condensations and rarefactions," and is in no sense a substantial entity, it is plain that two such interfering systems of air-waves must, in the nature of things, mutually destroy each other and cause silence, since two equal systems of water-waves, so traveling together that the crests of one system will fall into the furrows of the other system, must, in the very nature of wave motion, neutralize both systems and produce a comparative level, or quiescence of the water. It follows, therefore, from the essential nature and principle of the wave-theory that there must exist this law of interference in two systems of sound-waves traveling in the relation to each other here described, or else there is no truth in the wave-theory.

Acousticians intuitively know this to be so, and hence with the most wonderful unanimity they all teach this law of sound-interference, and apparently believe, in all sincerity, that it must be true, since the wave-theory is an admitted doctrine of science, and since water-waves are well known to interfere just as required by the law. Yet, strange to say, not one acoustician—not even the apparently unprejudiced Prof. Rood—has thought it worth while to test the law by sounding two unison tuning-forks half a wave-length apart, or two common unison pitch-pipes, for the purpose of determining scientifically the truth of the wave-theory. Had they ever done so, they would at once have run their undulatory boat upon a scientific snag, which would have knocked an irreparable hole into its bottom. We declare most positively that, so far from causing silence, *not one particle of difference can be perceived in the intensity of the sound of two such instruments held in any possible relation to each other while sounding*, whether a half, or a quarter, or a whole wave-length apart, or when the listener makes his observations in line with the two instruments, or in any other direction from them. We aver upon our

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honor as a scientific investigator that not the slightest shade of difference in intensity can be detected by the acutest ear, and consequently that the pretended law of interference, on which the very life of the wave-theory rests, is false in every particular. We challenge Prof. Rood to make the experiment in the presence of his students in the hall of Columbia College, and allow us to be present. If scientific truth, and not mere accepted theories of science, true or false, is what that great institution wants to teach the young men of this city and country, then let Prof. Rood at once accept our challenge, demonstrate by a practical test that our position is erroneous, if he can, and we will give all the facts to the readers of THE MICROCOSM in his own words. Will he do it?

Prof. Rood must not, however, be too severely censured for taking for granted the absolute correctness of this law of interference, and thus aiding, unintentionally, in fastening a most pernicious scientific fraud upon the teachings of modern physics when a simple experiment would have dissipated the whole trouble. Teachers who have, all their college days, been running in a certain theoretical groove, both in teaching and in being taught, and who have imbibed the smoothly-worn ruts of that groove still more strongly by seeing nicely-executed engravings of the same in every text-book on the subject they have had occasion to examine, are not to be expected easily to divert their mental wheels from such grooves or even to make an effort to do so, when it is so much easier traveling in the beaten track. Hence it was that as radical and ambitious a scientific thinker as Prof. Tyndall, in the most astonishing manner, kept right on in this same groove of sound-wave interference, taking for granted that it was all true, when two unison penny whistles, and two children for assistants, would have enabled him to make such a start in revolutionizing the science of acoustics as to have added to his immortality a thousand per cent. in a single year.

Unfortunately for him, he missed the opportunity, and, by inexcusably neglecting such a simple experiment as truth and common sense required, he put himself on record in his published "Lectures on Sound" (at pages 259, 284, 285), in describing this supposed law of interference, in such manner that he has no doubt a hundred times regretted it since he has read the "Problem of Human Life." In that book, at pages 280 and onward, we took occasion to analyze his unmistakable teaching concerning the operation of this law. He not only taught in his most lucid manner that two unison forks, sounded half a wave-length apart, would neutralize each other's "*condensations* and *rarefactions* of the air," and thus "*produce absolute silence*," but to make sure that his audience of young scientific students should not misapprehend his meaning, he drew sketches of two such tuning-forks first placed a whole wave-length apart, so that the condensations from one would coalesce with the condensations from the other, and the rarefactions of the one with the rarefactions of the other, thus augmenting their sound four-fold according to the law, and then he represented, by another sketch, the forks half a wave-length apart, showing, by an even tint of shading, that all condensations and rarefactions were obliterated, the air being entirely quiescent and the sound of the two forks being totally silenced. Reader, this indisputable teaching of that great physicist does seem absolutely incredible in the light of our statements just made, that, however these unison forks may be sounded, and whatever their relation to each other or to the listener, *not one iota of difference in the intensity of their two united sounds occurs*, as this fundamental law of interference so authoritatively teaches. Would it not be well, then, for us right here to reproduce Prof. Tyndall's words, that the reader of this editorial who has not seen our original analysis, may know of a certainty that we do not misrepresent the wave-theory, and that he may thus catch a glimpse of the important revolutionary movement in science now being foreshadowed by the Substantial Philosophy? Here is Prof. Tyndall's description of the two forks, but without the cuts, which the reader's knowledge of such matters will readily supply:

"Now let us ask what must be the *distance between the prongs A and B* [one prong of each of the two forks] when the *condensations* and *rarefactions* of both, indicated respectively by the dark and light shading, *coincide?* A little reflection will make it clear that *if the distance from B to A be equal to the length of a whole sonorous wave* [52 inches] *coincidence between the two systems of waves must follow.* The same would evidently occur where the distance between A and B is two

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wave-lengths, three wave-lengths, four wave-lengths—in short, *any number of whole wave-lengths.* In all such cases we should have *coincidence* of the two systems of waves, and consequently a reinforcement of the sound of one fork by that of the other. . . . But if the prong B *be only half the length of a wave behind A* [26 inches] what must occur? *Manifestly* the *rarefactions* of *one of the systems of waves will then coincide* with the *condensations* of the other system, and we shall have *interference:* the *air* to the right of A *being reduced to quiescence.*"—"Lectures on Sound," p. 259.

Now is it possible to misunderstand this language? We do not think it is; but lest there may be a doubt, here is a confirmatory citation which will make assurance doubly sure, while actually explaining the so-called law of interference, both as to water-waves and sound-waves. We beg of the reader, if he wishes to become intelligently posted upon these most important matters of physical science, now in the process of being sifted as never before, not to neglect, through prejudice or anything else, to read and even study these citations in the light of our critical analysis of the same:

"In the case of *water*, when the *crests* of *one system of waves coincide* with the *crests* of *another system,* higher waves will be the result of the coalescence of the two systems. But when the *crests* of one system coincide with the *sinuses* or *furrows* of the other system, the two systems in whole or in part *destroy each other.* [Of course, no one doubts the truth of this statement as applied to water-waves, because there we have actual wave motion.] This *mutual destruction* of two systems of waves is called *interference.* The same remarks apply to *sonorous waves.* If in *two systems of sonorous waves condensation coincides with condensation* and *rarefaction with rarefaction,* the sound produced by such *coincidence* is *louder* than that produced by either system taken singly. But if the *condensations* of the one system *coincide* with the *rarefactions* of the other, a *destruction* total or partial of *both systems is the consequence.* . . . If the two sounds be of the *same intensity* their *coincidence* produces a sound of four times the intensity of either; *while their interference produces absolute silence.*"—"Lectures on Sound," pp. 284, 285.

Yet, reader, it is a sober, scientific truth, that while every word of this teaching concerning the action of water-waves is in strict accordance with facts and observations, since there is *real* wave-motion involved, *not one word of it is true as relates to sound!* There is, of necessity, no silence by interference in the case of two sounds, since there are no air-waves, constituting sound by which interference is possible. Is not this a plain reason? If sound did really consist of air-waves, composed of "condensations and rarefactions," as the theory teaches, there would of necessity be coalescence and augmentation of atmospheric action (loudness), or interference and atmospheric quiescence (silence), as the case might be, and as the two equal systems of sound-waves, from the two unison instruments, might happen to be traveling, just as in the case of water-waves, as Prof. Tyndall teaches. But there being no air-waves, with "condensations and rarefactions" constituting sound, such supposed interference is false in theory and false in fact, and it is within the easy reach of every Professor, and even of every beginner in science, to demonstrate the truth of what we are here saying to his own absolute and irresistible conviction, by sounding two unison forks as the theory directs.

Prof. Rood teaches the very same doctrine set forth by Prof. Tyndall, and in the same clear and unmistakable language. It would not be fair to let the reader take our mere word for this, after quoting so liberally from Prof. Tyndall. Here are Prof. Rood's words:

"Thus far we have occupied ourselves with single sets of waves, and have supposed the particles of air to be acted on by only one wave at a time. It will, however, *more commonly happen* that it is necessary to deal with particles which are at the same instant being acted on by more than a single wave. Let us take the simplest case and suppose our particles acted on by two equal and similar sound-waves; now, it may happen, under these circumstances, that the two waves agree in their action, any particular layer of air being at the same moment subject to a condensation or rarefaction from both these sources. When this happens the motion of its particles will be *twice as great* [Tyndall says it produces '*four times*' as much sound!], and we shall hear a louder sound. But something else is *equally*

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likely to occur: it may happen that just at the moment when the layer ought to be condensed by one wave, its companion attempts to rarefy or expand it; these two motions will then *neutralize each other,* and *instead of sound we shall have silence.*"—"Acoustics," *Johnson's Encyclopedia.*

Thus we have it, that any two sounds traveling together through the same body of atmosphere are "*equally likely*" to interfere, "neutralize each other, and instead of *sound* we have *silence*"! How unpleasant would be our chances at conversation with each other, and what ridiculous music we should expect to have from an orchestra, if it so happened that there were any truth in this law of interference, and if one half of the time we should hear no sound at all! Fortunately for mankind it is not true, nor is the theory upon which it is based. As sound is a *substantial force,* according to the new philosophy, having a real and objective existence as truly as has the force of heat, electricity, or magnetism, there cannot, in the nature of things, be interference in two streams of sound crossing each other's path, or traveling together in whatever relation, any more than interference in the case of two streams of substantial *heat,* or two streams of substantial *magnetism,* or two currents of substantial *electricity* when crossing each other's path or when traveling in certain given relations to each other. And it follows plainly, from the facts presented in this argument, that any phenomenon observed in sound by Prof. Rood or Prof. Tyndall, which seems to look toward, or favor, this law of interference, *must so seem from a mistaken conception of such phenomenon, since the very law of interference is itself demonstrably false on its face, as here shown.* Hence, the true explanation of any such observed phenomenon which may appear to favor the law of interference in sound-waves, after the law itself has been exploded, *should be sought after in some other and legitimate direction, if we would act the part of capable investigators and not stultify our intellectual manhood by committing logical suicide.*

Now, what is the principal phenomenon of sound upon which Prof. Rood, as well as Prof. Tyndall, based this claimed law of interference? Bear in mind that since a practical test of two unison instruments sounded half a wave-length apart, as the law of interference necessarily requires, would have exploded the law (and it does almost seem that so profound an experimenter as Prof. Rood must have known it), he was obliged to have resort to some sort of fact or appearance in acoustics by which to illustrate the law and prove its truth to his audience of scientific young men, or else to let the law pass as a mere assumption, without even the shadow of foundation to support it. So he did find just one fact which, as we are now willing to admit, he honestly supposed to prove the correctness of that law. That fact was the well-known phenomenon of "beats" which are heard in two sounding instruments when slightly out of unison, that is, sensible swellings and sinkings of tone, succeeding each other with a rapidity proportioned to the number of vibrations in a second from absolute unison in the two instruments.

Every musician is perfectly familiar with this phenomenon, especially those who have had any experience in the tuning of instruments. But in what a sorry predicament is this law of interference, as well as the wave-theory of sound now left, when we assert as we do and will immediately prove, that "beats" do not in the remotest degree relate to or have a thing to do with any such law as that of sound-wave interference. Prof. Rood, however, finding himself confronted with this problem of musical *beats,* and no one having ever hinted the possibility of its having any other meaning than that of air-wave interference, in the broad sense of this supposed law, he naturally accepted the phenomenon as a *bona fide* instance of air-wave interference, at the very time when the *law* itself, as he should have known, was a self-manifest fallacy of science. How vastly more scientific would it have been on the part of the distinguished physicist of Columbia College, had he lectured his students something on this wise:

"Young men, let us first try the *law itself* and see if any such thing as real interference exists in our supposed 'condensations and rarefactions' by sounding two unison instruments half a wave-length apart, thereby causing the *condensations* of one system of wave to fall into the *rarefactions* of the other system and thus produce silence, as the very nature of the law requires. If we shall find by the most careful experiments that no such *silence,* nor even the slightest diminu-

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tion in sound-intensity results, then, young gentlemen, we are in duty bound as unbiased scientific investigators to discard the law as a fallacy, however necessary it may be to the theory, and having done this, to try to explain 'beats' in some other way, if possible; and if we can find no satisfactory explanation, after the law itself is destroyed, then we should leave the question of their true solution open for further experiment and discussion."

Had Prof. Rood made this frank statement to his students, some one of them, if not himself, without doubt would have reached the plane of the Substantial Philosophy ere this by an independent course of investigation similar to that pursued in this magazine.

Let us now proceed to take from the wave-theory, and from Prof. Rood, this only plausible support of the law of interference upon which the superstructure of wave-motion depends, and that, too, by the simplest possible explanation of "beats," thereby showing that the law itself is a pure fallacy of science. It is well known that any sustained or continuous tone produced by one instrument, will, by sympathy alone, set a suitable unison instrument near it to vibrating and sounding audibly. Of course while the two are thus sounding jointly, there must be a sensible augmentation of tone (as might easily be proved by having a sufficient number of such sympathizing instruments in the room to equal, in the aggregate, the intensity of the actuating sound), and should this sympathizing instrument be stopped off and again permitted to sound, it would naturally cause a very slight corresponding swelling and sinking of the sound heard—in other words, a succession of faint *beats*. This, however, is but the preparatory steps to our explanation. Should two unison tuning-forks be placed on their resonant cases close together, and both be made to sound loudly by external force, such as a violin bow, it is plain that each must augment the other's normal volume of sound by sympathy, just as certain as that a single fork will set its unison neighbor into sympathetic vibration, only the two bowed forks will augment each other's sound to a vastly greater degree. Then, further, if two such forks sounding in unison sympathy will augment each other's tone, it seems rational that by changing their phase to one of opposition or to one of dis-unison, the sympathy will be changed into repulsion (somewhat analogous to the case of substantial magnetism when reversing the polarity of two attracting steel magnets), and they will then mutually detract from the strength of each other's normal sound-force by repugnance, in about the same proportion (while this phase of opposition continues) as their unison sympathy had augmented it.

If this new substantial principle in acoustical sympathy is understood, then we have a complete explanation of "beats" by sympathetic and unsympathetic vibration alone. Here it is: If one of these unison instruments, which is greatly augmenting its fellow by sympathy, and at the same time being greatly augmented by the other's sympathetic action, should be reduced one vibration in a second below that of the other's number, what would take place? Plainly, the two instruments, during the greater part of each second, would be more or less out of unison or in a phase of opposition, and consequently their mutual sympathetic augmentation during that period would be more or less broken and thus changed to repugnance, and the sound would necessarily sink; but during one brief instant of each second it must so happen that the two instruments will make several vibrations substantially in unison, thereby again for an instant augmenting each other's sound by sympathy, thus causing a sensible swelling of the tone while such unison phase continues. These successive changes from attractive sympathy to unsympathetic repulsion in the sounds of the two forks, or from a phase of unison to a phase of opposition, is all there is of "beats," and they are thus proved absolutely to take place at the instruments themselves, and have nothing to do with the clashing of supposed air-waves after they have left the instruments. Hence it is, that the nearer the two forks are together, the stronger or more distinct will the *beats* sound to a listener stationed a given distance away. And it is further evident, if our explanation of *beats* be the correct one, that the two forks can readily be separated so far apart *that all beats will cease at the ear of this listener, though his distance from each fork remains precisely the same, thus demonstrating again that the interference of air-waves at the listener, or their effect upon Corti's arches within his ear, has nothing to do with these phenomena.*

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We deem it but proper to state here, that we reached the above result, of separating the two beating-forks, purely by scientific ratiocination, and before any experiment whatever had been tried to prove it, thus making the fact of manifold greater value to science. Will Prof. Rood please try this experiment of separating the two beating-forks, and thus satisfy himself upon the subject?

A word further by way of explanation. By a "phase of opposition" in two forks when *beating*, we mean such relation between them that when the prongs of one fork have just completed their swing in either direction, the prongs of the other are part way between the extremes of their amplitude. It is always when the two forks are in this relation to each other that the faint portion of the *beat* occurs, and it is always when they are completing their swings *synchronously*, or exactly at the same instant, that the *beats* are loudest. But there is still something more in this connection than acousticians perhaps have ever dreamt of. Two *beating* forks, when approaching the exact point of synchronism in their swings, must exert a *physical sympathetic effect* upon each other's motion by which the one in advance is retarded or held back, and the one close behind is accelerated or hurried forward, and then in turn both retarded as they meet and pass, *and by which their absolute unison of swing occurs sooner than it otherwise would, and continues longer than it otherwise would by the same attractive sympathy which had hastened their synchronism.*

The above position being correct, is an additional proof that the explanation of *beats* here given must also be correct, and that the sinkings and swellings of the sound heard, instead of being caused by the interference of air-waves, do actually occur among the prongs of the vibrating forks, and alone as the effects of sonorous sympathy and repulsion, as the phases of the prongs' relations to each other change from synchronism to opposition, and *vice versa*. Now, how can this assumed fact of the two forks' physical influence upon each other be optically proved to the student's satisfaction? Let us see if the following experiment will not do it:

If two forks are first made to vibrate in perfect unison and are then bowed loudly on their resonant cases close together, it would be impossible, according to our view, for them to swing in a phase of opposition, that is, out of absolute synchronism, longer than for a very brief period on first starting. Why? Simply because, start as they may, when first bowed (and they would be vastly more apt to start in opposition or out of absolute synchronism than in it), *sympathetic attraction, as already described, would retard one and accelerate the other till the two forks would thereby be immediately brought together and thus be made to swing in synchronism, and then* (by the sympathetic augmentation of each other) *continue to swing at their greatest amplitude and loudest tone.* To exhibit this on a screen in a darkened room, we have only to resort to the well-known method of attaching a small mirror to one prong of each fork, by which the two beams of light are made to sweep across the screen corresponding to the actual movements of the prongs, and, if we are right, it will be seen that at some trials the two lines of light, by proper means of observation, will behave as we have described, and thus demonstrate the physical effect of the forks upon each other's motion, substantially as we have here predicted. Let investigators of acoustical science, who have the means at hand, try this experiment and prove us in error if such be the case.

We frankly confess that we have not tried this experiment, but we deduce it scientifically from the fact that our position is demonstrably correct on the cause of "beats," and further, from the fact that if the sound of one unison-fork will actually overcome the inertia of another fork at rest, and by sonorous sympathy alone start it into vibration, as we know it will, it is every way reasonable to believe that the same sympathetic force will retard one fork and accelerate the other so as to force them out of a phase of opposition and into synchronism by a mutual interference with each other's swings till such synchronism is established. While we assume this proposed experiment with a screen to act substantially as described, we are unable to predict with certainty the extent of the lengthening of the lines of light by the sympathetic action of one fork upon another.

We have thus endeavored, as concisely as possible, to explain and account for "beats" by a scientific exposition of the facts involved, and by such proposed tests as cannot fail to satisfy any fair-minded investigator, if they shall turn out as

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we predict, that the law of air-wave interference is one of the baldest theoretical errors of modern science. At all events, we firmly believe that, as a conscientious scientist, Prof. Rood will be enough impressed by the solution of the problem here given to try just one experiment of having two unison instruments sounded half a wave-length apart while listening, himself, in line with the same, that he may totally and forever disabuse his mind of this impossible so-called law of sound-wave interference. If he will do this, and then, if any other observed fact or facts in acoustics shall still seem to point toward air-wave interference (as for example the double-siren, singing flames, Chladni plates, holding a tuning-fork cornerwise to the ear, placing two organ pipes on the same wind chest, etc., which, by the way, no more resemble this pretended law of interference than do the "beats" just explained), we will cheerfully undertake to explain them in strict accordance with the substantial view of the physical forces as taught in this magazine, and will endeavor to make our explanation as satisfactory to him against the law of interference and the theory it supports, as we claim to have done in the case of "beats." If Prof. Rood shall desire to see sympathetic vibration explained on the principles of Substantialism, and without any aid from the fictitious air-waves of the old theory, we refer him to the "Problem of Human Life," pages 79, 80, and we will cheerfully send him a copy free of charge, if he so desires and will let us know.

A MIRACLE NO VIOLATION OF NATURAL LAW.

BY ELD. THOMAS MUNNELL, A. M.

Henry Drummond, F. R. S. E., F. G. S., has written a work of exceptional value to both the scientist and theologian, named "Natural Law in the Spiritual World." His aim is to show that the laws of the natural and of the spiritual worlds are identical—not analogous, but identical. He claims that these two worlds are not two separate and different sections of the universe, but are all of a piece and need no laws based on different principles. In his chapter on Biogenesis, he shows again, from Tyndall, Huxley, and other high authorities, the utter failure of Atheism to establish spontaneous generation, and that the old Latin formula—*Omne vivum ex vivo;* all life from the living—is both scientifically and theologically true and must be true forever. That Jesus uttered an unalterable scientific truth when he said "Ye must be born from above," is illustrated in the fact that a plant from a higher stratum must reach down its living roots to the dead clay and mineral below in order to lift their helpless elements up into vegetable life. This being "born from above," and the principle involved in it, is the same great law that prevails in the spiritual world, where a soul that is dead in sin shows the same inability to vitalize itself that is manifest in the rock; and had not the Life Divine reached down from Heaven to men no spirit could ever have been animated by "the life of God." So in his articles on "Degeneration," "Growth," "Life," "Death," etc., in each of which he shows, beyond a question, that the laws in the natural and spiritual worlds are not merely analogous, but identical.

While enjoying Mr. Drummond's comprehensive thinking and his magnificent mental balance, I could not keep out of mind a certain resemblance between his philosophy and that of the founder of the Substantial Philosophy; for although the former is not so far-reaching as the latter, yet as far as it goes it belongs to the same class of truths, and is a powerful contribution to the divine light now reaching us from different directions, and showing that there is not only no quarrel between the natural and the spiritual, but that they are but the two halves of one whole—creation.

Mr. Drummond makes the common mistake of dividing all created things into the natural and spiritual instead of the physical and spiritual. All created things, whether physical or spiritual, constitute nature, which simply means that which is produced or is born, or that which begins. Angels as well as men belong to nature, for they were created, and nature and Creator are exactly co-extensive and

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coeval. Why the universe should be divided into the natural and the spiritual, when the latter is as natural as the former, is not very plain, and yet this mistake has confused the otherwise most excellent thought of our author no little in many parts of his work. Had he named his book "Physical Laws in the Spiritual World," it would not only have rendered his thought far more perspicuous, but would have separated nature, or creation, into its parts as they really exist.

In developing the Substantial Philosophy, Dr. Hall has far surpassed Henry Drummond in dividing, not only all creation, but all things into the material (physical) and the immaterial (spiritual), and holds that this generalization includes everything inert, active, human, angelic and divine.

God himself is no part of nature, but there can be no good reason why the spiritual, as well as the physical, should not be included in the word nature, since it was all alike produced by "the word of his power." Nor is there any good reason visible why the law of continuity should not prevail from the lowest to the highest stratum of the whole universe. If reversion to type is a law of the physical kingdom, it surely prevails also in the spiritual kingdom, as Mr. Drummond has abundantly proved. If death, scientifically defined, means "the non-correspondence with environment" in one kingdom, it is just as true in the other, and so. generally, we may know that the laws of nature are continuous from first to last in all created things.

The philosophy of Mr. Drummond was published only last year, but nearly a decade before this Wilford Hall surveyed the real line that marks the boundaries of the two halves of all existence, and called them by their proper names.

The evident trend of all the best thought of the day is to dispense with the supposed impassable gulf lying between the physical and the spiritual hemispheres, not by throwing any artificial bridges over the chasm, but by revealing to our wondering eyes the natural bridge that always has been there—or rather by showing that there never was such a chasm as has been supposed. Hence, the law of continuity from the nadir to the zenith of creation may be easily believed in, especially when Substantialism surveys the frontiers of the two great hemispheres of nature. Some of these laws we partially understand; some are entirely out of our reach. We know enough of the law of gravitation to avail ourselves of its power as a mechanical force. Hence, it is no miracle to employ this force in turning a water-wheel or in the ascent of a balloon, but there are laws no doubt that belong to the upper regions of even physical nature, of which we know nothing, and of which we have no command. The use of such physical laws would be superhuman, and therefore to us miraculous. The command of any of these higher physical laws would be as miraculous as if it were a violation of some law of nature.

It is wholly unnecessary to do any violence to nature in order to secure a miracle. Miracles were intended as credentials to embassadors to this world from a foreign court, and the evidential value of a superhuman work performed in *obedience* to some higher natural law is just as great as if it had been performed in *contravention* of some law. If water was turned into wine in the exercise of a higher natural law, of which man has no command whatever, it shows that Jesus was not a mere man just as well as if he had violated a dozen laws to accomplish it. Are we sure that all the natural forces that make wine are pent up in the grape-vine? It was a miracle to make iron swim in the shape of Elisha's ax, but it is no miracle to make it swim in the shape of a ship's hull. Iron on water acts differently under different conditions, and so water under one condition may remain simple water, but under another may turn to wine, and the latter result be just as natural as the former. A miracle is therefore not necessarily anti-natural nor supernatural, but need only to be superhuman to secure all the evidential force a violation of nature could produce. Assuming that it was unnecessary for Jesus to call upon any law in the spiritual realm to make the wine, his command of that which is not in human power in the physical proves him to be superhuman and the Sent of God.

This doctrine in regard to miracles may not be free from objection, but it was fully developed by the writer nine years ago, in the *Christian Quarterly*, and still retains its hold upon my own mind. A certain class of scientists have always made objection to the miraculous in religion on the ground of the inviolability of the

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laws of nature, and surely we are under no obligation to saddle religion with a load which it need not carry.

If, as Substantialism teaches, all physical substances are regularly graded from the coarsest to the finest—from the rock, soil, tree and water to the gases, electricity, magnetism, etc.—if water analyzed into its invisible elements sends them back where they came from among "the things which do not appear," Heb. i. 3, and if one analysis and refinement after another shades off till it touches the boundaries of vital life, thought, mind and spirit, it will not be difficult to accept the doctrine of the continuity of law as taught by Mr. Drummond.

As no human eye can take in all the degrees on the Zodiac at once, so no human intellect will ever understand all the laws of nature, and it is not worth while to assume that Jesus had to master any of these laws in opening the eyes of the blind or walking on the sea. Nature is all of a piece, from the lowest to the highest, and the identity of law throughout is no improbability, and therefore the miraculous need not be anti-natural; for just as we call upon dynamite to do what other physical forces are unable to do without arraying one force against another, so Jesus could employ some higher natural force to accomplish what the forces with which we are acquainted are utterly unable to do. Therefore, a miracle is no violation of natural law; the harmony between the physical and the spiritual departments of nature is complete, while the apparent conflict between them arises only from our comparative ignorance of both.

THE ORIGIN OF SIN.

BY J. M. WASHBURN.

[PROFUNDITY IN PHILOSOPHY.—We dare not give our readers the paper we print below on The Origin of Sin without a word of explanation accompanying it. We will say, first, that the writer, as we happen to know from personal acquaintance, is a profound philosophical New-Church reasoner, and, judging from his article, as here printed, altogether too profound, in our opinion, for the vast majority even of educated men. We dislike to admit it, but we must confess that we feel a good deal more at home in the simple, beautiful, and common-sense principles of the Substantial Philosophy than we do in trying to unravel the complex combinations of terms, phrases, and sentences in which Mr. Washburn seems perfectly at ease. This, perhaps, is so much the worse for us. Indeed, he would repudiate the thought that there is anything at all difficult of comprehension in what he writes, but on the contrary, that a man must be stupid who cannot fully grasp his paragraphs as fast as one would ordinarily read.

One thing is true—it is the very kind of reading that New-Church people, or Swedenborgians, are continually used to in their church papers. Whether the majority of them understand it any better than we do, is not for us to say, or even to guess. We feel safe, however, in suspecting that it takes a peculiar order of intellect to constitute a successful New-Church man or woman; and the fact that all good New-Church people are supposed to enjoy, and therefore easily to grasp, such prodigious profundity in religious philosophy, as here set forth in Mr. Washburn's paper, fully accounts, to our mind, for the well-known fact that there is such a trifling comparative few who are ever able or willing to embrace the doctrine. We would as soon, almost, as a business undertaking, attempt to organize a church out of "*lightning calculators*," such as Barnum exhibits, as to form a congregation of men and women capable of drinking intelligently into such abstruse metaphysics as here dealt in by our esteemed contributor. At all events, let every reader attack the article, and the one who comes nearest to comprehending it shall have a cash prize of twenty-five dollars, if any plan can be hit upon for deciding the matter judicially.—EDITOR.]

The world, theologic and scientific, has puzzled long over the question, What is the origin of sin, and how did it come into the world?

Can any light be thrown on this hidden question? It shall be the endeavor of this article to cast some rays of light upon it.

It seems proper to observe, at the beginning, that the matter has been obscured by the conceptions people have of the soul itself, and by the idea entertained of the divine omnipotence. Both the conceptions of the soul and the idea of the divine omnipotence are sensuous, naturalistic and confused by a sort of scholastic legerdemain.

I shall endeavor to avoid confusion in the use of language and terms.

We may find relief by analyzing and understanding the Divine utterance, that man was made in "the image and likeness of God." Accordingly, what is the exact meaning of "the image and likeness of God"?

It seems plain that in the creation of man, there is *a resemblance* to something in God. The generative quality in man—that which causes him to be man—is the image and likeness of God in him. The sacred utterance implies that

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there are two things in God which by creation could not be given to man, but in the creation *the image* and *likeness* of them could be given. And the question is, What are the two things in God, the likeness and image of which constitute the creation of man?

God cannot be nothing, but he must be the very substance that is the contrary of nothing. Then if he is infinite, he is infinite substance; and in infinite substance is involved a possible infinite variety in creation—infinite in the worlds made—in the things made in the worlds—in the people to inhabit the worlds.

Then all the things in the infinite are infinite. In the infinite substance there is infinite essence, or an infinite emanation from the substance. Thence, in what does the infinite essence of God consist? The infinite essence of God is the Holy Spirit, the creative word, the emanating life, the substance of all substances; and it is two-fold in nature, consisting of love and wisdom. These are inherent in and emanate from the infinite substance.

But it must be noted: 1. That *the emanating essence* is substance; 2. That infinite love is about identical with infinite life; 3. That these two infinite substances are the Word that was in the beginning—the Word that was with God—the Word that was God—and the Word through which "all things were made."

In God is a communicable substance and an incommunicable substance. The first is absolute Deity; the second is the divine creative, emanating substance—the cause of all things. For the infinite wisdom through the infinite love creates all things.

In the infinite *wisdom* are infinite thought, infinite consciousness, and infinite freedom. In the infinite *love* are infinite goodness, affection, energy, etc.

The attributes of the infinite are alone in the infinite. And God cannot create the infinite; for by creating an infinite, all his substance would pass to the new being, and he would cease to be. And this is not possible even with God and his omnipotence.

But while God cannot create a new infinite being, he can create a finite being, in his image and likeness. A being in his image and likeness is the man of the Bible; and his very creation consists in and is constituted by having his image and likeness. Then the word itself intimates that the "*image*" of God in man is that in him which *thinks*—has wisdom, consciousness and freedom. And the "*likeness*" of God in him is that which loves, feels, has affection and even life. Or to say the same thing in briefer terms, *Man is man by having a will and an understanding*. While God has these in an infinite degree, man has them in a finite degree. But man, having them in a finite degree, makes him "the image and likeness of God."

"The image" is the image of infinite thought, wisdom, consciousness and freedom in God; and "the image" gives man finite thought, wisdom, consciousness and freedom. And these are *the substance* of man and constitute his creation, when united by the creative force with "the likeness," which is life and love in a finite degree.

Now in life and thought is consciousness; while consciousness itself is a sort of superintending thought. And in consciousness is intuitive perception—the highest kind of thought—which notes the distinctions of right and wrong *in its own states*. Intuition is inherent in the thought which is perception in consciousness.

Thought itself is substance, and is light in the soul. Thought is an emanation from God into his "image" in man.

Life is also a substance flowing from God into his "likeness" in man; and in the union of life and thought comes consciousness. Indeed, life in *form* is thought, giving consciousness. Thought, acting on the nerves of the soul (or person) so as to put it into some sort of action or endeavor, is *volition*. The "image" and the "likeness" of God in man are substance from the Infinite Substance, and their *form*, in fact, constitutes *created* man.

In the creation of man Order has an essential place. Order is *the condition* of thought, consciousness and freedom. *Proper* thought, consciousness and freedom occur and continue so long only as Order directs them. In dis-order, thought, consciousness and freedom still occur, but they are dis-orderly and perverted. And exactly at this point is the introduction of sin. *Sin* is thought, consciousness,

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and freedom in *dis*-order. Hence, "Order is the quality of the disposition, determination, and activity of the parts, substances, or entities which make the form. Whence is the state? The perfection is produced by wisdom from its own love; and the imperfection is forged by unsoundness of thought from impure desire."

The definition includes substance, form, and state. And it should be carefully observed that there is no substance without *form*, "because every substance is a form," and "the quality of the form is state, the perfection or imperfection of which results from order."

Now we can see exactly how sin originates: From man's being an "image" of God, he is endued with finite freedom to think: from his being a likeness of God, he has life and feeling: and so long as life forms thought in order, there is no sin—the life of God then flows in the orderly soul; it is in harmony with God, having all the purity and felicity of the divine life flowing into it.

From the image and likeness of God in man comes man's *personality;* from the disorderly action of personality comes *selfhood*, or the improper activity of the personality. In all conceivable forms the selfhood is sin, because it is contrary to the order of man's creation.

The selfhood is generated in the freedom which is inherent in thought and consciousness; while thought, freedom, and consciousness are inherent in the image and likeness of God in man, which cause him to be man. Or, in other words, in man's personality, and constituting it are the thought, consciousness, and freedom, the disorderly action of which necessarily originates sin. And, in the thought, consciousness, and freedom constituting the personality, any force thrust upon the thought, consciousness, and consequent freedom by physical omnipotence—if that was possible—would destroy the personality constituted by the image and likeness of God, whose states and activities are thought, consciousness, and freedom.

So, as we may say, the divine wisdom and love had the alternative of creating an image and likeness of himself as man, with the liability inherent in the image and likeness to act disorderly and so introduce sin, or to desist from creating a finite being having thought, consciousness and freedom. But that this alternative was presented to the creative wisdom and love is a thing of the clearest intuitive perception. God could not create another God; and any being inferior to God is finite; and inherent in finite thought, consciousness and freedom is the liability for sin to originate, the liability itself being beyond hindrance by God himself—beyond such hindrance, because it is contrary to the creative wisdom and love, the image and likeness of which constitute man.

Finite man has two sides to his nature—in the image and likeness of God in him. The one side allies him to the creator; the other, to nature and the world of sensuous things. Life flows to man on the inward side lying next to God; while he comes to a consciousness of nature and the created world through the outward side, created so as to enable him to live in the material world.

These two sides of his nature as created are related in order. God, the creator, is the subject of thought, love, consciousness and freedom on the one side; and the world and things created are the subject of thought, love, consciousness and freedom on the other side. The action of personality relates to both these sides in order; the action of selfhood relates to both these sides in disorder. The ability to turn the thought and love into disorder is inherent in freedom. Any undue thought of the world loved by man is disorderly, and originates sin. And as such thought and love are in the side of man's nature that is in the world, they introduce sin into the world by generating it.

In this manner, *What is the origin of sin?* becomes clear and free from doubt to the mind that follows the train of ideas which shows it; and as the mind perceives what is the origin of sin, the person sees exactly how it came into the world.

Some incidental thoughts may aid the mind in removing perplexities. But for consciousness, man would not *know* that he lives, as animals do not *know* that they live. Consciousness arises from the union of life with thought, or from the form of life which is thought, and the consequent activity of thought. Or consciousness is produced by the motion of thought. Thought is of the substance of man. Or thought is changes of state in the substance of the soul which is the man.

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When thought is in order, the soul sustains the relations to God and the world which God intended by man's creation. When thought is in disorder, sin is in man.

Sin is generated through the choices of the mind. To be consciousness, there must be states of thought; in states of thought there is diversity, seen in perception. In freedom resides the ability to choose any state perceived in consciousness. Any state of consciousness is disorderly if it tends to lead the person unduly to the world or the selfhood, or tends to think of God and substantial things from ideas derived through the senses of the material body. And a disorderly state of consciousness perceived, loved, and chosen, originates or produces sin in the soul.

And thus there is no power that can hinder the introduction of sin, outside of the choices of the mind, while the choices of the mind are inherent in the very nature of the mind in the only way God could make it.

Hence, in a finite mind allied at once to two worlds, the spiritual and the natural, there is always the liability to commit sin. And infinite power, either physical or spiritual, could not hinder a soul or person from sinning, but through its own free choices, without destroying the soul itself. This results from the nature of a being created in the image and likeness of God.

It is worthy to be observed that *personality* relates the individual to both the natural and the spiritual world in the proper manner, or in God's order. But *self-hood* is the disorderly relation of the person to both the natural and the spiritual world. The self-hood has its genesis in the disorderly action of the image and likeness of God in man. In such disorderly action is the origin of sin. Sin is disorder.

The relation of God to all created beings is the same. Love is the order of that relation. To violate love is to violate order. And this is to introduce sin into the world. Generally, departure from the order of man's creation is the origin of sin. Nothing can keep the finite creature from departure but the continuous purpose to be kept and guided by life and love from God in the soul. Omnipotence outside of the soul could not do it, for it has no relation to the soul. And nothing can control such a creature, to keep it in the order of life, but love and truth—two divine substances—accepted in the purposes and choices.

The wisdom of God acting through life from him is the creative substance. And the first of all creatures are made by God by the direct and immediate exercise of creative power. Afterward they are created through the medium of parents. The first creation of man was the best that infinite love, acting through infinite wisdom, could create. The first of the race were the image and likeness of God created in the best and highest order possible to God himself. And these were the people of "the golden age"—the race that lived in the Eden of excellence. And Darwinism is the most absurd burlesque that a mind blinded by the culture of the senses could devise of the creation of man in his own image and likeness. Indeed, all the accepted evolution-theories are but absurd and grotesque caricatures of the divine method of creation. Darwinism seems to be the exponent of the soul's activity wholly on the plane of naturalism. It is the philosophy of a mind entirely occupied by information derived through the senses, employed by the natural reason alone.

One more incidental thought seems pertinent in this connection. Life emanating from God continues creative after it flows into the soul of man. But flowing into the soul, it takes the very qualities which belong to the soul. Then the children have these qualities transmitted to them by natural generation. The qualities of the soul are its substantive essence, which are the creative emanations, having flowed into the soul from God, but, by flowing into the soul, has taken its qualities from the real condition of the soul state.

The transmission of the qualities of the soul to children is what is known as the heredity. This heredity is double, coming from both parents. From the nature of the image and likeness of God in man, each person can constantly originate sin in himself, and so make it a part of his substance as to transmit the new taint to his children, and thus a family or nation may become worse and worse.

The undue culture of the part of man that lies next to the senses is a prolific source of sin; and the excessive indulgence of the sensuous nature closes up the

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part of the soul that lies closest to God, and produces the condition called naturalism. The worst form of naturalism is materialism and atheism. Then there is conceived to be no God but the unknown mystery of nature.

CAMPING TOUR TO THE YO-SEMITE VALLEY AND CALAVERAS BIG TREES.—No. 12.

BY PROF. I. L. KEPHART, D. D.

Having bidden adieu to the Yo-semite Valley, our next objective point was the Calaveras Big Trees, situated in Calaveras County, seventy-five miles east of Stockton, and, by the road, ninety-five miles north of the famous valley we have just left. We retrace the route by which we entered the valley, more than fifty miles, to Upper Garrote, stopping the first night at Hardin's Ranch, and arriving at Garrote about 4 P. M. of July 12th. Had we known it in time, it would have been better for us to enter that valley by the Coulterville road and leave by the Big Oak Flat road, as that would have afforded us the opportunity of viewing the scenery on both routes.

As the reader has already been given a description of the route over which we make our exit, as far as to Garrote, we will not detain him with any account of this part of our journey, other than to say that the usual interest and hardships common to campers in the mountains were ours to enjoy and *endure,* in making this part of our return trip. We dinnered at Crane's Flat, and camped for the night at Hardin's Ranch, six miles this side of Crockers. On the 12th we dinnered at Watson's Ranch and arrived at Garrote, as above stated, where we made some additions to our commissary stores. Leaving Garrote, we left the Big Oak Flat road, and turning to the right, struck for Sonora, via the Iron Bridge. Having traveled about five miles we came to Goodenough's Ranch, where we stopped for the night. It being Saturday, our intention was to secure a good camping ground where water, hay, and milk could be procured, and remain there over Sabbath. At Goodenough's the hay, water, and milk were in abundance at reasonable prices; but, unfortunately, the place was so "stuck among the hills," that the only level spot on which to stand our wagon was in the immediate vicinity of the stable, and scores of hogs were running in every direction. This was quite too much for the sensibilities of the women, and we were in quite a dilemma. We were right at the beginning of an awfully steep, narrow descent of four miles to the Tuolumne River. It was now past six o'clock; if we pulled out of there we would have to drive down that great hill and up another almost as steep before we could find hay, water, and a camping place; and if we should chance to meet a wagon on the narrow steeps, the only way we could pass each other would be by taking the wagon to pieces and standing it against the bank until the other drove past, and then putting it together again.

Under these circumstances, we concluded that we must remain where we were until morning, which we did. But at an early hour the next morning we were up, and, in compliance with the request of the women, we "hooked up" and left without breakfast, to get away from the hogs. Our morning drive was a romantic one. For four miles we descended the narrow, winding, steep road to the river, much of the way being so narrow that a deviation of one foot from the track would have hurled us hundreds of feet into the yawning chasm. Crossing the river on the new iron bridge, we began the ascent. It was steep, long, laborious. At 9 A. M. we arrived at a ranch within nine miles of Sonora, where we went into camp, to remain and rest over Sabbath. Here the tenant, a Mr. Howard, an old miner from the State of Georgia, treated us very kindly, and we spent a very pleasant time. Having killed, on Saturday, three quail and a dove, we now cooked them, and prepared a regular square meal, cooking and eating breakfast and dinner together. The afternoon we spent in reading and conversation, in which we were joined by Mr. Howard, whom we found to be a very interesting, companionable old bachelor.

Monday morning, being greatly refreshed by our rest, we bid Mr. Howard adieu, and, proceeding on our journey, we arrived in Sonora about 9 A. M. This

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town was originally settled in 1848 by some Mexican miners from the State of Sonora, and, being then surrounded by very rich placer-mining districts, it grew very rapidly, so it is said that by the end of the first year of its existence it numbered a population of 5000 inhabitants. Owing to the fact that the town has been frequently swept with destructive fires, most of the buildings now are of brick, having iron shutters to the windows, and iron doors. The town has an ancient, irregular appearance, and is the county seat of Tuolumne County—a county of irregular shape, bounded on the east by Morro, on the north by Alpine and Calaveras, on the south by Mariposa, and on the west by Stanislaus counties.

At one time this was a busy, bustling city, rushing with business; but since the exhaustion of the mines in these parts, it has dwindled to about 1500 inhabitants. Still, considerable business is done here, and the town has four churches, an academy, public schools, small library, two weekly papers, water-works, foundry, and two hotels. Here we added to our commissary stores, and then proceeded in the direction of Columbia, four miles distant. This town was once a place that enjoyed great prosperity. It was built in a beautiful valley; but the soil has all been mined off over hundreds of acres, and to the depth of from three to fifteen feet (and in some cavities even to the depth of fifty feet), leaving only the jagged clumps of limestone rock, rearing their heads all over the literally "scraped and peeled" valley, as monuments of the energy with which hungry mortals delved after the precious metal.

These were at one time among the richest mines in the Golden State. From 1853 to 1857, it is said that their weekly output averaged 100,000 dollars in bullion, and that they produced more large nuggets than any other mining district in the state, and that the gold was rated for the exceeding fineness of its quality. But alas for the town! The mines have been completely exhausted, and, as a consequence, the town has dwindled into insignificance. From 1860 to 1870 the population of Tuolumne County decreased from 16,229 to 8171, the result of the exhaustion of the gold mines, and its present population does not exceed 9000.

Passing through Columbia, we proceeded in the direction of Parrot's Ferry, and when the sun's approach to the meridian, with the gnawing at our stomachs, reminded us of the flight of time, we halted for dinner. Having shot two rabbits we had a genuine stew; and procuring milk of the good farmer's wife near whose ranch we were stopping, we fitted up a good dinner, which was enjoyed by all.

Dinner over we continued our journey, winding down a tremendous hill to the Stanislaus River, which we crossed on a rope ferry. The waters rushed by, a perfect torrent, filling the channel to the top of the banks. The ferry is located in a remarkably romantic place, and is kept by an old man and his somewhat demented maiden daughter. They were both very kind, and exhibited to us some very interesting mineralogical specimens gathered in that vicinity, chief among which were some remarkably fine specimens of ferns, photographed in the pipe-clay rocks.

But I should have said that before descending to the river we passed Gold Springs, which was once a noted mining camp. Here, on the right of the road, is a large, freely flowing spring of ice-cold water, a very rare thing in auriferous districts, over which a monster weeping-willow spreads its protecting branches and grateful shade. It is the opinion of Prof. Whitney that this spring existed here during the time when the mastodon flourished, and has continued to flow ever since. His opinion is founded on the fact that numerous remains of these monster animals are found in the vicinity of this spring.

Having crossed the river, we ascend the great hill, anxious to "get out into the southwest" before night overtakes us, so as to procure hay for our faithful horses. Beyond the top of the great hill or table mountains, having made a considerable descent, we notice to the left of the road a "finger board" pointing down a steep, winding trail, bearing the inscription "Half a mile to the natural bridges." For want of time we did not visit these, but were informed that they are peculiarly interesting, resembling fine gothic arches, hung with stalactites, and span Coyote Creek, a stream of some size that winds down from Vallecito. As the sun was now rapidly sinking in the west, and there was no sign of a convenient camping ground, we hastened on down the side of the brown mountain covered

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with stretches of dry grass and clumps of chaparral, manzanita and wild lilacs. To our left, in the canyon below, winds Coyote Creek, of which Joaquin Miller has said:

> "Here winds a thick and yellow thread,
> A mossed and silver stream instead;
> And trout that leaped its rippled tide
> Have turned upon their sides and died."

But, as the once flourishing placer mines of this region are thoroughly exhausted, this once "yellow thread" now winds along as clear and sparkling as before the miner's shovel and pan disturbed the auriferous soil, and again the trout leap its rippled tide. The Table Mountain, over which we have been passing since we left the Stanislaus River, is an immense lava formation of about 1500 feet in width. It was thrown up hundreds of centuries ago by a mighty volcanic eruption, and is so constituted that time makes but little impression upon it; hence the absence of timber, and the paucity of shrubbery.

No opportunity for procuring hay and water presenting itself, we pushed on into the outskirts of Vallecito, where, in the twilight, it was our good fortune to meet, in the person of a Mr. Crawford, another of those whole-souled Irishmen who think it no hardship to be accommodating. Having made known to him our wants, he at once told us to go into camp right in front of his cozy little home, actually took rails off his fence to furnish us with wood to cook our supper and breakfast—and for which he would not accept a penny—furnished our horses with all the good barley hay they would eat for twenty-five cents, and gave us half a gallon of milk for ten cents, and from his fine, heavily-ladened orchard gave us all the apples we wished, gratuitously. Even when we had procured all the milk we could use, his good wife brought us over an extra pint, for fear we would not have enough, and for which we could not prevail on her to take a penny. The reader can imagine how refreshing to the weary, benighted campers was the kindness of this good family. We learned of Mr. Crawford that he and his wife are members of the M. E. Church, and we feel well assured that they are faithful workers in their denomination as well as ornaments to the cause of Christ.

Vallecito (Little Valley) was at one time a very flourishing mining town. Mr. Crawford informed us that it was no uncommon thing for miners, at one time, to take out from twenty to fifty dollars per day. The gold was found beneath three layers of lava, and was procured by sinking shafts through the lava, and then bringing the auriferous earth to the surface and washing it in the waters of Coyote Creek. The most prosperous mining times here were in 1852 and 1853.

After bidding Mr. and Mrs. Crawford good-bye, on the morning of July the 15th, we passed through the village and proceeded in the direction of Murphies, distant about nine miles, where we arrived about 9 A. M. This being the depot at which to lay in supplies for the Big Trees, we halted for some time, made the necessary purchases, and took a view of the town. Murphies is a village of about 400 inhabitants, is situated in a little limestone valley, nearly surrounded by the red hills of the region. Immense sums of money have been expended in digging ditches and building flumes for conducting the water to desirable places. It is said that in this (Calaveras) county alone over 300 miles of ditches have been dug for conducting the water for placer mining. The water for Murphies has been brought, by means of ditches, a distance of fifty miles, the work of the Union Water Company, which has its office here. The mines having been exhausted, the water is now utilized for irrigating purposes.

From Murphies it is sixteen miles to the Big Trees. The road follows Murphies Canyon, and in the sixteen miles we make a rise of about 2300 feet; here most of the road is "up hill," and much of it very steep. This distance was successfully, though laboriously, covered during the remainder of the day, and the evening of July 15th found us safely encamped in the immediate presence of the world-renowned *sequoia gigantea*. Of these immense trees I will tell you in my next.

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THE WORLD SAVED THROUGH A NATION.—No. 3.

BY REV. S. A. TAFT, D. D.

14. It is a fact that the Jesus of Matthew, Mark, Luke, and John was the redeemer and savior of Israel. He was both the redeemer and the redemption price paid for Israel. Nor could he well be, directly and immediately, the redeemer of any other people. (1) Because no other people, as a people, were in precisely the same situation as Israel. No other sustained precisely the same relations, and no other was amenable to precisely the same government. (2) Because redemption is an act of government. And it must be an act of the government that holds and prevails over the nation or people redeemed. It cannot be the act of any other government, for governments, like individuals, can redeem only that which is their own. And only government can redeem its own. The individual cannot redeem it, but the government only. (3) Because the government of God over Israel is the only government that has ever ventured upon the tremendous work of redeeming its people. No other government known to history has ever assumed to buy off its criminal class from condign punishment justly inflicted, and especially not where that class consisted of the whole people, as was the fact in the case of Israel. No other government could do this. And yet this is just what the divine government has done. And the only divine government known to the Bible is the government of God over Israel. Under no other government or law was divine redemption possible. Men cannot be redeemed from law as "a mode of existence," or as "an order of sequence," but from law as something *laid down*, an injunction, command, regulation, etc. (4) Because in the case before us, the object, or thing, to be redeemed was the property or possession of the government, and, therefore, that alone could be redeemed, and only the government whose it was, could redeem it. (5) Because Jesus, acting under specific law, as was the fact, could represent only those over whom that law or government prevailed or held. He could not go outside and represent any other people whatever. Nor could he take any other people to himself and represent them under his own government. Every specific people must be represented under their own law. They cannot be represented under any other law. (6) Because never, since "the confusion of tongues," has the race, as such, been in any such organic relationship under law as to render it possible for any one, not even the Lord Jesus himself, to represent them as a grand totality or whole. It could not be done. And therefore Jesus did not, he could not represent the race in this great act of redemption, but his own people only. (7) Because the government of God over Israel was the only government or law on earth that could pronounce Jesus a curse. And yet he must be made a curse; for it was only as he was made a curse, or was accursed, that he could redeem. He must himself be made a curse for those who were accursed, or they must remain accursed forever. There was no help for it. And no law could condemn Jesus but Israel's law, and Israel's law could condemn him only as it saw him hanged on a tree. For no other law ever said, "Cursed is every one who is hanged on a tree." But Israel's law said this, and therefore it could curse even the Lord Jesus, if it found him hanged on a tree. It did so find him, and therefore it cursed him. And so Jesus was made a curse. And under this law this curse attached at all hazards to every one who was hanged. The law did not stop to inquire into the status of the man hung. On a tree, he was accursed anyhow; no matter how innocent he might be, nor by what means or measures or by whose hands he was put there, on the tree, he was cursed. And therefore again, acting under this law—and this was the law under which Jesus did act—he could represent only those who were amenable to the law. And we know that this was Israel, and Israel alone. (8) And finally, because representation implies headship. The party representing must be the head and front of the people represented. And both together must be in organic, constitutional relationship under the law or government that purposes to redeem, and such exactly was the fact with Jesus and Israel. He was the head and king of the nation, and he was the head and king of no other people whatsoever,

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and therefore he could represent no other people. Israel, then, and Israel alone was the party or people represented, and hence the party or people redeemed. *Jesus was on the cross for Israel.* He was made a curse *for them.* God's own nation, or people, then, was the direct and immediate object of divine redemption. And they had first to be redeemed, before the blessing of Abraham *could* come on the Gentiles. Gal. iii. 13, 14. But,

15. It is a fact that, right at the time, or in immediate connection with the fact and circumstance of the redemption of Israel, *the new covenant was dedicated or brought into force.* A most important event.

There were really four great ends to be compassed by the death of Jesus, and ends that could be compassed in no other way. These were, (*a*) to redeem Israel, Gal. iv. 4, 5; (*b*) to give force to the new covenant, Heb. ix. 16, 17; (*c*) to make the Gentiles near, Eph. ii. 13; and (*d*) to put away sin; or lay broad and deep a foundation for the sure and certain, total and complete extirpation of sin, root and branch, from off the face of the earth, Heb. ix. 26. And these ends, as I claim, were all marvelously compassed in that most tragic event, the death of Jesus. And the time must come, the time will come, when, as the grand outcome of what the Christ of Israel said, and did, and was, there will be no more sin, political, civil, ecclesiastical, or moral on the earth. All will have disappeared, and there will be no more oppression, injustice, and wrong, but righteousness, and righteousness alone, forever. Glorious day! And may the Great God hasten it.

The dedication of the new covenant consisted in sprinkling it—or, which is the same thing, the Lord Jesus who represented it, and in whom all its marvelous behests were embodied, for he was the mediator of the new covenant—with blood. And this was done after the model of the pattern or type dedication of the old covenant. Ex. xxiv. 5–8. But the new covenant was not dedicated, as in the case of the old covenant, with the blood of animals, but with the blood of Jesus, who was himself, as just noted, the glorious and immortal mediator of that wonderful instrument. The gore of the matchless Son of God, streaming from his head, hands, feet and side, was the blood of the new covenant. And this, its dedication with the life-blood of a living Christ, made it a vitally living testament. And it thenceforth became the fundamental law of the holy commonwealth; and the old covenant, the codicil instrument, was really no longer in force, on and from that event. It died when the new covenant lived, for it was to hold only until the new covenant was brought into force. And now, under the new law, the worshiper in Israel can be perfected; whereas, before he could not be. It was not in the nature of things, it was impossible that the blood of animals should take away sins. But the blood of the new covenant can do this. It cleanses from all sin. And in this fact of difference in the *detergent force* of the blood of the two covenants lies the radical and essential difference of the covenants themselves. If the detergent force of the blood of the old covenant could have perfected the worshiper, made him morally clean, pure, sweet, etc., then there would have been no need of another covenant, and Jesus need not have died. Gal. ii. 21; iii. 21. But as it was, another covenant was necessary, and he must die to give force to that instrument. "For where there is a testament, *there must also of necessity* be brought in the death of the testator."

The blood of the old covenant was provisional and temporary. It was indicative. It pointed out and called attention to a deep-laid want it could not gratify, a necessity it could not meet. It had no power to stay the yearnings of a true Israelite to be delivered from sin. It could do nothing for him here. It was but the shadow, of which something better and higher was the substance. The blood of the new covenant, on the contrary, is permanent and abiding. It meets without reserve or discount the deep-laid necessity to which the blood of the codicil covenant simply called attention.

On and from the dedication of the new covenant, therefore, the nation and people of Israel were no longer bound by the old law, but were at perfect liberty, and under the most imperative obligation, to espouse the new law. It was to this end that an invitation of long standing was so earnestly renewed in the time of the Master. See Matt. xxii. 2–9. And most fortunate would it have been for them and the world had they responded. "But they made light of it, and went away, one to his farm, another to his merchandise." They would not come. The

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king therefore was angry, and sending forth his armies, he destroyed those murderers—for some of them were murderers—and burned up their city. And yet the refusal of these invited guests to come, or their fall, was the riches of the world, and their diminution the riches of the Gentiles. But how much more their fullness would have been, and will be when it shall have come in, the enriching of both the world and the Gentiles. As it was, however, no thanks to Israel, that anybody or anything was enriched. It was all by the grace of the God of Israel, and that part of Israel who were a medium of that grace (for all Israel did not fall), that the world and the Gentiles have been blessed at all. The God and Sovereign of the nation has been infinitely better than the nation itself; and therefore the world and the Gentiles have been blessed, and will continue to be blessed, though a part of the nation is in shame and disgrace. But both would have been enriched infinitely more, had Israel maintained his fullness and come under the new law. In that event the channel of the world's history would have turned in another direction entirely; and the world would have been many centuries nearer the goal of its perfection, greatness and glory than it now is, or is likely to be right soon. But Israel would not come, and therefore his fate, and the comparatively meager progress of the world; for the world cannot make progress without Israel. Israel must lead. As it is, however, the Gentiles have been greatly blessed, in that they have been admitted, without stint or limit, except as to character, to glorious *fellow*-citizenship in the kingdom of God. And this is a boundless benediction; for it secures partnership in Israel's redemption, and hence in Israel's salvation.

16. And finally, it is a fact that, when the nation and people of Israel had been redeemed, the new covenant dedicated, the Gentile made near, and all possible had been done for the nation, and by the nation, as originally organized and constituted; and when the foundations of the new State had been laid from among those of Israel who believed; and the time had now come to take the nation out from under the old law, and place it under the new law, and to throw wide open the doors of the holy commonwealth to the incoming of the Gentiles in glorious *fellow*-citizenship; and because Israel would not, and because the codicil law had expired by virtue of its own limitations as well as by the enforcement of the new covenant (for the old covenant was to hold only until the Seed should come, concerning whom and in whose interest the promises had been made); it is a fact, I say, that, when all this had been done, and for the reasons noted, God, the Jehovah and Sovereign of the nation, proceeded to tear down and break up the old organization of his commonwealth. And this he did by forces from within and from without, until it was utterly demolished, and there was absolutely nothing left of it but its broken and scattered fragments. Its capital was destroyed; its country was laid waste; its king was called home; the rebellious and unbelieving portion of the nation, so many of them as survived the judgments of God attending its overthrow, were taken up, carried away, and buried in the graves of the Gentile nationalities of the earth, where they are to this day, and must remain until their Sovereign shall call for them again; and the residue, the believing and loyal portion of the nation, not one of whom was involved in the final overthrow, having been previously commissioned and sent out to that work, went right on saving all possible of their countrymen, and working up a glorious *fellow*-citizenship from among the Gentiles, to the end that, in the great hereafter, God's house might be filled. And thus ended Israel as it was.

And from that day to this there has been no national organization of Israel, and will not be, until the fullness of the Gentiles be come in, and the glorious Head and King of the nation shall return from his long, long absence. Then will God call together his nation again; purge them of all rebels; enter anew into covenant relations with them; make them indivisibly one again; reorganize them, and build them up anew upon the foundations already existing, and that were laid in the far-off centuries of the past; and with them proceed to take possession of his own dominion and the world. Then will there occur a revolution that shall sweep the entire earth. And thus shall God's Kingdom become a great mountain and fill the whole earth. All, everything from far and near, from pole to pole, and from the rising to the setting sun, will have been either taken up into and made one with God's Kingdom, or rooted out of the earth. The holy common-

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wealth must possess the gate of its enemies, and become universal. Heaven has decreed it; and what God decrees will certainly be. And so, finally, we have "The salvation of the world in and through and by the salvation of a specific nation." I repeat, this is God's plan, and it is sure to prevail. And thence on will be the glorious condition of things noted in Isaiah lxv. 17 to 25 inclusive. Wonderful day! Glorious future! The world in all these ages has been cursed by sin; and it remains that in the ages to come it shall be gloriously blessed by righteousness. We have had the age of sin; we must have the age of righteousness. And let all God's people say, THY KINGDOM COME.

GOD AND MAN.

BY ELD. J. J. MILES.

The Bible, being God's word, must teach the true science concerning God, man, and the universe. What then saith the Scriptures?

"God is a spirit [Pneuma]." God is the only "I Am," the only self-existent being. God is an all-wise intelligence, and the creator of all things. Creation, or miracle, does not mean something out of nothing, or something accomplished by no adequate or appropriate means. For "the Lord *by wisdom* hath founded the earth; *by understanding* hath he established the heavens. *By his knowledge* the depths are broken up, and the clouds drop down dew." If the adaptation of means to ends be proof of mind, of intelligence, surely the infinite mind or intelligence brings about ends by suitable means, works in no other way, whether in miracle or creation. But God's resources are infinite, beyond our ken. Nature is simply one of God's ways of working. I think the following Scripture contains the philosophy of nature's working: "It is the same God that worketh all in all," and "which is his body, the fullness of him that worketh all in all." True, this is spoken of the church, and the powers, or gifts, possessed by its members. The church is not God, and the Bible does not teach a pantheistic idea in reference to the church when it makes these two utterances. Just so there is no pantheism in the idea that God is in all nature working all nature. Is there not a perfect analogy between the kingdom of nature and the kingdom of spiritual things? Hence, Paul can give the law of the kingdom of grace in the very language of the law of the kingdom of nature. "Whatsoever a man soweth, that shall he also reap." And we read, "Do not I fill heaven and earth [all nature, the universe] saith the Lord?"

Is there any simpler way of accounting for the why of all force than this: *the force within all forces that makes them a force is God?* Does not the Bible declare, "In Him we live, and move, and have our being"? Let God withdraw his presence, we would cease to live, or move, or have existence! It is God's presence that runs the universe, that keeps it in existence! God is omnipresent, and I do not think of God as some said of Paul, "his bodily presence is weak"; on the contrary, God's presence throughout the universe is the very power that intelligently runs the universe. The very rocks and the very dust of the earth all work intelligently. The very trees, and flowers, and grasses, seek and appropriate their food just as intelligently as man! Every motion of every atom in the universe is pervaded with intelligence, accomplishes intelligent purposes! I can account for it by God's omnipresence, and in no other way.

Now, what saith the Scriptures respecting man? "We are His offspring." "What hast thou that thou didst not receive?" All man's powers, attributes, capacities are derived from Deity, the fountain source. "God created man in his own image, in the image of God created he him." "Let us make man in our image, after our likeness." Man is an organism, a compound; "The Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life, and man became a living soul." If the whole tribe of infidel material scientists choose to confine their investigations to "the dust of the ground," thinking to find the potency of life in matter, let the blind be leaders of the blind! Let them find out all about matter that is possible to be known. I care little for their recognition. God's truth will prevail by its own inherent energy. Let the

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light shine, and no fears about the darkness. For my part, believing the Bible, I believe that man is a *compound being;* he is dust, but not all dust; the *breath of life* breathed into him by God, this it is that is the life of man, this the source of man's intelligence; and clearly this is *immaterial substance* and not simply a principle. We must go to the invisible, to pneuma, to breath or spirit, if we would get into the realm of original causes. I cannot see pneuma (spirit), but I can investigate the *phenomena* of spirit, of mind. I can question my own con sciousness, the workings of my own mind when I am awake, or in dreams when the body is, as it were, temporarily dead. The phenomena of mind in cases of insanity, *delirium tremens,* states of the nervous system produced by opium, etc., and clairvoyance, can all be investigated. What we want is facts, *well-attested facts in the line of the phenomena of mind.*

Is not man an organism, composed of many parts, yet all comprehended in two items, "dust of the ground" and "the breath of life"? And is not God an organism composed of many parts? Is not vegetable life one thing, animal life another thing, intellectual life another thing, and spiritual life another thing? and the life or forces in all matter another thing? Are not all these substantial essences, though immaterial? Do they not all exist organized in God? May not organization be essential to their perfect working? The dust body is not essential to their working, for Paul says "there is a natural body and there is a spiritual body," but I do suppose that organization, a body, a form, is essential to *man's existence as man,* with all the powers mental, moral, and physical man is possessed of. And I cannot myself conceive of God except as an organized being having form and parts. Certainly this is the Bible representation of God.

As to the possibility and probability (and in the light of Scripture I think I may add certainty) of the material body, and indeed all material substance being derived in its ultimate elements from spiritual substance, this I think has been beautifully and unanswerably argued by Thomas Munnell in THE MICROCOSM.

The finite can never comprehend the infinite. But as man is God's offspring, by searching man we can find out something about man's Father. Certainly man has no power, no attribute, no capability of any kind that is not derived from his Father, and hence *whatever of these we find in man in a finite degree, must exist in God in an infinite degree.* Jesus Christ was the only perfect man. What do the Scriptures say about Jesus? He was not only man, but God. We read "No man hath seen God—he hath declared him." "God was manifest in the flesh." "Immanuel, which being interpreted is God with us." "He that hath seen me hath seen the Father." "Christ who is the image of God," and again, "the image of the invisible God." "The express image of his person." And "God was in Christ."

The heathen made images of their false deities, of wood, stone, brass, etc., bowed down to and worshiped these images, supposing that their invisible deities resided in these images. Jehovah commands, "Thou shalt not make thee any graven image, or any likeness of anything that is in heaven above, or that is in the earth beneath, etc.; thou shalt not bow down thyself to them nor serve them." Jehovah, however, did at length set up his image in this world, not an image of wood, or of gold, or of silver, the work of men's hands, not a dead image, but the living Jesus. In coming to this image, bowing down to him, serving him, we come to God, worship and serve God. For "God was in Christ." This image is not deaf, but hath ears to hear, yes, he actually heard and answered prayer. If, then, Jesus heard and granted requests, if a father can hear and grant the requests of his children, when he sees it is for their best good, certainly the Heavenly Father can to-day do the same. Science teaches me this! I mean the science of mind.

My mind moves my material body at will, and through my body moves chairs, tables, material substances. My mind acts freely according to new circumstances, and performs what at any moment it wills to perform. Jesus Christ acted thus freely when upon earth. Man is the offspring of God: what man can do, surely it is reasonable, scientific, to conclude that God can do, and does do. People talk about the universe being under fixed laws, as if those laws were above God Almighty, and he were so bound by fixed laws that he cannot act freely as any man can act! They forget that mind itself has its laws, and from all we see

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and know about mind, this very freedom to act according to its own will in every new emergency and according to the circumstances of the present moment is an essential law of mind.

To conclude, true science must investigate pneuma, investigate mind, immaterial substance, if it would investigate the real causes, the real forces, producing all we see and hear in this world. And by investigating the phenomena of the mind of man, we can learn something reliable concerning the Father mind, God: and investigation on this line establishes the truth of the Bible. God is spirit. All things are of God. Hence the universe of matter and mind originated in spirit. The universe is not self-existent. No being but God has life in himself. Hence God's omnipresence is essential to the continued existence of the universe and of all the life in it. Jesus Christ was "God manifest in the flesh," "the express image of his person," a finite manifestation of the infinite God. We must study Jesus to find out God. Study the Son to know the Father.

If it could be proved that man is a magnetic or life-force battery, sending out magnetic or life-force currents, and receiving back intelligence from outside existences, I would conclude that Almighty God is an all-powerful life and force battery or organism, in the center of the universe, his mind originating all existences, sustaining them in being by the life forces emanating from him, and holding telegraphic, phonetic, optic, etc., communication with all of the vast universe, so that not an insect dies without his notice, everything beheld by his eyes and heard by his ears and felt by his sense of touch.

TIME AND SPACE.

BY J. C. DUVAL.

I believe it is the opinion of most of the scientists of the present day that time and space are nothing of themselves, but merely terms made use of to express the *necessary condition of things* in the universe. As far as time is concerned this may be so—at least I can say nothing to the contrary. Time is either future or it is past. It may be likened to a river rushing by a mathematical point in a certain portion of space which has no dimensions, neither length, breadth, nor depth. All the water above this point may be considered future time, and all below it time passed. But as this point has no dimensions, no duration of time will be required to pass it, consequently there can be no *present time.* It departs the moment it arrives, goes as soon as it comes, and dies the instant it is born.

But with regard to space, I think there are several reasons for considering it as *something* of itself, though it possesses none of the properties or qualities of material bodies, unless the fact that we can measure and define limited portions of it be regarded as such. It is hardly possible to suppose that space is *nothing*, or merely a *condition of things existing,* because if we could imagine the annihilation of everything else in the universe, space would still exist; but without space it would be an impossibility for anything to exist, and therefore we cannot regard it as merely a necessary condition of things existing. Unlike time, it is never future or past, but always present and unchangeable. Unlike time, too, we can measure off, say a cubic yard of space, as accurately as we can a cubic yard of any material substance. Suppose we measure off a cubic yard of space and inclose it in plates of brass, can we say that the space inclosed is *nothing?* If it be *nothing*, ought not the plates to be absolutely in contact? But they are not in contact in any direction for three feet—and why? Because there are three feet of space between them. Then this space must be regarded as *something*, a something that is capable of containing within itself a cubic yard of any material substance, such as iron or stone. Could this be possible if it were absolutely *nothing? Nothing* has no properties nor qualities, and is utterly non-existent, and it cannot be supposed that it could affect anything in any way that does exist. But space as we see does affect other things very materially. The difficulty in regarding space as something of itself lies in the fact that it possesses none of the properties or qualities of material bodies.

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But I contend that everything is *something*, whether it be cognizable to our senses or not, that in any way affects other things, for most assuredly nothing or that which does not exist can have no effect upon anything. You cannot put a cubic yard of stone into a cubic foot of space, and why? Because more space is requisite for its occupation, and you must add on two feet more, of what? of *nothing?* no, of space. Is it possible to suppose that space is nothing, when we know that it occupies and fills the whole of the universe? Moreover, we cannot conceive of the annihilation of space any more than we can of the annihilation of matter. A cubic inch of space must be as eternal and indestructible as a cubic inch of iron. The term *nothing* is merely a relative term to express the lack or absence of *something*, just as cold is a term used to express the absence of heat. To say that nothing is a tree without roots, trunk, bark, branches, and foliage would probably be as good a definition of *nothing* as could be given. The mind is incapable of grasping a definite conception of *nothing*, for the moment we give to it any property or quality by which, as it were, it is brought within the scope of our reasoning faculties, it ceases to be *nothing* and becomes *something*. But we can readily form a definite conception of space, or at least of portions of it. We know there are about 95,000,000 of miles of space between the earth and the sun, for we have actually measured the distance, and that the earth performs her revolution around the sun once every twelve months. Now, is it reasonable to say that all this vast space traversed by the earth in her revolution around the sun is absolutely *nothing?* If space be nothing, then it follows that that portion of it between the earth and the sun (95,000,000 miles) is nothing, and if there be *nothing* between the earth and the sun, then they should be in contact—a most momentous nothing, for if it did not *exist*, the earth would be burned up in the twinkling of an eye.

In my opinion, whatever goes to make up the condition, or status, of the universe—suns, worlds, moons, comets, space, forces, etc., are all *things*, or entities of themselves, whether they be material or not.

Materialists account for the design that is apparent in the arrangement of all things by the assertion that "all things were as they are eternally, and of course that they could not be otherwise than as they are." But such an assertion, as far as I can see, has no bearing whatever upon the question, for if things were as they are, eternally, then there must have been eternally an intelligent designer, otherwise we must admit that the arrangement of everything has been by chance, whether or not the arrangement was made in time or eternity. Let us suppose that our own globe (and we will take it as an exemplar of all the rest, for the reason that we know more about it than we do of any other), was created 200,000,000 years ago, or at any other definite period of time past, that at that time the various materials of which it is composed were floating around chaotically in space, and let us see what has been done by chance to bring about its present status or condition. In the first place it *chanced* that all the materials and substances of which the earth is composed, were brought into the requisite juxtaposition, and by means of the forces we term gravity, cohesion, centripetal and centrifugal, which *chanced* then to be in operation, it assumed its present form, and was whirled round upon its axis, and in its orbit, around the sun. (But when first formed, why it did not drop at once to the sun by the force of gravity before the requisite propulsion was given it to render effective the centripetal and centrifugal forces, this deponent saith not.) At all events it *chanced* that the various seasons and alternate day and night resulted from these movements.

Then the distance at which the earth performs its revolution around the sun *chanced* to be the very one that would have been selected by an intelligent designer. If nearer, everything on the surface of the earth would have been scorched to a "crackling;" if farther off, all animal and vegetable life would have been destroyed by excessive cold or want of sufficient heat. Then, as air was essential to all animal and vegetable life, the constituents of which it is formed *chanced* to be in abundance on hand at the proper time, and enveloped the surface of the earth everywhere, so that all parts obtained an equal portion of this necessary material substance. Then, as water was also essential to the existence of animal and vegetable life, it *chanced* also that the larger portion of the earth's surface was covered by that fluid; but as the water of the ocean was unfit to sustain the higher

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orders of either animal or vegetable life, by reason of the salt and other minerals with which it was impregnated, and besides could not benefit the dry land without some provision for its distribution in sufficient quantity, it *chanced* that water itself possessed the very properties or qualities that enabled it to free itself from all impurities and to distribute itself over all parts of the earth's surface—over the highest mountains as well as the lowest valleys. It *chanced* to be of such a nature that it was constantly evaporating or expanding into mists or clouds of vapor, which being by *chance* lighter than the air, were carried upward; and as the atmosphere, owing to *chance* causes, was almost always in motion in one direction or another, these mists or clouds were borne along with it. Still, the dry land would have received no benefit from all this if had not *chanced*, also, that these mists or clouds were constantly being converted back again into the fluid state, by changes of temperature, etc., in the air, so as to render them subject to the law of gravity by which they are drawn to the earth and distributed over its surface in snows and rains. (There may be other substances besides water that possess the property of continually changing their form from the fluid to the gaseous state and back again to the fluid, but if there be such I am not aware of the fact.) Then, just at the proper time when the world *chanced* to be fitted to sustain animal life, there chanced to be a germ of life in a certain substance called "Protoplasm," from which all the different species of animals, including man (according to the doctrine of evolution), were developed during the lapse of countless ages. What a slim chance this was for populating the globe, for of all the substances and materials of which this earth is composed, this "germ of life" existed only in one spot, according to Haeckel, and only in "Protoplasm."

But "Proto" was equal to the emergency, as the millions and billions of men and animals now in existence on the globe will testify. If it had not been for this little chance germ of albumen lying perdu in "Proto," there never would have been any Babylonian, Greek, Persian, or Roman Empires; Alexander never would have wept for another world to conquer; Napoleon, Austerlitz, and Wagram would have been unknown; the pyramids never would have been built; Queen Bess would not have beheaded her sister Mary; George Washington would not have girdled the cherry tree with his little hatchet, and Cleveland never would have been elected to the presidency! Hurrah! say I, for this chance "Proto," or rather I would hurrah if I were one of the "lucky ones"; but as it is, I am not so sure it would not have been better for me if "Proto" had never existed.

But the series of *chance* results that followed the action of evolution upon this "germ of life" are the most wonderful and astonishing of all. In all the innumerable species of animals, birds, fishes, reptiles, and insects its action has been in every instance just what we might reasonably suppose it would have been if directed and controlled by an omniscient omnipotent Intelligence—every species being admirably fitted by its form, limbs, wings, teeth and claws, for its environments and mode of life, from the ant to the elephant—which last, being the only quadruped too unwieldy and bulky to obtain its living in the manner of other ruminants, was supplied with a trunk to remedy these defects of form. What can we possibly infer from all this, except that evolution worked *intelligently* of itself, or under the supervision and control of some intelligent power.

I once knew an "old Texan" who had acquired a well-deserved reputation for "drawing the long-bow." On one occasion, I called to see him just after he had returned home from a search after some missing stock. In telling me about it, he remarked:

"By the way, a very singular thing happened to me to-day."

"What was that?" said I.

"Well," said he, "in riding through some scrub-oak my horse struck his hoof against something that had a metallic sound, and, dismounting to see what it was, I found a cow-bell."

"Well," said I, "I don't see anything strange about that."

"No," said he; "but wait until I finish my story. I hadn't gone more than a quarter of a mile when I found another cow-bell, and a few hundred yards farther on I found another; and sir, if you will believe me" (but I didn't) "before I got back home I had no less than seven cow-bells hanging to the horn of my saddle—all picked up during the day in my wanderings through the woods."

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When he told me of his finding the first cow-bell I believed him; when he found the second I began to waver in my doubts, and when he found the third I had pretty well lost all faith; but when he got back home with no less than seven cow-bells hanging to the horn of his saddle, all picked up that day in his promiscuous wanderings through the woods, I knew that he was merely practicing a little at his favorite pastime of "archery at long taw"—in plain terms, that his whole story was a lie from beginning to end. And yet these materialists would have me believe that I am finding, not half a dozen, but hundreds of cow-bells in everything I investigate.

Chance! chance! chance! entirely too much chance, when in fact there is no such thing as chance. There are "accidental happenings," as we term them, for the reason that we are ignorant of the causes that lead to them, but there are causes which produce them as certainly and as inevitably as that water will result from the proper combinations of oxygen and hydrogen. Despairing of ever being able to account satisfactorily by this interminable concatenation of chances for the present status of our globe, I cut the "Gordian knot" with the sword of intelligent "Design," and presto! everything becomes plain and easy of comprehension to the most ordinary intellect.

By referring everything to the pre-ordering and arrangement of an intelligent Designer (and this surely is but reasonable, when design is apparent in everything we see) all things are satisfactorily accounted for, and chance is utterly eliminated from the "Universal Scheme."

THE CHEMISTRY OF WHAT WE DRINK.

BY HENRY A. MOTT, PH. D., F. C. S.

Coffee.

Coffee has been used as an article of food for ages. It was used in Persia in the year 875. In the fifteenth century it was introduced into Arabia, and in the middle of the sixteenth century was used in Constantinople. In 1652 the first coffee-house was opened in London by a Greek named Pasque. Twenty years after a house opened in Marseilles. Since that time coffee has been introduced in all countries.

Simmonds states that the production of coffee all over the world amounts to 13,000,000 cwt., having a value of £39,000,000, or nearly $200,000,000. Coffee may be said to form almost the exclusive dietetic *warm* beverage of 100,000,000 of the human race.

Soil and climate are the principal elements which affect the quality of coffee. It does not depend on the process of treatment so much as tea. But its flavor depends on the roasting and infusion. Coffee is best produced between the isothermal lines of 25° north and 30° south of the Equator. When the temperature is below 55° F., it cannot be cultivated to advantage.

It is cultivated in the West India Islands, in the provinces of Central America, Peru, Bolivia, and especially Brazil, the greatest market of all. It is widely spread over Arabia, western coast of India, Ceylon, Sumatra, Bourbon, Mauritius, Java, and other islands of the Eastern Archipelago, and various parts of Africa.

Arabian and Mocha coffee is small and of dark yellow color. Java and East India coffee is larger and of pale yellow. The Ceylon, West India, and Brazilian have a bluish or greenish-gray tint.

The coffee plant is called *Coffæa Arabica,* and is usually grown on the hillside. Within the tropics it thrives best at an elevation of 1200 to 3000 feet, but rarely grows above 6000 feet. It flourishes when the subsoil is gravelly. The tree lives and is fruitful for about thirty years. The plant is very prolific, remaining in flower during eight months and producing a succession of crops of fruit—three harvests annually. The picking requires care. The tree is pruned so as to remain about six feet high. The fruit is called a bean or berry, he beans being in pairs, which are face to face and inclosed in a hard coriaceous membrane, and surrounded by a pulpy pericarp. The seed itself is hard and tough, and requires

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the use of machinery in breaking the pericarp and freeing it from the coriaceous covering, and is at length cleaned by the process of winnowing. Good hands will gather four bushels of berries a day. Each bushel of ripe berries will yield ten pounds' weight of merchantable coffee.

It is common in some places to make an infusion of the raw coffee, but it is almost universally roasted, and, unlike tea, has its aromatic qualities generated in the process of roasting.

The object of roasting is not merely to render it friable, so as to promote grinding, but to create or develop the aromatic volatile oil, and care is required to limit the operation, so that the oil will not be destroyed by burning the bean.

When roasted to yellowish brown it loses 12½ per cent.; to chestnut brown, 20 per cent.; and when black, 23 per cent. So 100 pounds of good coffee will only weigh about 80 pounds when well roasted. It gains in bulk by roasting about 50 per cent. A chestnut brown is the best color, and the coffee contains the richest oil. In the process of roasting some of the coffee is volatilized, water is expelled, some of its sugar is changed into caramel, the cells containing fat and albumen are ruptured, the berry is made to swell by the escape of gases, and a rich volatile oil is formed. This fragrant aromatic oil is so powerful that one drop would scent a whole room with the odor of coffee. According to Konig, 8.66 per cent. of water and 9.11 per cent. of organic substances were lost in one experiment on roasting coffee.

The following is an analysis of coffee:—

	FINEST JAMAICA PLANTATION.	FINEST GREEN MOCHA.
Gummy matter	25.30	22.60
Caffeine	1.43	0.64
Fat	14.76	21.79
Tannin and caffeo-tannic acid	22.70	23.10
Cellulose	33.80	29.90
Ash	3.80	4.10
Potash	1.87	2.13
Phos. acid	0.31	0.42

The following is an analysis of coffee by Payen:

Cellulose	34.000	
Water (hyg.)	12.000	
Fat	10 to 13.000	
Glucose, dextrine, etc.	15.000	
Legumen	10.000	
Caffeat of potash and caffeine	3.5 to 5.000	
Nitrogenous substances	3.000	
Free caffeine	0.800	
Concrete essential oil	0.001	
Aromatic fluid essential oil	0.002	
Ash	6.697	(too high.)

The properties of coffee are mainly due to: 1. Unessential oil; 2. Caffeo-tannic acid; 3. Caffeine; 4. Concrete fatty substance. The soluble matter in unroasted coffee amounts to 28 per cent.; in roasted, 39 per cent.

Coffee is a powerful respiratory excitant, its action being chiefly dependent on the nitrogenous element, caffeine, which is very analogous to theine.

Three-quarters of an ounce of coffee gave by experiment 0.68 and 1.68 grains of carbonic acid and 28 and 54 cubic inches of air per minute. It caused an increased rate of respiration, depth was slightly increased, and there was an increase in rate of pulsation. Coffee does not increase the vaporizing action of the skin, but decreases it, and therefore dries that organ. Coffee, therefore, lessens the loss of heat, increases the heart's action and fullness of pulse, and excites the mucous membranes. Coffee is more fitted for the poor and feeble than tea; more fitted for breakfast, as the skin is then active and the heart's action feeble, whilst in good health and with sufficient food it is not needful after dinner; if then drunk, it should be taken directly after the meal.

In some respects tea and coffee are antidotes of each other.

Coffee is an excitant of the nervous system, but not in the same degree as tea.

It produces sleeplessness in many persons when taken at night, probably by exciting the heart's action.

Coffee is a strong antidote in poisons by opium, and may be used as a corrective in persons whose skin is very active.

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Milk added to coffee forms a more perfect food than with tea, as both have the same action on the skin and respiration, whilst milk counteracts in a degree the action of tea upon the skin.

The addition of chicory to coffee does not increase its action on any part of the system, but rather lessens it. It alters the flavor of the coffee, which some seem to prefer.

Coffee is adulterated with chicory—roasted grains—wheat, rye, peas, and beans, ground to powder. Sometimes with roasted roots—carrots, parsnips, and mangold wurzel, and potato.

Acorns, sawdust (mahogany), lupin seeds, oak-bark tan, exhausted tan and burnt sugar have also been detected as adulterants.

There are various tricks perpetrated in the coffee trade—such as converting Maracaibo coffee, by a process of sweating (by means of steam), into Java coffee, worth about six cents a pound more than Maracaibo coffee.

Old coffee is also polished and sometimes colored bluish green.

Coffee can be distinguished under the microscope from any other berry. It is composed of strong, angular, thick wall cells. A thin, tough, Japanese-paper like membrane may be detached from the berry, and is composed of spindle-shaped fibers attached to a tissue.

IS DRUG MEDICATION A SCIENCE, AND HAS IT BEEN A BLESSING OR A CURSE TO THE HUMAN FAMILY?—No. 4.

BY MRS. M. S. ORGAN, M. D.

A "healing art" to be successful in its practical application—to be in reality what its title purports—must be based upon correct premises. These premises must comprehend—

1. A correct knowledge of the nature of disease.
2. A correct knowledge of the nature of vitality.
3. A correct knowledge of the relation of remedies to disease.
4. A correct knowledge of the relation of organic to inorganic matter.
5. A correct knowledge of the *vis medicatrix naturæ.*
6. A correct knowledge of the action of remedies.
7. A correct knowledge of the relation of disease to the vital functions.
8. A correct knowledge of the conditions of cure.
9. A correct knowledge of the nature and source of remedies.

These propositions embrace all the premises of the medical profession—all the principles of the "true healing art." Each is fundamental. The 2, 3, 4, 5, and 6 we discussed in our last paper, and demonstrated that these primary principles were *not* embraced in the so-called medical science of to-day.

The first and absolute requisite to a right medical practice is a correct and well-defined knowledge of the essential nature of *disease.* In all the standard medical works of the past and present—in all the current medical literature—in the teachings of medical professors, the evidence is positive and conclusive, that the essential nature of disease is not comprehended; of this, their own confessions are sufficient.

Says Prof. Henle, in his work on "General Pathology," "The devil of medicine is disease." The context shows that he means by this, that as this notorious person called the devil, has in all ages perplexed the minds of theologians as to his source, character, etc., so in the medical world this thing called disease has ever harrassed and bewildered the minds of the profession. This confession he wrote after a careful review of all the conflicting opinions and arguments adduced by medical men from the age of Hippocrates down to the present century.

Prof. Geo. B. Wood, author of "U. S. Dispensatory" and "Medical Practice," says: "Efforts have been made to reach the elements of disease, but not very successfully, because we have not yet learned the essential nature of healthy actions and cannot therefore understand their derangements."

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Prof. Gross, of the Philadelphia Medical School, says: "We know very little of the essential nature of disease—in fact, nothing at all."

Prof. Jamison, of Edinburgh, Scotland, says: "The present practice of medicine is a reproach to the name of science, while its professors give evidence of the almost total ignorance of the *nature* and proper treatment of disease."

The old animistic idea, that disease is an entity, an occult something at enmity, or war, with the living system, still retains its hold upon the human mind; and we find this concept a basic influence in molding the theory and directing the practice of the medical profession to-day.

Prof. Payne speaks of disease as something to be "eradicated from the system;" Prof. Wood as of something that "takes root." Standard medical works describe it as "running a course," of "obtaining foothold," of "attacking the system," of "changing its seat," "of being imported," etc., etc.

Current medical journals still continue to discuss the questions, "*Where* is the seat of a fever?" "Is typhoid a blood disease or a nervous affection?"

Dr. Bigelow, of Boston, in his work, "Nature in Disease," says: "By self-limited disease, I would be understood to express one which receives laws from its own nature, and not from foreign influences, one which, after it has obtained a foothold in the system, cannot in the present state of knowledge be embodied or abridged by art." Did any exponent of science ever pen a more manifest absurdity than that something "did," or could, "receive laws from its own nature"? To do this necessarily embodies creative force and intelligence; a power possessed alone by Infinity.

If words have any meaning, if language is a vehicle by which thought is conveyed, then we have, in the quotations just given, the conclusive proof that the doctrine of disease entertained by our primeval ancestors has not been materially improved upon by the medical profession, with all of its research and accumulated lore of three thousand years. It virtually embraces the same concept as a basic principle for its therapeutics. All its theories of disease embody the tenet that disease is something antagonistic to the organic weal—a foe at war with vitality—a something to be subdued and eradicated from the system.

Aside from accidents—mechanical injuries—and mental impressions, there are but two sources of disease in the world, viz., poisons taken into the system from without, and effete or waste matter retained. In either case the result is obstruction—a clogging up of the vital machinery, or an obstacle to its normal action. These extraneous materials are the *cause* of disease, and, aside from the exceptions just enumerated, the *only* cause.

And what is this inscrutable thing, *disease*—"this devil of medicine" which has for so many centuries harrassed and bewildered the whole medical profession? In technical terms we would define it as disordered physiology, pathological action. It is simply the concentrated and intelligent effort of nature to remove obstructing material from the system and to repair damages; it is a process of purification, a vital action to cleanse the channels of circulation and restore normal condition; it is remedial labor—the very *vis medicatrix naturæ*. So far from the *vis medicatrix naturæ* and disease being forces, or entities at war with each other—as the medical profession claim—they are identically one and the same thing.

Disease is not therefore a thing or an action to be dreaded so long as the causes exist. While the causes—extraneous matter—exist, health and life are in jeopardy. The vital instinct recognizes this danger, and its friendly preservative effort to expel this obstructing material is disease—its warning voice appealing to the mental consciousness. While disease is *always* remedial action, it may prove fatal. If the obstructing material be excessive in quantity, or very deleterious in quality, or if the constitutional vigor be feeble, or if these causes be combined, the remedial effort may so exhaust the vital force that death will result. But bearing in mind what disease *is*, it becomes easy to comprehend, what at first seems paradoxical, how the *vis medicatrix* which *preserves*, and the morbid action which *destroys*, are identical; how a *conservative* effort may at the same time be *destructive*. And just here is where nature, by her appeal to the mental consciousness, asks for medical aid.

When mind-force can truly co-operate with vital force, by bringing into effective service those means which will conserve vital power, the grand desidera-

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tum of medical science will have been achieved. But giving drugs, is only adding to the causes of disease already existing, thus taxing the vital powers still more—prolonging the struggle—and enhancing the danger. Giving drugs to subdue *disease*, to eradicate it, is simply to *kill vitality*. Such, under all conditions, is the inevitable result of giving medicines—which are drugs, poisons, impurities. Drugs, of *themselves*, occasion disease. Administer drugs to a healthy individual, and disease will be the certain consequence. By taking the various medicines of the pharmacopœia, a skillful physician may induce all the diseases known to the nosology.

Thus, certain combinations of brandy, cayenne pepper, and quinine, will induce inflammatory fever; calomel, niter, and opium, typhus or typhoid fever; gamboge, scammony, and ipecac, cholera morbus; niter, antimony, and digitalis, spasmodic cholera; cod-liver oil, salts and sulphur, the scurvy; castor oil, epsom-salts, and a hundred other articles called cathartics, each taken separately, will occasion diarrhea; lobelia, ipecac, Indian hemp, and many other drugs, will induce vomiting. And what are these actual diseases but efforts of the vital powers to expel the drugs—the poisonous obstructions—vitality acting in self-defense?

All the varied functions of vitality may be arranged into two sets of processes. One transforms the elements of food into tissue and expels waste matters; this is the normal action of the system—physiology. The other expels extraneous substances and repairs damages; this is disease—pathology. How marvelously simple are all of Nature's laws when once we possess the key to her operations!

Disease being but the natural process to restore normal conditions, it necessarily follows that there is no "law of cure," as is claimed by the medical profession. The allopaths say this "law of cure" is "*contraria contrariis curantur;*" the homeopathists, that it is "*similia similibus curantur;*" the eclectics, that it consists in "sanative" medication. But science and logic both affirm that the theory of a "law of cure" is a self-evident absurdity.

All disease is but the result of violated law—the suffering or punishment ordained by nature as corrective discipline.

Nature, having established penalties as the consequence of transgression, would she stultify herself—make null her law by providing remedies to do away with penalties? In all the universe of nature there is no "law of cure." Nature has provided no remedies for violated law, but she has established a *condition* of cure; and this condition is *obedience*—a return to absolute allegiance. The very same condition applies to the transgression of physical law as to that of the mental and moral—"cease to do evil, learn to do well"—or to act obediently.

When medical men learn that *all healing power is inherent in the living system*—that disease is the abnormal, but intelligent and natural, effort of the system to remove obstructing and dangerous material—they will not strive to subdue, repress or eradicate it, but to regulate and rightly direct it; and to do this is simply to balance the circulation, and to balance the circulation we have but to regulate the temperature. Only upon this simple, undeviating condition of cure can a true "healing art" be predicated. It is the fundamental principle underlying all successful medical practice. But while the requisitions of this condition of cure seem simple, they require a thorough knowledge of anatomical, physiological, and hygienic science. The danger in all disease is to the extent that the remedial action is determined from the skin, and concentrated upon some internal organ. A true medical art is, therefore, to equalize the remedial action, so that each organ shall perform its legitimate share of the necessary work—of the extra duty imposed—and no part be injured or ruined by overwork. This scientific analysis of diseased action, and of the principles which underlie a true healing art, cannot be controverted.

In view of these demonstrable facts, how unscientific—how fearfully dangerous to life and health—is the practice of administering drugs! The vital powers are abnormally taxed to expel the already existing foe—extraneous matter—and to pour drugs into the system is to distract and divide the effort from the expulsion of the original foe to that of the recent one—drugs. It is like fighting a foe in front and rear.

Search through all the medical literature extant and you will find no rational or scientific explanation of disease or the *modus operandi* of medicine. It is

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all empiricism. *Experience* is the guide of each school, and the proof adduced as to the correctness of its theory and practice. But what *is* experience? Simply the record of what has occurred; it does not inform as to what should be. Anything and everything may be proven by experience, according to the rule by which it is interpreted.

Experience is of no value whatever unless based on some recognized law of nature and interpreted by some demonstrable rule in philosophy.

A physician may have fifty patients, and administer to them the regular prescribed remedies, and one half of them die and the other half recover.

The question in point then is, what had drugs to do with these results? What can *experience* decide in the case?

The physician of course assumes that the patients who survive do so through the aid of the medicines administered; while those who die, do so in spite of them. While one who reasons from a knowledge of the law of vitality, and of the relations of dead matter to the living system, will decide that those who die are killed by the drugs, while those who recover do so in spite of them.

Experience, interpreted by Nature's well-demonstrated laws, most emphatically corroborates the statement which we have already quoted from Dr. John Mason, that "drug medication has destroyed more life than war, famine, and pestilence combined."

LOVE OF THE BEAUTIFUL.

BY CALVIN RANKIN.

Possibly the Creator has shown his kindness to the human family in no one particular more than in that innate love of the beautiful which he has so benevolently made a part of the nature of man, and he has also proven his own love of beauty by lavishly diffusing it over all his works. We see it displayed in the majestic strength of man and in the charming grace of woman. The heavens are resplendent with the glory of thousands of shining worlds, and the bosom of the mighty deep is grandly beautiful at all times, whether calmly flowing at rest or storm-convulsed into mighty waves. Every bird that cleaves the air on pinion free, or trills its love-song to its gentle mate, every butterfly that joyously flits away its brief hour of life on gaudily painted wing, every fish that glints and glitters in its sportive gambols, every drop of crystal dew that in the morning sunshine vies in brilliancy with the most precious gems, and every flower that lades with its perfume the soft-blowing zephyr, are mute though eloquent witnesses that He who created them all made them after a divinely conceived model of beauty, and intended them to be admired and enjoyed by mankind.

It would seem that no one—especially he whose occupation compels him to pass the greater part of his time in some of our large, overcrowded cities, where the works of nature have perforce been supplanted to a great extent by those of man—could enter the majestic aisles of God's primitive church, the glorious woods, where "Heaven's breath smells wooingly," and while listening to the "speaking silence" of nature, fail to feel himself brought nearer to nature's great Organizer. Yet, encompassed as we are on all sides by objects of beauty, it is a lamentable fact that many go through life with their eyes seeled and senses dormant, and fail to extract that subtile enjoyment from surrounding objects which they are calculated to give.

How often do we hear some friend of ours lamenting the fact of his inability to travel—to "go abroad," as the phrase goes—when in every short walk he may take within a mile of home, had he the eyes to see them, there are invariably to be found objects at which to express surprise and delight, in the shape of some interesting plant, insect, or other wilding. A great many long for the fair things that are unattainable, because far off, and altogether overlook the fair things near at hand.

Let us link arms with this complaining friend of ours, and take him for a leisurely stroll along the path that starts from his own door and ends on the turnpike road a mile away, and see if we cannot point out to him some objects

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of beauty worthy of his notice. As we start out our ears are greeted with the perpetual psalm of praise that rises from the merry-throated warblers, those "little dewdrops of celestial melody." The hedges by our side are sparklingly bright with wild rose and honeysuckle, and resonant with the chirp and buzz of free and happy insects. The broad flanks of waste through which our footpath wends its quiet way have an interest as real as the most beautiful borders of trimly-kept garden paths, and being perfectly free from all stiffness and mannerism of arrangement, they have a sweet grace peculiarly their own. To the passing breeze soft flowering grasses wave and bend their heads with courtly grace, and on the banks of the stream that flows beside our path for a little way, then bends across it with a sudden curve, we come upon most brilliant masses of wild flowers; a primitive plank bridge here spans the stream, and from its vantage-ground we see the lovely water-lilies, considered by the Greeks of sufficient importance to be dedicated by them to the water nymphs, and through the clear, cool water we can watch the silver minnows as they breast the stream in shoals, like some miniature aquatic army on the charge. The willows, too, by this stream, are a never-failing mine of wonders, with their lithe and slender branches gracefully drooping o'er, as though to admire their reflected images in the shining water.

But an enumeration of all the natural objects of interest offered us in our footpath walk would be like the enumeration of the ants that carried off the contents of the granary—a story after which "finis" could never be written; yet some take this same walk day by day for years without being conscious of the lavish feast of mind-food they so carelessly pass by; for, although a love of the beautiful is inherent to some extent in all natures, yet it, like everything else, is susceptible of cultivation. The question now arises, how best can we cultivate it?

Probably one of the best methods of promoting this culture and insuring its growth is a close and critical observation of all objects that come beneath our notice, with a view to discover their merits and beauties. This will, if persisted in, after a time grow into a confirmed habit, and be resorted to without conscious effort; and the practice will open up unbounded and ever-varying sources of innocent and refining amusement. To one so accustomed the world assumes a new and brighter look. The dark side of everything will not continually persist in being presented to his view, for he is now able to discover the silver lining even in the blackest of clouds. He no longer regards a horse as a mere beast of burden, or valuable only according to its "record," or a speckled trout as something simply calculated to please his epicurean palate. A field he no longer looks upon as a mere feeding-ground for cattle, or a place for the raising of grain, but rejoices in the lights and shadows of its beautiful green and the graceful waving of its luxuriant crops. Trees he no more considers as valuable only for fuel, but, like things of life, they seem to stretch forth their arms and invite the weary traveler to repose in their cooling shade. By him the lofty mountains, the majestic waterfall, the rippling and gurgling rivulet, the fleecy clouds, the ever-surging ocean, are now considered as a few of the many *chefs-d'œuvre* of the Great Master, exhibited for his pleasure and improvement, the full meed of which he is calculated to enjoy.

Another method of cultivating a love of the beautiful is to be found in the practice of the art of drawing, the effect of which is to induce the before-mentioned habit of observation and close study of the object to be copied, and a consequent discovery of its best points. The eye is hereby opened to the infinite beauties in nature, which might otherwise have remained as a sealed book. The art of drawing should be included among the primary studies of youth, for at that tender age the mind is so readily influenced that it becomes of the utmost importance to develop and strengthen this divine love of beauty, and to fix the habit of searching for and appreciating it. By aiding their children in accomplishing this object, parents will not only confer upon them unlimited sources of present enjoyment, but may also contribute much to their future happiness and usefulness.

Again, a love of the beautiful may be acquired by the reading of well-selected books descriptive of rural scenery, many of which are to be found in the works of our well-known authors and poets. A fine description of a scene is the next best

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thing to seeing it; indeed, the description by an intelligent and practical observer is sometimes much better than seeing the object itself, for such a one might discover many points of interest that would escape the notice of the less skillful; and then these descriptions often combine, with their truth to nature, the charms of poetic imagery and a smooth and flowing versification. The moral and refining influence of such reading and such tastes is sadly needed at the present time to counteract the pernicious tendency of that flood of corrupting literature which is pouring over the length and breadth of the land, ministering to a morbid love of excitement, keeping the seed of our finer sensibilities buried in the unfruitful clay of improbable fiction, and strengthening the worst passions and propensities of our nature.

Having thus seen how much a due appreciation of the beauties of nature is calculated to add to the general happiness of man, should we not, by every legitimate means in our power, brighten and beautify our surroundings—our grounds, our homes, our own persons even? And this should be done, not for our own edification or a desire to outshine our neighbor, but for the pleasure of others. If wives desire to have their husbands consider their homes the "one dearest spot on earth," let them make those homes as bright and cheerful as in their power lies. Where peace, contentment, and beauty reign, there will a man, after his struggle with the business cares of the day, be glad to remain; for he will consider it a haven of safety and rest, a placid and calm inlet from the tumultuous and surging ocean of daily turmoil. But, on the other hand, many and many a man has been driven from his home to the more congenial atmosphere of his "club," or to the gaudy and glittering saloons of vice, and probably from there to everlasting destruction, simply because his own domain was not kept bright and cheerful enough to fill that demand for relaxation and pleasure that is a part of our very natures. Parents also should make for their children a home enlivened by the sunshine of love and the brightness of nature's gifts, and furnish them with innocent and instructive pleasures and enjoyments, or those children will soon begin to regard their home as little short of a prison house, and seek for amusement elsewhere; and then, if they fall amongst bad companions and pernicious influences, and adopt unto themselves the "broad, straight path," the weight of the blame will most surely be laid at the parents' door. Let us then strive, even in our domestic life and home surroundings, to make everything assume a cheerful and smiling aspect, and thus, in a measure, alleviate the sorrows and lighten the burdens that we are all, to a greater or less extent, called upon to bear.

Now let us briefly glance at the question of personal adornment. As regards the matter of dress, it must be regulated entirely by individual taste and judgment. The advice of Polonius to Laertes,

> "Costly thy habit as thy purse can buy,
> But not expressed in fancy; rich, not gaudy;
> For the apparel oft proclaims the man,"

is, when understandingly read, sound and logical, and no better recommendation could be given as regards the question of raiment. As far as the beautifying of the person is concerned, much difference of opinion exists, principally amongst the ladies, who are also the chief devotees of the practice. Some are apt to raise their hands and elevate their eyebrows in most majestic horror when they discover one of their less puritanical sisters resorting to the products of the chemist's art to improve or cover over some blemish of complexion, while every smile of their own may reveal a row of shining pearls—from the dentist's; others, notably those with plump and well-rounded arms, are apt to shrug their dainty shoulders at the slightest allusion to a padded sleeve; still others there are who, themselves possessors of a luxuriant capillary growth, actually shudder at the bare idea of false crimps or puffs, although they may be at the very time wearers of that nondescript article the definition of which Webster gives as "hurry, confusion." Although all this is, like the question of raiment, something that must be governed according to individual ideas, still we cannot help thinking that any means, providing they be harmless, conducive to the beautifying and improving of the human face and form, should be resorted to at least without the fear of censure. The Bible tells us we were created in God's own image; and if, from any unfortunate cause, the perfect body should happen to have become deformed, who could be found to

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find fault if we were to endeavor to conceal that deformity as much as possible? Then why, we ask—and ask seriously—should we be censured for endeavoring to beautify and improve the body which is not deformed?

The Creator has placed us upon a globe full of wonders "framed in the prodigality of nature," but he never intended that we should be debarred from altering, to a limited extent, what he has given us, and molding them to suit our own tastes and ideas. On the contrary, he expects us to do so, and to put to the best use the talents he has left in our keeping. And as he has so unmistakably demonstrated by his works his own love of the beautiful, and also endowed us to a certain extent with the same divine attribute, let us continue to cultivate and improve it, and thereby make life the more worth living by surrounding ourselves with objects pleasing to the senses as well as entertaining and instructive; for by doing so we will, when gathered unto our fathers, be the better adapted to enjoy the glorious wonders and revelations which are promised us on the other side of the gates of the Imperial City.

A. Wilford Hall:

DEAR DOCTOR,—In the issue of THE MICROCOSM for May appeared an article advancing a new theory as to the cause of earthquakes. I would like to inquire, if the phenomena are due to internal disturbances, how you account for the fact that miners working at considerable depth below the earth's surface feel nothing of the shock imparted to those above them, and why it is house-chimneys are *turned around* without disturbance or damage to buildings?

Why may not such phenomena be produced by disturbances resulting from certain electrical conditions of the earth and atmosphere? Yours truly,

Minneapolis, Minn. R. L. THURSTON.

REMARKS BY THE EDITOR.

It is reasonable to suppose, if earthquakes result, as they certainly do, from internal disturbances of the earth, that the farther down we go in a mine the less shock we would feel from such subterranean disturbance. What we feel is generally the undulatory motion of the surface of the ground, which would be greatly curtailed in a deep mine, walled in, as it is, on all sides and overhead. We confess we never heard of a house chimney being "turned around" by an earthquake, much less without disturbing the building! That earthquakes are related to electrical phenomena we have never doubted, but these take place within the earth's interior, where the disturbances evidently originate.

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EDITORS' TABLE.

THE REV. DR. STONE ON SOUND.

A. Wilford Hall, Ph. D., LL. D.:

DEAR SIR,—I intimated in a former letter that I had some difficulty in conceiving sound to be a substantial entity, and I have wished to get your ear long enough to present my difficulty. What and where is sound when no longer audible? Is it *silent* sound? If so, the world must be vastly crowded with such entities. I see many reasons for believing in the substantial theory in some directions, and am puzzled over some other things that I cannot adjust to the theory, such as the above. I greatly desire a solid foundation under me, and not one to be shattered by logic. Be patient with me. I am a rather slow scholar, but a sincere seeker for truth. Yours truly,

Omaha, Neb., Sept. 1, 1885. M. STONE.

Dr. Stone is eminently right in desiring "a solid foundation" on which to rest his faith, both in science and religion. Nothing, either in science, religion or philosophy, we can conscientiously assure him, is calculated to furnish such solidity for the basis of our faith and hope as the rational and invulnerable principles of Substantialism. Had the doctor studied those principles, as set forth from month to month in THE MICROCOSM, and with that care which he will no doubt give to them in the future, he would have been able to answer his difficulties, as to what becomes of sound after it ceases to be heard, not only to his own satisfaction, but would have been ready to enlighten others less posted on the subject than himself, and thus be adding, as he should, new converts to the Substantial Philosophy.

We have repeatedly had occasion to state, when explaining the essential principles of Substantialism, that every manifestation of force in nature emanates, in its peculiar form, from the universal fountain of force, and that as soon as such form of force, whether light, heat, sound, electricity, or any other, has served the purpose of its manifestation, it falls back into the force-element from whence it emanated and remains there according to the true law of the conservation of force without one atom of its substantial entity being annihilated or ceasing to exist.

The law of the conservation of force, of which modern science treats so learnedly, can only be true, or have any intelligible meaning on the principles of the Substantial Philosophy. Indeed, the notion that the physical forces are but various modes of motion, and not objective entities, destroys the very idea of the conservation of force, for *motion* cannot in the nature of things be entitative, being but the designation given to the phenomenon of a body in changing place. Hence *motion* cannot be conserved because it necessarily ceases to exist as soon as the moving body comes to rest, *just as certainly as that motion had no existence before the quiescent body had begun to move.*

Thus, according to the modern scientific notion of force, as a mere "mode of motion" of some material particles, such as those of air, in the case of sound, or those of ether, in the case of light and heat, the whole theory turns out to be a flat contradiction of the very possibility of the conservation of force. We distinctly made this point and emphasized it in the opening of the second chapter of the "Problem of Human Life," and we have seen no occasion to modify our views except to add to their truth and importance by additional considerations, each one of which has tended to confirm the underlying principles of the Substantial Philosophy.

How self-evident, then, is the conclusion of Dr. Stone, if Substantialism be true, and if all force is real substance, and if no force ceases to exist when it has served the purpose of its manifestation, that "the world must be vastly crowded with such entities!" And still there seems to be abundant room for all the forces to keep up their manifestations, since it is but a vague and mistaken idea of the Doctor, under the false teaching of the schools, that a particle of new force is ever created or destroyed. According to the Substantial Philosophy, the universe is filled with this force-element, as the universal fountain from which every conceivable form or manifestation of force emanates, and to which it returns after it has served its use in the divine economy of nature. But sound, after its appropriate use, does not return to this fountain in the form of sound, but as a portion of this universal reservoir, so to speak, of crude force. This fountain, according to Substantialism, is in direct connection and correlation with the supreme and intelligent force of the universe—God himself—from whom the force-element derives its power to emanate in different channels of manifestation, such as light, heat, sound, gravity, electricity, magnetism, cohesion, etc.

Thus, in this fountain of crude force the only possibility of the law of conservation is made reasonable; and within it the only possible convertibility of the forces can take place. All force, after it has served the purpose of its manifestation, loses its identity but not its entity in this correlated fountain, just as a drop of water loses its identity when it falls into the ocean. God is correlated to this force-element, because he uses it in its various forms as his agents and instruments through which the operations of nature are carried on; and this force-element is correlated to God because from him alone can it receive its power of manifestation, and from him alone come the laws and principles upon which it goes forth in various forms to accomplish the works designed by infinite wisdom. Without an intelligent source from which a system of natural laws could emanate, the forces of nature could not act at all, much less harmoniously, in accomplishing their various missions. Thus, the Substantial Philosophy, by consistently explaining the forces as real entities or objective existences, and by beautifully showing how it is possible for them to be conserved, correlated with, and converted into each other, and then how it is possible for the different forms of force to operate under harmonious laws by means of their correlation with the intelligent source and primordial fountain from which emanate all force and all created things, may safely defy the cavils of all objectors, and successfully undertake to give a true and rational solution of every scientific problem that can be presented.

The schools, by their confused and irrational jumbling of the forces and modes of motion, as equivalent terms and phrases, have left science in a deplorable state of unintelligibility. They talk of the conservation of force, yet by making out force to be mere *motion* they destroy all possibility of conserving it. They talk of the convertibility and correlation of force, yet they have nothing but motion to be converted or correlated, and as motion will not persist, not being an entity, nothing can be done with it. It took the Substantial Philosophy in the closing decades of the nineteenth century to harmonize these conflicting elements of the scientific theories as set forth in the text-books, which by their contradictory teaching tear down with one hand as fast as they build up with the other. This very solution of the problem propounded by Dr. Stone, and by which the correlation, conservation, and convertibility of the forces, as objective entities, can be made harmonious and consistent, is enough to immortalize any system of philosophy if it had nothing more to commend it. How much more should the Substantial Philosophy be received with open doors by every college and university in this land, solving, as it triumphantly does, every problem of science and harmoniously reconciling nature's most intricate phenomena.

Such a philosophy, as here set forth and explained, can be understood by a child, and its adherents need not to borrow a philosophical microscope to see and distinguish its salient points. The newest beginner in its study can confound the veteran professor in his confused attempts to solve the simplest problems, according to the teachings

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of current science; and one such tyro in the Substantial Philosophy can cope successfully with half a dozen college graduates at one time, each raining difficulties upon him as fast as he can talk, as did a young man recently from this office.

If Dr. Stone is an unbiased seeker after scientific light, as we believe him to be, let him at once grasp this solution and explanation by careful study, and then acknowledge the same in THE MICROCOSM as a triumph which could alone be achieved by the Substantial Philosophy.

HONEST SKEPTICISM AND SUBSTANTIALISM.

Some minds are so constituted that they are capable of accepting and believing the supernatural facts and teachings of the Christian Religion without a doubt, and without any aid from the collateral evidences to be drawn from the analogies of nature, or the demonstrations of science and philosophy. Other minds, equally honest and equally cultivated, cannot accept or believe these alleged supernatural facts which took place so many centuries ago, and which have been handed down to us, as they claim, through so much mutilation of history, revolution of empire, and church dissension. They urge, if these supernatural facts did really occur at that far distant age, and were really necessary at that time to confirm the Christian Religion at its start, why should we not at this distant day have something equally confirmatory to aid the mind in the midst of honest doubts?

In answer to such frank avowment of difficulties on the part of the skeptic, we say, that although we have not now the same form of miraculous interposition that the early adherents of Christianity possessed, we have something which, when added to the overwhelming probability in favor of the truth of those miracles as recorded, gives us a decided advantage over the people of eighteen centuries ago. They had only supernatural proof of the truth of religion addressed to their uncultivated senses, while their minds were utterly benighted upon the marvelous teachings of nature herself which would, correctly understood, have more than doubly assured them that the alleged miracles were what they purported to be. We now have what they lacked, and after eighteen hundred years have gone by can point with full assurance of scientific faith to nature's own confirmation, through innumerable channels of facts and analogies, to evidences of immortality for man vastly more satisfactory to a logical and cultivated mind than would be any number of simple miracles merely addressed to the unaided senses.

It remained for the Substantial Philosophy, more than eighteen centuries after miracles had ceased to confirm the mission of Christ and the apostles, to point out to the cultivated intellects of the nineteenth century the semi-miracles of science which had been kept in store in Nature's secret archives against this time of need, when skepticism should so pervade the honest minds of advanced thinkers as to bar them from all appreciation of, or even belief in, events which really occurred eighteen hundred years ago.

The invisible and intangible entities and verities all around us in nature—as truly substantial and real as was the material wine made out of water, at Cana of Galilee, or as were the material loaves and fishes multiplied indefinitely—have been hidden from the world in God's providence during these centuries, to be made known when the scientific fullness of time had come to demand them. It was at this time that Substantialism stepped in and unfolded another gospel.

We do not believe it to be sacrilegious or profane assumption on our part to proclaim the truth here implied in regard to the important mission of this new philosophy to mankind at this overwhelming juncture of materialism. Until its advent, there was no explanation possible to be drawn from the discoveries of science, as universally taught in the schools, with which to meet the arguments of the defiant materialists, by which they demonstrated the soul to be nothing but molecular motion and thus proved death but an eternal and unconscious sleep. With every Christian college in the land committed irrevocably to the molecular vibration of material bodies as constituting all we know of *force*, no minister of religion thus educated could stand for one instant in the presence of a disciple of Haeckel or Huxley with his sweeping deduction from these very Christian teachings, that the soul, or mind, or spirit, or life, as the *force* which moves and controls our material bodies, was anything more than mere phenomena of matter, analogous to those exhibited as the results of gravity, heat, magnetism, electricity, etc. Clearly, urge these materialists, if all natural phenomena constitute nothing but the motion of material molecules, which motion necessarily ceases to exist as soon as the molecules come to rest, then who dare say that life-phenomena or mind-phenomena, so analogous to those of electricity, heat, etc., are not the mere motion of the brain and nerve molecules? No answer has ever been made or can be made by any Christian philosopher to this fatal argument of materialism against Christianity, according to all the teachings of scholasticism for more than eighteen hundred years. And it was not till the mission of Substantialism was proclaimed in the closing decades of the Nineteenth Century that the fetters were stricken from the hands of the Christian clergy and they were enabled successfully to wield the "sword of the Spirit which is the word of God."

Is it too strong, then, to liken this scientific revelation, from the hitherto sealed book of nature, to a reign of semi-miracles, which are but the operations of the laws of God not before understood? The Substantial Philosophy, let it then be proclaimed to all men, has, in a most important sense, again brought life and immortality to light by the discovery and announcement of great truths from the volume of nature which has been sealed from the eyes of men since the world began, and without the aid of which materialistic atheism had absolute control of the world.

We challenge any clergyman on earth, however learned he may be, to make any sort of reply to this materialistic argument against immortality based on the universally admitted doctrine of *force as but the motion of material molecules*. The Rev. Joseph Cook, the profoundest thinker on this very question living, was utterly confounded and helpless in attempting to reply to this materialistic argument against the soul as an entity. (See the "Problem of Human Life," page 71.) It was only by the discoveries which form the basis of the Substantial Philosophy that any escape from the clutches of materialism is possible. With the fear of God alone before our eyes, we unhesitatingly take the responsibility of uttering these daring words. We solemnly assert that without the scientific revelations brought to light by the Substantial Philosophy and announced through the pages of this magazine no man can defend the Christian religion for one moment from the assaults of any intelligent materialist. This new philosophy alone has proved itself equal to the task. Let it therefore be proclaimed from the housetops and carried to the uttermost parts of the earth that substantial aid has at last come to the beleaguered Christian Church.

THE NEW UNIVERSITY.

The proposal to found and build the University of Substantialism at some eligible location, meets with nothing but approval from the friends of the Substantial Philosophy throughout the country. If their enthusiastic letters were bank-checks, even of small denomination, the new university would be endowed liberally with funds in a very short time. But it is with Substantialism as it was with Christianity, that at the start "not many *mighty*" in this world's goods are called. It is those who have a greater interest in the unadulterated truth of a system of doctrine, whether scientific, philosophical, or religious, than in its popularity, who are attracted to the principles of Substantialism. Hence the rich, as a rule, can see nothing worthy of their

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serious consideration that does not emanate from the respectable colleges and universities which have been richly endowed by wealthy millionaires, and which already exert a commanding influence among the noble and aristocratic of this world. Such has always been the case in every new movement or discovery in science, however much it involved the welfare of mankind. Hence the friends of Substantialism expect the endowment of an institution, based on such new and revolutionary discoveries in science and philosophy, to move somewhat slow at the start. We expect aid only from those whose convictions in favor of great truths and their permanent good to coming generations rise above those which bind human nature to the claims of sordid avarice and established respectability. But let no friend of the cause despair or even lose courage for a moment in the final and glorious triumph of this Substantial crusade against false science. Men of great souls have the work in hand, and no earthly power or influence can prevent its ultimate success, and that, too, in the near future.

PHOTOGRAPHING SOUND-WAVES.

We announced last month an article by the editor on the above-named subject to appear in this number. The article was kept back in waiting for alleged new information on the subject as the result of experiments made in Germany, till it was too late for the present number. It will therefore appear in the next issue with all that is known on the subject up to date.

MICROCOSMIC DEBRIS.

—A package of bonds was recently received at the Treasury for redémption, from which every number had been cut out. They came from Chicago. The Treasury officers were at the time puzzled to know what particular species of villainy had been perpetrated or attempted, which could have given rise to such a mysterious procedure. The explanation came by letter a day or two later. The owner of the bonds was in New York and wrote to his wife in Chicago, asking her to send him the numbers of his bonds and send the bonds themselves to the Treasury. The faithful creature complied literally by cutting out the numbers from both bonds and coupons.

—A correspondent of the London *Times* says that notwithstanding the cholera-stricken condition of Spain, the next few months will see several thousand packages of fruit consigned from that country to the United Kingdom every week, notably nuts from Barcelona, lemons from Valencia, and grapes from Almeria, these last being packed in barrels filled up with cork dust. Thousands of packages of Spanish fruits and nuts will also reach our ports during the next few months, and there is no way of discovering how many cholera germs may come here in this manner.

—A bee raiser of Port Jervis has discovered toads making great inroads upon the population of his hives. During the dry weather a few weeks ago he examined the hives in the morning and found a toad at the entrance of each of several boxes. The toads were apparently asleep, but as soon as a bee or two appeared would shoot out their tongues and convey the honey gatherers into their capacious mouths. The toads were killed and dissected, and many bees found in their stomachs. The bee raiser has elevated the hives.

—The attempts to introduce the American brook trout into English waters have not been attended with success. During the last ten or twelve years thousands of fry have at various times been turned into different waters, but in no instance has the fish really been established. Occasionally a specimen is taken here and there, but as years go by there is no perceptible increase, while in some waters, which were liberally stocked, they have disappeared altogether.

—The German Military Pigeon Department, now employing 4000 birds in the different fortresses, is about to be enlarged. The pigeons are taught not to alight on the dove coet, but to push against the wire wicket, which admits them and sounds an alarm. The messages, carried in quils, contain, in micro-photographic reduction, about eight pages (octave) of writing, which by the hydro-oxygen gas microscope are reproduced in natural size.

—The Bible contains 3,566,389 letters, 810,697 words, 31,173 verses, 1184 chapters and 66 books. The twenty-seventh chapter of Ezra contains the alphabet. The nineteenth chapter of the Second Book of Kings and the thirty-seventh chapter of Isaiah are alike. The first man recorded as being buried in a coffin was Joseph—fiftieth chapter of Genesis, twenty-sixth verse.

—According to a temperance orator at Winthrop, Me., of twenty-seven men who banded themselves together to oppose the Washingtonian temperance movement, eleven died of the abuse of liquor, and four through accidents caused by it; seven were lost at sea, and an eighth sailed and never was heard from; two killed themselves, and two were hanged at the South.

—A man went into the country for a walk. He carried his overcoat on his arm, but finding it burdensome, hung it on a fence. Taking a card from his pocket, he wrote: "Do not touch this coat; infected with small-pox." He came back two hours later and found the card, upon which was written, underneath his warning: "Thanks for the coat; I've had the small-pox."

—The depression of the coal trade in South Wales is so serious that over 40,000 men are affected by it. The national industries in England are at a low ebb, and the lessened output of coal, which arose through a decreased activity in manufacture, is taken as special evidence of an undesirable and very grave condition.

—Cholera failed to strike a single one of the 4000 women employed in the national tobacco factory at Valencia, Spain, though the disease raged violently in that city, and the *Medical World* recalls that tobacco workers were also noticed to enjoy exemption from an attack during an epidemic at Amsterdam.

—For the opening season a dance teacher has devised what he calls the dervish. It consists of a few slow, measured, stately revolutions in ordinary waltz time, followed by a dozen rapid waltz ones, done so suddenly that the couples look like wild dervishes of the desert, who ought to howl as well as whirl.

—Starfish have appeared on the oyster grounds about Norwalk, Conn., in great numbers, and the owners of deep-water beds in that locality are greatly alarmed for the future of the crop. One cultivator took a hundred bushels of these destructive pests from his grounds in a single day recently.

—The women engaged in the production of cheap Bibles are the worst paid in London. If the people who are engaged in folding and binding cheap Bibles to send to the heathen are half starved in order to do it, we are likely to make more heathens at home than we convert abroad.

—An association for the protection of plants has been started at Geneva. The object is to preserve Alpine rarities from the extermination with which the annually increasing number of botanists, mercenary collectors, and mountaineering tourists generally is said to menace them.

—At the instance of the German Minister of War, who desires to protect carrier pigeons, the public foresters have received orders to keep the sharpest possible lookout for birds of prey, and to exterminate them as far as possible.

—Edwin Booth and his daughter have just placed in the Episcopal church at Middletown, R. I., a window in memory of the actor's deceased wife. It is 13 by 9 feet, and is of admirable design and color.

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—It seems that Prof. Huxley's physicians sent him to Italy in the hope of curing his chronic insomnia. They might have kept him at home and recommended as a remedy the reading of his own books.

—The present year has been a very disastrous one to the great St. Louis estates, and the losses sustained by leading families of the city by reason of the shrinkage of certain securities is $5,000,000.

—Georgetown, Col., has had to import a new corps of female teachers for its public schools, only one of last year's "school-ma'ams" remaining. The rest have all married or are engaged.

—The legatees under the will of the late Sir Moses Montefiore number nearly 200, ranging from Earl Shaftesbury to a cowherd, and they receive sums varying from $500 to $25.

—A Nevada court has held that a man with $5 in his pocket and a week's board paid ahead is a "capitalist" within the meaning of the law. Alas! how few capitalists there are.

—Miss Leona Call has filled a Greek professorship in the Iowa State University so acceptably since her brother's death, that it is likely she will be formally elected his successor.

—Census returns from various parts of Massachusetts show a considerable reduction in population as compared with the census of 1875.

—Iowa has had five new public libraries organized within a year, showing the interest in libraries which is growing among all Western States.

—The *Prairie Dog* is the name of a new paper at Grand Island, Neb. Each issue will probably be full of biting paragraphs.

—The Chinese in New York have published an almanac. It looks like a fire-cracker label, and is as large as a barn door.

—Prince Ludwig Ferdinand of Bavaria, son-in-law of Queen Isabella of Spain, is practicing medicine at Nymphenburg.

—The weight of 1,000,000 dollar bills in greenbacks is within a fraction of 2841 pounds.

Dust, Fogs and Clouds.

Mr. John Aitken has been experimenting on the artificial production of fogs and clouds, and an abstract of his paper before the Royal Edinburgh Society is given in *Nature*. The conclusions he has arrived at are these: 1. That whenever water vapor condenses in the atmosphere it always does so on some solid nucleus; 2. That dust-particles in the air form the nuclei on which the vapor condenses; 3. That if there was no dust there would be no fogs, no clouds, no mist, and probably no rain, and that the supersaturated air would convert every object on the surface of the earth into a condenser on which it would deposit; 4. Our breath when it becomes visible on a cold morning, and every puff of steam as it escapes into the air, show the impure and dusty condition of our atmosphere.

It is not the dust motes revealed by a beam of sunlight when shining into a darkened room that form the nuclei of fog and cloud-particles, since these may be entirely removed by heat, and yet the air remain active as a cloud-producer. The heat would seem to break up the larger motes which reflect the light into smaller and invisible ones. By atmospheric dust is meant these infinitesimally small and invisible particles. The larger motes which reflect the light are no doubt active nuclei, but their number is too small to have any important effect. All forms of combustion produce large quantities of this dust, and Mr. Aitken does not therefore anticipate any diminution of the fogs of large towns like London, by improved fire-grates and the like. They would be whiter and purer if there was no smoke, but Mr. Aitken is not altogether certain that the removal of smoke and sulphur would not cause greater evils than their presence.

Frog Vitality.

Experiments made in the past have generally demonstrated what is really the common-sense view that the frog cannot live for any protracted period without air. Yet there cannot be the least doubt of frogs having been found alive under the most astonishing circumstances. In the center of rocks, generally sandstone, and in the hearts of trees, they have frequently been discovered. Ambrose Pare, chief surgeon to Henry III. of France, relates a fact of which he was an eye-witness. At his seat near the village of Meudon he was overlooking a quarryman whom he had employed to break some hard and large stones. In the middle of one they discovered a "huge toad," full of life, although there was no visible aperture by which it could get through. On May 21, 1793, a mason named George Wilson, who was engaged in building a stone wall, came across a toad which, out of sheer wantonness, he immured in the wall. Sixteen years afterward, in 1809, it was found still alive. At Windsor, in 1790, a live frog was dug up from a depth of nine feet below the surface. At Castleton, in 1779, many frogs were found from five to six feet below the surface, apparently dead, but when exposed to the air they soon showed signs of animation and became active and healthy. In 1788 some laborers in digging a well some twenty-five to thirty feet in depth threw out what appeared to be stones covered with earth. These, however, proved to be frogs, and were so numerous that many of them were cut through with spades. Being exposed to the air they soon revived, but could not survive the direct rays of the sun. A writer who witnessed this discovery considers they must have been covered up "many hundreds of years."

Early in 1862 a man in Tyr Nicholas Colliery, Cwm Tylery, near Newport, found in the nine-inch bed of coal a live frog. The hole it was found in was not more than three and a half inches in diameter. There was a slight hollow over the coal where it was found, and the frog when released commenced moving about, but seemed larger and more lively next day. This was 200 yards below the surface. In 1731 a toad was found in the heart of an old oak near Nantz, without any visible entrance to its habitation. Near Caen, in an elm at about four feet above the earth and exactly in the center of the tree, a live toad of middle size, but lean, was discovered. When an opening was made it "scuttled away hastily." This tree is also said to have been firm and sound. Some twenty years ago, in course of the excavations that were made in connection with the Hartlepool waterworks, the workmen found a toad imbedded in a block of magnesian limestone at a depth of twenty-five feet from the surface. The toad's eye shone with unusual brilliancy, and it was full of vivacity on its liberation. The creature continued for some time in the possession of Mr. Spence Horner, the President of the Natural History Society, and for a long period was in as lively a state as when found. Similar instances might be quoted as having occurred at Selksworth, near Sunderland, at Kilmarnock, at some quarries near Cheltenham, and in other places. Only three years ago there was published a well-authenticated instance of a frog having been discovered in the root of an oak tree—at least two hundred years old—near Balham, Surrey.

A New Application of Electricity.

Major David Porter Heap, Engineer-Secretary of the Light-House Board, has perfected a new arrangement of the electric light in its application to light-houses which promises to be of great service in the time of fogs. This discovery of his he proposes to give to the government.

He early saw grave objections to the use of the arc light, the principal one being that it penetrated fog but little more than other and feebler lights now in use. His conclusions in this respect have recently been verified by the experiments at

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South Foreland, England, made by the Trinity House, where it was shown that a 15,000 candle-power electric light penetrated fog very little further than an oil or gaslight of 2500 candle-power. The reason of this is that the arc light is mainly composed of rays toward the violet end of the spectrum, while oil light is composed of rays toward the red end, and these latter rays are the most fog-penetrating.

If any one will look at an arc light through a piece of red glass he will no longer see any arc, but only the hot carbons glowing like two red-hot tapers, and the light will be very much diminished. The sun through a fog looks red, thus showing that only the red rays can struggle through. Now what is needed most for light-house purposes is a very powerful light, rich in red and yellow rays. This latter condition is fulfilled in the incandescent lamp, but unfortunately those so far constructed are of but small candle-power, the brightest so far made not much exceeding 150 candles.

Major Heap believes that this power can be greatly increased, and as a step to this end has invented, and intends to try experimentally, a lamp constructed as follows:

The size of the flame of a third-order oil light is a cylinder $1\frac{3}{4}$ inches high and $1\frac{5}{8}$ inches in diameter, and the lens containing this light is constructed to give the best results from this sized flame. Now suppose two disks of carbon, each $1\frac{5}{8}$ inches in diameter, one placed $1\frac{3}{4}$ inches above the other and connected around their circumference by twenty-four carbon filaments 1-5 of an inch apart, and the whole inclosed in an air-tight glass bulb, through which pass wires from each carbon disk to the source of electricity.

If it be assumed that each filament can give 15-candle power, which is not an extravagant estimate, the twenty-four filaments should give 360-candle power, and this would raise the third-order lenses to nearly an equality to the present first-order, which contain lamps of 420-candle power. Should experiment show that the above assumptions are correct, a larger incandescent lamp could be made to be used in a first-order lens, which calculations show should exceed 1000-candle power.

The incandescent lamp possesses various other advantages for light-house illumination, which it is unnecessary to touch upon until its power can be sufficiently raised to make it an efficient light.

Ingenious Arrangements for Measuring Sunshine.

When the British Association first met at Birmingham, in 1839, the famous French astronomer, Arago, was present. The weather was cloudy, and when at the end of the meeting it cleared he formally took off his hat to the sun, as he declared he had begun to fear that he had come to a land where that luminary would never show his face again. This was, of course, only a joke of Arago's, but in the course of this last spring two Russian officers were visiting Kew Observatory, and on being shown the apparatus for sunshine registration and for solar photography, these gentlemen expressed their honest surprise that such researches should be attempted, as it was a well-known fact that the sun never shone in England.

It is, however, in that country that the subject of sunshine registration has received most notice and been most successfully studied. It is now nearly half a century ago that a plan for recording sunlight photographically and continuously throughout the day was submitted to the Royal Cornwall Polytechnic Society by Mr. T. Jordan, while the proposal of the late Mr. J. F. Campbell, of Islay, for registering sun heat dates from the year 1853, and was described in the report of the British Meteorological Society for 1857. It is this latter process which has met with general acceptance, as it entails so little trouble. The record consists in the amount of charring an organic substance, such as wood or paper, undergoes from the solar action, and which is, of course, perceptible to the eye. The photographic process, on the other hand, always entails a certain amount of development of chemical treatment, even though of a very simple nature, to render the solar trace visible.

The least reflection will show the reader that in order to obtain a continuous record of sunshine throughout a cloudless day some contrivance is necessary to follow, so to speak, the sun in his course. This was formerly done by means of an instrument termed a heliostat, by which the sun's rays, whatever be his altitude, were always reflected along the same direction throughout the day. This entailed the employment of clockwork to drive the reflecting mirror, and a similar power was also required to move the paper past the slit through which the sun's rays were admitted.

Mr. Campbell hit on the very ingenious notion of employing a glass sphere as a lens, so that as the sun traveled round the ball its image should travel round on the opposite side. The first instrument consisted of a ball placed inside a mahogany bowl, turned to the exact focal length of the ball. Such a bowl was capable of receiving a record for six months, from one solstice to the next. It was, however, impossible to distinguish the records of consecutive days from each other, and accordingly a plan had to be devised by which the record could be obtained on a slip of cardboard or other material, which could be replaced daily.

A very ingenious frame was finally devised by Prof. Stokes, of Cambridge, provided with grooves, into which the cards are slipped. The grooves are in three pairs—for the summer, the winter, and the equinoxes respectively, and the cards have hour lines printed on them. The instrument can thus be used as a sun dial, for the spot where the solar image appears—where the burning is taking place—of course, corresponds to the spot where the shadow of the gnomon would cut the scale of the dial. These instruments were first brought out at the end of 1879, and by this time there are nearly fifty of them in various parts of the United Kingdom.

Answers to Correspondents.

H. A. WAY.—We cannot give discount on single copy of any of our books. If you wish a copy of "The Problem of Human Life," consult our advertising pages, and you will there see how to obtain it free.

CHARLES DU BOIS.—We are pleased that you think so highly of our magazine, notwithstanding the objection you have to the article you mention. We endeavor to select articles that will meet with the approbation of our readers, and if occasionally there should be some not in conformity with individual ideas, it only goes to prove that the same medicine has a different effect on different patients.

MRS. G. HOATLING.—Yes, Dr. Mott's articles will be continued right along—at least until the principal things that "we eat and drink" have been exhausted.

DR. C. SUTHERLAND.—In answer to your query, and also in answer to several others who have written us on the subject, we will say the advertisement will not again appear, and in future no wines or liquors will be advertised in this magazine.

THE OCTOBER NUMBER.

OF

THE MICROCOSM

Contained the following articles:

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The Microcosm.

December, 1885.

FORCE IN ITS VARIOUS ASPECTS.

BY REV. F. HAMLIN, D. D.

The philosophy of the schools to-day is to the effect that, "in the present state of science it is impossible to know whether forces are merely properties of matter or whether they are forms of matter itself, existing in an exceedingly minute, subtile condition without weight and scattered throughout the universe;" while the general opinion is in the direction of the "property or quality" theory. From these apparently harmless seeds has sprung up a rank growth of bold materialism which threatens to choke the fragrant flowers of orthodoxy. For the logical conclusion must be that if sound, light, heat, magnetism, etc., are only results of molecular vibration of material particles, then all other unseen agencies and forces of the world, including life, mind and soul, may be no more substantial than these, and that, with cessation of "molecular vibration" in the physical at death, the soul will cease to be. Thus, we perceive that the teachings of science to-day are in deadly antagonism to the Bible idea of immortality. Being well persuaded that the establishment of the substantial nature of force would be fatal to these materialistic tendencies by proving that, in the field of the unseen, real entities exist, let us calmly look this question in the face.

I. *Is force a quality, or an extra active property acquired by one substance or thing from another? We hold that* force is *not* a quality or property, for we can, and therefore must distinguish between properties and forces. Men speak of the "inherent forces of nature," of "blind, insensate forces," of "physical forces." But when we consider that nature is seemingly composed of matter, *i. e.*, the material, and that matter, *per se*, is *inert*, to say that force or energy inheres in it, is a clear contradiction of terms. And equally absurd is it to predicate power to "see, hear, or move" of that which is "blind and insensate." With equal vagueness men talk of "*active force;*" as if force could be *passive*, or unenergetic. Such a conception is as absurd as it is weak.

Gravity, when holding a stone still upon the earth, is exerting the same energy precisely as when drawing the stone through the air at the velocity of a cannon ball. Cohesive force is just as energetic in holding the particles of a diamond together, as when first bringing them together in the formation of the carbon crystal. Surely the very nomenclature of so-called science sometimes betrays its truthlessness. The fact is that *properties* of bodies do not in any manner or degree exert mechanical force or aid in overcoming the inertia of said bodies; *their whole office is to permit a certain kind of motion or quality of effect through the application of adequate mechanical force.* Properties are utterly passive! As well insist that the steam-engine and boiler have the quality of acting and performing their accustomed work, by virtue of their organization, or peculiar mechanical structure, and that the heat and steam, instead of being substantial entities, are the mere "properties" of matter. *Indeed no property can become a force* in any sense, save as such power to act is added extraneously. For example, the property of incompressibility in water becomes elastic, in the form of steam, only when the extraneous substantial force of heat is imparted to the water. *And to mix up properties and forces into the same class is the greatest help we can render infidelity.* If force or energy is only a property of matter, then is it dependent upon the continuity of matter for its continued existence, and then infidelity may

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sneeringly reply to your claim that the soul is a substantial entity, by saying, "It is only a force or property of matter," and therefore will cease to exist when the body dies. But if force is a substance, as in the case of the water that turns the wheel or the steam which moves the piston, then substantial contact must be essential to motion. Hence the magnetic current which moves the iron bar must be substantial, since it accomplishes similar corporeal results to that of steam; and in this way alone can the soul be proved by science to be a substantial entity.

From the foregoing it appears that properties and forces are no more identical than is the elasticity of the leather band on the wheel identical with the force from the engine-room which drives that wheel. Force, being an *incorporeal substance* (as we shall soon show), is well illustrated by rays of magnetism which dart off from a magnet's poles, through sheets of glass, and lift ponderable bars of iron. Such active energy is an objective entity, and does not come under the laws and properties of matter at all. Like all other entities, it is indestructible; we cannot alter its quantity, nor can we originate or destroy even the smallest quantity of it. We may *hide*, or *discover* it, but cannot make or annihilate it. Giving the horse rein and whip does not create him, nor does hiding him behind or within stable walls consign him to nonentity! Force is a subtile, imponderable, immaterial entity, and not a property acquired by one substance from another.

II. *But it is claimed that force never exists by itself as an individual object or thing; and therefore cannot be more than a property of matter, like fusibility, transparency, etc.*

1. *It is here assumed that whatever does not (sometimes at least) visibly exist by itself is not a substance.* What argument then could be made if the skeptic applies this proposition to the question of soul entity? He would say, "The soul, so far as science can determine, never exists by itself, but only as an extra, active property of matter; therefore the soul is not an entity."

The true answer is, *Force is substantial, it is a real thing!* I know we are told that force is "a mode of molecular vibration;" but how this molecular vibration of any kind or of any mode can take place in inert matter, before a force interposes to produce it, we are not told! I suppose the effect produces its own cause!!! There can be no other conclusion, and how chimerical and absurd is this! What, then, is force? That which pulls the plum downward? What is magnetism, which, though apparently distant from the iron, draws it to the poles of the magnet? These and all other forces must be substantial, for the idea of an inert body being moved by nothing is inconceivable! There must be actual contact of some substantial body, some real thing, as the means or cause of motion.

And that *real thing* which causes the motion of a body forward, as in the case of an armature, cannot be the *vibration* of the molecules of the medium which fills the space between the two bodies thus separated. Mere *vibration* of a medium cannot pull or push a body at all. At most such vibration could only cause the body to *tremble.* As well talk of pulling a balloon to the earth by causing an atmospheric tremor, or of pulling a boat to the shore by causing a tremor among the molecules of the water! Indeed, modern science, with its prodigious disclosures, actually proposes to pull the boat through the water alone by the molecular tremor of the *shore,* and that, too, without any force to make the shore vibrate. A magnet, Sir William Thomson tells us, will pull a bar of iron from a distance through a perfect vacuum (or without any intervening medium) alone by the molecular tremor of the magnet and without any force to make the magnet tremble! Why not, then, pull a steamship to its mooring without a rope, by simply making the wharf tremble, or by letting it tremble without any cause? Nonsense!

Man cannot move a piece of material iron without substantial contact with it, and no more can the magnet attract and lift steel or iron, or two magnets repel each other, without a substantial body projecting itself from one to the other. The connecting link may be invisible, but a house is not a "mere property," and is no less substantial because a blind man cannot see it. So of gravitation; the falling apple must have behind its motion a substantial cause. The opposite view is unreasonable.

And further: 2. *Force does sometimes exist by itself, has evidently an active*

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property, and may have passive properties which, because of the intangible and tenuous nature of the possessor, cannot be discovered by the human eye.

Magnetic force being a substance, as before shown, surely exists by itself as an entity, at least while passing from the magnet to the iron, and as such must be an individual object or thing, and not simply a property. If the hammer-claw which draws the nail is a real thing, and could not do that work unless it were something more than a "property," then no less is any other agent a real thing which draws or lifts a nail, and magnetism is that real objective thing. The hammer is as really "a mode of molecular vibration" as is magnetism, and the particles of cohering matter in the hammer-claw are no more real than the substantial rays of magnetic force; for each produces corporeal effects upon the inert. This same evidence of separate substantial existence is revealed in "centrifugal force;" only the *real* could carry the mud from the rapidly revolving wagon wheels. That which produces a tangent movement of matter must be *real, distinct,* for that movement is an effect and *a special effect.* True, the material is essential to force manifestations, because of its intangibility or invisibility, but the method and means of manifestation must not be confounded with the thing revealed! To declare all things properties, and therefore unsubstantial, which do not always reveal themselves independently of the material, is to plunge into materialism at a single leap, while to establish the substantial nature of force by appeal to its corporeal effects, is at once to render possible scientific demonstration of soul entity; "if substance, then indestructible; then personal immortality can reasonably be established, since a substance involving thought, feeling, sensation, and self-consciousness, cannot as such cease to exist."

Nor should we forget in this study of the nature of force, that 3. *While all force is substantial, it does not necessarily follow that all substance is "mere force."* The soul is not mere force because substantial. The soap bubble and the oak tree are both material, but you may not measure the lifetime or the mission of the latter, by the relative uselessness and perishability of the former. Even so by the brevity of independent manifestation or endurance of any mere force, we may not measure the lifetime of a soul. Charcoal is one thing, but a diamond is another. No substantialist claims or admits that the soul is a "mere force." It is that and more. The word substance is with us a generic term, embracing not only all material objects, or entities of the universe, but all immaterial entities whether they be on the one hand vital, mental or spiritual, or on the other the physical, unintelligent force elements of nature, which influence sensuous observation, or otherwise manifest themselves in material and physical phenomena, so as to come within the range of our reasoning powers. "No pent-up Utica is ours."

And now one thought more: 4. *While the forces of the world are different in kind and character, they are all substantial.* Some critics are so superficial as to suppose that because the forces are of different kinds they are different in nature. As well say that two men are not substantially alike, because of difference of disposition, color, or intelligence. Some admit, as Christian believers, that spirit force or soul force must be substantial in order to give us hope of immortality, but will foolishly insist that *sound force, heat force, electric force,* etc., are mere properties of matter, or modes of molecular motion! What incapacity for logical reasoning! If one form of force, by which an inert material body is moved, or energetically kept in its place, is substantial, or a real entity, then every force is as truly entitative or substantial. There may be, according to Substantialism, as great a diversity of character in the different forms of force, as in the different forms of material bodies; yet no material body ceases to be substantial, because of its peculiar form, character, or degree of tenuity, whether it be solid, liquid, vaporous, or gaseous. It is still *matter* and *substance,* whatever its mutations and changes may be. This of itself ought to teach every careful and unbiased thinker that every form and manifestation of force, by which any observed phenomenon in nature, or any sensuous effect is produced, must be essentially substantial or entitative, since all physical effects presuppose substantial contact of the thing effected with that which produces such effect. Hence, the vital force which moves the body of a living creature, must be as really substantial as are the mental powers of that creature which directs

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and controls the movements caused by its vital energy. Hence, the vital force is as really substantial as is the spirit force, or psychical force, which is to constitute our substantial and personal identity in the immortal life. What would a substantial, immortalized spirit be worth without mental power, or if it did not *live*, or, in other words, if it did not possess *vital force* equally substantial with the spirit form? Thus, Substantialism reasons from the substantial existence of God, and of the human spirit, which all Christians admit, downward through mind, soul, life, instinct, to the unthinking and unliving forces of nature, deducing the substantiality of the lower from the admitted substantial nature of the higher. If soul force is an entity, as appears by the effects it produces, then all other forces are proven to be entities by the same facts; or, magnetism being thus proven to be an entity, we reason *upward* step by step through physical forces, such as sound, light, heat, etc., through vitality, instinct, mind, and spirit, culminating in God himself, as the self-existent source and fountain of all force.

From the foregoing it appears:

1st. That force is not a mere property of matter, for while properties are always passive possessions, forces are ever active.

2d. That force is substantial, *i. e.*, is an entity, as appears from its ability to affect the material, etc., and from the fact that it does sometimes exist apart from the material.

3d. That while all force is substantial, it does not necessarily follow that all substance is "mere force."

4th. That while the forces of the world are different in kind and character, they are all necessarily substantial.

God hasten the day when these truths shall be everywhere accepted; for independent of them, philosophy blooms into materialism, and Christianity finds no support in science. That the time is at hand when the "mode of motion" and "molecular vibration" hypotheses will be abandoned, and the substantial theory adopted, is evident from the fact that while Prof. Tait and others. "over the deep," are beginning to see and acknowledge the truth, Mayer, Helmholtz, Tyndall & Co., stand speechless at the Marriage Feast, where Science and Religion are being joined in an everlasting wedlock. "What God has joined together let no man put asunder."

DAYS OF CREATION.

BY REV. THOMAS M. WALKER, D. D.

Nothing in any language can exceed, in sublime simplicity, the narrative of Creation given in the first chapter of Genesis. It is simply a statement of facts. There is not the slightest intimation that would lead to even a suspicion that words were used in any other way than their primary or common signification. Nor is there found in any other part of the Bible a key to open a door to any other interpretation than that the earth was made, substantially as it now exists, in six days of twenty-four hours each. We cannot conceive that Moses understood the facts in any other way when he wrote this account; or afterward when he read on the tables of stone these words, engraven by the finger of God, "For in six days the Lord made heaven and earth, the sea and all that in them is, and rested on the seventh day, wherefore the Lord blessed the Sabbath day and hallowed it." Nor can we conceive that the Israelites understood in any other way these same words as they were proclaimed by the voice of God from Mount Sinai. And we may further safely say, that for two thousand years after the giving of the law, no one understood this first chapter of Genesis in any other way than that the days were natural days of twenty-four hours each. And even beyond this, no one will deny, that with the knowledge or the facilities to know that then existed, no other interpretation was reasonable or possible. The conclusion then necessarily follows, if this interpretation is not the true one, that the language in this first of Genesis, and in the fourth commandment is misleading, and necessarily conveys a false impression. Can this be so? Can we safely admit that Moses, under inspiration, and the voice of God from Sinai meant long, indefinite, un-

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equal eras in the past in which it requires the fancy of a modern geologist to see any resemblance to days?

We are told that science has demonstrated that the work described in the first chapter of Genesis was not accomplished in six days of twenty-four hours each, and that the narrative of Moses and the revelations of geology can only be reconciled by allowing a day in the narrative to stand for an indefinite period. It is claimed that this is a legitimate use of the word, and is so used in other parts of the Bible. But no instance of this kind can be found, except where the thing described, or some circumstance shows, at once and clearly, its indefinite use. There is nothing here, however, to suggest a meaning other than a natural day, and much to fix the time to twenty-four hours; such as numbering the days, first, second, third, and so on, ending with the seventh, which was to be perpetuated as a day of rest. So, likewise, not simply the word *day*, but the constituent parts of a day; evening and morning are named with no other apparent object than to emphasize the time allotted to each department of the work.

The standing still of the sun at the command of Joshua is referred to as a similar instance, where the words were not understood until interpreted by modern science. The cases, however, are not parallel. It was clearly not the purpose in the one case to show anything in regard to the movement of the heavenly bodies, but simply to convey forcibly the fact that the day was extended, giving Joshua time to make his victory complete, and beyond this the whole record has only the force of a figure of speech. In the other case it was clearly the purpose of the writer to convey to the reader two definite conceptions, the order of the work, and the time consumed in its accomplishment. The order was light, the gathering together of the waters, vegetation, the heavenly bodies, living beings and man—the time was six days. The time was evidently as important as the order, and was made equally plain. Or again, the writer in Joshua describes the event as it appeared to an observer, and just as, even, an astronomer would now speak of such an event when not sitting upon his scientific throne. And so in Genesis, Moses describes what took place as it would have appeared to the reader if he had then been living and stationed at some point on the earth's surface. He would see the whole work accomplished in six days. Were these, then, six natural days? or were they periods equal in time to thousands or millions of years or ages? Great eras there have been in the history of the earth. This no one denies; but have there been just six and no more? and are they sharply separated? or, indeed, is there anything about them that would suggest to an intelligent mind the thought of their having any similarity to days? Our dull imagination can see nothing of the kind.

If we yield the simple, natural interpretation of this narrative we vastly weaken the defense of the Bible; or what is equivalent, we weaken confidence in human ability to understand it. If the world for more than two thousand years necessarily misunderstood this simple statement of facts in the first of Genesis and has been under the necessity of awaiting the development of modern science, may the world not likewise be mistaken in regard to the meaning of other not more simple statements of facts in the Bible, such as relate to the birth and death and resurrection of Christ? What, even, shall we understand our Saviour to mean when he says to the thief on the cross: "To-day shalt thou be with me in Paradise"? Did he mean that this should be before the going down of the sun, or at some time within the present geological era? May it not be possible, on this basis, that we must await some new development of science, or higher criticism for the meaning of these simple statements of facts? But do the revelations of science demand that the six days be understood to designate six indefinite periods succeeding each other in the past, and not six natural days as all Bible readers have understood until a recent date?

The opening sentence in the Bible is remarkable for its terse comprehensiveness. "In the beginning God created the heavens and the earth." By this we understand that the whole material universe sprung into existence from the creating hand of God at the same time. But when that beginning was is not stated. It may have been fifty thousand or fifty million years or ages ago; or any time or period in the past eternity. Here is room for the wildest fancies of scientific speculators. Revelation is wholly silent as to what took place during the period that

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intervened between this beginning and the time when Moses opens his narrative. It is evident that this act of creation was not a part of the first day's work. The statement in this first sentence of the Bible stands too distinctly alone, connected with no time except the indefinite beginning, to be dragged in as a part of the first day's work. What took place between the beginning and the first day we can readily believe the wisdom of the Creator left to be made known in time by the discoveries in geology, and this especially rather than reveal it in language that would mislead until it should be superseded (we can hardly say explained) by the record of the rocks not unveiled till the nineteenth century.

We certainly do no violence to the Bible or to any fact of science when we assume that Moses opens his narrative of the six days' work long eras after the beginning. Assuming this, then, his account begins very naturally with a description of the earth just before the work began. Thus he says: "The earth was without form and void, and darkness was upon the face of the deep." But whence came this confusion and darkness, as seas and continents, animals and vegetables, existed on the earth in great variety and abundance long before man, who was one of the subjects of the six days' work, appeared on the scene? In answer to this question we need only refer to the accepted geological history of the earth. What, we may ask, separated the geological days, granting the days to be indefinite eras? We will be told that they were separated by convulsions and changes in the physical condition of the earth that involved in ruin all that belonged to the preceding era. We then do no violence to the possibilities of geology when we assume that such a convulsion took place before the era of man, and that vapor was evolved that shut out the light of the sun, and hence "darkness was upon the face of the deep." Then turning to the Bible we find Peter using this geological fact to silence the caviling infidels of modern times, who sneer at the possibility of another destruction and renovation of the earth. They say: "Where is the promise of his coming, for since the fathers fell asleep all things continue as they were from the beginning of the creation?" Peter charges ignorance upon these latter-day critics. "For this they willingly are ignorant of, that by the word of God the heavens were of old and the earth standing out of the water and in the water, whereby the world that then was, being overflowed with water, perished." This perishing of the old world cannot refer to the Noachian flood; the description does not suit, and the language is too intense—but it does correspond perfectly with the description of Moses—"without form and void." Of this they were willfully ignorant. These unbelieving philosophers might learn this, not from the Bible, but from their own pet science. The only serious difficulty that seems to stand in the way of this hypothesis is, that forms of animals and vegetables that now exist on earth had existed long before the time that we assume as the beginning of the present era, and hence there could not then have been a total ruin or "perishing of the world that then was." But we can see no reason why, in renovating and repeopling the world, God should not reproduce forms that had existed before as well as produce new ones, making changes here only so far as to correspond with changes in the physical condition of the earth. This is in harmony with God's plan, everywhere seen, to bind infinite diversity in a compact unity.

Granting as true what we have assumed, then, the six days' work appears in glorious sublimity. From darkness and chaos the earth emerges, under the might of God, day by day, in perfect order, to its grand completion on the sixth day, with man as the last and crowning act of his hand. The simple narrative in Genesis gives us the time and order of this work—"And the spirit of God moved upon the face of the water, and God said, Let there be light, and there was light." Or at the command of God the vapor, that darkened the earth, parted to the extent that the light of the sun reached the earth as through a thick cloud, thus establishing day and night in regular succession. Then on the third day the command is given, "Let the waters under the heaven be gathered together in one place, and let the dry land appear." What than followed is described in inimitable style in Ps. 104, "The waters stood above the mountains. At thy rebuke they fled; at the voice of thy thunder they hasted away. They go up by the mountains; they go down by the valleys, unto the place which thou hast founded for them. Thou hast set a bound that they may not pass over; that they turn not

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again to cover the earth." Does this describe an event that was in process of accomplishment thousands or millions of years? Or was the work all performed in a few hours in the morning or evening of this, to our conception, almost interminable day, and the remainder was rest? How is it? Then on the fifth day God said, "Let there be lights in the firmament of heaven." Then the clouds disappear, and the sun and moon and stars, in all their glory, are visible from the surface of the earth. In this the writer describes the event as it would appear to a beholder from the earth, and not in the technical language of science, which here would have been sadly out of place.

Thus the narrative goes on in the same simple strain in the account of the production, on the fifth and six days, of the fowls of heaven and beasts of the field, the whole work culminating in man, and then follows the seventh day of rest, to be perpetuated as a weekly sabbath to the end of time.

Now we may ask, is there a solution of the problem of creation in its order and duration that is more beautiful than this, and one attended with fewer difficulties? In this line no fact of science is called in question, and the beauty and simplicity of the Bible narrative are preserved, and the entire field of scientific research is left open.

IS MATTER HETEROGENEOUS OR HOMOGENEOUS?

BY HENRY A MOTT, PH. D., F. C. S.

According to the Substantial Philosophy matter is considered to be perfectly homogeneous. A mass of matter may have porosity, but the matter itself is homogeneous.

When a mass of matter is expanded by the application of heat, every particle (so to speak) expands—a grain or the million million millionth part or any further millionth part of a grain of matter expands just as we see one pound or one ton expand. The expansion is not due to the separation of the particles farther apart, but to the expansion of every particle as the mass is seen to expand. A gas is simply a highly attenuated condition of any particular form of matter, and depends for its existence on the temperature of the medium in which it is found. The normal condition of all the elements and their compounds is the solid, and this view was first pointed out by Dr. A. Wilford Hall. It is on account of the presence of the substantial heat-force, in different degrees, which determines whether an element or its compounds can exist as a liquid or a gas. Deprive a liquid or gas of its heat and the result is a solid. Experiment has shown that if any of the gaseous elements, which exist as such at the average temperature, be subjected to pressure and deprived of some of their heat, they will condense to a liquid, which can be poured from one vessel to another. The gaseous and liquid states of matter are forced conditions, and depend for their existence on the temperature of the medium in which they exist.

As the word "particle" will be used frequently during the course of this article, it is best to understand what is meant by it when used in connection with the Substantial Philosophy.

A particle of matter is a small mass of matter which is capable of being divided into smaller particles, these into still smaller particles, and so on *ad infinitum*. In other words, according to the Substantial Philosophy, matter is subject to infinite divisibility.

With these brief remarks let us proceed to consider such arguments as have been advanced to show that matter is heterogeneous and not homogeneous.

The modern theory regards matter as composed of molecules, and these in turn of atoms.

The molecule is, according to the physicist, that portion of a substance which moves about as a whole, so that its parts, if it has any, do not part company during the motion of agitation; and, according to the chemist, the molecule is the smallest particle of a substance that can exist and still possess the properties of the substance. The atom, never having an isolated existence, except in

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and during a chemical change, Prof. Tait[1] says: "We have made certain steps toward the knowledge of the nature of particles or molecules of matter; but as to the question of atoms—that is to say, whether, in going on dividing and dividing, if we could carry the process far enough. we should finally arrive at portions of matter which are incapable of further division—that is a question, I say, whose solution seems to recede from our grasp, as fast, at least, as we attempt to approach it."

The atom, however, is regarded as an infinitely hard particle by one school. While by another school it is regarded as a vortex ring, composed of a portion of a perfect fluid, supposed to fill all space, different from ordinary matter, but still endowed with inertia. The vortex atoms possess motion, which motion cannot be destroyed any more than the vortex atom can be cut.

According to the first speculation, the atoms would have to be at a great distance apart, as experiment has shown that there is no portion of matter whatever that is not capable of further compression by the application of sufficient pressure. After the infinitely hard particles are brought together by compression naturally the mass could be compressed no further. Taking Newton's suggestion as correct, that the particles of air at ordinary pressure of the atmosphere had a diameter equal to about $\frac{1}{9}$ of their mutual distance from one another (*i. e.*, $\frac{1}{10}$ of the distance from center to center), then it is obvious that if you were to compress a mass of air into $\frac{1}{10}$ part each way in each of these dimensions, you would bring the particles in the various layers into contact with one another, and as the particles are supposed to be infinitely hard and incompressible, it would be impossible to compress the group further. Hence air could not be compressed to a smaller bulk than ($\frac{1}{10}$ of $\frac{1}{10}$ of $\frac{1}{10}$) $\frac{1}{1000}$ of the bulk (more correctly $\frac{1}{1414}$) it has at ordinary pressures and temperatures. This result being inconsistent with what we know about the compression of gases, no value can be attached to this speculation, even if the atoms were considered to be at much greater distances apart. As to the other theory or notion that, what we call matter is only the rotating portions of something which fills the whole of space; that is to say, vortex-motion of an everywhere present fluid, such a theory must account for gravitation; while in general it is conceded that vortex atoms, if they be at moderate distance from one another, will not exhibit, in their behavior to one another, anything of the nature of gravitation. Again, this motion has to assume the existence of another medium than any yet proposed or known of, and of which there is no shadow of proof as to its existence.

Still another school of philosophers propose to do away with anything material in the ordinary sense of the word matter—dispense with atoms altogether and substitute centers of force, mere geometrical points which can exert repulsive or attractive forces; or rather such forces tending toward or from a certain point, but nothing at the point: except in some unexplained way-mass. So far as external bodies are concerned, this point is supposed to behave just as an atom would do. Unfortunately for this theory, inertia cannot be explained, and, as Spencer has said, "A center of force absolutely without extension is unthinkable." "The idea of resistance cannot be separated in thought from the idea of an extended body which offers resistance."

Some scientists would make "every atom its own God." Examination shows the proposition to be thus: Every atom, being self-existent, had the power in the beginning to adopt what laws of motion it pleased; so they all, by some mysterious universal suffrage conveyed through the infinity of space, or through the immeasurable sphere of the primeval nebulæ, *mutually agreed* on the law and intensity of gravity, and have steadily kept to their agreement ever since. If this proposition looks absurd, such scientists can blame no one but themselves, for the doctrine of inherent forces cannot be translated in plain English in any other way. To talk about "self-contained energy" is to say that a body can both expend energy and yet retain it, and still some scientists feel perfectly at home with such an idea.

The above considerations, we think, do away with the idea of atoms, and the various arguments used to show that matter is built up of them.

Now, as Prof. Tait says, "we have made certain steps toward the nature of

[1] "Recent Adv. in Phys. Sci."

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particles or molecules of matter;" let us proceed to investigate the steps as presented in the various arguments which have been advanced, and submit them to the light of Substantialism. Prof. Tait argues that because water can be decomposed by a galvanic battery into its constituent gases, this shows at once that there must be some limit to the division of a drop of water; a point we cannot pass without producing something different from water. There must, at last, come a state, he supposes, in division of the drop when any further interference with one of the particles will make each fragment something other than water—will take away some of its oxygen, or a part of its hydrôgen, leaving too much of the one and too little of the other.

Such a weak argument as the above hardly needs an answer. Why did not Prof. Tait take a simple instead of compound substance, and then there would be nothing to decompose about it, if such decomposition ever could take place or had any need to take place in the simple division of a compound substance theoretically down to infinity. The substantialist denies most positively that, by the simple division of a substance even to infinity, the proportions of the constituents composing the drop of water could be changed in any way by division. The relation of hydrogen to oxygen is as two volumes to one, and always remains so until the final point is reached—infinity, a point beyond the comprehension of the finite.

It only minces things to talk about the division of a compound substance, and there being a limit to its divisibility because by some chemical or other process it can be decomposed into its constituents; for the fact is that until such process is applied the division can be kept up theoretically until infinity is reached.

Even if the compound were decomposed into its constituents by the application of some process, while we would have no longer the original material (which would be our fault for applying the process), the constituents remain, which we can still divide and divide until their division enters the sphere of the unknown.

Cauchy claims to have shown that there could be no separation of the various colors of light from one another, unless the particles of a substance were at a distance from one another through which the light was passing, comparable with the length of the wave of light, or, at least, were not infinitely small compared with it. Therefore, it is claimed, matter cannot be homogeneous, as all kinds of light would travel with the same velocity in glass, just as in the air outside.

Now since the average length of a wave of visible light is about $\frac{1}{40000}$ or $\frac{1}{50000}$ of an inch, the grained structure of matter (the prism) must be very much more minute than the wave-length, for the dispersion would be greater than we find it.

It is supposed that it is much less, about the $\frac{1}{10000}$ part of the length of a wave of light—that is, in the course of one of these waves of light, which is only about the $\frac{1}{40000}$ part of an inch in length, there cannot be much more than 10,000 alternations from molecule to nothing and from nothing to molecule; using, then, the 10,000 and 40,000 as factors, the heterogeneity or grained structure of matter would be approximately 400,000,000 in the inch.

If there was any truth in the wave-theory of light unquestionably some such result would be arrived at as just stated. The Substantial Philosophy, however, already teaches that light is an entity, a real objective thing—that light is an immaterial substance, one form of the force-element of nature. The dispersion of light through a prism is not due to any molecular structure of the glass or to supposed distances between the particles, but is due simply to the action of the substantial light-force upon the substantial force of cohesion which holds the particles of the glass together. The particles of the prism are so held together by the force of cohesion that when a ray of light is allowed to pass through the prism the resident force of cohesion splits up the substantial light-force into more elementary forms, and the amount of dispersion is entirely due to the material structure (so to speak, as put together by the force of cohesion) of the prism, and differs in prisms of different composition, as it does in various other substances which are equally able to dissociate and disperse the light. The supposed argument, based on the speculations of Cauchy, founded on an incorrect theory (the wave-theory of light) must be abandoned, as no argument at all in favor of showing that matter is heterogeneous instead of homogeneous.

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Another method used for showing that matter is heterogeneous, as proposed by Sir William Thomson, is founded upon the amount of heat which would be generated by electrical action between particles of different materials when they are intimately combined together.

It is well understood that when two bodies are electrified, one with positive and the other with negative electricity, they attract one another. Therefore if a plate of copper and one of zinc be connected by a metallic wire, however thin the plates or the wire, the force of attraction at once commences to exercise itself, altogether independent of the force of gravity.

Now there is a force acting through a given distance; therefore the amount of work it can do can be computed, and if the zinc plate be allowed to come up to the copper plate the amount of work done by the electrical attraction can be ascertained.

If an enormous number of plates were taken, piled one on another so that they touched only at one point, the amount of work done by the electrical attraction if the plates were brought together could be calculated. By carrying this process far enough (no matter how thin the plates) you would reach an amount of work, if in the form of heat, which would melt the whole of the zinc and copper.

As we know the amount of heat generated when copper and zinc are mixed intimately in the formation of the alloy brass, it is claimed that the size of the particles can be calculated to account for their giving no more than the heat which is actually observed on their coming together. From calculation, Thomson has deduced that if the thickness of the zinc and copper plates could be reduced to about $\frac{1}{700000000}$ of an inch, there would be an amount of heat produced, by piling them together alternately, which would more than correspond to the quantity of heat which is produced by their chemical action when they are melted together. From this it is argued that the $\frac{1}{700000000}$ part of an inch is considerably under the thickness to which a plate of zinc or copper can be reduced and still be zinc or copper, as we know and handle them. That is, in these metals the grained structure is of dimensions considerably exceeding $\frac{1}{700000000}$ part of an inch.

Viewing the above in the light of Substantialism, no such result is arrived at. In the experiments alluded to, we have to deal with three forms of the substantial force element of nature. In the first place, we have to deal with the substantial force of cohesion, which holds together the particles of copper in the copper plate, and the particles of zinc in the zinc plate; and then we have to deal with the substantial force of electrical attraction, which tends to draw the negatively electrified plate of copper toward the positively electrified plate of zinc, and *vice versa*. Now, it is definitely established, according to the Philosophy of Substantialism, that force acts only upon force. Therefore, if we should pile up, in the manner stated above, 700,000,000 plates of copper and zinc alternately in one inch, and bring them together, the substantial electrical attraction would be capable of acting upon the substantial force of cohesion sufficiently to cause this force to be modified from the condition it exercises itself in the solid plates, to the condition under which it exists in the fluid or melted state of the copper and zinc; and this change takes place or results from the substantial force of electrical attraction acting upon the substantial cohesive force in such a way as to cause part of the cohesive force to be converted into sufficient substantial heat to reduce the solid plates to a fluid mass.

The value of Sir Wm. Thomson's experiment is not to show then that matter is heterogeneous, but is of great value to Substantialism, as it shows approximately (as the result is only supposed to be accurate by thirty or forty per cent.) the amount of electrical attraction necessary to convert part of the substantial cohesive force into substantial heat, and, in fact, overcome the force of cohesion in solids, like copper and zinc. The accuracy of this position is enforced by the fact, that naturally in a solid more cohesive force is required to hold the particles together than is required in the fluid state of matter—a state where very little cohesive force is at work; it therefore follows that in reducing the substantial force of cohesion present in the solid so as to leave just sufficient for the fluid condition something must become of the excess. The fact is that to the excess of

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cohesive force in the two states of matter (*i. e.*, solid and fluid) we are indebted for the substantial heat-force which brought about the physical change converting the solid copper and zinc into a fluid or melted mass.

(To be concluded in the next number.)

THE SUBSTANTIAL PHILOSOPHY AND MERCERSBURG THEOLOGY.

BY REV. J. I. SWANDER, A. M., D. D.

We open this paper with what may be regarded by some as a very startling declaration, viz.: "*Either the Substantial Philosophy is correct as to its essential points and peculiar claims, or the Christian church has, for eighteen centuries, been doing an astonishingly extensive business on an exceedingly small and questionable capital.*"

The last part of the foregoing proposition we cannot for a moment entertain as true. Objective Christianity cannot yet be measured by any subjective apprehension thereof. The church is better than many of the teachings and theories of Christian schools. How greatly it is to be desired, that "the king's daughter, *all glorious within*," should be permitted to appear equally glorious without; and, with "the virgins," her companions that follow her, come up out of the wilderness of false teachings in science, leaning upon the substantial arm of her beloved! The religion of Christ is not a mere philosophy, and yet it, of necessity, involves concrete philosophic principles. Without such principles in veritable substance it could never have had an origin in God, a mission in man, nor a real existence in the world. The essential principles of the Substantial Philosophy were always present in the world, and the world was made by God according to the workings of its invisible forces. In these latter days Substantialism, as a system in the process of formulation, came to its own, and yet its own, involved in the dusky clouds of materialism, knew it not until the day-star arose in "The Problem of Human Life," and poured the prophetic beams of a newly-discovered truth upon the sombrous horizon of the human race. Even since the day of Pentecost has the light been shining in darkness, while the darkness comprehended it not, so far as prevailing theories and current teachings of science had anything to do with such comprehension. Christianity, being a substantial and objective power in the world, was dependent for neither reality nor success upon a correct scientific apprehension of itself by the world. Under favorable circumstances, and in the presence of essential conditions, it generated in many millions of individuals a faith which was for them not only the substance of things hoped for, but also the victory which overcame the world, notwithstanding its false philosophy. Nothing short of such substantial light could have led the most vigorous nations of the world forward for eighteen stormy centuries in the central channel of the world's civilization and intellectual progress; and nothing less than such substantial force could ever have sustained the church in her constant conflict with the powers of darkness and the principalities of perdition.

We are, therefore, compelled to accept as true the first member of the proposition standing in the lead of this article. There is but one way to attempt an escape from such a conclusion, viz.: To assume that the higher and more spiritual realm of nature, as it reaches its completion in man, and in the Son of Man, who is at the head of a supernatural order of things in his mediatorial kingdom, is permeated with and perpetuated by objective entities and invisible forces, and that the lower department of this one stupendous universe, as usually studied in the common school of physics, is (according to the current teachings of science) destitute of all forces except such as are supposed to be generated in matter and propagated by favorable combination or molecular motion. Such an assumption, however, would be just as untenable as it is unreasonable. There is no reason whatever to suppose that God would place invisible entities and force elements in one realm of being, and, in the absence of all corresponding substantial force, either abandon the other, or permit it to operate itself by the constitutional inertia of its material molecules. No one, without embracing the most laughable

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absurdity, can for a moment suppose that that God, of whom are all things, would build a two-storied creation with no single design and organic connection running from cellar to dome; and that he would ordain two diametrically contradictory laws, one to operate the lower story *in* from without, and the other the upper story *out* from within. If that were the case in fact, we could conceive of but one possibility as to Jehovah's purpose in such a line of proceedings, viz.: That he intended to contradict himself, and by so doing drive the human family into the frigid zone of infidelity, and all the rational creatures of the universe to the remotest bounds of hopeless atheism.

The last supposition cannot be entertained as reasonable with reference to Him who always acts wisely and beneficently in working out the organic unity of his one comprehensive design. On the other hand, this is just what much of our atheistic and theistic materialism has been doing in its inability and unwillingness to see the invisible forces of nature, and by its consequent false interpretation of nature's laws. Thank Heaven, a better day is dawning! Substantialism has ordered a halt to such a crazy tendency in the world's most popular trend of thought; and yet the Substantial Philosophy will never be able to go forward in the accomplishment of its highest mission for the glory of God and the happiness of men, until it shall have carried its laudable work into the higher domain of the ethical, and applied its fundamental principle to assist in the solution of those problems which lie within the sphere of the Christian church. It is, therefore, very important that the church of God throughout the world should know the present as the day of her gracious visitation. We say *gracious* visitation, because God gives more grace through true philosophy than through lame and rickety theories of theology. "Lift up your heads, O ye gates; and be ye lift up, ye everlasting doors" of Zion; and the blessings of Substantialism shall come in; and standing at the holiest altar of the Most High, it will proclaim to reason and faith through all the land, and unto all the inhabitants thereof: Hear, Oh Israel; the Lord thy God is the *one* God who evolved or spoke the universe into existence from himself, and will, through the constant operation of substantial forces, carry forward his design until the whole creation shall reach its ultimate destiny, and fill its highest mission in rolling back the substantial waves of declarative glory to encircle the grand majesty of his substantial throne.

It is to the credit of the Christian religion that many of its professors and advocates were ready to embrace the Substantial Philosophy upon its first appearance among men. On the other hand, it is mutually commendatory to Substantialism that it was not welcomed into the world by any one Christian denomination more than another. Its reception by Christian ministers and members of all churches bears testimony to its genuine catholicity as a system of philosophy. "Strangers of Rome, Jews and proselytes," all hear the new philosophy speak from the inner sanctuary of nature the intangible forces and "wonderful works of God." True, we would almost naturally suppose that it should have received its first most cordial greeting from men whose schools of philosophy and theology had emphasized the existence of objective entities in the constitution of the world. Yet such is not the case in fact. The reverse may be slightly true. Like Esaias Substantialism can now be very bold, and say, I was found of them that sought me not; I became manifest unto them that asked not of me. How history does repeat itself! The Christ of God came first to his own, and his own received him not. Jesus appeared a Jew among Jews, and yet they looked upon him as a root out of dry ground. They saw in him neither form nor comeliness, although they had rocked the promises of Heaven in the cradle of their theocracy for many centuries, and nursed the coming Messiah in the bosom of their church for more than a thousand years. The writer, having a limited acquaintance with Mercersburg theology, and knowing that it contains some things in common with Substantialism, was once naturally disposed to wonder why the latter, upon its first appearance in the world, did not receive a more general greeting by the advocates of the former. But amazement has vanished away before the light of history. Our solution of the puzzle has been given in one of our former communications to THE MICROCOSM. The key to the solution is found in the compounded and confounded principle of prejudice and infidelity which once prompted the question: *Can any good thing come out of Nazareth?* Had Sub-

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stantialism made its first appearance in the University of Marburg, Heidelberg, Erlangen, Berlin or Bonn, as the production of some titled German professor; or had it been first announced, even by some great apostle of evolution, from the Chair of Natural Philosophy in the Royal Institution of Great Britain, or from the eminent Prof. Tait in the University of Edinburgh, it is quite possible that some of our Mercersburg leaders would have tossed their best beavers into the air with a shout: Lo, this is *our* god; we have waited for it.

For twenty-eight years we have been an earnest disciple in the Mercersburg school of philosophy, and as such we continue even unto this day, with our pen in hand to defend it, according to our limited ability, so far as it embraces and advocates the truth, against all enemies whomsoever, domestic or foreign. Why should we do otherwise? Under God it has saved us from the infidelity of mere subjective theology, as well as from much sentimental nonsense in religion. Brought as a seed-thought from Germany by that pious and learned young philosopher, Dr. Frederick Augustus Rauch, and planted in American soil, it is here to stay, and can be driven from the field no more than midnight can abolish the ordinance of sunrise. For more than a quarter of a century it has been taught in Franklin and Marshall College, Lancaster, Pa. It has also been ably advocated in the *Reformed Quarterly Review* by some of the most scholarly men and vigorous thinkers of the age. Before the dawn of Substantialism it was the most splendid organic apprehension of the truth that ever challenged the reasonable consideration of thoughtful men upon the American continent. Its distinguishing excellency and peculiar merit consisted not altogether in the fact that it viewed creation as essentially one organic whole with the Christ as its throbbing heart-center, but also and rather in its claims that the higher moral and spiritual spheres of the world by their very constitution possessed objective entities whose real existence depended in no sense upon the subjective exercise of the individual's faculties and powers. At times these great truths were brought forward and emphasized with such stress of earnest zeal as to make Mercersburg apostles the targets for all the sharp-shooters who could fortify themselves behind the various subjective theories in philosophy and religion. As time rolled on, however, the great principles of truth thus advocated by the Mercersburg school began to be regarded by many as something indispensable to a successful defense of the faith once delivered to the saints. At this we have not been astonished. We have, however, been amazed at the treatment given by some of the Mercersburg philosophers to the valuable *counterpart* and very *foundation principle* of their philosophy, as brought to light by A. Wilford Hall in the "Problem of Human Life," and as since advocated in THE MICROCOSM. Where now is Franklin College? Where is the successor to the historic institution which one hundred years ago was established mainly by the exertions, and endowed partially through the contributions of Dr. Benjamin Franklin, from whom also it received the name which is above every name found upon the list of America's colonial philosophers? Where is the consistency of the men who were once considered worthy of being known as the disciples of the immortal Dr. J. Williamson Nevin? Have they lost their courage? Have they fully satiated their philosophic maws with a possession of one half of the truth? Or is Mercersburg philosophy something so high on transcendental stilts as not to be able to apply itself in searching after the deep things of God and the intangible force elements of nature as they authenticate themselves in the general domain of physics?

We have before us a letter from one whom we regard as the fairest representative and ablest advocate of Mercersburg philosophy—a Christian gentleman and scholar, in whose presence we are always proud to stand with reverential attitude. Hear him speak. He says: "The chief point of Mercersburg philosophy is its view of an objective real spiritual world, or sphere of being from which the phenomenal world has its source, and by which it is constantly upheld. Truth is an objective spiritual essence, as also the beautiful and the good." Very "beautiful," very "good" and very true! But why stop at the halfway-house when in search after all the "essence" of the whole truth? If Mercersburg philosophy teaches that there is an objective essence underlying the phenomenal in the world of ethics and esthetics, why should it be thought a thing incredible when Substantialism not only teaches the existence of corresponding immaterial force ele-

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ments in the lower strata of nature, but also brings forward abundant evidence to *prove* that its teachings are correct? If truth is an "essence," why should the school of philosophy, which teaches such truth, so stultify itself before high heaven and all the world as not to concede the truth of what has been reasonably claimed and logically proven true? If truth is an essence, why not admit that sound, heat, gravity and magnetism, are essential substances from which corresponding phenomena in the physical world have *their* "source," and by which *it* is "constantly upheld"? Have Mercersburg philosophers made this admission? Some of them have done so most heartily. Others begin to see the fundamental tenets of Substantialism "as trees walking." But as a school of philosophy Mercersburg has not yet believed with the heart unto scientific righteousness, and made confession with the mouth unto a substantial salvation.

On the other hand, its great and historic institution of learning at Lancaster, Pa., has placed itself, by implication, in the awkward attitude of either indifference or opposition to a veritable though revolutionary system of newly discovered facts, phenomena, and logical deductions in science, which Benjamin Franklin would have received with greater emotions of delight than those which are supposed to have filled his philosophical soul when he caught the lightning in the clouds, conducted it to the earth, and caged it in his little demijohn. And what was the reception given to Substantialism in the institution where the spirit of that great philosopher is supposed to vapor, and where the name of Franklin is used as an inheritance of honor? Scarcely had "The Problem of Human Life" been circulated in the states of the American Union, and made a visit to some of the nations across the waters of the ocean, announcing not only the counterpart, but also the *justification* of the Mercersburg philosophy, by presenting the infallible testimony of nature's right interpretation, than the professor of natural science and chemistry unsheathed his "two-edged sword," and began to carve the air as though "hell herself had oped her dolorous portals to the peering day" of truth, making it possible for the very devil of unscientific fallacy to escape from the authorized version of his undulatory realm.

Yes, gentlemen of the Mercersburg school, we are sorry to witness your want of discernment, courage and perseverance in that mighty trend of philosophic thought in which, for a quarter of a century, we have been companions in tribulation. Although we have all left Sodom for the same common cause, the writer cannot tarry with you at the incestuous little city of Zoar. "Walked we not in the same spirit? Yea, ye did even run well." Who did hinder you that ye should not continue on the same line of logical deductions to the goal of the glorious race? Having begun in the spirit, are ye now made perfect by molecular motion? Have ye suffered so many things in vain? if it be yet in vain. We have been persecuted together. For this additional reason we are loath to leave your company. *We shall never consent to any such unnecessary separation.* Our substantial spirits shall still commune together in that "objective real world or sphere of being, from which the phenomenal world has its source, and by which it is constantly upheld." If you cannot yet hear the music of something better than undulatory bagpipes, and recognize the other force elements of nature, we are willing to wait for your advancement along the line of a more comprehensive and catholic philosophy. We shall not become impatient at your slow progress, for we love your company. Neither shall we ever fail to thank God for the preparatory benefits derived from your masterly advocacy of *one section* of the truth. We shall inquire at the Mercersburg oracle and consult its splendid published literature in all the philosophic inquiries of our future. It may be neither willing nor able to accompany us in the domain of physical research, but its following will be only a question of time. *We* are going forward. Our coadjutors are not of them who either loiter by the way, or draw back into materialistic perdition.

Believing that in science, as well as in religion, the logically "just shall live by faith" in the invisible, we propose to advance as long as we find ourselves keeping company with revelation, reason and the right use of common sense. You may tell us that we are presumptuous, and that only "mortals rush in where angels fear to enter." If so, we shall still choose the conservative courage of such mortals in preference to the radical cowardice of mere scholastic angels. Come and go with us, and we will show you entities which have been hid from "the

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wise and prudent," to be revealed in these last days unto—well, unto babes; for of such is the Kingdom of Heaven, and the Kingdom of Substantialism, with its invisible power and inevitable glory. Yes, come and go with us, and we will guide your flight to a realm of truth, which in other ages was not made known unto the sons of men, as it is now revealed unto those who believe with rational consistency in the *whole* "real objective world, or sphere of being, from which the phenomenal world has its source, and by which it is constantly upheld." Standing thus at the altar in the substantial sanctuary of Nature, you will experience a confirmation of your Christian faith as you survey the grand system of infinite and finite entities, more real than Arcturus with his sons, more glorious than the bands of Orion, and more responsive to the constitutional yearnings of your deathless spirits than all the sweet influences of the Pleiades.

ON THE REALITY OF FORCE.[1]

BY WALTER R. BROWNE, M. A., M. INST. C. E.,
Late Fellow of Trinity College, Cambrridge.[2]

The Royal Society of Edinburgh have lately published the first part of an essay on the laws of motion, by Prof. Tait, F. R. S. E. This essay is a further development of the views upon force and upon the proper mode of presenting the principles of mechanics, which are set forth in the article on mechanics by the same author in the new edition of the Encyclopedia Britannica. Their appearance in such a publication, together with the weight attaching to the name of their author, is sure to give to these views great currency and authority; and I trust therefore it will be considered only just that they should be submitted to careful but fearless criticism.

The main point of difference between Prof. Tait and previous writers on mechanics is the view which he takes of force. Force he takes to be a mere expression, an abridged notation for some such word as "the time-rate of change of momentum," having no real objective existence whatever. Accordingly it should be possible, and is even desirable, to expound the whole of mechanics without introducing this word at all, and so without giving the student a chance of mistaking it (as he is certainly prone to do) for the symbol of a real existence. In preparing his article for the encyclopedia, however, Prof. Tait found it difficult to make this desirable change; and accordingly that article proceeds on the old lines until it arrives at the last chapter, where the new discovery is set forth and expanded. In his recent paper Prof. Tait proposes to supply this defect, and to give a sort of outline of a new *Principia,* in which the term force is absent, and replaced by the purely abstract conception which is its only proper signification.

I shall not criticise this first installment of the work, only remarking that, before studying the laws of motion, the student will apparently have to master such conceptions as those of potential energy, conservation of energy, quaternions, vectors and scalars, the principle of least action, etc. I am thankful, at least, that I was myself taught mechanics before its text-books were constructed on the new principle. But the new treatise will not need much discussion if its *raison d'etre* (the non-objectivity of force) is shown to be erroneous, and it is this point to which I wish to address myself. Turning to the article "Mechanics" in the new encyclopedia, which alone supplies the evidence on which this rests, we find, as already mentioned, that the new conception of force, as something without objective existence, is only hinted at the beginning, and then relegated to an appendix at the end, the whole of the results being developed in the ordinary manner. This appendix of "General Considerations" is therefore the place where we are at last to find the evidence we seek; and here, in fact, we do find it, put in the

[1] We submit a review of Prof. Tait on Force by the distinguished English engineer Walter R. Browne, for the benefit of the readers of THE MICROCOSM, requesting that they compare the review here presented with the review written by the editor, and published in the October number. At some future time we shall consider some of the arguments presented by Browne, especially the views he advances respecting centers of Force.

[2] Phil. Mag., Nov., 1883.

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simplest and clearest form; so that we are at once able to examine and estimate its value. It is all confined to a very few paragraphs (291–295), and may be expressed in the following propositions:

(1) We believe matter, whatever it may be, to have an objective existence, chiefly because it is "conserved," *i. e.*, because experiment teaches us that its quantity cannot be altered.

(2) The only thing in nature which is also conserved in this sense is energy.

(3) Therefore, energy is the other objective reality in the physical universe; and we must look to it for information as to the true nature as of what we call force.

(4) Taking as the simplest case the fall of a stone toward the earth, we find the equation $\frac{1}{2} Mv^2 = Wh$, which may be interpreted as stating that the kinetic energy acquired is equal to the force acting, multiplied by the distance fallen through. But if we introduce the element of time, by means of the relation $h = \frac{vt}{2}$, this equation at once becomes $\frac{Mv}{t} = W$.

(5) Hence force appears in a new light. It *is* now the time-rate at which momentum is generated in the falling stone.

(6) But a mere rate, be it a space-rate or a time-rate, is not a thing which has objective existence. No one would confound the bank rate of interest with a sum of money, nor the birth or death-rate of a country with a group of individual human beings.

(7) Therefore, force, being a rate of generation of momentum, is not an objective reality.

I do not think Prof. Tait can quarrel with this mode of stating the argument, which is mainly in his own words. It is a clear and connected chain of reasoning; and, therefore, the conclusion may be overthrown by overthrowing any one of the premises. It may be thus overthrown, unless I am mistaken in more ways than one.

First, we may proceed to attack Prop. 1. That conservation cannot be the ordinary ground for believing in the objectivity of matter is simply proved by the fact that the mass of mankind have always believed (and, according to Prof. Tait, believed rightly) that matter exists, without having any idea what conservation of matter means, nay, more, while believing that matter is not conserved.

And if it be said that it is not a question of what is, but what ought to be the evidence for our belief, this does not affect my denial. We believe matter has an objective existence, not because it is conserved, but because *it persists;* in other words, because it has effects upon us which are regular, constant, can be re-experienced at will, and have all the other characteristics of an independent object. This proves to us that matter exists now; but it does not even begin to prove that it has always existed and will always exist. I have not the slightest difficulty in conceiving that the universe may be annihilated to-morrow, though I am sure that it exists to-day; even as Prospero did not mean to deny the reality of cloud-capped towers and gorgeous palaces, while asserting that they would one day become as the baseless fabric of a vision.

Secondly, we may challenge Prop. 3. We have only to put it in a general form to see its weakness. It would then run thus: "We believe a subject of thought, X, to have a characteristic, A, chiefly because it has another characteristic, B. There is another subject, Y, which also has the characteristic B; therefore, it also, and independently, has the characteristic A." It is clear that this does not hold unless we assume the characteristic B to be always and necessarily implied by A. But, obviously, this need not be the case. Thus, I may believe Camoens to be a great poet chiefly because a great many people have considered him as such; but a great many people have considered Mr. Tupper a great poet, and yet I am not logically bound to accept their verdict. But apart from this, there is another flaw in the proposition; for the subject Y, though really having the characteristic A, may be simply another form or a function of subject X; or, again, both may be functions of a third subject, Z, which has the same characteristics. In either case Y is not a separate independent possessor of B. The latter supposition really holds in the case of energy, as will be seen hereafter.

Thirdly, we have a still more important and obvious fallacy in Prop. 5, which is really the key of the whole. It needs only to be stated in order to be-

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come evident. It is the fallacy that because one thing, A, is proportional to and measured by another, B, therefore A is the same as B, and nothing else. To show that we have here a real instance of this general fallacy, we have only to put side by side Newton's second law, as quoted by Prof. Tait himself ("Elements of Nat. Phil.," 1873, p. 66), and the words stated in Prop. 5. Newton, law 2: Change of motion *is proportional* to the impressed force.

Tait, Prop. 5. Force is the time-rate at which momentum is generated. The fundamental difference between Newton and Tait, and the fallacy mentioned above, could not be more clearly illustrated. Nobody, I presume, will assert that Newton meant to identify the two things spoken of. We do not say that the queen is proportional to the Empress of India, or a triangle proportional to a three-sided rectilineal figure. The absurdities into which we should fall if we adopted this view generally will be patent to everybody. For instance, we must say that the heating-power of a fuel *is* a certain number of pounds of water and a degree on the mercury scale, and so forth. But we need go no further than the equation given by Prof. Tait himself in Prop. 4. The expression on the left-hand side is the energy acquired, and that on the right-hand side the force multiplied by the distance. According to Prof. Tait the force is not objective, because the symbol representing it expresses the time-rate at which momentum is generated; while the energy is one of the two objective existences which are beyond the reach of cavil. But if we interpret the expression for the energy in the same fashion, we find that it is a mass (*i. e.*, a weight, W, divided by a velocity, g) multiplied by the square of a velocity (or rate of motion), and divided by two. We are therefore bound to regard as non-objective something which may be expressed as a time-rate of momentum; but we are bound to regard as objective something which may be expressed as a weight multiplied by the square of a rate, and divided by twice another rate. It is difficult to see how this can be supported; or, again, why an argument which is true for one side of an equation may not be applied to the other.

The only other mode in which Prof. Tait proceeds to prove the non-objectivity of force is a curious one; it proceeds by anecdote rather than argument. After observing that the third law of motion tells us that force is always dual, and that to every action there is always an equal and contrary reaction, he goes on thus (Art. 289): "'Do you mean to tell me,' said a medical man of the old school, 'that if I pull a "subject" by the hand, it will pull me with an equal and opposite force?' When he was convinced of the truth of this statement he gave up the objectivity of force at once."

I cannot help thinking that this gentleman was not only a doctor of a very old school, but a very old doctor of any school; for I have in vain endeavored to discover in this rebellious behavior on the part of subjects anything which could constitute any reason—physical, metaphysical, logical or otherwise—for believing or not believing in the objectivity of matter. Why a thing should be real if left to itself, but become unreal and fictitious if it is opposed to something equal to itself, is a puzzle. We may conceive our doctor arriving at very singular conclusions if he carries out the same principle consistently. Thus the celebrated Irishman, who complained that it was not his fall that hurt him, but the stopping so suddenly, might have been told that he was in error; his fall was an objective action, but when it was stopped by the equal and opposite action of the earth, it became a mere rhetorical figment. Again, if a gentleman squeezes a lady's hand that is an objective fact; but if she squeezes his in return, then it becomes merely a subjective impression. This would not interest the doctor, but may be a useful hint to younger practitioners. If it be objected that in these cases the opposition is temporary, while in the case of force it is permanent, I would reply that permanence, *teste* Prof. Tait himself, is a proof of reality rather than the reverse. And I still inquire in what way the existence of two equal and opposite causes proves the unreality of either or both of them.

There is one deduction from the new view, which Prof. Tait makes himself (Art. 297), and which deserves notice. He observes that "equivalent quantities must always be expressed by equal numbers, when both are measured in terms of the same system of units. It appears, therefore, from the conservation of energy directly, that potential energy must, like kinetic energy, be of dimensions

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$[ML^2T^{-2}]$. Now it is impossible to conceive of a truly dormant form of energy whose magnitude should depend in any way on the unit of time, and we are, therefore, forced to the conclusion that potential energy, like kinetic energy, depends (in some as yet unexplained, or rather unimagined, way) upon motion. . . . The conclusion appears inevitable that, whatever matter may be, the other reality in the physical universe—energy, which is never found unassociated with matter—depends in all its widely varied forms upon motion of matter."

Now I should have thought it an accepted principle in science that if a train of reasoning is found to lead to a conclusion which not only has not been explained, but of which no explanation has been imagined—in other words, which is not only a mere unsupported hypothesis, but as to which no hypothesis can, by the wit of man, be framed—then that is sufficient reason for concluding, not that the unimaginable is inevitably true, but the reasoning is inevitably false. It will be a bad day for science when its leaders forget the principle of which Newton was so brilliant an exponent—the principle, namely, of distrusting your conclusions the moment they are shown to be incompatible with ordinary matters of fact.

But in the present case the particular flaw in the argument (apart from the general question at issue) is easily seen by an instance. Let us suppose a current of water (it is an ordinary case) running through a fan water-meter, the disk of which it keeps in rotation, and then passing by a pipe into a tank. When this is over the quantity of water which has come to rest in the tank should be the same as that which has passed through the meter; but this will be indicated by the counter, *i. e.*, by the number of revolutions which the disk of the meter has made in the time. Then, following Prof. Tait's reasoning, we should say: "It is impossible to conceive of a truly stationary mass of water whose magnitude should depend in any way on the number of revolutions of a meter, and therefore we are forced to the conclusion that the water in the tank must really be continually causing the revolution of a meter, though we cannot explain or even imagine where the meter can be." To this it would be sufficient to reply that the water was measured, not when it was at rest, but when it was moving; and so we reply that what we have measured is not potential energy directly, but kinetic energy, which was being transformed into or from potential energy, as the case may be. It may be well to add that what we have measured does not, of course, give us the total potential energy existing in the body, any more than the meter would give the total quantity of water in the tank, supposing, for instance, that this happened to be the sea.

That the criticism of this paper may not be negative only, I will indicate another line of attack on Prof. Tait's position, which is of a positive character. We have seen that he recognizes two distinct and independent realities as revealed to us in nature, namely, matter and energy; and his argument is based on the fact that both of these are subject to the law of conservation.

But I have elsewhere shown at length[1] that the whole of the recognized laws of mechanics, including the conservation of energy and matter, flow directly from the three laws of motion (if not from general principles still), if we take as our definition of matter, that it is a "collection of centers of force distributed in space, and acting upon each other according to laws which do not vary with time, but do vary with distance." I have also shown[2] that the second principle—the conservation of energy—does not hold in any cases where the forces are not of the above character. Hence, instead of the four fundamental realities, space, time, matter, and energy, we need only three, space, time, and force; and from these the mechanical universe, as we know it, can be constructed. But it will not be contended that we know anything of energy as an independent objective reality except what is revealed to us in the study of mechanics; in fact, its existence was never suspected until the modern development of that study had begun. Hence it appears that all the facts forthcoming to prove its independent existence can be perfectly accounted for apart from that hypothesis; and that being so, the evidence in favor of the hypothesis sinks absolutely to zero. But that for which there is no evidence is not to be believed.

I will here conclude this paper, perhaps already too long. If any illustrations

[1] "The Student's Mechanics."—Chas. Griffin & Co., 1883.
[2] Phil. Mag., 1883, p. 35.

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used are not a kind ordinarily adduced in such discussions, it is Prof. Tait's old-school doctor and "his subjects" who must be my excuse. For the paper itself I do not make any excuse, because I am convinced that the new views of Prof. Tait, and others, on the foundation of mechanics are doing very serious harm, especially among those who approach the subject from the practical side. It is not that they are led to inquire more closely into these fundamental principles, and the evidence for them—that would be a useful result—but they are led to think that there is no real ground of truth in any of them; that they are mere convenient working hypotheses, which may be left to contradict and stultify each other just as may happen. When this belief is fully accepted, the era of fruitful progress in physical science will be at an end.

PHOTOGRAPHING SOUND-WAVES.—No. 1.

Startling Disclosures in Physical Science.

BY THE EDITOR.

Much interest has been manifested during the last few years upon the above-named subject, owing to vague rumors going the rounds of the press that a young German scientist, by the name of Toepler, had succeeded in actually photographing the waves of sound. The public generally, knowing that The Microcosm denies the validity of the wave-theory of sound, has taken a special interest in sending us these slips, cut from their various family newspapers, numbers of which come to us from all sections of the country, each sender supposing that he alone had been the fortunate finder of the valuable piece of information. For a long time we paid no attention to the rumor, regarding it as one of the innumerable scientific vagaries about sound which have no more real foundation in truth than has the wave-theory itself, upon which they all were based. Especially were we inclined to consider this particular rumor unworthy of any special attention, since none of our scientific journals, of the current type of theoretic belief, had gone to the trouble of translating the claimed wonderful achievement from the German, and thus giving the details of the discovery to the English reading public.

From the brief reference to it, however, by Prof. Rood of Columbia College, with his indorsement of it in his lecture on the "Voice and Ear," and from verbal descriptions by those who had read the German accounts of the experiment, we have gathered sufficient data to give a general idea of the so-called process of photographing sound-waves. In the first place, it would strike one who is in the habit of reflecting scientifically, that it was an impossibility to make a photograph of that which is perfectly invisible, as is the case with air. Hence it was generally supposed, by those with whom we casually conversed on the matter, that the air through which the supposed sound-waves were passing when photographed must have been mixed with opaque substance, such as smoke or floating particles of dust. But this is not the case, and no such idea is involved in the process. The sound-waves are claimed to be those of pure air, and the effect which is rumored to have been photographed or made visible on the sensitive plate, is the amount of *refraction* in a beam of light while passing from the normal air through the *condensed* portion of such wave.

It is well known to every student of physics that a ray of light on passing at an angle from a rarer into a denser medium, or *vice versa*, bends at the point of intersection. Any one can demonstrate this fact by putting the end of a straight stick into a vessel of clear water. If the stick be held perpendicularly in the water, the part below the surface will be perfectly straight, or in line with the part above; but if the stick, while thus partly immersed, should be tilted at any angle either way, its lower portion will appear to bend abruptly upward. This, of course, is due to the *refraction* of the light. It is on this principle that the prism acts in dividing a ray of white light into its constituent colors, and upon which the whole science of spectrum analysis is founded. And it is this well-known

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phenomenon of the *refraction* of light which was seized upon by the ingenious German photographer either to achieve a marvelous triumph in delicate optico-acoustics, or else to perpetrate an enormous scientific hoax upon the whole civilized world. That it is the latter which he has succeeded in accomplishing, we firmly believe, and will proceed to give our readers what we deem good and sufficient reasons therefor.

It is claimed for the German scientist, that on sending the flash and sound report of an electric discharge through the air of a room, otherwise darkened, an instantaneous camera process, properly directed against this path of sound and light, will show on the sensitive plate the difference of *refraction* from the normal to the condensed portion of the air constituting the wave. The question now presents itself, is such a result reasonable or possible, even admitting condensations and rarefactions to go forth from the vibrating instrument, thus constituting sound, as the current theory of acoustics maintains? Is there, or can there be, in the very nature of such supposed condensations, enough compression of the air, according to the most extravagant claims of the theory, to show the refraction of light on a photograph plate?

We will here undertake to convince the reader, by an argument based on considerations as new to science as they will prove confusing to physicists, that no such photographic result is possible, the theory itself being the criterion; and that if it were possible to photograph such an inconceivably small refraction of a beam of light, its deviation from a straight line would be vastly too diminutive to be seen under the most powerful microscope ever constructed. Now for the proof of all this.

In the article on Sound in Appleton's "American Encyclopedia," Prof. Mayer, of the Stevens Institute, Hoboken, N. J., the very highest authority on acoustics in this country, in speaking of the sound of the note C passing through the air, says:

"This compression *gives to the compressed half of the wave an increase of* $\frac{1}{679}$ *to the ordinary density of the atmosphere.*"

Let us observe here that this is, without doubt, the most extravagant estimate ever recorded by a physicist, of the amount of condensation in a sound-wave over the ordinary density of the air; and yet, in order to show its destructive effect upon this photographing claim, we need only a few moments of calm calculation, the conclusiveness of which Prof. Mayer would at once admit. Will the reader, therefore, follow us for a brief excursion into this novel department of the *refraction* of light?

It is a well-known law of physics that light will refract or bend from a straight line, in passing from normal air into a denser medium, such as compressed air of different degrees of density, all the way down to that of water itself, substantially in proportion to the difference of density of the different mediums. That is to say, a beam of light will bend or refract one inch from a straight line in passing through *four* inches of water, and proportionately less as the medium becomes rarer. Now as water is 773 times the density of air, it is plain that a beam of light, in passing from normal air into a density of two atmospheres a distance of four inches, would only bend $\frac{1}{773}$ of an inch from a straight line. But bear in mind that the condensation in the compressed part of a sound-wave, according to Prof. Mayer, is only $\frac{1}{679}$ of one atmosphere over the normal air, and that a beam of light, therefore, in passing from normal air four inches into this condensed part of a sound-wave, should give a refraction of but the $\frac{1}{679}$ of $\frac{1}{773}$ of an inch, or, as a beginner in mathematics can see, but the $\frac{1}{500000}$ of an inch in round numbers, throwing aside all fractions. Dare Prof. Toepler, Prof. Mayer, Prof. Rood, or any other scientist, dispute these startling figures? If not, then we have the annihilating result of a bend or refraction of a ray of light, passing from our normal atmosphere into the condensed air of a sound-wave, so trifling as to be *more than six times too small to be visible under the most powerful microscope in existence,* allowing 80,000 diameters as the maximum limit of magnifying power in the best instruments. Yet this refraction—the $\frac{1}{500000}$ of an inch on an eight-inch square photograph plate (showing *four* inches of the beam in the condensed air, and *four* in the normal air)—is seriously claimed to be photographed and made visible by Prof. Toepler, and the result inadvertently vouched for as

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true, and illustrated by Prof. Rood, who would, no doubt, have seen its preposterous character at a glance had he analyzed the problem scientifically, as for the first time presented above. Will the press of the country now take the same pains in copying this exposure of the hoax that it has taken in giving it currency?

But destructive as are these facts and figures to the pretended scientific achievement of Prof. Toepler, in photographing atmospheric sound-waves which have no existence in fact, and terribly as they bear against modern scientific efforts at defending the current theory of acoustics, we have not yet exposed more than the cuticle of the enormity of the claim based on Prof. Mayer's $\frac{1}{610}$, compared with what is yet to follow. We are prepared to show by the highest mathematical authority in the world—Prof. G. G. Stokes, F. R. S., of Cambridge University, and who now occupies the very chair once filled by Sir Isaac Newton—that Prof. Mayer's estimate of the compressed part of a sound-wave was enormously exaggerated, the real increase in density being but a minute and almost inconceivably small fraction of what the American physicist had calculated, and hence that the $\frac{1}{500000}$ of an inch refraction deduced therefrom is vastly too large.

A short time since, Dr. Henry A. Mott, Ph. D., F. C. S., our associate in this magazine, wrote Prof. Stokes on the subject of the extent of the atmospheric condensation which takes place in the passage of a sound-wave, and quoted from Appleton's "Encyclopedia" Prof. Mayer's computation of the amount of such increased density as $\frac{1}{610}$, naming also the conclusions we had deduced from Prof. Mayer's figures, as given in the "Problem of Human Life," as to the physical strength the stridulating locust must possess if such condensation of the air does really take place in sound.

It will be remembered by those who have read the "Problem" that we showed mathematically that at the ratio of condensation specified by Prof. Mayer, a locust, in the act of stridulating, must exert a mechanical squeezing force on the four cubic miles of air permeated by its sound, of at least 5,000,000,000 tons—equal to the actual lifting of that much weight. Nay, we now add, as an entirely new argument, that any such condensation taking place in the free and open air would require thousands, if not tens of thousands, of times the mechanical power we then calculated, *which was based on the compression of confined air, as, for example, in a tube.* Clearly, one inch of mechanical compression of confined air in a tube would require not a thousandth part as much mechanical force to effect it as if it were in open space, *owing to the enormous velocity of the compressing body needed to accomplish it.* Did ever a wave-theorist think of this most suggestive fact? And would it not be an interesting algebraic problem for some Lord Rayleigh to tackle with his "higher mathematics"?

Of course Prof. Stokes, the greatest mathematician in Europe, needed only to glance at our figures, as presented to him in Dr. Mott's letter, to see that it rendered Prof. Mayer's estimate of the extent of the condensation actually preposterous. Hence nothing remained for the distinguished successor of Sir Isaac Newton but to repudiate both the American physicist and his mistaken figures, and that, too, in the strongest terms. Here are a few of his emphatic sentences which Dr. Mott permits us to copy from Prof. Stokes' letter:

"You quote a few words from an article written in an 'American Encyclopedia' by some Prof. Mayer. . . . I cannot, of course, judge without the context about what Prof. Mayer says. But I should suppose that a condensation of $\frac{1}{610}$, with the frequency of the note, middle C, *would give a sound of deafening intensity.* . . . As to what you say about the locust, that only, take what view of it you please, proves the extraordinary delicacy of our organs of sensation. The *condensation,* it is true, must be almost *inconceivably small.* . . . The numerical calculation you found on the case is based on the estimate of $\frac{1}{610}$, which I don't admit the least bit in the world," etc., etc.

Unfortunately for this most desirable exposure of the wave-theory of sound, in about the only way modern physicists will feel its force, Dr. Mott's proverbial candor got the better of him, and led him to give away an opportunity of capturing the biggest game yet caught. Had he not prematurely exposed his hand by laying before the distinguished physicist our "numerical calculation" of 5,000,000,000 tons of mechanical pressure, as the true measure of this insect's physical strength correctly deduced from Prof. Mayer's $\frac{1}{610}$ increase of density, there

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is not a shadow of doubt but that Prof. Stokes, not seeing the trap set for him, would at once have agreed with Prof. Mayer, at least substantially, and would thus have committed himself irrevocably to the startling proposition that the great American locust actually possesses the mechanical squeezing force of more than one million forty-ton locomotives under a full head of steam! But as luck would have it, the Doctor's frank anxiety to get as soon as possible that great scientist's opinion on the whole matter in controversy, let our "5,000,000,000-ton" locust out of the bag, thus putting the wily investigator on his guard, and thereby preventing one of the best schemes for scientifically smashing the wave-theory ever offered. As it turned out, Prof. Stokes saw the difficulty in which Prof. Mayer's candid statement had involved him, and he was too experienced a controversialist to be caught in the squeezing power of the same mighty insect. He saw that it had pressed the scientific life out of his Yankee coadjutor, and he did not propose to be subjected to a similar process, and in order to avoid the disaster, he did not, of course, dare to name any figure whatever, as the amount of condensation a sound-wave would produce, an oversight upon which the Hoboken physicist had so signally gone to pieces. Had the great mathematician ventured to specify $\frac{1}{1000000}$ or even $\frac{1}{10000000000}$ as the true increase of atmospheric density caused by a sound-wave, which not only generates sound, but produces heat enough to add one-sixth to its velocity, Dr. Mott would instantly have reduced the 5,000,000,000 tons to suit the new ratio, and would still have had left a squeezing power by our locust of more than a thousand able-bodied horses. No one need to take our statement as true who can work out a sum in simple arithmetic.

Now, Prof. Stokes knew at a glance that this calculation, based on Prof. Mayer's $\frac{1}{879}$, was substantially correct, and that, too, without making a figure on paper to prove it; and hence it is not surprising that he should admit, as he does in his reply—"the condensation, it is true, *is almost inconceivably small*," and consequently that Prof. Mayer's estimate "is almost inconceivably" excessive; for it is plain that the $\frac{1}{879}$ of a density of one atmosphere is very easily *conceived*. But the great mathematician had not the courage of his American brother physicist to name any amount of condensation whatever; neither had he the frankness to admit the wave-theory overthrown, as he absolutely knew it to be by this condensing argument; for, take such sensible and measurable "condensations and rarefactions" away from the theory, and every one knows that there would be nothing left of it. Hence Prof. Stokes knew that his only method of escape was to be non-committal, not to acknowledge any degree of condensation—not even "the least bit in the world"!

But, "whom the gods would destroy they first make mad." Dr. Mott's letter appears to have completely turned the head of the Cambridge professor, and notwithstanding his evident resolve not to commit himself to any definite amount of condensation, he does actually do it in spite of himself. Here are his committing words, as already quoted:

"The *numerical calculation* you found on the case *is based on the estimate of* $\frac{1}{879}$, *which I don't admit the least bit in the world*"!

Thus, while distinctly denying the correctness of the $\frac{1}{879}$ of Prof. Mayer, he virtually admits the correctness of our deduction therefrom by not calling it in question, as he would have done were it wrong on its face. In this way he unwittingly concedes that Prof. Mayer's $\frac{1}{879}$ *is as much in excess of the truth as* 5,000,000,000 *tons, fairly deduced from it, is in excess of the locust's real compressing strength—not to exceed one ounce.* Let us, therefore, assume *one ounce* as the aggregate condensing power of the locust distributed throughout the four cubic miles of air permeated by its sound, since its stridulation can only be heard, according to the theory, by means of these "condensations and rarefactions." Then, by reducing the 5,000,000,000 tons obtained from Prof. Mayer's estimate to ounces, we find that the real extent of condensation, according to Prof. Stokes, is but the $\frac{1}{160000000000000}$ of what Prof. Mayer erroneously estimated; or, in other words, but the $\frac{1}{160000000000000}$ of $\frac{1}{879}$ of one atmosphere!

Having thus sapped the very foundation of the wave-theory, we are now prepared for the *denouement*, at which we have been aiming all this while, as relates to the amount of *refraction* in a beam of light which would take place when we have the true density of a sound-wave from which to calculate it, instead of the

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"almost inconceivably" exaggerated density of Prof. Mayer. As the $\frac{1}{610}$, which was 160,000,000,000,000 times too large, gave us $\frac{1}{500000}$ of an inch refraction, it follows that the true increase of density, according to the highest living authority, gives us but the $\frac{1}{160000000000000}$ of $\frac{1}{500000} = \frac{1}{80000000000000000000}$ of an inch! This is, therefore, the fraction of an inch which the tacit admission of Prof. Stokes has forced upon Prof. Toepler to make visible on his photograph plate—more than 1,000,000,000,000,000 times too small to be seen under a microscope! Yet Prof. Rood, of Columbia College—regarded by many as equal in point of authority to Prof. Mayer himself—indorses, in his public lectures, this photographic result as a genuine achievement! Will Prof. Rood speak out, and give us his opinion in regard to this exposure?

Having thus shown the utter impossibility of the claimed process of photographing sound-waves by the refraction of light, let us, in concluding this part of the discussion, briefly examine into the *probabilities* of its having been done, leaving the impossibility of the thing out of the question, coming, as the report does, from physicists who have taught us for scientific facts the very fallacies so frequently laid down in our acoustical text-books. Take, for example, what we quoted last month (MICROCOSM, Vol. V., pp. 61–62), from both Prof. Tyndall and Prof. Rood, in which they set forth as simple scientific facts that two unison instruments sounded half a wave-length apart (so that the condensations from one will fall into, or exactly coincide with, the rarefactions from the other) will neutralize each other's sound, and cause "absolute silence." Yet, when we find, as we do, by experiment, that not the slightest difference in the intensity of the sound occurs, place the two instruments as we may, listen to them as we will, and sound them as we can, is it not a little too much for wave-theorists to insist that we must believe these scientists and their coadjutors upon their *ipsi dixit*, when they claim to have photographed these same *sound-waves* which the experiment just referred to demonstrates to have no existence in fact? For most clearly, if atmospheric sound-waves do really exist, they should neutralize each other when they come into the relation of interference, and should thus produce silence, exactly as these scientists teach, and just as two systems of interfering water-waves are known to do. Hence, we claim that no such thing as aerial sound-waves exist, except in the text-books and in the imaginations of wave-theorists. How, then, can such absolute nonentities be photographed?

Again: when the very highest authority on acoustics living—Prof. Helmholtz—totally failed to comprehend the action of his most favorite instrument, the double-siren, representing its effects as directly opposite to those actually produced—as shown so fully and unanswerably in the "Problem of Human Life," pages 293–296—is it anything surprising that a vastly less experienced German scientist should honestly fancy that he had caught a photograph of an imaginary sound-wave, when he had caught nothing of the kind?

Even such a critical experimenter as Prof. Mayer positively declared in our presence that the celebrated *Konig instrument* (for dividing a stream of sound into two branches and thereby causing interference as they come together) would, at the interfering point, produce absolute silence; yet when we insisted on his trying the experiment, he got out his instrument (a beautiful one imported from Paris), and after several trials, with manifest confusion, abandoned it as a failure! Now if he could have been thus deceived for years, taking for granted what he supposed theoretically ought to be true, is it any marvel that an enthusiastic photographer should imagine that he had accomplished what he had so much desired to do?

If the distinguished Prof. Tyndall could honestly believe that he blew out a candle by passing a *sound pulse* through a tin tube, and that the puff of air from clapping the books together had nothing to do with it (see "Problem," page 270, and onward), ought we to be surprised to find that a young scientific photographer, who believes in the wave-theory, and who was ambitious to achieve fame, should be deceived in thinking that he had caught in his camera one of the very sound-waves which blew out Prof. Tyndall's candle? And if Prof. Tyndall himself, with all his experience as a physical investigator, could ignore the mighty volume of expanding powder gas at a magazine explosion, and seriously believe that it was the *sound-wave* which destroyed the church at the village of Erith,

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miles away, and smashed the windows in most of the houses, might we not indulge a much younger scientist in the delusive fancy that he had caught on his sensitive plate one of the veritable sound-waves which had played such havoc with Welsh window-glass?

Next month we will present another aspect of this so-called photographing of sound-waves, in which we will describe a real achievement of a citizen of New York, which, whatever it may claim to do, conveys real scientific instruction to the studious reader.

THE PHILOSOPHY OF POVERTY: ITS CAUSE AND CURE.—No. 4.

No Communism or Socialism in These Views.

BY PROF. H. S. SCHELL, A. M.

Experience teaches us that all suffering, whether mental or physical, is caused by violations of laws of nature; whenever, therefore, we feel suffering either of mind or body, we may rest assured that some law or laws of nature have been transgressed. Experience also teaches that whenever that transgression ceases, the suffering caused by it will also cease as soon as the effects of the transgression are over.

Poverty, I apprehend, has been for ages and is now the cause of more suffering than any other infliction, and must, therefore, be the result of violations of one or more laws of nature and the penalties attached to those violations. To cure it we must, therefore, ascertain what law or laws have been violated and then cease to transgress them; poverty will then disappear ,and plenty will take its place.

This being the case, no efforts in any other direction will avail either to abolish or even materially mitigate the evil. Conventions may be held to discuss the "miseries of the masses," to denounce the "tyranny of capital," to strike for higher wages, and to boycott; and processions with banners flying may fill the streets, but all will be in vain; laws of the great God have been set at defiance, and until their violation ceases and those laws in their majesty are recognized and honored, no relief worth a thought will be afforded.

In previous papers I have claimed, and still maintain, that two laws of the Creator have been violated, and that the wide-spread poverty prevalent over all the civilized world is the result.

These laws are, *first*, that a very large proportion of the human race has been for ages, and is still, deprived of the *free use of the soil;* and, *second*, that the products of their labor have always been, and are still, *heavily taxed.*

These premises being admitted, it remains to be shown how the soil can be reclaimed and restored to the community—thus making the use of it free to all—without danger of jarring society or interfering with any in the possession of their homes, and how revenue for public necessities can be obtained without taxing the products of labor, either foreign or domestic. This problem solved and the remedies applied, the violation of nature's laws can be discontinued, and all *enforced* poverty will then be banished.

I claim that a simple change in our methods of taxation will entirely remedy the evil, and a perfect conformity to the laws of nature will follow. I propose to abolish duties on importation, and all taxation of every kind and character except that on land—bare land—exclusive of any and all improvements which may be upon it—for to tax improvements would be to tax the productions of labor—and this tax levied judiciously will practically restore all land to the people as a whole, without interfering with any in the possession of their homes, and will also furnish sufficient revenue for all purposes of government, federal and state.

Land is not a product of labor—it is a gift of nature—taxing it, therefore, is no infringement of the rights of labor or of the laws of nature.

Land has two elements of value; one given it by labor, the other by the community without any exertion of labor. The first should not be taxed; the second

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may be. A tract of land located a hundred miles away from any settlement or from a road leading to a settlement, has no value except such as labor applied to it gives, and should not be taxed; but a tract located within *one* mile of a growing city may be worth ten thousand dollars per acre, this value being given it solely by virtue of its proximity to the city, and the fact that, as the city increases in population, the land will eventually be required for city purposes. Now, inasmuch as the whole of this particular value of the land has been given by the community, and not by the labor of any individual who may occupy it, the interest of that value belongs, of right, to the community, and may be justly claimed and taken by it through taxation. If, therefore, the *interest of its value* is taken by the community, the land, for all practical purposes, is restored to the community, though the person who occupies it may continue to do so, or even to sell, exchange, mortgage or bequeath it, and if the taxes on such lands, whether in city, village or country, amount to sufficient to defray the expenses of all departments of the government, there will be no necessity of taxing the products of labor, and, therefore, the two laws of nature which I have named as having been violated will be restored to their normal dignity, and their violation then ceases. The cause of enforced poverty being thus abolished, that terrible foe to human happiness will disappear.

It must be evident to every reflective mind that nature gives to each human being as soon as he enters this state of existence, a right to the *free use* of the four elements, viz., fire (which embraces the light and heat of the sun), air, earth and water, and if he be deprived of either he must die. All the vast multitudes who are now upon the earth who are deprived of the free use of land must, therefore, live by sufferance, and be wholly dependent for their continuance in existence upon those who have possession of the soil. This deprives them of freedom, and gives the others enormous power over them, leading to their oppression, and helpless, hopeless poverty. To show clearly that such, in the nature of things, must be the case, let us suppose that the free use of either of the other elements was denied them;—they could not breathe without air; they would die of thirst without water; and would freeze to death without the light and heat of the sun; and if either of these had been seized by a portion of the race, that portion could demand of the rest for its use, and obtain, anything short of the sacrifice of their lives; their liberty and life-work could be exacted, and death would follow if they refused to yield them. It would be precisely the same should they be deprived of the free use of the land, as they could no more exist without land to live upon and from which to obtain their food, than they could without fire, air and water.

Now, in this country, our government and its predecessors have given away, or sold for trifling sums, all the land of the country, except in the Far West, and at least thirty-five millions of our population, young and old, are deprived of the free use of any of it. In pursuing this course the government has trampled upon the laws of God and the rights of man. They have, virtually, made slaves of that vast multitude of our people who, in order to gain a livelihood, are now compelled to work for others, and all the majority of them get is a poor living. It often happens, however, that their work is not required, and then, being thrown out of employment, starvation stares them and their families in the face. Now, if they had the free use of the soil, which is as much their natural right as the free use of air, light, and water, this could not happen, and they would be able to support life without being dependent upon others.

But this great outrage upon their God-given right to the free use of the soil is not all; the right which nature gives to every one to the *full* enjoyment of the fruits of his labor has also been trampled upon by our government. It has taxed the products of that labor, or, in other words, has taken away a portion of those products from the laborer, and to that extent has increased his poverty.

These two crimes—these violations of the laws of nature and the rights of man—are the cause of nine-tenths of all the *enforced* poverty there is in the country, the cause of the other one-tenth being the exercise of the power which monopoly has to take from all classes an undue portion of their earnings, which power was also granted by the government. Of course there are numerous instances of personal poverty which is not enforced but voluntary, among those who are idle, intemperate or improvident, but of this I am not writing. A great crime

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has been committed against God and man, not only by our government, but by all the governments of the civilized world, and for ages it has been practiced. It is certainly time that a stop should be put to it, and as the way this can be done has been pointed out, and as I have shown in previous papers that at least one thousand million dollars could be saved annually by a simple and practicable change in our method of taxation, it is to be hoped that our government, at least, will give the subject early and serious attention.

It may be objected that if we abolish duties on some descriptions of imported goods, certain manufacturing interests will be injured; but if taxing the productions of labor is a violation of the law of God and of the rights of man. the objection loses its force, and manufacturers of such goods must turn their attention to other pursuits. It may also be suggested that it would give an unfair advantage to foreign nations with whom we trade, but I am under the impression that if we abolish duties on their productions, they would do the same on ours; but, should any refuse to do so, a positively prohibitory tariff levied for a short time on their products would, undoubtedly, induce them to admit ours free.

To levy taxes judiciously is of the highest importance to the welfare of a nation. The land on which is built the house, store, shop or factory, and the farm of every one should be held sacred and as lightly taxed as possible, say not more than two or three per cent. on the value of the bare land; but where lots in cities and villages and their suburbs, or lands in the country, are kept from use merely that they may increase in value as population increases, and thus enable their owners to acquire wealth without earning it, and solely at the expense of the whole community, they should be taxed, at least, legal interest on their full value. This would force the owners either to pay the community well for the privilege of enjoying the monopoly, or else to sell to those who would use and occupy the land, or to let it be forfeited for non-payment of taxes, and thus be restored to the people. This plan would bring back to the people many million acres now held by railroad companies and speculators, and millions of building lots, in cities and villages and their suburbs, and when thus restored they could be let in such quantities as parties would be willing to pay the taxes on, and for such time as they paid the taxes and, like land held in *fee simple*, be occupied, let, sold or bequeathed from generation to generation, but also, like such land, be subject to periodical valuation, say whenever the census was taken. Land held in this way would be as secure to the occupant as land held in *fee simple* is now, for each would hold it as long as the taxes were regularly paid and no longer. Landlords in cities and elsewhere should be limited in their demands for rent, and not allowed to charge tenants more than the land tax and ten per cent. on the value of the buildings and other improvements they may have on the land, as more than this would tend to impoverish their tenants by taking from them an undue proportion of their earnings, which would be unjust.

Some may apprehend that the theory I have advanced tends toward "communism," but any person who will read my articles carefully and without prejudice, will see that there is no necessity for disorganizing society or causing anarchy in the slightest degree, and I most positively disapprove of such a course, and exhibit my disapproval by claiming that each person is entitled to the enjoyment of all the fruits of his labor, whether it be mental or physical, whereas communism demands that these fruits should be divided amongst the community.

CAMPING TOUR TO THE YO-SEMITE VALLEY AND CALAVERAS BIG TREES.—No. 13.

BY PROF. I. L. KEPHART, D. D.

It was six P. M. when we arrived at the camping ground. Our journey up from Murphies, beneath the scorching rays of a July's sun, was very fatiguing. The latter half of the road was beskirted by towering cedars, firs, and the stately sugar pines. These pines are very valuable for lumber, and mostly of immense size, some of them having attained a height of 300 feet, and a diameter of twenty.

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Their usual size, however, is a height of 200 feet, and a diameter of from four to seven. They closely resemble the white pine of the Atlantic States; but they bear immense cones, two of which we brought home with us that actually measure fifteen inches in length, and fifteen and one half inches in circumference.

Landed in camp, about all we felt like doing that evening was to prepare supper, make ourselves comfortable, and *rest*. However, weary as we were, we could not resist the inducement to look at a few of the famous Big Trees. How could we, when near by stood old Dowd (so named in honor of the discoverer of the grove), 14 feet in diameter, and just "over the fence," and within three rods of our camp stood the mighty "Emerson," and yonder in the direction of the Sperry House (a fine hotel kept by Mr. Sperry, the proprietor of the grove), and within one hundred yards of our wagon, stood the "Two Sentinels," just sufficiently distant from each other for the main wagon road to pass between them. We stood and looked at these trees, and felt—extremely disappointed! Having been gazing, during the whole of the afternoon, at the stately sugar pines, these "Big Trees" did not seem near so large as we had expected they would. Only when we walked down to, and *around* them, did the immensity of their size begin to impress itself upon our minds; but even then we could not realize that they were as much as three hundred feet in height. Returning to our camp, we relished a bounteous supper, and having lighted a camp-fire by burning sugar pine cones, we sat around chatting for an hour, and then retiring, enjoyed a good night's rest.

Morning having come, before starting on a stroll through the grove we paused to ascertain our geographical whereabouts; and our guide-book informed us that the Calaveras Grove of Big Trees is situated in Calaveras County, near the line of Tuolumne County, in a small valley that extends in a northwest and southeast direction, lat. 30° N., and long. 120° 10' W., in the Sierra Nevada Mountains, at an elevation of 4370 feet above the level of the sea. There are really two groves, the Calaveras and the South. The former is about 3200 feet in length and 700 feet in width, and contains ninety-three mammoth trees (*Sequoia gigantea*) and more than one hundred sugar pines. The South Grove is seven miles south of the Calaveras, extends east and west three and a half miles, and contains 1380 large trees—any tree under eighteen feet in diameter not being considered large.

These trees (the North Grove) were discovered in 1850 by Wooster, Whitehead and party, so it is said. In 1852 they were again discovered by a man by the name of Dowd, who was employed as a hunter, to supply a body of miners with fresh meat from the large quantities of game frequenting the mountains. Pursuing a bear that he had wounded, he suddenly found himself in the presence of these colossal trees; and the sight so astonished him that he forgot all about the bear.

Returning to the miners' camp, he gave a description of what he had seen; but the miners laughed at his story and ridiculed his enthusiasm.

He said no more about it; but a few days later he reappeared in camp with the news that he had slain an enormous bear, and desired the assistance of some of the men to bring the carcass into camp. A party accompanied him; for miles they toiled on until they were on the point of becoming disgusted, when all at once they were in the presence of the mammoth trees. Then the hunter confessed that his bear story was only a ruse by which he contrived to bring them into the presence of these giants of the forest, that they might see for themselves and testify to the truthfulness of his former report.

In due time an article appeared in the *North American Review*, describing the new California "sensation." It attracted but little attention in this country; but, when republished in an English magazine, it stirred and aroused the interest of the most distinguished botanists in the mother country, and Dr. Lindley named the new species *Wellingtonia gigantea*. When this became known in America, *our* scientists became indignant at the idea that America's greatest tree should bear the name of *England's* greatest hero. A warm discussion ensued, which, however, was brought to a satisfactory termination by an agreement that the English might, if they wished, retain the appellation, *Wellingtonia gigantea*, but among orthodox Americans it should be known by the name of the Indian chief, *Sequoia*. (See "Nelson's Guide Book," p. 35.)

In this valley snow usually falls about the first of December, and disappears

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about the middle of April. Vegetation blooms early in May, and remains fresh and green till the middle of October. The San Joaquin and Sierra Nevada Railroad, the eastern objective point of which is this valley, now runs to within forty miles of the grove. A line of stage-coaches forms the connecting link between the railroad and the grove. The Sperry House affords splendid hotel accommodations for all tourists; but the most satisfactory, inexpensive and independent manner in which to visit the grove (for those who have plenty of time) is in a camper's wagon.

On the morning of July 15th, having set our camp in order, we set out for a stroll among these wonderful trees. We passed down between the Sentinels, which stand on the edge of the small rivulet that flows through the valley (each over 300 feet high, and one of which is 25 feet in diameter), and going in the direction of the Sperry House, we soon came to the pavilion. This is a circular summer-house and dancing-hall erected on the stump of one of these great trees, which was cut or bored down in 1853. The tree was 92 feet in circumference and over 300 feet high. Five men worked twenty-five days in felling it, using large augers. The stump has been smoothed off, inclosed by the pavilion—a nice summer-house—and it is said that it easily accommodates thirty-two dancers. Theatrical performances have been held on it, and in 1858 a newspaper —the *Big Tree Bulletin*—was printed on it. Near the stump lies a section of the trunk; one section of it was taken to the Centennial Exhibition in 1876, and beyond the space thus made vacant lies the remainder of the body of the tree. The section lying near the stump is stripped of the bark, and measures 25 feet in diameter. A set of plank steps are reared against this section, and in the afternoon we returned to this place, and the Professor and I ascended these steps and, seating ourselves on the immense log, wrote letters to our friends, while the women remained in the pavilion, chatting and posting their diaries.

Leaving the pavilion and proceeding on our stroll, we soon came to a cluster of *Sequoias*, named, respectively: "U. S. Grant," "W. T. Sherman" and "J. B. McPherson." To the right and southward thirty yards is a group of three trees named, respectively. "Phil. Kearney," "John F. Reynolds," "Commodore Vanderbilt." Sixty yards east of "Grant" and "Sherman" is the "Pride of the Forest." It is 23 feet in diameter and 300 feet high, and one of the healthiest and most graceful trees of the grove. Near it stands "Phil. Sheridan," and near this lies the trunk of the "Miner's Cabin," which was blown down in 1860. It is 319 feet long, and twenty-one and a half feet in diameter.

Seventy yards east of the "Miner's Cabin" stand the "Three Graces," a most beautiful cluster, and 50 yards north of these stands "Andrew Jackson." To the west from "Jackson." 20 paces, stands "Florence Nightingale"; eastward 30 paces, the "Bay State"; north 40 yards, "W. C. Bryant," to the left of which, 20 feet, stands "Wm. H. Seward." Beyond "Seward" is the "Pioneer's Cabin," one of the largest trees, whose hollow trunk resembles a cabin and chimney. South of the "Pioneer's Cabin," 70 yards, in the center of the grove, is a tree 280 feet high, 17 feet in diameter, and so hollowed out on one side by fire that it has been named "Pluto's Chimney." The chimney extends from the ground to the height of 90 feet.

Eighty yards east of the "Pioneer's Cabin," the one on the right the other on the left of the path, stand "California" and "Broderick," and near by stands "Henry Ward Beecher," which is 280 feet high and 14 feet in diameter. A few steps from this is the "Fallen Monarch," the base section of a huge trunk, which, seemingly, has been down for centuries. It is still 18 feet in diameter, though all of the bark and much of the wood has been wasted away by time. What is left is perfectly sound; but the upper half, which struck the earth with greatest force, has all disappeared, and trees nearly a century old are growing where it struck. It must have been over 300 feet high and 25 feet in diameter.

Fifty paces east of this is "Abraham Lincoln," 18 feet in diameter and 320 feet high; and 100 yards north of this is "Elihu Burritt," twenty paces to the right of which is "Uncle Sam," near which stands "Alta California." Fifteen steps north of this one is "Union," next to which stands "General Wadsworth." The trees of this cluster average 15 feet in diameter and 260 feet in height.

Beyond this stands "The Mother of the Forest." The bark of this tree was

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stripped from it in 1876, to the height of 116 feet, and carefully taken down in sections, numbered and taken to Philadelphia, Pa., set up in the Centennial Exhibition, and from there it was taken to London, set up in the London Museum, and burned when that building was destroyed by fire. The following measurements and figures will give an idea of this, now dead, but still standing, tree: At its base its circumference is 84 feet; at 20 feet from the ground, 69 feet; at 70 feet from the ground, 43 feet 6 inches; at 116 feet from the ground the circumference is 39 feet 6 inches. Its height to the first branch is 137 feet, and its total height is 321 feet. Now, reader, these are *facts*, and not merely "California big yarns."

North of "The Mother" and outside of the inclosure are "The Twins," and a nameless tree, 16 feet in diameter, and 300 feet high. Fifty yards on the trail after it turns southward is "General Sutter," which, dividing thirty feet from the ground, forms two distinct trees, each 280 feet high. "Salem Witch," "Longfellow," "Asa Gray," and "Dr. John Torrey," are next close together, and are all fine trees. Fifty feet to the west of these stand "The Trinity," three trees growing from one trunk. One hundred feet from "Longfellow" is the family group. Of these, "The Father of the Forest," long since fallen, measures at the base 112 feet in circumference; it can be traced 300 feet where the trunk was broken in the fall, and where it still measures 16 feet in circumference. This tree must have been at least 400 feet high. A hollow chamber or burnt-out cavity extends through the trunk 200 feet, large enough for a man to ride through on a donkey. We all walked through this trunk; and the Professor and I, proceeding some 20 feet beyond the opening in the side through which the women made their exit, mounted the little ladder standing there, and actually came out at a knot-hole *without any difficulty;* FACT!

Ninety yards from here are the "Starr King," "Richard Cobden," and "John Bright." "Starr King" is the tallest standing tree in this grove, being 366 feet high. "Daniel O'Connell" and "Edward Everett" stand next, south of the above trio. Midway to the "Father" stand "James King of William" and "Keystone"; and close north are "Sir John Franklin" and "Dr. Kane." Near "Dr. Kane" is the "Century," and ten feet from the "Keystone" stand "La Fayette" and "John Le Conte." "Hercules" stretches his huge body across the path next. This was the largest tree standing in the grove until 1862, when during a heavy storm it fell. It is 325 feet long and 97 feet in circumference. A few paces north of the roots of "Hercules" are the "Sequoia Queen," and her "Maids of Honor."

"Sir Joseph Hooker," "John Lindley," "Humboldt" stand together on the hillside near the shattered top of "Hercules." Near these are two young sequoias, say sixty years old. "The Mother and Son" are directly in the path, and 30 yards north of these is "Gen. Scott," 325 feet high. "The Old Maid," 60 feet in circumference, which fell toward "The Old Bachelor" in 1865, lies along the hillside all broken to pieces, and near "The Old Bachelor" stands "Kentucky," "The Siamese Twins," "Daniel Webster," and "Granite State" right on the trail, with an average diameter of 20 feet and a height of 305 feet. "The Old Republican," "Henry Clay," "Andrew Jackson," and "Vermont" greet us next. Then come "The Empire State" 94 feet in circumference, and "Old Dominion," both first-class trees. Next we come to "George Washington," between which and "The Empire State" stands "Uncle Tom's Cabin." From this we soon emerge from the grove right at our camp, where, before crossing the fence, we stand a few moments admiring "Emerson." Such is the North Calaveras Grove of "Big Trees." For the measurements and description of localities, etc., I am indebted to Sperry Hotel circular letter-head. During the following two days we made frequent tours through this grove, and in the afternoon of the second made preparations to visit the South Grove, an account of which I will give in my next and *last*.

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THE CHEMISTRY OF WHAT WE EAT.

BY HENRY A. MOTT, PH. D., F. C. S.

Fish.

As in many places fish constitutes the sole food of the inhabitants, who are called *Ichthyophagi,* it is necessary to devote considerable time to the consideration of this article of food.

Fresh and salt waters abound in a vast variety of fish. About 9000[1] species of living fishes are known, variously distributed, and found in greater or less numbers in almost all the waters of the globe, fresh and salt. The greatest number of species, however, are found in the tropical waters, and especially in the seas of the Indo-Moluccan Archipelago.

Dr. H. Simpson[2] states that no less than forty-five varieties of fish are eaten in one locality in India, viz., Dacca.

In northern localities, where it is too cold for higher vegetation, fish forms the principal food.

In the writings of Moses[3] it is stated: "Whatsoever hath fins and scales in the waters, in the seas, and in the rivers, them shall ye eat. . . . Whatsoever hath no fins or scales in the waters, that shall be an abomination unto you." For this and other reasons considerable prejudice existed against the consumption of fish. The Egyptian priests were forbidden to eat fish of any kind, under the idea that it increased the sexual appetite, or that it was the cause of leprosy. Henry I. is said to have died from eating too much of the lampreys.

At the present time, however, the lamprey, sturgeon, cod, whiting, and eels (fish without scales) are eaten with relish and without producing any bad effects.

Some fish are poisonous—mostly those found in tropical climates, and these are only poisonous at intervals.

The symptoms produced[4] resemble those of cholera. Sometimes an eruption, like nettle-rash, appears, or various nervous disorders, such as trembling or convulsive twitching of the limbs, paralysis and stupor.

Just what the poisonous effect is due to is difficult to ascertain; certainly sometimes to idiosyncrasies, and more frequently to the fact that the fish have been dead too long, although it is said that putrid fish have been eaten and enjoyed by some tribes.

It has been stated that a fish must be regarded with suspicion "if it has attained an unusually large size, or is destitute of the natural fishy smell, or has black teeth, or if silver or an onion boiled along with it becomes black; but all these tests are unreliable." As a general rule, the flesh of fish should not be soft, but firm and hard; and the gills of the fish should have a rich, dark color, and not a pale color, which is, as a rule, present in stale fish. Any one who has had the good fortune to eat fish within a few minutes after being caught, knows the marked difference between such fish and fish purchased in the market.

Letherby[5] says: "Fish is not a favorite article of diet with the laboring classes, unless it is salted or smoked, and then it is chiefly used for its flavoring qualities."

There is no doubt about fish being inferior to the flesh of quadrupeds and birds, as an article of nourishment, as it lacks the satisfying and stimulating properties. In Holland, Sweden, and Russia, however, where the poor rarely taste meat, the staple article of food, with coarse bread, is dry, salted fish, and it is found to be sufficiently nutritious. As fish does not satiate the hunger as well as meat, the appetite returns oftener, in consequence of which more fish must be eaten than would be required of meat.

The fact that the health of the inhabitants of fishing towns is high, and the fisherman is more or less active, tends to show that a fish diet is capable of sustaining life in an effective manner. Dr. Davy[6] states "that the ichthyophagous class

[1] "Johnson Cyc." Fish.—Theo. Gill. [2] "Rep. on Dietary," 1862.
[3] Leviticus, xi. 9, 12. [4] "Food and Diet."—Pereira, p. 284, 1843.
[5] "On Food," p. 41.—1872. [6] "The Angler and His Friend."—John Davy, p. 114, 1855.

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are especially strong, healthy and prolific; and, in fact, in no other class do we find larger families, handsomer women, or more robust and active men."

Among the different varieties of fish[7] we find the cod, lisse, plaice, sprat, turbot, sole, flounder, sturgeon, sword-fish, haddock, whiting, herring, mackerel, shad, pilchard, eel, mullet (red and gray), skate, halibut, bass, sea-bass, bluefish, blackfish, pike, carp, tench, roach, pickerel, perch, salmon, trout, bream, anchovy, whitebait, and smelts.

Fishes are generally divided into two classes, viz., into white-blooded and red-blooded. The first class may be represented by cod, sole, turbot, brill, plaice, flounder, etc. The second class may be represented by salmon, etc.

The flesh of white fish, as a rule, contains less oil than the flesh of red fish. In the salmon the oil is distributed throughout the muscular tissue. In the cod it is stored up in the liver. The sole contains little oil; the eel, however, contains considerable.

The nutritive value of different varieties of fish differs much more than the nutritive value of the flesh of the mammalia.

Fish differ in delicacy and flavor. The whitebait, when properly cooked and served, is the most delicate, while the trout, smelt, Spanish mackerel, shad, salmon, and halibut are highly esteemed.

The quality of fish depends considerably upon the time of spawning, for just before this period the animal is fatter and has a richer flavor, and is therefore appreciated the most. During the spawning time the fish is "out of season," and is flabby and inferior, and just after spawning, from loss of fat, the fish is thin and more or less unfit for food. Young fish are always "in season," as they have not arrived at the age of spawning.[8]

Mr. Tull[9] states that fish were at one time subjected to the process of castration and spaying, the object being to prevent the excessive increase of fish in ponds where the numbers did not permit any of them to grow to an advantageous size. Not only, it is stated, was the desired result attained, but the fish that had undergone the operation grew much larger than their usual size, were fatter, and remained always in season. This practice is not, however, kept up; in fact, it has been the study of pisciculturists for some time to study and perfect processes for the artificial incubation of the eggs, so as to stock the rivers with fish.

The cod and mackerel (in common with allied species) deposit eggs whose specific gravity is so light that they ascend to the surface and then undergo development.

The herring, like the mackerel, is a deep-water fish, which visits the coast periodically for the purpose of finding spawning grounds. They associate in immense schools, of which the females are said to exceed the males in the proportion of more than three to one. The eggs of the herring are deposited on the ground and there become matured and hatched.

Investigation showed that the eggs of fishes are impregnated after leaving the parent,[10] and it was found that fish-eggs could be impregnated and hatched artificially by man with vastly better results than were produced when the fish were left by themselves.

The possible yearly increase of fish is very great, the ratio of increase varying from 100 to 1 in a yearling trout, to perhaps 1,000,000 to 1 in a full-grown sturgeon.

This increase, which is nearly all lost in nature, can be almost entirely saved at a comparatively insignificant expense by artificial impregnation and hatching.

The honor of the discovery of the artificial impregnation of the eggs of fish is generally conceded to Major G. L. Jacobi, of Hollenhauser, whose experiments were published in the *Hanover Magazine*, in 1873.

Stone says: "The principle of the artificial impregnation of eggs is substantially the same with all the varieties of fish that have been experimented with."

It consists in mixing the eggs of the female fish with the milt of the male in some convenient receptacle immediately after the eggs and milt leave the fish. The fecundation of the eggs being merely a mechanical process, this artificial

[7] See "Foods."—Edward Smith, p. 106.
[8] See "Food."—Pavy, p. 170.
[9] Phil. Trans. 1754.
[10] See Fish Culture, "Johnson Cyc."—L. Stone.

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mixing impregnates them better than if the fish had mixed the eggs and milt themselves.

The subsequent treatment of the eggs after impregnation is quite various with different kinds of fishes. The salmon (*salmo salar*), the shad (*alosa præstabilis*), the glass-eyed pike (*lucioperca*), and the yellow perch (*perca flavescens*) are representative fish, the salmon representing the class of fish depositing their eggs separate like shot, and spawning in cold water; the shad representing the fish which have similar eggs, but spawn in warm water; the glass-eyed pike representing the fishes whose eggs come separate from the fish like shot, but which stick inseparably together upon entering the water; and the yellow perch representing the fish which deposit their eggs united in a gelatinous mass, resembling frog spawn.

The time it takes for salmon eggs to hatch depends wholly on the temperature of the water. If the water stands at 45° F., as at the Cold Spring Trout Ponds, at Charlestown, N. H., it will take seventy days, but at the U. S. Salmon Breeding Station, at the headwaters of the Sacramento River, only thirty-five days are required, as the water is 55° F.

As an illustration of what is done at the various fish-breeding locations of this country, it may be stated that at the Cold Spring Trout Ponds in 1873, 200,000 trout eggs were hatched, also 50,000 California salmon eggs, and 160,000 Penobscot salmon for the State of Vermont. In 1867, at an expense of a few hundred dollars, shad were artificially hatched, and returned to the Connecticut River by Seth Green,[11] one of the pioneers of American fish-culture. In three years, the time required for shad to mature, these fish had become more abundant in the river than they were before the white man began to fish them out.

There can be no doubt but that fish-culture is destined to be one of the great practical arts of the present civilization.

(*To be continued in the February number.*)

THE ENCYCLOPEDIA, DICTIONARY, AND THESAURUS.

THEIR VALUE TO YOUNG STUDENTS.

BY THE EDITOR.

We have often wondered why it was that so little had been written illustrative of the importance of a good encyclopedia to persons seeking for general information. There prevails a very erroneous conception of the use and value of such a condensed library or compendium of knowledge. It is generally supposed that an encyclopedia, like the common dictionary, is only needed and to be used as a reference book for the purpose of acquiring a knowledge of some particular thing which happens to be sprung by reading other books, or that may come up in conversation, about which doubt at the time exists; and that, as in the case of the dictionary, it would be a dry and profitless employment of one's time to go into a regular reading of such a work as a set line of study.

No greater mistake than this, however, could well be made by an intelligent young man or woman who may be anxious to become generally posted, and who might laudably wish to appear to their associates intelligent on all subjects that are liable to come up in conversation.

Persons who have not given special attention to the advantages to be gained by the regular study of a good encyclopedia as a home or school book, can form but a limited conception of the extent and variety of information that will accumulate in a retentive memory by a regular habit of such a course of reading. The very diversity of the subjects treated, in the alphabetical order of titles, furnishes a relaxation to the mind of the student as he finishes one subject and takes up another on a question wholly unanalogous and quite probably bearing no resemblance to the one just concluded. This very relief from mental strain, or unbending of the intellectual bow, furnishes a source of rational recreation while

[11] See Conn. Fisheries Report, 1871.

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storing the mind with useful knowledge so varied in its character as not to become wearisome and insipid. For we may rest assured that not one of the thousands of subjects so carefully treated in any good encyclopedia, even if all be not absolutely correct, but contains information of real value to the person who may wish to become largely intelligent upon matters of universal knowledge. And one of the most inspiring results of such a regular reading of an encyclopedia is the grand impression one receives of the work of intellect required to discuss and formulate such an enormous variety of subjects, and, by the joint efforts of the different minds employed, to bring together such an almost inconceivable amount of information as is massed in a set of these volumes. A hasty glance through such a work, with a mere glimpse of the results which have cost so much research, study, and erudition, impresses one with the majestic achievements of the human intellect somewhat as we are impressed by the works of creative wisdom when viewing through a telescope the starry heavens, and then turning to scan the superlative wonders in the other direction revealed by the microscope.

Another way of profitably reading an encyclopedia, as a school-book for home study, is to take one subject of general information, in almost any department of knowledge, read it carefully and at the same time note down every principal word it contains, which will be found to be the basis of some other encyclopedia article. Then, when the first article is finished, take up the others referred to in it, in the order of their occurrence, and in like manner, while reading each article, note down all new subjects alluded to in it, and so on till the subjects noted shall run out. We venture to predict that such a reading and such a persistent noting down of new subjects embracing other articles in the same encyclopedia, would, by direct accumulation and constant accretion of new articles, ultimately lead to a reading of the entire encyclopedia, as completely as if gone through page by page consecutively.

Before commencing to write this paper we spoke of the last-named conclusion to our corresponding clerk, Robert Rogers, who agreed that we were right, and by a couple of hours of careful investigation, with a set of Appleton's "New American Encyclopedia," we reached the conviction that our broad position was unquestionably correct, and that by commencing with any one prominent article of either of the volumes that might by chance be taken up, the whole encyclopedia would be embraced and exhausted by the continuous noting down and reading the various new subjects incidentally mentioned, as herein set forth.

Let us now illustrate this position and see if it does not show evidence of truth. Take, for example, the single article on "*glass*," to commence with. By glancing over a portion only of this article we noted down the following list of subjects incidentally mentioned therein, each of which forms the foundation of explanatory discussion in other articles somewhere in the different volumes. The reader, by looking over this list will see what a vast amount of information would be obtained should each subject, thus alluded to, be thoroughly read up. The following is a partial list of these leading words:

Chemistry, fusion, vitreous luster, silica, alkali, lime, metallic oxide, crystal, quartz, soda, chloride of silver, enamel, mica, boracic acid, potash, zinc, barytes, iron, lead, flint, soot, manganese, oxygen, uranium, strass, copper, silver, gold, saltpeter, magnesia, arsenic, alumina, antimony, porcelain, silk, caoutchouc, wax, soap, diamond, litharge, rosin, emery, steel, oil of turpentine, camphor, wine, feldspar, basalt, carbonic acid gas, opaque, transparent, malleability, amethyst, lenses, microscope, lava, volcano, hieroglyphics, astronomy, Thebes, Egypt, Nineveh, Phœnicia, Pliny, Sidon, Alexandria, Strabo, Theophrastus, Aurelian, Liebig, Cicero, Herculaneum, Pompeii, Rome, England, Europe, Venice, Bohemia, Cherbourg, Paris, Oxford, London, United States, Great Britain, France, Australia, Germany, New Hampshire, Harvard University, Washington, Munich, New Haven, Boston, Massachusetts, Virginia, Missouri, Mississippi, Florida, New York, Jersey City, Philadelphia, Pittsburg, Ohio, Alleghanies, Michigan, etc.

Such is a mere specimen of the range of subjects forming special articles in this encyclopedia, hundreds upon hundreds of which will, if carefully examined and noted, yield equally formidable batches of new articles discussed in still other parts of the same work, till the whole storehouse of knowledge is involved in the almost limitless details of the descriptions and investigations.

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Now suppose the student shall have read through this discussion of "glass," and after resting shall attack "chemistry," the first word noted in his list of new subjects; it, alone, will certainly yield as many more themes for separate articles that will be entirely new, and so on, more or less, with each of the words in this entire category of subjects, so that by the time the reader has gone through with the progeny of "glass" alone, and noted all the offspring they shall produce, he will have many thousands of uninvestigated articles on his hands to look after, which in turn will bring forth still a greater crop of new sheaves to be thrashed; and so on till every word of the mighty compilation of subjects shall have become involved.

We do not expect any student ever to exhibit such industry as to pursue this course in the study of an encyclopedia, however thorough and instructive it might prove to do so. We only refer to it, and illustrate it by a single example, that the reader may catch a glimpse of the resources of intellectual food which are condensed in one of these most valuable compendiums of human knowledge.

Whatever the motive of wealth or personal aggrandizement may have been which prompted the originator and getter-up of the first general encyclopedia, from which all other works of the kind have emanated with various degrees of improvement, one thing is sure, that the world owes a debt of gratitude, that never will be paid in time, to the man who first conceived, formulated, and carried out this idea.

Even the value of the common dictionary is greatly underrated, being regarded as a book never to be opened or examined only as one wishes to determine the definition, orthography, or pronunciation of some word that may happen to be in doubt. On the contrary, one of the most accurate and accomplished conversationalists we ever knew, as to the proper meaning and pronunciation of words, and as to an interminable supply of the same, was a young lady in Dubuque, Iowa, whose mornings and evenings were regularly devoted to a diligent study of "Webster's Unabridged Dictionary" as a simple and ordinary school-book for home use. No Vassar girl she chanced to meet could begin to cope with her for accurate and extensive command of English words, or for a comprehensive grasp of their unexceptionable pronunciation. So thorough and infallible did she finally come to be regarded in this latter particular, and so famed as a linguist generally, that, by universal consent among her acquaintances, she was regarded as an orthoepic oracle. Surely this was something of which to be justly proud, and, compared with the ordinary accomplishment of punishing a seven-octave pianoforte, shone like Sirius in the presence of a cluster of telescopic nebulæ.

And in this connection we may add, that the most generally intelligent person of his age we ever knew, as relates to all questions of science, history, biography, geography, art, literature, manufacture, commerce, monetary matters, etc., was a young man in Tiffin, Ohio, who gave several hours a day to the patient and careful reading of the various articles of an encyclopedia as a simple school-book, which he had purchased with money he had earned by teaching school.

We instance these two persons as mere illustrations of many others whose influence in society, as intelligent and accomplished young men and women, depends largely upon the knowledge they have obtained in the manner here intimated.

And here, *en passant*, we wish to refer to another book partaking somewhat of the nature of a dictionary, and of the greatest importance to the student of the English language—a book, perhaps, the least known of any school or text-book published. Indeed, we may truthfully say, that not one person in one thousand, among even the educated classes, has ever heard of the book, much less seen it. We refer to the "Thesaurus" of English words, a book of seven hundred pages, the compilation and arrangement of which cost a patient English scholar (Dr. Roget) an entire lifetime of more than fifty years to accomplish. We have spoken to a score or more of educated persons, incidentally alluding to the "Thesaurus"; and, to our astonishment, not one of them knew what we meant, or had ever heard of such a work; yet it is one of the most invaluable private text-books in the English language for the general student, and, especially for a writer, next to a good encyclopedia and a standard dictionary.

But what, asks the reader, is a *thesaurus?* It is not a book of synonyms

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(several of which exist by different authors), but it is a work of vastly wider range and of immensely greater importance. It contains all the principal words of the English language so arranged and classified as to be readily found, and alongside of which is presented every word or phrase directly or remotely having the same meaning, or presenting any resemblance to such signification; and then, in another column, the opposite words and phrases are given, or those having similarly opposite shades of meaning. The convenience and usefulness of this wonderful exhibit of patient, scholarly industry and research can scarcely be overestimated by a writer for the public press, especially one not long experienced in literary composition.

One of the most detestable things in current literature is the careless repetition of the same word or phrase in close proximity, when substantial synonyms are within ready reach. This glaring defect is surprisingly common and observable even in the set papers of some of our best magazines and daily journals, and so marked is its inexcusable recurrence that a sensitive reader is tempted at times to throw down the publication in disgust before finishing the article.

The habit of thus reiterating favorite and hackneyed forms of speech, by even some of our most popular writers, when no reasonable necessity exists for so doing, could at once be corrected by a little attention to the instruction which this admirable volume affords. Not a single instance, we venture to assert, occurs in ordinary composition, where the same expression need be repeated till the chain of argument has advanced so far from the previous employment of the term that its sound has ceased to ring in the reader's memory. Could the tautological essayists here alluded to fully realize the intrinsic value of this work, as an aid to the selection of a rich variety of expressions, and by which even a superabundant choice of words and phrases might always be at hand, they would surely not be caught unnecessarily repeating themselves in the reiteration of commonplaces to the utter disregard of refined literary taste.

In conclusion we would say, so important do we regard the book referred to as a companion-piece to an unabridged dictionary for any man or woman who writes, or expects to become a writer for the public, that its cost would be but a mere bagatelle compared with its permanent advantages. And realizing, as we have personally done for these several years, the value of this book to the student and writer, by which he may concisely express his thoughts even to the nicest shades of meaning, we are only surprised that it has not already found its way into the library of every thinking person in the land.

"TIME AND SPACE."

There appeared in last month's MICROCOSM an article, from the pen of our esteemed contributor, Mr. Duval, with the above heading, in which the writer insists that "space" must be "something" in itself, because *something* can be put into it. From the criticisms of a number of our readers we have deemed it necessary to call attention to this singular position and reasoning by a few brief remarks; and we ask the reader, before proceeding farther, to turn to the last MICROCOSM, p. 80, and re-read this very critical article of Mr. Duval.

We have no hesitancy in admitting the reasoning of our contributor to be quite ingenious, to say the least; but it can only be ingenious *sophistry*, in the very nature of the case, and it is a fact that sophistry very often is so ingenious that it becomes difficult, if not impossible, to expose it in such language as to make its fallacy manifest even to the mind of a logician. But we will try to look into this, as it appears to us, self-contradiction in essential meaning, if not in definite terms.

There can be, in the first place, no such thing as *vacant space*, in the absolute sense, in the universe. To be absolutely *vacant*, space should be entirely beyond the reach of all substantial entities of whatever kind or character. The apparently vacant space, for example, in this room is filled with many different and real substances, material and immaterial—such as air, odor, heat, light, sound, magnetism, electricity, gravity, etc., or with the force-elements of nature,

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out of which the forms of force here named proceed, or are generated. Could we produce a perfect vacuum in perfect darkness and silence, and in the absence of heat, magnetism, electricity, etc., still there can be no space that is not permeated at all times by *gravital attraction*, or the substantial force-element which constitutes it. This proves that no such conception is possible, to begin with, as *absolute vacuity*, leaving out of account the omnipresence of a substantial God himself, which no exhausted receiver would exclude.

But this unavoidable conception of some sort of substance as actually present everywhere in the universe (making it impossible to conceive of space not filled with something) did not enter into Mr. Duval's premises or calculations at all. He assumed the utter inconceivability of an absolutely *vacant* space free from any substance, and yet insisted that such space—such positive *absence of everything*—must still be "*something*," because it naturally left room for *something!*

Now we fail to see the logical force of such reasoning. If *vacant space*, in the absolute sense, is not the absolute equivalent of *nothing*, in its most elementary signification, then we should like for Mr. Duval to tell us in concise words what constitutes *nothing*. We challenge his fine intellectual abilities to conceive of *nothing*, by any stretch of his imagination, according to his views, because he has no place for it unless it should be in absolute *vacuity;* but as he makes absolute vacuity a "*something*," he has no use for the term *nothing* in his vocabulary, since the absolute absence of everything, could it exist, instead of being *nothing*, he also claims to be "*something*."

Now, since the absence of all substance (*absolute vacuity*) is with him still "*something*," we cannot for the life of us see why the absence of light, called *darkness*, the absence of sound, called *silence*, or the absence of heat, called *cold*, is not also "something," since *darkness*, *silence*, and *cold*, just as certainly leave room for *light*, *sound*, and *heat*, as vacuity leaves room for substance. But Mr. Duval admits very correctly, though not very consistently, that *darkness*, *silence*, and *cold* are simply and absolutely *nothing*, for no reason in the world except that they are each specifically the absence of something. He would not think of insisting that a *shadow* was something because the thing which casts the shadow might occupy its place. But he does insist that *vacuity* is something, because something might be put into the place of such vacuity! He supposed that because he can calculate the cubic contents of a box inclosing a yard of vacant space, therefore this space must be "something," or else he could not calculate it, and if the space were not something, the sides of the box would touch. By the same sophistical method of reasoning he should conclude that because he can calculate the length of a *shadow* in feet and inches, therefore a shadow must be *something* or he could not calculate it. We can measure off a cubic yard of *darkness* inclosed in "plates of brass" just as readily as we can measure off a cubic yard of *vacuity* or a cubic yard of marble. Therefore if darkness was not *something* the sides of the brass box ought to come into actual contact! Is this sound reasoning, or is it sophistry?

But is it not possible to determine concisely and almost intuitively what is meant by *time* and *space?* Let us see. *Time*, in its specific sense, is measurable duration in which the sequence of finite events is conceivable and possible; while in its generic or absolute sense, *time* is the ceaseless onflow of infinite duration, of which neither beginning, middle, nor ending is conceivable or possible. *Space*, in its specific sense, is measurable distance or expanse between points of observation, as the conceivable *room* or *vacancy* in which objects may exist; while in its generic or absolute sense, space is simply *room* or *extension*, occupied or unoccupied, of which center, diameter, or circumference is neither conceivable nor possible, and wherein substance exists or may exist to infinity; and hence *space*, in itself, is *nothing*, being generically and in an absolute sense the opposite of *something*, just as *darkness* is the specific opposite of *light*, *silence* the specific opposite of *sound*, and *cold* the specific opposite of *heat*, neither of which, as the opposite or absence of the specific entity involved, can be anything.

We have read many pages of attempted definitions of *time* and *space*, given by the most learned men of the world, from Plato and Aristotle down, as collected by the tireless research of our associate, Dr. Mott, and we marvel, as we read, at the labored array of words and sentences in an almost meaningless effort to reach intelligible conclusions, when the words themselves scarcely need defining at all,

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except so far as the merest statement of a few self-evident truisms is concerned, as presented above.

Of course, as Mr. Duval insists, we cannot conceive of the annihilation of a cubic yard of *vacant space* in its specific sense, only by filling it with some substance; neither can we conceive of the annihilation of a cubic yard of *nothing* only as we put *something* in its stead. The only way we can annihilate a cubic yard of *darkness* is to fill the same space with something—*light*. Yet a cubic yard of *darkness, vacuity*, or *nothing*, conveys one and the same idea, only considered from different standpoints.

The fact that there are 95,000,000 miles of space between here and the sun, as Mr. Duval urges, no more proves space to be "something," than the fact of 95,000,000 miles of darkness between here and the sun (in case the heavenly bodies should all cease shining) would prove darkness to be something. According to Mr. Duval, if there were absolutely *nothing* substantial in the entire universe, still the universe would be absolutely full of "*something*," since the *absence* of everything is as really "something," as its *presence* would be! Was there ever a more stultifying self-contradiction than this? We repeat, then, if absolute vacancy or pure space is still "something," it is clear that *nothing* and *something* must be synonymous terms. In sober truth, should any such conception as this ever chance to find a serious lodgment in our brain, we should begin to suspect that we had found at least one absolutely "vacant space" in the universe, namely, in our own cranium.

IS DRUG MEDICATION A SCIENCE, AND HAS IT BEEN A BLESSING OR A CURSE TO THE HUMAN FAMILY?—No. 5.

BY MRS. M. S. ORGAN, M. D.

Startling as it may sound to the Christian world—which indorses the theory and practice of drug medication—it is nevertheless an incontrovertible fact that drug medication has its origin essentially in *materialism;* without this foundation its whole superstructure would "dissolve like the baseless fabric of a dream." Its primary premise, drugs—inorganic matter—acting upon living matter through inherent affinities, necessarily incorporates, or, in fact, is based upon the doctrine that vitality is but the result of inorganic affinities; that certain combinations of matter terminate in organic structure and life. There is no escape from this conclusion; for, if drugs—inorganic matter—act upon living matter through innate affinities, then there is, there can be, no barrier between the organic and inorganic world; the play of inorganic forces would necessarily culminate in vitalized structure; and it can then truly be predicated of matter, that "it contains in itself the promise and potency of every form of life."

The elemental principles of Nature's constitutional laws necessitate the acceptance of one of two positions: either there is *no* affinity whatever between organic and inorganic force—that their relation is one of perpetual antagonism; or else drugs—inorganic matter—*do* act upon living structure through inherent affinities. If the latter be true, then its corollary, vitality, mind, and spirit are the result of peculiar arrangements of matter, must also be true. Matter then becomes the eternal self-existent creative force from which emanates all life, organic and mental. There is no intermediate ground between these positions; they stand in direct antithesis.

If the fundamental premise of drug medication be true, then materialistic philosophy solves the problem of all life, vital, mental, and spiritual, and death inevitably terminates all.

Thus it becomes evident that the principles underlying a true medical science embody vastly more than the preservation of physical life and health, all-important as these are. These principles reach back to the very origin of life—to Creative Force—and out into the illimitable future, with its glowing inspirations, its thrilling hopes of an individualized immortality; for the origin and

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destiny of human life are but the poles of a grand, stupendous circle of ceaseless activity, growth, and development.

Science has fully demonstrated that the relation between organic and inorganic affinities is one of continual and determinate antagonism. The inorganic world, with all of its mighty forces in perpetual action, is limited to the precincts of inorganic affinities; there is no kinetic or potential energy in its constitution to pass one jot beyond this boundary. With all of its stupendous operations, its diversified influence, with all its subtile, penetrating agency, it is not possible for it to produce even the lowest form of organic life.

Had there been no Omnipotent energy behind these inorganic forces the world would have continued to roll on its ceaseless rounds—lonely, silent, songless, with never a form of animate life.

In order for organic form and life to be produced it was absolutely essential for an intelligent creative agent to superinduce new laws of aggregation and arrangement, by which matter could be liberated from the sovereignty of primitive affinities—to implant in the constitution of vitalized structure the power to subordinate the antecedent forces of the inorganic world, and thus *force* matter into higher forms and systems.

All scientific observation and experience establish the fact that vitalized structure can maintain its existence only through virtue of inherent power to subdue the affinities and demolish the arrangement of inorganic matter. Only when vitality yields its claim can inorganic energy assert itself, and bring matter back to its original kingdom.

The effort of materialism has ever been to break down the walls of partition between the organic and inorganic—to account for all the manifestations of life and mind upon chemical and mechanical principles.

Materialists confidently affirm the eternity of matter, and that through forces which inhere in it all life and mentality have been evolved.

Yet these very same physicists, when trying to solve the phenomena of vitalized power, have been compelled to pause on the confines of the inorganic world, and acknowledge their inability to analyze the forces which evolve organic structure and life and mind, or to discover any affined relations between the kingdoms of organic and inorganic matter.

"Science knows much of this intermediate phase of things, that we call Nature, of which it is the product. But science knows nothing of the origin and destiny of Nature. . . . Who or what bestowed upon the ultimate particles of matter their wondrous power of interaction? *Science does not know; the mystery, though pushed back, remains unanswered.*" [1]

No one of any scientific attainment will for a moment dispute the fact that organic and inorganic structures are composed of the same primordial elements; for the nature and form of structures depend not upon the matter of which they are formed, but upon the constitutional laws by which the matter is arranged. If inorganic forces control the primordial elements, inorganic forms necessarily result; if vitalized forces control, organic structure will inevitably be evolved.

Those who have followed the line of argument pursued in this paper, will recognize the appositeness of discussing the true relation between the organic and inorganic world; for upon this depends the truth of the position, that drug medication is not a science.

If the relation between dead matter and living matter is one of antagonism, and not affinity, then it necessarily follows that the fundamental premise upon which drug medication is based must be false; and the premise being false, all the theories predicated upon it must be false, and the practice growing out of them must be injurious and fatal.

The testimony of the ablest medical professors and most experienced practitioners corroborates the *scientific fact* that drug medication *is not a science.* Did space permit many solid columns of such testimony could be given.

Why have so many medical men thus borne testimony against the very system of which they are the theoretical and practical exponents? Simply because universal experience in medical practice has compelled it. An unbiased and logical mind instinctively takes cognizance of the fact that a *true healing art* must neces-

[1] "Fragments of Science."—Tyndall, p. 415.

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sarily be productive of successful results—that the restoration to health and the preservation of life would be the universal rule in the treatment of all phases of disease, and death but the exception.

In a former article it was indicated that a true healing art consists in using such extrinsic means as will co-operate with the efforts of vitality, which in all forms of disease is ever a remedial action. A correct system of medication must, therefore, be based on the well-authenticated law of nature, that *all healing power is inherent in the living system.* All that medication can possibly effect is simply to supply those conditions and agents which will enable the *vis medicatrix naturæ* to perfect its work.

Nature's *materia medica* consists of pure air, water, food, light, temperature, exercise, rest, bathing, sleep, clothing, electricity, animal magnetism, mental environments, passional influences, mechanical and surgical appliances. A true healing art consists in supplying the system with whatever of these it can use under the circumstances.

All disease, all abnormal action of body and mind, are produced through violations of organic law; and according to the well-defined principle of justice, which is embodied in all natural law, the only way to regain health of body and mind is to return unreservedly to the wise and beneficent, but inexorable, authority of Nature—to use those agents and conditions which *preserve health* to *restore health.*

As the action of vitality in the remedial struggle is always abnormal-pathological, instead of normal-physiological, these hygienic appliances must be varied to meet the exigencies of the case, and this necessarily requires skill in interpreting the pathognomonic symptoms; and to apply these remedial agents so that they will effectively harmonize with the *vis medicatrix naturæ* demands a thorough knowledge of anatomy, of physiological, psychological, and pathological law.

This theory of hygienic medication has been fully tested in all forms of disease with the most satisfactory success. The most dangerous acute diseases, the most complicated chronic diseases, have under its remedial appliances been so directed and assisted, that the restoration to health has been the almost exclusive and universal sequence. When other results have followed it has been due to want of constitutional vigor to expel the morbific material which caused the disease. This is not mere assumption, as the experience of drug medication unavoidably must be; for hygienic medication is predicated on well-recognized laws of nature—laws which are as fixed and determinate as the creative power which called them into action.

THE UNIVERSITY OF SUBSTANTIALISM.

This symbol of an educational institution, soon to begin its mission of enlightening the world, conveys an idea to the minds of our readers of significant importance second to none which has found a place in these pages, if we except alone the Substantial Philosophy upon which, as an educational basis, the university is to be founded. Not having had the honor of conceiving the idea of such an institution (it having been sprung by a whole-souled philanthropist, who has done more in his day to extend educational influences in the West and South than any man living), we feel at greater liberty to speak frankly and freely concerning its claims upon the thinking community, and especially upon those who already have embraced the principles of Substantialism, than we could possibly feel or claim a right to exercise, were the project one of our own suggesting.

Believing the university here foreshadowed to be a necessity of this age spontaneously growing out of the inevitable progress of events as they are developing in the higher elements of science, philosophy, and religion; and knowing of a surety that it is only a question of brief time before it will stand erect in the eyes of the world as an accomplished fact, and, in the magnificent proportions of its grandeur and utility, challenge the admiration of mankind, we are not afraid of ever becoming ashamed while we live, nor of any reproach falling upon our memory after

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we have gone hence, for venturing here to urge upon every friend of the cause which the university is to represent, to commence acting at once, and in the most energetic as well as substantial manner possible, in its behalf.

Up to the time of this writing the leaders in the movement have already received the offer of buildings and grounds, with money donations besides, in two separate localities, as inducements for bringing the university to their respective cities. The offers are now under consideration, while friends in other sections are prospecting for even larger inducements, with strong hopes of success. Every well-wisher of the enterprise can therefore possess his soul in confidence that the institution is sure of a good home and of a hearty welcome to it, as soon as the contingent fund, for the organization and the initial expenses, has been subscribed. Such fund should be not less than $10,000 from the friends of the cause, aside from all that may be donated to the institution itself as a bonus, by the town or city which may succeed in securing its location. Hence it behooves every personal well-wisher of the movement to bestir himself to the extent of his means that the enterprise may not flag.

We are aware that no mere begging appeals to the friends of Substantialism would be likely to do any good in the way of securing contributions to a contingent fund so absolutely needed for defraying the initial expenses of establishing such an important work. Mere begging has served its day and generation, and appears to be about "played out," to use an expressive slang phrase. We have about concluded that unless an appeal can be made in some manner to an intelligent man's or woman's self-interest, or sense of obligation either to immediate or remote posterity, or to the community at large, for which due credit and honor are to be given in return, it is an up-hill business to force a single dollar from such person's pocket in aid of any institution whatever. Society seems to have come to such a pass, perhaps justly so, that a gift of money, from a mere feeling of friendship or desire to oblige a professional beggar for this or that institution, is so rare as to have become conspicuous for its rarity. Men now seem to act almost exclusively in such matters from some phase of self-interest, either for the benefit of their own present and future reputation, or for the advantage of their posterity. Some few appear to give from the sole motive of benefiting mankind and of elevating the race to a higher plane, morally, intellectually, and physically; though in such giving they very properly keep themselves also in view, and do not lose sight of the fact that their good works will follow them; and in this way they well know that their names will live in the grateful remembrance of the world for their generous acts.

Surely there is nothing discreditable to any man or woman in such honorable feelings of pride, and in such *unselfish* giving with a *selfish* motive. This seems paradoxical, but it is not, when we reflect that terms often have, even in the plainest Scripture passages, a two-fold meaning. Sordid or purely avaricious selfishness is a crime that degrades humanity, and is on a par, in Scripture language, with idolatry; but selfishness, in its higher sense, is Christ-like. It is in this divine sense that it is even commendable, as among the nobler impulses of human nature, involving, as it does, the very first law of our being which God has implanted in every man's and woman's bosom—the Christian no less than the chiefest of worldlings. Christ "became poor that we through his poverty might be rich," and it is no blasphemy to teach that he did it selfishly, even while laying down his life for his enemies; for this God-man passed through his terrible ordeal of sufferings "for the joy that was set before him," and it was this divinely inspired selfish motive of final victory which enabled him to "endure the cross and despise the shame," that he might attain his seat "at the right hand of the throne of God."

It is, then, by no means a discreditable motive in any man, should he give in aid of a beneficent cause or institution, if, in addition to a desire for benefiting his race, he should also feel the thrill of a "joy set before him," in the certain recognition by posterity of the fact that he had performed a noble and generous act.

If it is not discreditable for a man to make provision before his death for the erection of a marble memento of his having lived and done good, it would surely not be otherwise than right for him to donate an equal sum to a beneficent institution with the motive, first, of benefiting and elevating posterity; and, secondly,

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of proudly and even selfishly having the same generous act recorded to his credit in the pages of THE MICROCOSM, where, better and more lasting than any monument of stone, it will live to tell the tale of his noble deed to coming generations.

We insist, therefore, that it is not only laudable and legitimate, but every way proper for one who gives liberally to any good cause to desire due credit for the same, that others may know of it to his honor, and as a salutary example for emulation. Our appeals to the friends of Substantialism, therefore, in aid of the coming university will be made upon the principle herein hinted, that every abettor of this work will thereby be erecting for himself or herself a monument in the living pages of this magazine, where its inscription will be read by generations to come, when the marble and granite slabs of the present shall have been gnawed into dust by the teeth of pelting storms and passing years.

As certain as that the Substantial Philosophy is eternally true, and that it must therefore live and be studied during all future time as containing the foundation principles of all true science, just so certain will these early volumes of THE MICROCOSM hold a place in the public libraries of future generations, and be reprinted and owned, and kept sacred in the private libraries of coming substantialists, and be handed down from fathers to sons as a scientific, philosophical, and religious inheritance more precious than gold or gems. We feel that we are as safe in predicting this fact as was John Adams, at the signing of the Declaration of Independence, in predicting the perpetual jubilation that would be witnessed for all coming time as the anniversaries of that memorable day should joyously recur.

Principles of science and philosophy can never die after they have been once made known and demonstrated to be true. And the early volumes which contain the original and detailed elaboration of such a wide-reaching revelation of natural laws and principles as are presented in Substantialism, must in the very nature of things never go out of print. No Mohammedan hordes with fanatical torch will ever again destroy the Alexandrian libraries which will shelve in perpetual preservation multiplied copies of all the books of preceding ages worth preserving. It is for this reason that we hold out these pages as the imperishable monumental record wherein the name, residence, and good deed of every man and woman who earns a brick in this initial university shall be perpetuated and honored when present dynasties shall have been forgotten, and when corn shall grow where Egypt's pyramids now stand.

We ask, then, all who are able or who would be willing to place their names on permanent record as among the earliest friends of Substantialism to send their subscriptions, either in funds or in pledges within reasonable time, to Rev. J. J. Smith, D. D., at Tomkins Cove, N. Y., who is the treasurer of the contingent fund of the university, and who will see that THE MICROCOSM gives due credit for the same as herein set forth.

We do not expect to be many more years with you in this work of helping to inaugurate the scientific and philosophical revolution which the coming university is to take up and carry forward; but while we do live, it shall be our chief aim, in the intervals of our editorial work, to make all the money we honestly can, every dollar of which, aside from the necessities of those having personal claims upon us, we propose most sacredly and religiously, as well as *selfishly*, if you please, to leave to the University of Substantialism, and shall expect to get due credit for doing the same.

RELIGIOUS HINTS FROM SCIENCE AND PHILOSOPHY.—No. 1.

BY J. W. LOWBER, M. A., PH. D.

THE PHYSICAL SCIENCES AND RELIGION.

"May knowledge more and more increase,
And man from bondage find release;
As the Bible he studies, and Nature's laws,
Which point to the same eternal cause."

There is much foolish opposition on the part of some religious teachers to science and philosophy. I heard a preacher, not long since, state in the pulpit

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that it was wrong to reason on any subject; that the food should be handed directly to the people. He was in favor of their eating it raw. From such preaching as that a congregation will never get more food than it can digest, either raw or cooked. I am of the opinion that we should select nearly all of our illustrations for the pulpit from the Bible; that inspired volume contains enough for the use of any preacher; but it is foolish to oppose that knowledge which is so essential to a proper understanding of the Bible. Some say we care nothing about theory, we only want right practice. There can be no practice without theory. False practice always results from false theory. It is necessary to know the cause in order to understand how to manage the effect. When a watch is out of fix, the watchmaker does not simply turn the hands, but he finds out the cause of the difficulty, and then remedies it. Carlyle claims that he can tell what a man's religion is by knowing his position with regard to the origin of things. When you find a nation materialistic in philosophy, you will find it the same in religion. The various theories of fatalism, taught by French theologians, were derived from the philosophy of Condillac and from Mohammedan ideas, appropriated by the French philosophers.

The history of an individual is frequently the history of a nation. The same peculiarities that are observed in the youth of the individual are also observed in the youth of a nation. The child directs its entire attention to the outer world; it is anxious to know the cause of the things about it. Well do I remember, when only four or five years old, the number of hours I spent in trying to learn the origin of the beech tree under which I played. In the early history of Greek philosophy attention was only given to the outer world. The great problem with them was this: What is the underlying element from which all things have come? One philosopher claimed water as the primary element; another, air; another, fire; and still another, the essence of things.

The soul, by the early scientists or natural philosophers, was regarded as material, being composed simply of air. Materialism belongs to the infancy of science, and not to its manhood. Science now has sufficient age to rejoice in its manhood, and to put away childish things. It is sad to think that there are great men in the scientific world who look so much at the material that they cannot yet see beyond it. Philosophy reached manhood in Socrates, Plato, and Aristotle, who taught the importance of studying mind as well as matter, and finding the permanent beyond the fleeting and the changing things of this world.

I have frequently heard it said, by both scientists and religionists, that the Bible was not given to teach men science. I somewhat doubt the absolute correctness of the statement. In the very beginning of the Bible we have a scientific statement of the origin of things. We find there the fundamental element from which all things have sprung. There are statements in the first of Genesis that progressive science of three thousand years is now making plain. The Hebrew word for God is Elohe, but in the Bible it was Elohim, that created the heavens and the earth. The plural form there used was entirely correct, for it denoted three persons in one nature; but this could not be understood until the mission of the Christ and the Holy Spirit into this world. When Moses speaks of the creation of light, he uses the word "aor," which is the word in the Hebrew language for electricity. Thus was modern science anticipated. If there is no science in the Bible, why is there none among those nations which have it not?

Ancient scientists believe in the eternity of matter, modern science teaches that matter had an origin; so the argument from cause to effect is placed entirely into the hands of religious teachers; for matter which possesses inertia could not have created itself. All nations have connected cosmogony with religion; science has shown the incorrectness of their ideas of creation, so their religious books have been superseded. The Bible cosmogony is shown to be correct by modern science; then the author of the Bible must have anticipated such science. Law passes as a golden chain through the entire system of nature. The naturalist himself cannot understand from whence all this order comes. How can matter with its universal property of inertia be in constant motion? There must be something in the cause to account for the effect. Law in the physical universe intimates a higher law in the moral, and it gives a very strong hint of the existence of the Great Lawgiver, who is the ultimate cause of all these things.

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EDITORS' TABLE.

THAT STRIDULATING LOCUST.

A. Wilford Hall, Ph. D., LL. D.:

DEAR SIR,—In the conclusion of your article on the subject of "Newton's Great Formula," in the September number of THE MICROCOSM, Vol. IV., page 379, I think you commit an error in your calculation as to the amount of heat that would be generated by a given number of locusts, according to the wave-theory, should they stridulate at one time half a wave-length apart. I quote your words as follows:

"As the 'condensed half' of each wave, according to Prof. Mayer, is thus heated, while the other half of each wave is equally cooled, by rarefaction (see 'Appleton's Encyclopedia'), it would, of course, only require *two locusts* of the same size and pitch of tone to stridulate half a wave-length apart (so that the condensations from one insect might fall into the rarefactions of the other) to heat the entire atmosphere 1–679; while four similar locusts would demonstrably double this temperature of the whole atmosphere thus permeated; and hence it follows that 1358 locusts, one-half of them stridulating half a wave-length from the other half, would actually raise the summer temperature of 90° to 180° F. Nothing in science can be clearer than this. Will Profs. Mayer, Rood, and Stevens, therefore, be kind enough to figure out, by their mathematical formulas of undulatory acoustics, and let us know just how many able-bodied locusts it would take, according to the solution of Laplace, to set the woods on fire? We want this information for THE MICROCOSM, as several of our rural subscribers are writing to us this summer complaining about these seventeen-year locusts."

Now if one locust, producing a condensation, generates thereby a given amount of heat, which it certainly must according to the wave-theory, it also produces alongside of it a corresponding rarefaction just as much below the normal temperature of the air, as the condensation is above it; thus the two constituents of the sound-wave, according to the theory, exactly balance each other and leave the average temperature of the air the same as before the sound permeated it. But should two locusts stridulate half a wave-length apart, as you suppose, so that the condensations of one system of waves fall into the rarefactions of the other system, and *vice versa*, it is plain that instead of increasing the temperature, the two systems of condensations and rarefactions would neutralize each other, according to the theory, producing neither condensation, rarefaction, nor sound, and consequently neither heat nor cold, but would leave the mass of air that would otherwise be permeated by the two sounds in a quiescent and normal condition of both density and temperature. How then is it possible, as you argue, for a large number of locusts, thus stridulating at one time, sensibly to augment the temperature of the air, according to the current sound-theory? I see also that you refer to Prof. Mayer's 1–679 increase of density, as equivalent to 1–679 increase of temperature in the condensed half of the sound-wave. Is that correct?

By explaining this in THE MICROCOSM you will no doubt oblige your readers as well as

Yours truly,

ROBERT ROGERS.

We anticipated, when writing the original argument, some such objections as are here presented by Mr. Rogers, and we are glad to have the opportunity of giving, in reply, a few additional considerations, which we regard of the utmost importance, against the current doctrine of acoustics, that the record of Substantialism upon these fundamental principles of physics may stand complete in the pages of THE MICROCOSM.

In the first place, if sound consists of "condensations and rarefactions" of the air, as the theory teaches, and if the locust in stridulating does really produce these mechanical effects throughout the four cubic miles of air permeated by the sound, it is indisputable that the insect, by its physical strength alone *must fill this entire mass of air with its mechanical force, by which alone such condensing and rarefying effects can be produced.*

We must bear constantly in mind, in all these discussions, that the *elasticity* of the air, which permits condensations and rarefactions to travel through it to a distance, is not *force* in any sense of that term, but is a *property* or *quality* of the air by which stored-up mechanical *force* may distribute itself and produce certain mechanical results. This rational view of *force* and *elasticity* was first hinted in the pages of this magazine, and upon which it was shown that however far away from a sounding body the supposed condensations may take place, they must depend alone upon the physical energy of such sounding instrument for the *force* which causes the distant mechanical effect. Hence, when the air is condensed, as claimed, a mile away from the locust, as the result of its stridulation, it is of necessity the physical energy of the insect alone which goes forth and produces this mechanical effect, *as really and truly as if the condensation had occurred within one inch of its vibratory apparatus.* There can be no possible dissent from this view among intelligent advocates of the wave-theory. If it were not true, then such condensation of the air a mile away from the insect—requiring the exercise of mechanical force—must produce itself, a clear absurdity in mechanics.

This fact conceded, we are prepared for such a solution of the supposed difficulty presented by Mr. Rogers as will alone destroy the wave-theory of sound. Here is the solution: As the mechanical force or energy of the locust fills the air for a mile in all directions in order to condense it and thus produce sound, it is plain that this *force* or *energy* of the insect must be everywhere present throughout the mass of air, while the sound continues *as a condition precedent or as the mechanical cause of such condensation before it occurs, and without whose actual presence no such condensing effect could take place!*

Hence, the prime fact to be considered in this branch of physics is not that the locust *condenses* the four cubic miles of air, and thus produces its sound; but, lying back of this fact, and as the condition thereto, is the *mechanical force* which is the cause of this condensation, and which must be present from the locust in every cubic inch of air to be permeated by the sound before such mechanical condensation can take place, and consequently before the sound can be generated. This is the fundamental fact of the present theory of acoustics—a fact which its advocates are compelled to face, however cautiously they may seek to ignore it, namely, that the insect actually sends out and fills the four cubic miles of air with its *mechanical energy* or *physical force*, through the property of *elasticity*, as the *cause* by which this condensing effect is produced! What can be plainer than such logic as this?

Now we are prepared for a direct explanation of the difficulty presented in the foregoing communication. As the force or energy from the locust must actually be present as the mechanical cause of the condensation of a given mass of air a mile away, let us suppose that some circumstance or counter-condition shall prevent this condensation from taking place; the energy of the insect must be there all the same, and must be exerted with precisely the same force as if the given mass of air were free to be condensed. What, then, becomes of this energy, as thus expended in attempts at condensation? According to all correct ideas of science, as laid down in the books, it is converted into the general fund of *heat*, even if it were expended upon a solid rock instead of air, and without condensing it at all. Hence, if the energy of one locust should be exerted upon a given mass of air to condense it, while the energy of another locust of equal strength were exerted upon the same mass of air to expand it, surely a scientist ought to be able to see that while these two

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quantities of energy, by acting in opposition, would prevent both condensation and rarefaction, they would none the less expend themselves as mechanical force; and although they do not generate sound, according to the wave-theory, by not producing "condensations and rarefactions," yet they do generate *heat* just as much by the conversion of the expended energy into another form of force, and precisely to the same extent as if the two amounts of energy had each produced a condensation and a rarefaction.

Plainly, then, if a hundred such locusts were expending each a given amount of energy or mechanical force upon a given mass of air, but were so placed in relation to each other that they would entirely counteract and neutralize one another's attempts to condense and rarefy the same, thus producing no sound, according to the theory, still there would be one hundred times as much mechanical energy expended upon this mass of air as would be expended by one locust, whatever condensation it might produce. Consequently, a hundred unison locusts, placed as we have supposed—half a wave-length apart—would expend and convert into heat or other force the same amount of energy precisely by their *efforts* to condense the air, as if the entire hundred insects should so stridulate that their condensations would all travel together, and thus, according to the theory, enormously increase the condensation and thereby the volume of sound.

If, then, a single locust can produce heat enough by the energy it exerts to so increase the elasticity of the air as to add one-sixth to the velocity of its sound, as the wave-theory teaches, it follows absolutely that a hundred such locusts, each exerting an equal amount of force upon the same mass of air at one time, should increase this temperature a hundredfold, whether their combined energy should be expended directly upon condensing the air or in opposite efforts at such condensations.

It is the same in physics as if a hot stove, situated in a room, radiated heat-force enough to melt a given quantity of ice placed anywhere in the room. Let the melting of the ice by the stove, as an effect, stand for the condensing of the air by the locust, as another effect. It is plain, if the melting of the ice were prevented by some counteracting condition, such as a covering of felt, this would not in the slightest degree lessen the amount of energy sent forth by the stove, and exerted upon the air of the room! And if a hundred such stoves were placed in the room at one time, all equally radiating heat-energy without still melting the ice, owing to some opposing condition, would there not be a hundred times as much heat-force sent out, and would not its mechanical energy be exerted upon the contents of the room just the same, whether the ice could be melted or not?

So the locust, according to the wave-theory, must send its condensing force and exert its mechanical energy throughout the four cubic miles of air exactly the same, even if another locust should, by a counter effort to rarefy the same layers of air, prevent all condensations and rarefactions from taking place. If the air is not condensed and if sound is not thereby produced, it is not because the energy of the locust is not present and exerted in full force, any more than the fact of the ice not melting and producing liquid water proves that the heat was not present from the stove. As mechanical force of a requisite amount has to be exerted by one locust throughout the mass of air, in order to produce the mechanical effect of condensing it, the demonstration follows that two such locusts will exert double the amount of energy throughout the mass that one would exert even if by their opposite efforts they prevent all condensation and rarefaction and thereby produce no sound. Here is the proof from Prof. Rood himself, as quoted in last month's MICROCOSM, page 62:

"But something else is equally likely to occur; it may happen that just at the moment when the layer *ought to be condensed by one wave*, its companion *attempts* to rarefy or expand it; these two motions will then neutralize each other, and instead of sound we shall have silence!"

Plainly if the "layer *ought* to be condensed," it is because there was a *mechanical force* exerted upon it sufficient to compress it, *since nothing else but such force or energy can condense air.* And surely as nothing can successfully "attempt" to prevent a condensation by an effort to rarefy the same layer of air, only the exertion of an equal and opposing mechanical force, it follows according to the undulatory theory that a thousand locusts, stridulating through the same mass of air at the same time, and completely counteracting each other's "attempts" at condensation and rarefaction, *would, nevertheless, expend upon the mass a thousand times the energy that one locust would exert, even though the one locust if alone should succeed in condensing the air and thus producing sound.*

What, then, becomes of this thousandfold energy exerted upon the air in these counter "attempts," since no condensation and no sound would result, according to the theory? Manifestly, on the combined authority of the scientific world, all such expended energy is converted into heat or some other form of force, according to the law of the conservation of energy, thus heating the air just in proportion to the numbers of insects which exert their energy upon it, either in successful or opposing "attempts" at condensation. And if one such locust, placed in the center of the four cubic miles, can and does generate heat enough by the exercise of its mechanical energy to increase the elasticity of this mass of air sufficient to add 174 feet a second to the velocity of its sound pulses, as the wave-theory positively teaches, surely two such locusts, exerting double the amount of mechanical energy upon the same air, ought to produce twice the amount of heat, by the conversion of mechanical force, and, thereby cause twice the amount of augmentation of atmospheric elasticity. Why, then, should the two not add twice 174 feet a second to the velocity of their combined sound-pulses? And is it not reasonable to suppose, if there is any truth in this theory, that a few thousand such locusts, placed at the center of this mass of air, and all stridulating at one time, might *set the woods on fire*, as our former article supposed? Surely these thousands of volumes of energy must, when converted into heat, do thousands of times the execution that the heat of one locust does, which is capable of so increasing the elasticity of the air, as to add "*one-sixth*" to the velocity of sound! Answer this who can.

(*To be concluded next month.*)

CHANCELLOR KOST ALSO WITH US.

Since the article on the "University of Substantialism," which appears elsewhere, was in type, we have received a letter from Rev. John Kost, M. D., LL. D., Chancellor of the State University of Florida, announcing his unqualified acceptance of the Substantial Philosophy as unfolded in this magazine, and declaring that he yields his entire assent to its principles as a system of scientific, philosophical, and religious teaching. This, he assures us, is the result of careful study and the most matured reflection upon the entire field of investigation covered by the new philosophy. He does not hesitate to avow his conviction that Substantialism is destined at a very early day to revolutionize science and philosophy as now taught throughout the civilized world, and that it will not be but a few years, in the very nature of progressive research and investigation, before the great scientists of our colleges and universities will gladly accept the principles of this new system of doctrine as the only discoverable means of solving the otherwise inscrutable problems of nature.

He also informs us that he is in hearty accord with the efforts now being put forth to establish a university as the radiating center for these revolutionizing doctrines, and that such an institution should receive the unreserved sympathy and support of every progressive investigator of science and philosophy in the land.

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We rejoice to be able thus to make known to the friends of the proposed university such a valuable accession to the cause of Substantialism; one of whom any cause may be justly proud. Besides, it yields encouragement to those who have the undertaking at heart, to feel that a man who has done so much for building up and endowing with funds and appliances a most successful college at Adrian, Michigan, and who has so liberally contributed to the founding of the State University at Tallahassee, Florida, will not be apt to feel indifference to the financial success of an institution based on principles with which every fiber of his being is in complete sympathy. We clip the following brief editorial notice from the Adrian *Evening Record:*

"The last annual of 'Appleton's Encyclopedia' speaks of the University of Florida, established at Tallahassee by the energy and liberality of Chancellor J. Kost."

The same "energy and liberality" which established that university we venture to predict—and on grounds of more than mere surmise—will not be lacking in aid of so promising a cause as the one represented by the Substantial Philosophy.

Next month's MICROCOSM will contain an interesting paper on the coming university from the finished pen of our contributor, Rev. J. I. Swander, D. D.; and the February number will be enriched with an article on the same theme by Chancellor Kost himself.

AN ENORMOUS UNIVERSITY GIFT.

The greatest endowment fund ever given to a college or university is that just presented by Governor Leland Stanford, of California. In consequence of the recent death of his only son, he resolved to establish a memorial institution, to signal his bereavement, of such gigantic proportions as to eclipse all similar institutions in the world. And he has really done so. He gives in money and productive property $20,000,000 to endow a university to be built with unparalleled magnificence on one of his immense estates of more than 7000 acres, located some forty miles from San Francisco.

Surely California, as the Golden State, may well be proud of such a golden university. Compared with it the greatest and richest educational institutions in this country dwarf into insignificance. The richest college in the United States (Columbia, of this city) has property all told amounting to less than $6,000,000. Harvard, the next richest, has less than $5,000,000, while Yale has nearly the same. The Johns Hopkins University is worth about $3,500,000; Cornell, $2,250,000; while the richest institution now in California—the State University—though rich compared with the hundreds of poor institutions of the kind scattered through the states, is worth $2,400,000, thus settling it to modest proportions alongside of its opulent neighbor.

By reference to the last report of the Commissioner of Education, it will be seen that all the colleges and universities in the United States put together are worth less than $100,000,000. Surely it is a matter for congratulation on the part of the State of California, as well as the founder of the university, that they can point to a single university worth more than one-fifth of all the institutions for educational purposes in this country.

But it takes something besides money to make a great college or university. The true educational value of such an institution consists in the principles of science, philosophy, and religion which are taught in it, and the educational order and government it maintains. A university that would now teach the Ptolemaic system of astronomy, with the general scientific and philosophical errors that prevailed during the time of Copernicus, could not be a great educational institution if it possessed a hundred million dollars as an endowment fund. Neither can the Stanford University ever become a great center of learning while it teaches the present undulatory doctrines of science and philosophy as authoritatively laid down in the text-books. Could Governor Stanford be made to comprehend the value of the Substantial Philosophy, as a revolutionary basis for a great institution of learning, he might make his $20,000,000 university a mighty blessing to all future generations. Cannot some one who knows Governor Stanford personally, call his attention to the new philosophy, and thus induce him to start his great work on a basis that will make it as useful for all time as its foundation will be imperishable?

INSTANCES OF GREAT LONGEVITY.

We have seen it stated recently, with considerable positiveness, that there is no proof of an absolutely authentic character that any man or woman now lives to be one hundred years old, and that all such reported cases of longevity are either unintentional exaggerations or wilful misrepresentations by the so-called centenarians themselves. It is hardly possible or conceivable that so many scores of instances as have been reported of late of persons living to the age of one hundred years or more, should all be thus unreliable and untrue.

As proof that the weight of evidence is vastly on the side of the truth that many do live to be centenarians, we need only to refer to the forthcoming census of the State of Iowa, to find scores of persons, whose names and residences are given, and who (most of them at least) have the unquestionable evidence of their ages, in the shape of birth-records, etc., which makes them from 100 even up to 121 years old.

In this list of remarkable instances of longevity, there are several persons named of 101, 102, 103, 105, 106, and so on up. Yet Iowa has never been considered better calculated to prolong life than most other states of the Union. Should it be proved otherwise, however, by the census of the whole country, it would probably turn the tide of internal emigration in that direction.

WHAT IS ELECTRICITY?

Several scientific readers of THE MICROCOSM have requested that a series of articles be written and published in this magazine explaining the generation and cause of electricity, and in a scientific way accounting for its interesting and marvelous phenomena. This is a vast field for exploration, and we are pleased to be able to announce to our readers that our associate, Dr. Mott, will present the initial discussion of that subject in a careful analytical paper in the next number of THE MICROCOSM.

MICROCOSMIC DEBRIS.

—A very simple, though somewhat expensive, arrangement of telephone wires has been introduced in a Glasgow merchant's office, by which, it is stated, the annoyances of induction are prevented. The office is connected with the proprietor's dwelling house, some thirty miles distant, by a private line. To prevent disturbance from the induction of other wires, he employs a return wire, and the wires are simply arranged in a spiral or helical form, as follows: Suppose each post to be provided with four insulators, arranged at the four angles of a square, the sending wire is attached to insulator 1 on the first post, 2 on the second, 3 on the third, 4 on the fourth, 1 on the fifth and so on. The return wire is attached to the insulators at the opposite corners of the square, or what would correspond to that position, thus forming the helix.

—There is a pool in Utah only a foot deep, and situated at a very high altitude, that refuses to freeze even in the severest winters. There is another that mysteriously replenishes itself with half-grown trout. One stream, though clear as crystal to the eye and tasteless, stains all the vegetation it flows over a deep brown. A warm spring near Salt Lake City is the strongest sulphur water in the world. A hot spring a few miles off, with waters so hot that you can hardly put your hand into them,

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and as bright as diamonds, is one of the most remarkable combinations of chemicals ever analyzed.

—The expression "galvanizing a corpse" has ceased to be exclusively metaphorical. Monsieur Kergovaty, a Frenchman, has discovered a method of preserving bodies by giving them a metal coating. We may, according to our means, become silver-plated, nickel-plated, or galvanized with zinc or copper. The process has been thus far tested successfully on eleven human bodies and more than one hundred times on the carcasses of animals.

—A writer in the *Russkaia Meditz* says that he has had great success in the cure of over 300 cases of acute and chronic catarrh, or cold in the head, by the use of ice cold water. The legs from the knee downward, are washed with it in the morning and at night, and rubbed vigorously with a coarse towel. It is necessary to do this for two days only, and many patients are said to have been cured in one day.

—OBJECT LESSONS IN GEOGRAPHY.—*Teacher*. "We will suppose the earth, which is round, to be represented by my head, and the sun, which passes around it, by my hand. Thus you see, as I pass the sun around the earth (my hand around my head), it sheds its light on the inhabitants thereof." The teacher will not be so enthusiastic over his object lessons in the future.

—An electric stud is the latest novelty of this inventive age. The diamond forming the stud has a cavity in the center. This forms the receptacle for a tiny electric lamp. Stored electricity can be carried in the waistcoat pocket, and when switched on to the stud lamp it greatly intensifies the brilliancy of the diamond, producing a splendid effect.

—A "Notice" worded as follows is said to appear on the door of a well-known business office: "The hours of attendance in this office are. To canvassers for church subscriptions, 10 to 2, book and insurance agents, 2 to 4; commercial travelers, beggars, and advertising men, all day. We attend to our own business at night."

—A London project is to make plates by photo-engraving of the American illustrated magazines, print them on a common quality of paper, and get them on the foreign market at half price within four days after the issue there of the originals.

—Twelve life prisoners in the Kentucky Penitentiary work at chair-making. Not one of them is under six feet in height. Eleven of them are ex-Confederate soldiers. They are all industrious, obedient, submissive, and uncomplaining.

—In Santa Clara County, Cal., there is a rat, allied to the ground-nest-making species, which climbs small trees and makes a compact nest of twigs among the branches, something after the manner of a gray squirrel.

—English entomologists are excited over the addition of a new butterfly to the British fauna, making a total of sixty-five species. The species is *Lycæna argiades*, a common dweller in Southern Europe.

—A census of the homing pigeons in France is to be taken this winter, in order that the War Department may know how many can be depended upon for use in case of an emergency.

—A Chinese banker, Han Qua of Canton, is said to be the wealthiest man in the world. He pays taxes upon an estate of $450,000,000, and is estimated to be worth $1,400,000,000.

—The San Diego (Cal.) Natural History Society are going to petition Congress to give them a deed of San Miguel Mountain, near San Diego, as a site for an observatory.

—An American has been appointed by the King of Corea to be chief farmer, with a view of introducing our vegetables into that country.

—In Boston, the *Advertiser* states, there have been fifty people killed and eighteen injured by horse railways within a year.

—Dio Lewis says that wearing large, thick, heavy boots and blue hand-knit stockings will improve a woman's complexion.

—Norway has over fifty public fish hatcheries, yet produces less than a tenth of what the United States does with ten.

—The total number of physicians in the world is estimated at 190,000.

The Nordenfelt Submarine Boat.[1]

Just before leaving Denmark for the south, the Prince of Wales, with the King and Queen of Denmark and the Czarina, witnessed off Landskrona, a town on the Swedish coast, an interesting and successful trial of the new submarine boat, which has been built at Stockholm upon the plans of Mr. Nordenfelt, the inventor of the machine gun so extensively used in modern warfare. Ever since the American civil war, naval engineers have been striving to solve the problem of submarine navigation, but until now with very little success. Mr. Nordenfelt's invention, however, appears to fulfill the numerous requirements necessary for overcoming the difficulties and dangers of maintaining, driving and directing a boat beneath the water. The boat is built of steel, and is cigar-shaped, with a glass conning-tower in the center, from which the commander can keep a look-out. This dome is protected by a strong iron cover. There are three engines, one to work the screw in the stern which propels the vessel, and two to work the propellers on either side, which, when set in motion, compel the boat to sink, and maintain her at a certain depth beneath the surface. When it is wished to sink the boat, enough sea-water is taken in to reduce the buoyancy till the tower is just above the surface. The side propellers being then set in motion, the vessel can be sunk to any required depth, there being an automatic arrangement by which the engines are stopped directly that depth is exceeded.

An automatic horizontal steering gear also prevents the boat from going down or up headforemost, an even keel being preserved throughout all the maneuvers. Should a breakdown of the engine occur, the boat, from its own buoyancy, at once rises to the surface. The motive power is steam, and as long as the vessel is above water the fires can be stoked, the smoke being driven through two channels, which pass partly around the hull and point aft. When, however, the boat sinks, the fires have to be sealed, and reserve steam is used, which is kept at high pressure in two tanks. With this the boat has been driven for five hours at a speed of three miles an hour. Her speed on the surface is eight knots. The crew numbers three, and, during their submarine existence, they have to subsist on the amount of air which they take with them in the hull, in which four men have subsisted for six hours without any especial inconvenience. The boat is sixty-four feet long, and the central diameter is nine feet. The enormous utility of such a vessel as this in naval warfare is at once apparent. Moving without the slightest apparent sign of existence, she can launch torpedoes against hostile vessels, enter a harbor unperceived, and render useless the most complicated system of submarine mines. The trial at Landskrona was witnessed by officers representing every European power.

Natural Enemies of Oysters.[2]

Man in former times, and even at present in some localities, might be classed with the enemies of the oyster. But now, when he is introducing artificial means for their multiplication, instead of an enemy he becomes their protector. There are animals, harmless-looking and small, which do far more damage to this delicious shell-fish than man, and

[1] From the London *Graphic*.
[2] Ralph S. Tarr, in *Science*.

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that, too, without giving anything in return. The many which are destroyed by human agency become few when compared to those killed by their smaller foes.

The oyster, although protected by a very hard shell that can be closed almost hermetically, is, on the whole, rather poorly defended, for there he lies right on the open bottom, exposed to everything that may chance to come along, without any power to move away and crawl into some crevice, but destined to remain motionless while attacked. Two kinds of animals do the most damage: one the common star-fish (*Asterias Forbesii*), the other a univalve spiral shell-fish, called by oystermen the "drill" (*Eurosalpinx cinerea*).

A star-fish approaches its victim, slowly crawls upon it, and then bends its five arms around the shell. The mouth of a star-fish is so small that an oyster a quarter of an inch long could not be taken into it. So what does it do, when its arms are encircled around the large oyster, but begin to project its stomach out of its mouth and surround the oyster with its stomach entirely outside of the body. Then the oyster gradually opens its shell, leaving the star-fish to do as it pleases. After a while the star-fish moves off, and we see that a large part of the oyster is gone. When the stomach is first protruded a liquid is excreted which seems to have the power of either killing or weakening the oyster. Just as soon as the shells are open digestion is begun by the star-fish, and after a short time the hunger of the star-fish is satisfied and the oyster is dead. Before long the star-fish feels like another meal, and he attacks another oyster, leaving the old one as prey to small crabs and shrimp. And so it goes on day after day, thousands operating in the same manner. At times they come in immense swarms from deeper water, in a single night destroying a large bed. In brackish water they do not flourish, but in the almost pure ocean water found in some oyster-raising districts the destruction is immense, and there is no remedy.

If some shell-fish for which the star-fish have a preference could be introduced among the oysters, perhaps the devastation might be partially checked. Oystermen formerly had the stupid habit of tearing every star-fish that happened to come in their way into pieces, throwing the fragments overboard. They were not aware that each arm had the power of reproducing the remaining four arms and becoming a perfect star, so that each time one was torn into two or three pieces, two or three new individuals were formed.

The other enemy, the so-called "drill," is well named, for its peculiar operations are based upon its boring or drilling powers. Although seldom an inch long, it can bore a hole through the hard shell of an oyster with surprising speed. The hole is always smooth and about in the same place, a spot covering a vital part being the point attacked. Similar "drills" operate on other species of shell-fish, and their deadly marks can be seen on the valves of the shells which are washed upon our beaches. In any collection of shells, and on any beach, numerous examples of the neatly-drilled hole can be found.

In the soft animal part of the "drill" there is a little tube-like proboscis which incloses another proboscis. Over the end of the latter there runs a little ribbon which is covered with teeth. This ribbon, or odontophore, is attached at each end on the two opposite sides of the inner proboscis. By means of muscles at the base of each end of the ribbon it may be pulled back and forth over the end of the snout, with the teeth projecting outward. When the oyster is to be attacked, the end of the snout is pressed against that part of the shell to be bored, and the muscles begin to work the toothed strap. The teeth rasp away at the shell, each time removing particles of calcareous matter until a hole is bored. Then the rasp acts upon the flesh inside, and as the meat is removed it is drawn to the mouth and eaten.

The "drill," after eating a meal, leaves its victim, and later attacks another. By the time it has finished its meal the oyster is dead, and its shell flies open, leaving the rest to crabs and shrimp. Filing away upon the hard shell wears the teeth away rapidly, but this is remedied by nature, for one end of the strap is gradually absorbed, while from the other end a new supply of toothed ribbon is being formed. So, on one side of the proboscis, there are fresh unused teeth; on the other side, old worn ones; and on the end, teeth just being worn; and the whole gradually moving away to one end, to be absorbed while other fresh ones are being formed.

Fighting Sleep.

Evil Practices of Drinking Tea to Keep Awake.

Unquestionably, the habit of taking tea or coffee by students, authors, actors, and, in fact, most persons engaged in brain work, in order to work at night, is downright madness. But more especially is this the case with students when preparing for an examination. More than half the cases of breakdown, loss of memory, fainting, etc., which occur during severe examinations, and far oftener than is commonly known, are due to this.

We frequently hear of promising students who have thus failed; and, on inquiry, have learned—in almost every instance—that the victim has previously drugged himself with tea or coffee. Sleep is the rest of the brain; to rob the hard-worked brain of its necessary rest is cerebral suicide. The late Thomas Wright was a victim of this terrible folly. He undertook the translation of the "Life of Julius Cæsar," by Napoleon III., and to do it in a cruelly short time. He fulfilled his contract by sitting up several nights successively by the aid of strong tea or coffee (we forget which). In a few weeks he had aged alarmingly and become quite bald, his brain gave way and never recovered. But for his dreadful cerebral strain, rendered possible only by the alkaloid (for otherwise he would have fallen to sleep over his work, and thereby saved his life), he might still be amusing and instructing thousands of readers by fresh volumes of popularized archæological research. Tea drinking as a preventive of sleep has always been well in favor with authors, and this is somewhat difficult to comprehend, for authors are commonly supposed to have the faculty of reason above the average. One would naturally think that those men who laid down golden rule after golden rule would at least follow the first law of nature—self-preservation. Yet what more notable inconsistency have we than in the case of Dr. Johnson, who thought nothing of drinking fifteen cups of tea at one sitting. Hazlitt, too, was a prodigious tea drinker, and his peculiar habits and manners were minutely photographed by his friends. He drank tea at the rate of a pound a week, always of the blackest quality. His doctors advised, nay even ordered, that he should give up the habit, as ultimately his digestive organs became diseased. But tea had the same fascinating influence upon him as opium upon the Mongol, and one evening after taking a libation, he had an attack of "tea poisoning" from which he never recovered.

It may be worth while mentioning the experiences of the Abbe Morgno, a French writer, now in his eighty-first year. At the commencement of his literary career he frequently burned the midnight oil, and that he might the easier combat sleep, was in the habit of drinking a cup of strong tea without sugar. Soon this began to show its evil effects. He found that his calculations became confused, and whereas before he had a perfect knowledge of the chief events in the national history, now he had to have recourse to books of reference. He found his memory becoming impaired, and, simply as a test, abstained for three months from tea drinking at night. In fact, he drank nothing whatever. The result was as he had anticipated—his memory returned, and since then he

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takes no stimulants of any kind, but goes to bed at nine every night and rises at five in the morning.

Ancient Medical Science.

THE FIRST DOCTORS, AND HOW THEY TREATED THEIR PATIENTS.

We find the earliest records of medicine in the Brahminical books, which contain curative forms. The Greeks left an Egyptian work on the same subject. It is composed of forty-two books, of which thirty-six contain the history of all human knowledge, and six contain the anatomy of the body, its diseases and their cure. Medicine then came to be the possession of the priestly class.

They represented disease as being the sign of the anger of particular divinities, and only curable by their special intervention.

Among the Egyptians medicine was divided into two kinds, the higher and the lesser medicine. The higher medicine was composed principally of magic formulas, and was only practiced by the superior priests, who boasted the power at their pleasure to be able to produce prodigious and supernatural effects.

Practical or lesser medicine comprehended the treatment and its various accessories. It was abandoned to the inferior priests. These were bound to confine themselves strictly for the treatment to the rules made in the books of Hermes. If they deviated from them—if the patient recovered or died contrary to the prognostic of the superior priest, the offending physician was punished by perpetual imprisonment and in some cases by death itself.

Carried into Greece by Egyptian colonies, medicine followed the same course. It was in the temples alone it was exercised, and the cure of disease was only attempted by the priests of the gods.

It was only a short time before the Christian era that medicine broke the boundaries of the temples and, emancipated from their bonds, was exercised publicly. Then men of genius and skill prepared themselves for the calling of medicine.

They studied with success, and disengaged it as much as was in their power from all superstitious practices. Hippocrates, the founder of the science, at last appeared.

His vast genius, his observant and methodical spirit, withdrew medicine from the chaos where it languished for so long a time, and made of it a beautiful and noble science.

The Egyptian system counted thirty-six genii, who were distributed into thirty-six parts of the body. Formulæ were composed for the invocation of each genius in particular, and by the means of the thirty-six sacred herbs discovered by Hermes, they cured a portion of the malady. No doubt the practitioners made some cures by the specific virtue of the herbs, but they delighted to exaggerate them, and had the presumption and impiety to declare that they could restore the dead to life.

However, after the appearance of such men as Galen and Hippocrates, medical science began to make its way slowly but surely against charlatanism and fraud. It was reserved for later years, however, to see it approach its triumph in the discoveries of anatomy and chemistry.

To the monks, who were in early ages the practitioners of physic, is due much of the impulse the science received toward progress in the path of discovery. They kept alive the spirit of inquiry, and aided in large degree to prepare the way for the great revelations of nature and her work, which afterward placed the science of hygeia first among our branches of knowledge.

ERRATUM: On page 93, November MICROCOSM, line 23 from top of first column, for *mutilation* read *mutation*.

Reviews of New Books.

Notice to Publishers.

Special arrangements have been made to have all new books sent us carefully reviewed by specialists.

A LIST OF AMERICAN NEWSPAPERS.

We have examined carefully every newspaper catalogue published in this country; but for convenience of arrangement and for completeness of lists of papers, in all parts of the United States and the Dominion of Canada, as well as for desirable and reliable information concerning circulation, date of commencement, general character of the publication, etc., we know of no work of the kind that equals the one now before us, recently published by Edwin Alden & Brother, advertising agents, Cincinnati, Ohio. Those desiring such a work of reference would do well to send $3 to above, and receive it postpaid.

"MARMONDALE AND OTHER POEMS," by Sheldon S. Baker, Saratoga Springs, N. Y. Price $1.25.—The author of this most interesting collection of poems is a man seventy-four years of age, and it has been his aim to record and clothe his thoughts in pure and simple language, so that the subjects and sentiments presented can be better appreciated by the average reader.

The poem "Marmondale" is a tale of the sunny south, and is rich in beautiful sentiments and original thoughts, and is well worthy the perusal of the most enlightened mind. We present the two closing verses of this poem as characteristic of its intrinsic merit:

"My muse, farewell! a sad farewell—
  Yet stay to wake my harp again,
And let its soothing numbers swell
  To sound a solemn, sweet refrain
For those dear ones, now passed from earth
By death, so call'd—the second birth.

"They've pass'd, and upward is their flight,
  And onward through the countless years,
To bathe in that eternal light
  Which shines for all in higher spheres;
The light of justice, truth and love,
Reflected from God's throne above."

Among the other poems we notice "Eveolean," a tale of the Revolution: "Retribution," "We Have Met," "A Poet's Dream," etc. The book is very elegantly gotten up, the type is clear, and the paper of the best quality.

We take pleasure in directing the attention of the readers of THE MICROCOSM to this beautiful production.

"THE ROYAL BAKER AND PASTRY COOK."—A royal addition to the kitchen library. It contains over seven hundred receipts pertaining to every branch of the culinary department, including baking, roasting, preserving, soups, cakes, jellies, pastry, and all kinds of sweetmeats, with receipts for the most delicious candies, cordials, beverages, and all other necessary knowledge for the *chef de cuisine* of the most exacting epicure, as well as for the more modest housewife, who desires to prepare for her lord and master a repast that shall be both wholesome and economical. With each receipt is given full and explicit directions for putting together, manipulating, shaping, baking, and kind of utensil to be used, so that a novice can go through the operation with success: while a special and important feature is made of the mode of preparing all kinds of food and delicacies for the sick. The book has been prepared under the direction of Prof. Rudmani, late *chef* of the New York Cooking School, and is the most valuable of the recent editions upon the subject of cooking that has come to our notice. It is gotten up in the highest style of the printers' art, on illuminated covers, etc. We are assured that every can of "Royal Baking Powder" contains an order for one of these valuable books.

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VOL. XIV. MAY. NO. 5.

1890.

THE BEE-KEEPERS' GUIDE.

PUBLISHED BY

A. G. HILL, : Kendallville, Ind.

TERMS OF SUBSCRIPTION, FIFTY CENTS PER YEAR

KIMBALL & BARRON STEAM PRINT, KENDALLVILLE, INDIANA.

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CONTENTS OF THIS NUMBER.

ADVERTISING RATES.

All advertisements will be inserted at the rate of 10 cents per line, Nonpareil space, each insertion. Twelve lines, Nonpareil space, make one inch. Discounts will be made as follows:

On 10 lines and upward, 3 insertions, 5 per cent.; 6 insertions, 10 per cent.; 9 insertions, 15 per cent.; 12 insertions, 20 per cent.

On 50 lines and upward, 1 insertion, 5 per cent.; 3 insertions, 10 per cent.; 6 insertions, 15 per cent.; 9 insertions, 25 per cent.; 12 insertions, 25 per cent.

On 100 lines and upward, 1 insertion, 10 per cent.; 3 insertions, 15 per cent.; 6 insertions, 20 per cent.; 9 insertions, 25 per cent.; 12 insertions, 33⅓ per cent.

PREMIUM CLUB LIST.

No 1.—For four subscribers ($2,) an untested Queen.

No. 2.—For eight subscribers ($4,) a tested Queen

No. 3—For five subscribers ($2.50,) a Standard Bingham Smoker, by mail.

No. 4.—For six subscribers ($3,) one New American Bee-Hive, ready for the bees.

No. 5.—For fourteen subscribers ($7,) three New American Bee-Hives, ready for the bees.

No. 6.—For three subscribers ($1.50,) one pair of Atmospheric Bee-Feeders, by mail. The best feeder made.

No 7.—For five subscribers ($2.50,) six Atmospheric Bee-Feeders, by express or by freight, with other goods.

No. 8.—For eight subscribers ($4,) a good Wax Extractor, with boiler attached.

No. 9.—For fifteen subscribers ($7.50,) one package containing five New American or Winter Bee-Hives, wood in shape.

No. 10.—For four subscribers ($2,) one setting Brown Leghorn Eggs. Extra good stock.

HONEY AND BEESWAX MARKET.

CHICAGO.

HONEY—Market well supplied with honey, it being in many hands. In lots it cannot be sold at over 12a13c., and in cases even less, if not in first-class condition. Extracted, 6a8c.; white-clover and basswood, in kegs and barrels, 7c.

BEESWAX.—25c.

R. A. BURNETT, 161 South Water St.

KANSAS CITY.

HONEY—Receipts are very light, and demand is increasing. We quote: White, 1-lb. 11a12c.; dark, 10a11c.; white, 2-lbs., 10a11c, dark 9a10c. Extracted, white, 7a8c. dark, 6c.

Beeswax—None in market.

CLEMMONS, CLOON & Co., cor. 4th and Walnut.

BOSTON.

HONEY.—It is moving fairly well at 16a17c., with occasionally an extra fancy lot at 16c. Two-lb. combs are a little scarce at 16a17c. Extracted 7a8c.

BEESWAX—None on hand.

BLAKE & RIPLEY, 57 Chatham St.

CINCINNATI.

HONEY.—There is a quiet but steady demand for choice white comb, at 12a15c.; dark is slow sale at 10a12c. Demand from manufacturers is fair for extracted honey, and it is good for best qualities for table use.

BEESWAX—Demand is good—20a25c. a lb. for good to choice yellow on arrival.

C. F. MUTH & SON, Freeman & Central Ave.

NEW YORK.

HONEY.—It is in good demand. We quote: Fancy white 1-lbs., 12a13c.; 2-lbs., 13a14c. Fair white 1-lbs., 13a14c.; 2-lbs.. 11a12c. Buckwheat, 1-lbs., 10a11c.; 2-lbs., 9½a10c. Extracted, basswood and clover. 8c.; orange blossom, 8½c.; buckwheat, 6c.; California, 7½c.; Southern, 72½c. per gallon.

BEESWAX—27

HILDRETH BROS.. & SEGELKEN,
28 & 30 W. Broadway, near Duane St.

ST. LOUIS.

HONEY.—We quote: Choice white clover comb 12a12½c.; fair, 10a11c.; dark, 7a8c. Extracted in barrels, 5a5¾c.; in cans, 6a6½c.

Beeswax.—24c for prime.

D. G. TUTT & Co., Commercial St.

SAN FRANCISCO.

HONEY.—We quote. White comb, 10a11½c.; dark, 6½a8c. White extracted, 6½c.; light amber 5¾a 6c.; dark amber, 4½a5½c.

BEESWAX—18cto22c.

O. B. SMITH & Co., 423 Front St.

CLEVELAND.

HONEY.—Best white 1-lbs. sections sell at 15a16c. Extracted 7a8c. Demand small and supply fair.

BEESWAX—22@25c.

A. C. KENDEL, 115 Ontario Street.

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THE BEE-KEEPERS' GUIDE.

VOL. XIV.—— MAY, 1890.——NO. 5.

For the Bee-Keepers' Guide.

SWARM HIVERS-

WM. CAMM.

In the April number of the GUIDE Mr. G. M. Alves brings up the question of swarm hivers, which reminds me of my own attempt, in the early years of my bee-keeping, in this direction. In looking back over the years of my experience, in bee-keeping, I am reminded of what Mr. Langstroth wrote about sanguine beginners trying all sorts of experiments, and ideas, and coming back at last, to the plainest and simplest appliances in the apiary. All the hives and "contraptions" that I have tried would fill a good sized barn; and yet, to-day my hives are of the simplest construction, from which I have banished glass, even quilts. A farmer, with my time taken up with other work, before I had hives enough to justify me in spending my whole time in the apiary, I was very anxious to discover some way of securing swarms that might come out when I was not about home, or when I was in a distant field at work. One of my first experiments was with some swarm hivers of my own invention. They seemed to promise well, certainly looked well, but did not work worth a cent; and I not only discarded them, but had forgotten them, till Mr. A's article revived their memory. I will describe them for the benefit of those who may think "the thing can be did," but like Mr. A. I would say "don't."

I made my hives beforehand and set each empty hive just where I intended it should stand with a swarm in it. Before swarming time I noticed the bees would carefully examine all these hives; and if any entrances were left open they would enter, and if not repelled by spiders, sometimes select them for homes. The idea struck me that if I could get the bees, in any hive, to pass into or through a particular hive every day, they would be sure to go to it when they swarmed, especially if I arranged matters so the queen could go no where else than into the new hive after leaving her old home. First I set an empty hive by the side of one about to swarm and arranged a passage about three inches wide and two deep so as to cover the whole entrance on the new hive and half the entrance on the old one, putting a queen stop over the other half of the entrance, It was several days before the colony swarmed; and the first day my machine was in place I began to "smell a mice." The drones could not get out to play, and so came into the wire covered passage and wore themselves out on the wires. I shortened the passage so that half the entrance of the new hive was uncovered; but only a stray drone found his way out and not one could find the way back. By the third day drones began to die in the passage and I had to take it off and clear it every day, till at last my swarm came out, queen and all, and settled on an apple tree near by. Investigation showed that one of my most prolific queens was so small that she had crawled out where ever her workers had to "hunker down" to get through.

Next I made an entrance in the back of each of two hives, set them side by side and arranged the wire covered passage in a half circle, and put a queen stop on the front entrances of b th hives. Here I had to clear my trap—for it was a trap, as well as a contraption—every day of dead drones, and workers, and when my swarm came out the queen tried to get through the wire cloth till tired and disgusted she went back into the full hive, while the swarm settled on the back of the empty one, and while I was hunting her up the swarm moved to my back between my shoulders. I had been sanguine of success and had spoken very hopefully, not to say confidently of a plan that seened so simple and certain; but the thing panned out so poorly that I threw the swarm hiver into the brush and turned attention to some other topic when this matter was even hinted at. That has been so long ago, and now I feel that I have so much company, that I can afford to laugh at it; but let me say to every one curious enough to experiment in that direction, that. "though speech may be silver yet silence is gold." Of course I do not wish to discourage experiment in any direction, and am well aware that problems, seemingly as difficult as this, have been solved; but if I were tinkering with a swarm hiver I'd hive a good many swarms with it before I let my wife know it if I could help it.

Speaking of hiving bees, however, reminds me of a device I planned and made during the winter, for lifting and turning hivis about, or moving them anywhere about the apiary. I took a couple of broad iron wheels, about 10 inches in diameter, that came off an old self-binder truck, and put them on an iron axle about 20 or 24 inches long. Then I framed a couple of plow handles together and stapled them upon the axle, with an iron arm running out about 18 inches from the lower end of each. My hives are on stands with oak sills, 2x4, and running fore and aft of the hive, so I can run my truck behind the hive, pass the iron arms under the bottom board, between the sills, and bearing down enough on the handles to clear the sills off the ground, turn the hive, or put it anywhere I wish, without jarring and with the greatest ease. Every bee-keeper who, on a hot day, has had to call out his Nancy Rebecca or anybody else, to help him lift a full and heavy hive, will at once understand how much of a help and convenience such a truck must be. I'm going to paint it and call it "The Dandy." "Go thou and do likewise."

Murrayville, Ills., April 13, 1890.

For the Bee-Keepers' Guide.

THE SWARMING PROBLEM.

BY H. D. STEWART.

This question has called forth many theories and suggestions but no plan has yet been found which makes the desired result a certainty. The bees still have their own way in the matter and so long as the swarming propensity is not brought under control it will probably give rise to more annoyance than all the

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other troublesome features of bee-keeping put together. Years ago the profits of the apiary were estimated from the number of swarms, and according as there were few or many it was said to be a poor or a good summer for bees. The "swarming period" was then the most interesting part of the season. The average bee-keeper thought that the more swarms he got, the better, and hived all that came out. I remember some of those old time bee-keepers who said their bees were doing "rousing" though they were really swarming themselves to death. In some places the same bad management still exists with the same general result, that enough empty hives and combs are on hand in the spring to hold the swarms of each successive season.

Swarming generally occurs at a time when there should be no division of the working force if the object is to secure a crop of honey. Good, strong colonies that would store a fine crop of surplus, if allowed to swarm may yield nothing; and both the old stock and the swarm may have to be fed to get them over the winter. As a rule the experience of all progressive bee-keepers has led to the same conclusion on this point.

When it is desirable to increase the number of colonies the objections against swarming may not be so gr at but the case is different when the object is to secure the profits in the form of honey, and especially when one has all the colonies he wants. The honey crop can generally be disposed of at a fair price and if not immediately sold it can be held over till a market is found. Bees, on the other hand, are sometimes hard to sell, in many localities good, strong colonies will not bring enough to cover the cost of the hive and the value of the combs. Selling bees at such prices does not pay. Yet it is done, and in a case that I know a careless bee-keeper sells his *first* swarms at one dollar each. This is certainly an example of the class who do much injury to bee-keeping as a business.

In regard to the prevention of swarming, the object should not be to breed out this natural inclination but to get things under the bee-keepers' control. How to accomplish this is a subject for thought and experiment. The swarming impulse is a "driving power" in the hive that needs to be guided rather than to be subdued or removed, like the artificial fertilization of queens, for instance, it will not admit of too much tampering. Only the most careful experiments in this direction should be encouraged.

Landisburg, Pa., Apr. 21, '90.

For the Bee-Keepers' Guide.

HIVE MAKING AGAIN.

BY EDWARD J. KUEBEL.

Friend Hill, on page 102 in my article there are two mistakes which I want to point out; first, it should read "$10 per thousand frames" and not "feet." The second place is a mistake which should read "take lumber 1x12 inches by 16 feet long, which I think is best and it will not waste as much as other lengths."

I believe between us is a little misunderstanding on my article on page 102, therefore I will try to explain. In your foot note it seems to me as if you think I am stepping on your toes, you being a supply manufacturer, but that is not so. I wrote the article that it should benefit some novice bee-keepers and only for such who have not much money, but it might be they have a little time to make a few hives, and especially for such bee-keepers who live so far from supply manufacturers.

You say in your foot note that a farmer can earn more money fixing fences, etc., that is all right as far as it goes, but, if you have a wet or rainy day, you can not do such work, or like some renters have nothing to do on such days.

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takes no stimulants of any kind, but goes to bed at nine every night and rises at five in the morning.

Ancient Medical Science.

THE FIRST DOCTORS, AND HOW THEY TREATED THEIR PATIENTS.

We find the earliest records of medicine in the Brahminical books, which contain curative forms. The Greeks left an Egyptian work on the same subject. It is composed of forty-two books, of which thirty-six contain the history of all human knowledge, and six contain the anatomy of the body, its diseases and their cure. Medicine then came to be the possession of the priestly class.

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Carried into Greece by Egyptian colonies, medicine followed the same course. It was in the temples alone it was exercised, and the cure of disease was only attempted by the priests of the gods.

It was only a short time before the Christian era that medicine broke the boundaries of the temples, and, emancipated from their bonds, was exercised publicly. Then men of genius and skill prepared themselves for the calling of medicine.

They studied with success, and disengaged it as much as was in their power from all superstitious practices. Hippocrates, the founder of the science, at last appeared.

His vast genius, his observant and methodical spirit, withdrew medicine from the chaos where it languished for so long a time, and made of it a beautiful and noble science.

The Egyptian system counted thirty-six genii, who were distributed into thirty-six parts of the body. Formulæ were composed for the invocation of each genius in particular, and by the means of the thirty-six sacred herbs discovered by Hermes, they cured a portion of the malady. No doubt the practitioners made some cures by the specific virtue of the herbs, but they delighted to exaggerate them, and had the presumption and impiety to declare that they could restore the dead to life.

However, after the appearance of such men as Galen and Hippocrates, medical science began to make its way slowly but surely against charlatanism and fraud. It was reserved for later years, however, to see it approach its triumph in the discoveries of anatomy and chemistry.

To the monks, who were in early ages the practitioners of physic, is due much of the impulse the science received toward progress in the path of discovery. They kept alive the spirit of inquiry, and aided in large degree to prepare the way for the great revelations of nature and her work, which afterward placed the science of hygeia first among our branches of knowledge.

ERRATUM: On page 93, November MICROCOSM, line 23 from top of first column, for *mutilation* read *mutation*.

Reviews of New Books.

Notice to Publishers.

Special arrangements have been made to have all new books sent us carefully reviewed by specialists.

A LIST OF AMERICAN NEWSPAPERS.

We have examined carefully every newspaper catalogue published in this country; but for convenience of arrangement and for completeness of lists of papers, in all parts of the United States and the Dominion of Canada, as well as for desirable and reliable information concerning circulation, date of commencement, general character of the publication, etc., we know of no work of the kind that equals the one now before us, recently published by Edwin Alden & Brother, advertising agents, Cincinnati, Ohio. Those desiring such a work of reference would do well to send $3 to above, and receive it postpaid.

"MARMONDALE AND OTHER POEMS," by Sheldon S. Baker, Saratoga Springs, N. Y. Price $1.25.—The author of this most interesting collection of poems is a man seventy-four years of age, and it has been his aim to record and clothe his thoughts in pure and simple language, so that the subjects and sentiments presented can be better appreciated by the average reader.

The poem "Marmondale" is a tale of the sunny south, and is rich in beautiful sentiments and original thoughts, and is well worthy the perusal of the most enlightened mind. We present the two closing verses of this poem as characteristic of its intrinsic merit:

"My muse, farewell! a sad farewell—
Yet stay to wake my harp again,
And let its soothing numbers swell
To sound a solemn, sweet refrain
For those dear ones, now passed from earth
By death, so call'd—the second birth.

"They've pass'd, and upward is their flight,
And onward through the countless years,
To bathe in that eternal light
Which shines for all in higher spheres;
The light of justice, truth and love,
Reflected from God's throne above."

Among the other poems we notice "Eveolean," a tale of the Revolution: "Retribution," "We Have Met," "A Poet's Dream," etc. The book is very elegantly gotten up, the type is clear, and the paper of the best quality.

We take pleasure in directing the attention of the readers of THE MICROCOSM to this beautiful production.

"THE ROYAL BAKER AND PASTRY COOK."—A royal addition to the kitchen library. It contains over seven hundred receipts pertaining to every branch of the culinary department, including baking, roasting, preserving, soups, cakes, jellies, pastry, and all kinds of sweetmeats, with receipts for the most delicious candies, cordials, beverages, and all other necessary knowledge for the *chef de cuisine* of the most exacting epicure, as well as for the more modest housewife, who desires to prepare for her lord and master a repast that shall be both wholesome and economical. With each receipt is given full and explicit directions for putting together, manipulating, shaping, baking, and kind of utensil to be used, so that a novice can go through the operation with success: while a special and important feature is made of the mode of preparing all kinds of food and delicacies for the sick. The book has been prepared under the direction of Prof. Rudmani, late *chef* of the New York Cooking School, and is the most valuable of the recent editions upon the subject of cooking that has come to our notice. It is gotten up in the highest style of the printers' art, on illuminated covers, etc. We are assured that every can of "Royal Baking Powder" contains an order for one of these valuable books.

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The Microcosm.

January, 1886.

THE SUBSTANTIAL THEORY OF ELECTRICITY.

BY HENRY A. MOTT, PH. D., F. C. S.

Our eyes have enabled us to become aware of the great importance of light, and had we eyes or a sense which could unfold the part which electricity plays in the economy of nature, our knowledge would be greatly increased, and scenes as varied as a gorgeous sunset would be disclosed to us.

"Every movement of our body," says Jenkin,[1] "each touch of our hand, and the very friction of our clothes, would cause a play of effects analogous to those of light and shadow on the eye."

Electricity may be developed in various ways—in every case of friction, and probably of contact of two different bodies, it may be broadly stated, there is a development of electricity. This is sometimes expressed in a different way. It is said that "different bodies are at different potentials with regard to electricity"; the word "potential," in an electrical sense, being used merely to express the degree in which a body is electrified. A violent blow, and even a steady pressure, produces opposite electrical states on two opposing surfaces—the tearing of paper or linen, the crushing of sugar, the cleaving of a sheet of mica—all produce it. Many bodies passing from the liquid to the solid state become electrical, the phenomena of combustion and evaporation are attended by it, and in the evaporation of water over the surface of the oceans is seen one source of atmospheric electricity. Certain crystals (*e. g.* tourmaline) when heated are found to develop opposite electrical charges at opposite poles. Many animals (notably the electric eel) and some plants produce electrification; and Volta showed that the mere contact of certain metals caused them to assume electrical states; so long, however, as there is no difference in temperature between various parts of their junction there is no *apparent* discharge or movement of electricity—no *apparent* current is produced. If, however, heat be applied to the point of contact of two dissimilar metals and their free ends be united by a wire, a current of electricity will be found to flow through the wire and through the point of junction, in a direction varying with the pair of metals employed. This phenomenon is known as thermo-electricity. Batteries of this kind have been constructed powerful enough to produce the electric light and other familiar effects of strong currents.

Static electricity is electricity *apparently* at rest, as putting bodies in opposite electrical states. Electricity in motion is current electricity. When a current of electricity circulates or flows over a wire, the wire does not weigh any more while in that state, but it possesses many curious properties—chemical, magnetic, and physiological.

Since the discovery of electricity by Thales, of Miletus, about 2400 years ago, it has been the endeavor of the physicist to find out what electricity really is. We have the comforting assurance of Prof. John Trowbridge[2] that, after a careful study of the subject, he must express the conviction "that we shall never know what electricity is any more than we shall know what energy is"; and Prof. Nichols, of Boston, says:[3] "Electricity in itself considered, and much of its attendant phenomena, belong to the realm of the unknown. We call it force, but after bestow-

[1] "S. P. C. K. Manual of El. Sci." Electricity, pp. 51–53.
[2] *Pop. Sci. Monthly*, Nov., 1884, p. 77.
[3] "Whence? What? Where?" p. 60.

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ing upon it a name, it still remains a mystery. Considered as a *thing*, we know as much of spirit as we do of electricity."

According to the latest theory, electricity and magnetism are not forms of energy, neither are they forms of matter. They are, according to Daniel,[4] provisionally defined as properties, or *conditions*, of the supposed all-pervading material, ether. And phenomena of electric attraction and repulsion may be explained as phenomena of ether—stress and current electricity is claimed to be due to a throb, or series of throbs, in such a medium when released from stress.

Light and heat waves are constantly throbbing in the medium, which is constantly being set in local strains and released from them, and being whirled in local vortices, thus producing, as is claimed by one school, the various phenomena of electricity and magnetism.

It must be understood that a force producing a "strain" is called a "stress," and therefore a "strain" does not include the force producing the alteration of size and shape. Gorden[5] says: "We must consider that this medium [the ether] transmits electric forces, but does not in general exhibit electrical properties of its own."

We must consider the ether all around a charged body to be in a strained state; but we know that no electrical properties are exhibited at any point near the charged body, until a portion of ordinary matter is placed at that point, and then the matter receives electrical properties from the medium immediately surrounding it.

By another school all of the forces of nature, or, as Carpenter states,[6] "the various moods that affect matter are so many kinds of energy, which is capable of assuming various forms." . . . Electricity, then, according to this view, is one form of energy. It must be understood that the terms energy and force do not mean the same thing.

Force is defined as an expression of the rate of speed at which any change takes place in matter, and Carpenter[7] states that "what its essence or primordial cause is, is a problem that science does not attempt to solve." And Prof. Tait[8] goes so far as to state that "there is probably no such *thing* as force at all"! The term energy involves two distinct ideas combined, whereas force involves only one. Energy has been defined as "the power of doing work," and work is force exerted through space, *i. e.*, the idea of motion of some kind is connected with it. Prof. Tait gives to energy as true an objective existence as matter. "Heat, light, sound, electric currents, etc.," he says, "though not forms of matter, must be looked upon as real as matter."

Jenkin[9] states "that it seems to have been natural to regard electricity as a kind of very subtile fluid, and the nomenclature adopted in treating of electricity is based on this idea. There has been much wrangling as to the hypothesis of one and of two fluids. It is quite unnecessary to assume that electrical phenomena are due to one fluid, two fluids, or any fluid whatever; but in this treatise the names employed will be chiefly those which have been suggested to men of science by thinking of electrical phenomena as due to the presence or absence of a single fluid."

It is a fact that, for purposes of calculation, electricity of either kind is treated precisely as if it were a material, incompressible fluid.

But Gorden[10] says: "We must not, however, commit ourselves to the idea that electricity is a [material] substance. We do not know whether it is or is not. There are many other instances of quantities which are not substances. . . . No one, for instance, supposes pressure to be a substance, and yet nothing is easier than to add two pressures together. Two equal weights in a scale-pan each produce their own pressure, and, when put in it together, produce a pressure double that produced by either of them. Two horses can move a cart too heavy for one, because the pressures exerted by them are added together" [very weak].

The one-electric-fluid theory assumes that all bodies in their natural state have always a certain amount of electric fluid, the repulsive effect of which is equal to the attraction exercised by the body upon it. This was deduced from the fact that when glass is rubbed with silk or flannel it becomes vitreously (+) electrified,

[4] "Prin. of Phys."—Alf. Daniel, p. 518, 1885. [5] "Electricity and Magnetism."—Gorden, p. 22.
[6] "Force and Energy," p. 3. [7] "Recent Adv. in Phys. Sci." [8] Ibid., p. 5.
[9] "Electricity and Magnetism," p. 1. [10] "Phys. Treat. on Elec. and Mag.," Vol. I., p. 15, 2d ed.

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and the material with which it is rubbed becomes resinously (—) electrified, and the quantity on the glass is precisely equal and opposite to that upon the rubber.

Lymmer's[11] theory, which, until quite recently, has been generally accepted as a correct hypothesis, assumes that every body contains an indefinite quantity of a subtile imponderable matter, which is called the electrical fluid. This fluid is formed by the union of two fluids—the *positive* and the *negative*. When they combine they neutralize one another, and the body is then in the natural or neutral state. By friction, and by several other means, the two fluids may be separated, but one of them cannot be excited without a simultaneous production of the other. There may be, however, a greater or less excess of the one or the other in any body, and it is then said to be electrified positively or negatively. Ganot says: "This theory is quite hypothetical, but its general adoption is justified by the convenient explanation which it gives of electrical phenomena."

We have now considered the various theories relating to electricity which have been advanced and entertained from time to time; it only remains for us to consider the substantial theory which is now being recognized throughout this country, there being numerous universities and high schools which have adopted it as being correct, and one which appeals to the reason as both rational and tenable—it being understood that, while the substantial nature of electricity has long been upheld by the institutions referred to, the elaboration and explanation of the formation of electricity in its finer details has not been presented before.

The Substantial Philosophy finds no difficulty, in not only explaining the various phenomena of electricity, but does explain what electricity really is, and the *modus operandi* of its production from other forms of force.

Before, however, presenting the views of Substantialism on this subject, it will be best to state as briefly as possible some well-known and established facts belonging to the Substantial Philosophy which bear upon the subject.

First.—The Substantial Philosophy regards all the physical as well as mental forces as objective entities, as real substantial things.

Second.—The word substance is a generic term, and embraces immaterial as well as material substance. All material is substance, but all substance is not material. It becomes necessary, therefore, in judging of the substantial or entitative nature of anything of which the mind can form a concept, not only by its recognizable or unrecognizable qualities through the direct evidences of our finite senses, but by its demonstrable effects upon other and known substances under the exercise of our rational faculties in judging, analyzing, comparing, etc., what it accomplishes and how it acts and manifests itself.

Third.—Immaterial substance is, then, regarded as the force-element of nature, which pervades all space and all material bodies, and which is being constantly put forth and sustained by the Infinite. The latter being something that the finite mind cannot comprehend, but at the same time must admit the existence of.

Fourth.—Matter is regarded by the substantialist as a homogeneous material substance, *being in most cases more or less porous*, and having been condensed out of the immaterial substance by the Great Intelligence who framed the laws of the universe, and who could resolve it back into its primordial condition by his infinite power—an operation that a finite ability could never accomplish. The one and only great and incomprehensible problem in this world which can never be fathomed or elucidated by the finite mind is that of the Infinite. Here Science must veil her face and bow in reverence before its all-pervading majesty.

Just, then, as we find a graduated ascending scale in the material world, from osmium, the heaviest of all metals, through acetylene, the lightest of all liquids, through vapor and through hydrogen, the lightest of all gases, and, finally, through odor, the most highly attenuated condition of all material substances—which in many instances we can only know of its existence by the application of our higher faculties of reason, as when the hound scents the trail of the fox two hours after he has passed—so we have a graduated ascending scale in immaterial substances, commencing where the material left off and ascending from cohesive force substance through the force of chemism, adhesion, heat, light, sound, electricity, magnetism, life, mind, soul, and spirit.

[11] See Ganot's "Phys.," p. 611.

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Fifth.—Science has shown that all matter and all force are indestructible; their quantity cannot be altered. Matter can change its form, and force can change its form of manifestation, but not one particle of either can be annihilated.

In considering the problem of electricity, it will be necessary to state a few well-known facts which have been deduced and verified by experiment and reason.

First.—Force acts upon force, and only upon force; that is, when changing from one form of manifestation to another.

Second.—When substantial electrical *force* disappears, it does so only to manifest itself in some other form of force, or to return to the fountain of all force, to be conserved in the force-element of nature.

Third.—When two *unlike* bodies are rubbed together, the substantial force used to perform the work is converted in part into substantial heat force, and also into the substantial force of adhesion.

Fourth.—*The substantial force of adhesion* is a force which is *only* exercised between different kinds of matter—the substantial force of cohesion acting between like parts of the same matter.

Fifth.—The substantial force of chemism is closely allied to the substantial force of adhesion, as it only acts between dissimilar forms of matter; but it possesses one property peculiar to itself of only exercising itself in fixed proportions, depending on the material substances combined.

Sixth.—*All material substances conduct electricity.* Some conduct electricity with ease, others do not; it is simply a question of degree, and depends upon the substantial cohesive force of the bodies, whether in one substance or another the substantial force of electricity will be permitted to pass with greater or less freedom.

The best of all conductors known is silver, which means that the cohesive force exercised in holding the particles of this element together is arranged in such a manner as to permit or favor the passage of the electrical force through it with the greatest facility.

The poorest of all known conductors is perfectly dry air free from suspended matter; and the reason for this is perfectly simple, and results from the fact that the cohesive force exercised in holding the particles of the constituents of the air together is arranged in such a way as to resist the passage of the substantial electrical force, and is capable of changing its form of manifestation, under some conditions, into substantial light force, etc. Good conductors *are for convenience* called CONDUCTORS, while bad or poor conductors are called insulators; and for all *practical* purposes such an arbitrary distinction has some advantage connected with it.

From this it will readily be perceived that there is no such thing theoretically as electrical force at rest or static. The force is always making progress through the medium or body that contains it, or through the medium or body it can with less contention more freely pass. The idea of a force not continually exercising itself in some way, whether the way can be observed or not, is as false a presumption as to deny the entitative nature of force. Force is always at work, observed or not observed. There can be no such thing *theoretically* as force at rest. For convenience it may for all practical purposes do to say that when the velocity of electricity through a given medium, or so-called insulator or di-electric, is very slow, in fact too slow to be detected by our most sensitive apparatus for detecting its movement, that it is practically at rest—no objection can arise from this.

Seventh.—As the word particle has been used in reference to matter, it will be best to understand, once for all, what is meant by the term. A particle of matter is a *portion* of matter which can be divided into still smaller portions, and such portions into still smaller portions, and so on *ad infinitum.*

It has been argued that although divisibility extends far beyond the limits perceptible to sense, it must not be assumed that it is wholly unlimited; for to adopt such an assumption were, in other words, to admit that the size of the ultimate undivisible particle is null, while it is evident that, if the ultimate particle have no extension, it cannot enter into the composition of an extended body.

The Substantial Philosophy considers matter to be infinitely divisible, but admits that any possible division of matter that we can accomplish would still be finite and possess extension. The further division beyond the finite limit lies only

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in the power of the Infinite; and if He should see fit to divide the same to infinity, it would disappear into the immaterial force-element of nature from which it was condensed, which still has extension. The idea of mathematical points of force is inconceivable, *and force only becomes conceivable as an extended active immaterial substance.*

Eighth.—If a piece of glass be rubbed with a piece of silk, the force expended in performing the work is converted into heat and adhesive force. The most delicate electrical detector cannot show the presence of the least trace of electricity so long as the silk is in *actual* contact with the glass; expend force, however, in removing the silk from the glass, then will the substantial force of adhesion disappear, to reappear as substantial electrical force. Both the glass and the silk being in an electrical condition, there *appearing* to be two kinds of electrical force—this, however, is only an appearance which disappears on thorough analysis and investigation. In the first place, no body on the earth is at *absolute zero potential* any more than there is, or could exist under the condition of things, a body at *absolute zero of temperature.* All bodies on the earth are charged with a certain amount of electricity, originating in various ways; but as all the bodies at rest in a room are at the same electrical potential, the potential of the bodies in the room, and over a limited area of the earth, may be taken at zero. A body, to show the presence of electricity, must be at + or − potential to surrounding bodies; must be, in short, in an abnormal condition. A cake of ice in a room, while at zero degrees Centigrade, is 20° hotter than it would be if removed to an atmosphere of − 20° C. The zero taken in the case of heat is not the absolute zero; neither is zero potential, as regards electricity, meant to mean the *absolute zero,* unless stated so. A body at zero potential in one city might be at + or − potential to a body at zero potential in some other city, provided the conditions were different in the two places.

We can with convenience dispense with the terms positive and negative electricity, as they are confusing, and indicate two kinds of electricity. In their place we will substitute + and − potential, which represents the real state of things. So that if by friction or other means a body is charged with additional electrical force, it is at a different potential than the earth; if charged with + potential, or electricity, it is at greater potential than the earth; and if charged with − potential, or electricity, is at less potential than the earth.

It must be borne in mind that substantial electrical force, like substantial heat and the substantial force of gravitation, is a simple form or manifestation of the force-element of nature. A metal rod,[13] heated at one point, has its heat potential at that point raised, and there is an immediate flow of heat to the colder part, or part of lower potential, which continues till the equilibrium is restored, by raising the lower potential and lowering the higher.

Fill with water two vertical pipes, connected below, and it stands at the same level in each. Press it down with a piston two feet below the level in one, and it rises two feet above the level in the other; and the force of the piston is the exact measure of this difference of potential. Decrease this force, and the tendency to equilibrium at once becomes manifest; remove it, and the equilibrium is restored.

So with the substantial electrical force. + and − electrical force are simply difference of potential. In a large conductor like the earth, the potential over any limited area, as stated, is equal or at zero; hence the potential of the earth is taken as the standard.

If two insulated conductors are oppositely charged (*i. e.*, at different potential), and either of them placed in electric connection with the earth, its equilibrium is restored; in the +, by a flow of electricity *to* the earth, and in the − by a flow of electricity *from* the earth. If both, while insulated, are placed in connection with each other, equilibrium takes place between them by a flow from + to −; and their potential will then be above or below that of the earth, that is, at + or − potential, according as the original potential of either was the greater. If the − potential of one was exactly equal to the + potential of the other, the resulting potential would be zero, like the earth. Charged bodies at the same potential naturally repel, and at different potentials attract each other, the flow of electricity being from + to −; a charged body, then, is one whose equilibrium is disturbed

[13] See the *Electrician*—article by Atkinson, p. 270, Vol. II.

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by a change of potential above or below the potential of the earth, and therefore shows a tendency to equilibrium.

These two kinds of potential have for another reason been called + and —, because when added together (as in algebra) they combine, and the substantial electrical force disappears, under some conditions, to reappear as substantial sound, substantial heat, substantial light, etc., which in turn disappear, to reappear in some other form, or go back to be conserved in the force-element of nature.

Poor conductors are bodies which strongly resist the tendency to equilibrium, and good conductors are bodies which only offer a feeble resistance. The resistance offered by good as well as bad conductors depends upon the substantial cohesive force which holds the particles together, and it is for this reason that when glass is rubbed with silk or flannel it becomes + electrified or at + potential, and the silk — electrified, or at — potential. If the glass is rubbed with cat-skin and then separated, the cohesive force of the cat-skin in this case permits it to become + electrified and the glass becomes — electrified.

A proof of the correctness of this view lies in the fact that when a conductor of electricity—silver, for example (which heads the list, and which is therefore marked 100)—is heated, while it conducts the substantial electrical force say at 100 at a test of 0° C., at 100° C. it can only conduct with the same freedom as it would if it occupied a place between copper and gold and was tested at 0° C. In other words, instead of 100°, its conductivity is reduced to 71.316, which means that the substantial heat force, in connection with the substantial force of cohesion, controls the conductibility of the metal.

As stated above, charged bodies (*i. e.*, bodies in abnormal conditions) at the same potential repel, and they do so in a manner analogous to the attraction exercised by the substantial force of gravitation between two bodies, and every particle of the substantial electrical force of the same potential repels every other particle at any given moment, with a force proportional to the mass, and varying inversely as the square of the distance between them.

There is, therefore, but one substantial electrical force, and this force is always making progress, slowly in some bodies, more rapidly in others, depending upon the work it has to do on the way. A body at a + potential *will in time* distribute to surrounding bodies (which naturally must be at — potential) its excess of electricity until an equilibrium is established. It must not be assumed, however, that when there is an *apparent* equilibrium the electrical force is at rest. The fact is *it is never at rest*, but always making progress, passing into bodies of – potential in its endeavor to adjust all bodies to the fluctuating conditions they are subjected to, and thus establish what we are pleased to call a zero potential, or equilibrium. When we bear in mind how the conditions and position of things in a room fluctuate, and how every little change produces a + potential, it can be readily understood how necessary it is for the substantial force of electricity to be active so as to produce the equilibrium, or a condition of things which at no one time shows, by the most delicate test *yet described*, an electromotive difference of potential, or, in plain English, a current of electricity. Before the closing of this article on electricity, in some future number of this magazine we hope, by permission, to describe a far more delicate test for showing electromotive difference of potential than is known at present by any but one electrician.

We have as yet only considered the production of electricity by the conversion of the force of adhesion. Electricity produced this way is small in quantity but great in intensity. The high tension currents given by frictional machines testify to this, and such currents have as yet only been used for amusing experiments, for lecture purposes, and for purely scientific research.

The various forms of apparatus for the production of the electric current have been divided by Hospitalier[18] into three large, perfectly distinct classes, characterized by the nature of the action which comes into play.

1. Apparatus in which chemical action is utilized, and which directly transforms *chemical affinity* (chemism) into electricity. These are galvanic piles, or galvanic batteries.

2. Apparatus which directly transforms *heat* into electricity. These are thermo-electric batteries.

[18] "Mod. Application of Elec." p. 3.—Maier, 1883.

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3. Apparatus which directly transforms work into electricity. These are electro-dynamic machines; and they are subdivided into magneto-electric and dynamo-electric machines.

It must be clearly understood that, according to the theory of Substantialism, the all-pervading force-element of nature is capable of manifesting itself in various forms, according as it is acted upon, and that each of the forms of manifestation of this reservoir of force is capable of being converted into any one of the forms which can be produced from the original condition of the force-element. So that, while the substantial force of adhesion and the substantial force applied to produce this force can be converted into the substantial force of electricity, so can the substantial heat force, light force, chemism force, cohesion force, etc., be converted one and all into the substantial force of electricity, if they are acted upon by some other substantial force under the proper conditions.

An illustration of the conversion of the substantial force of heat into the substantial electrical force, by the action of the substantial force of cohesion, is witnessed in the heating of tourmaline.

The conversion of the substantial force of chemism into the substantial electrical force is witnessed in the battery.

A theoretically perfect battery is one which must fill the following conditions:[14]

1. It must possess a great electromotive difference of potential.
2. It must have a feeble and constant interior resistance.
3. Its electromotive difference of potential must be constant.
4. The materials used must be inexpensive.
5. The battery must not consume anything when it produces no current—that is, when the current is open.
6. It must be so arranged that we can easily verify its condition and working, and add fresh materials when required.

It is a fact that no known battery realizes all these conditions in the highest degree.

(*To be continued in the February number.*)

LIFE AND THE BIOPLAST.

BY REV. JOS. S. VAN DYKE, D. D.

I.

Prof. Huxley, who congratulates himself on having at last discovered "the physical basis of life"—though "bathibuis," which he once regarded as the parent of all living organisms, has turned out to be nothing but sulphate of lime, compelling him to disown the child which he once loved most ardently—persists in viewing life as a mere machine, of which the protoplast is the engineer. He asserts:

"A mass of living protoplasm is simply a molecular machine of great complexity, the total results of the working of which, or its vital phenomena, depend, on the one hand, upon its construction, and on the other, upon the energy supplied to it; and to speak of vitality as anything but the name of a series of operations, is as if one should talk of the 'horologity' of a clock." ("Encyc. Brit.," article Biology, p. 589.)

"A machine of great complexity" life quite manifestly is, since it is capable of turning out strange products, of effecting most singular metamorphoses. The kind of machine which we denominate human actually converts beef into metaphysics, bread into logic, turkey into imagination, oatmeal into obstinacy, sauerkraut into love, potatoes into hope, mackerel into piety, love into hatred, and plum pudding into cheerfulness.

Of this machine, "its vital phenomena depend, on the one hand, upon its construction, and on the other, upon the energy supplied to it." Its construction, be it remembered, is the combined result of "the fortuitous concourse of atoms during the cooling of this planet," and the blind working of purely physical forces.

[14] See "Electricity and Magnetism."—Jenkins.

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These causes, acting either singly or in conjunction, might have produced a "machine," we presume, whose vital phenomena would have been totally different. In that case the human machine might possibly have believed that a cause is not equal to the effect it produces; that material causes can produce spiritual effects; that there is no basic distinction between the living and the non-living; that an intelligent effect does not imply the existence of an intelligent cause; that it is as unreasonable to regard thought as anything else than the activity of invisible and fortuitously aggregated molecules as it is to conceive of the ponderability of platinum as a substantive entity; that the freedom of the will is an inconceivable, though pleasing, delusion.

"The energy supplied" to this "machine of great complexity" must come, we presume, from without, for otherwise our author would have contented himself with affirming, "its vital phenomena depend upon its construction." If the energy supplied was from without, as it evidently must have been, then this molecular machine must have indicated at stated intervals its need of new energy, the kind it coveted, and the amount demanded, attracting it as exigency required; or physical forces external to the machine must have been able to see when energy was needed and what kind was needed; and, having made choice between rival candidates, must have been equal to the task of enforcing obedience to the conclusions reached in their high council-chambers. Intelligence must have been resident somewhere, either in the machine itself, or in the forces which furnished energy. But to talk about the intelligence and the will of "a mass of living protoplasm" seems a little like talking about the conscience of a mosquito; and to talk about the intelligent purpose manifested by modes of motion does indeed seem like talking about the "horologity" of a clock, or rather, like talking about the "horologity" of clock-force.

Moreover, the employment of the term vitality, as though it were synonymous with life, tends to produce confused ideas. Does the author mean us to understand that the vitality of each protoplast, in this "molecular machine of great complexity," is precisely the same as the life of the organism which it aids in constructing? Is the life of each organized being nothing more than the aggregated life of the millions of protoplasts which weave the body? If so, where is the agency which directs the movements of these protoplasts, or bioplasts? How does it happen that the different parts of organic structures are so nicely adjusted, and so intimately correlated each to the other? Every organ is perfectly adapted to the parts adjacent, to the symmetry of the entire body, and to the functions it is designed to perform. A mere "mass of protoplasm" is not a personality, even if each protoplast is. To render a bioplasmic mass a personality there evidently must be some superintending agent. What is this agent? Beale denominates it life. Those who call it molecular machinery seem to us as if they were talking about the length, breadth, thickness, and color of love; or the inertia, figure, and porosity of an abstract conception; or the size, mobility, attraction, and compressibility of a mathematical point.

"OPPOSITION OF SCIENCE, SO CALLED," TO SCRIPTURE.

BY REV. GEORGE SEVERANCE.

The opinion is quite current that religionists are more conceited and intolerant than any other class of people. Whether there is more or less truth in this allegation, it would be very gratifying if all other theorists were exempt from such charges. But it is a settled point men of strong skeptical tendencies are vulnerable to similar charges. Men of science, so called, do not regard themselves as learners, but usually assume to be masters of speculative thought. When they speak they claim to speak *ex cathedra,* and they wish you to treat their *ipse dixit* as a finality.

Though Herbert Spencer has treated many subjects in an able and interesting manner, while minds as astute as his dissent from him on important points, yet inwardly he feels that he has reached the *ultima thule,* and little more needs to be

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said. Haeckel, the atheistic scientist, speaks with all the self-assurance any prelate ever spoke, and is hardly rivaled by the occupant of St. Peter's chair at Rome. In reading Tyndall you discover all the self-assurance the most opinionated display in their arrogance.

In their discoveries in the department of physical science, men may have attained to the highest eminence without having solved all the problems of the universe. Men may shine brilliantly in dealing with their specialty, and be unsafe guides when theorizing on subjects they have not fully mastered. Men may talk wisely of protoplasm, bioplasm, and the moneron, while confessedly quite ignorant of what lies back of these substances. There is often a great display of erudition in many a fine-spun theory touching evolution, without theorizing satisfactorily concerning causes that antedate what is evolved.

A man may be of high authority on subjects pertaining to physiology, and on account of unacquaintance with the science of psychology be of no authority whatever. A man may be a skillful exponent of scientific theories of the past, true or false, and yet be no real scientist, because he was against recent discoveries which have exploded many cherished theories of other ages. The Ptolemaic theory of astronomy was once supposed to be the true scientific theory, but the science of the schools did not yield to the demonstrations of Copernicus until a most bitter warfare had been waged between science—falsely so called—and true science.

Copernicus, Galileo, Bruno, and Roger Bacon were most cruelly persecuted in letting in light on the unscientific theories of their day. When we come to our enlightened nineteenth century, we see something of a continuation of the conflict between true and false science. The wave-theory of sound has been shown to be unsound. But is there not a pride of opinion which prevents the so-called scientists making concessions which facts demand at their hands? If the corpuscular theory of sound is untenable, why do not these reputed scientists who have a world-wide reputation take up the gauntlet and explode the novel theory of A. Wilford Hall? There is a lack of honesty and fairness on the part of these men. If it is demonstrated they are in a scientific error, the last thing thought of is a confession of that error. Is it manly on the part of Mayer, of this country, to refuse to enlighten a respectful correspondent in regard to the popular theory of sound, if his position is tenable? If it is not tenable, and he knows it, why not have the manliness to confess it?

What is wanted of scientists, as well as others, is to cultivate teachable dispositions. God's universe is spread out before us, and the most learned should be continual learners—not ashamed to unlearn what has been proved false, though ever so ardently cherished. The average Englishman seems hardly capable of apprehending any substance with which he does not come in physical contact; at most nothing is real which is not tangible to the five senses. Place before him a sirloin of beef, or a well-cooked slice of ham, and his perceptions are as clear as crystal. It is a marvel that he ever conceded there are any forces in nature superior to the wedge and screw. It must have been quite a conquest of his prejudices to admit the centripetal and centrifugal forces of nature, as he never analyzed them as he would solid chemical substances. The same, in substance, may be said of the average Anglo-American. An Englishman, by virtue of his nationality, is to be presumed a materialist. He can hardly conceive of a future state of being independent of a future general resurrection of the fleshly bodies of the entire human family.

The word Substantialism is not yet to be found in Webster's "Quarto Dictionary." Whatever the soul is, it must be substance of some sort. And it is singular that the Substantial Philosophy has not at this late day furnished a term which gives a concise idea of any entity, however sublimated it may be. To say the soul is immaterial, is not to give a clear idea of it. Immaterial conveys the idea of non-existence. Substantialism conveys the idea of real entity, whether more or less attenuated.

Our leading universities are thunderstruck at the idea sound is substance. But the stridulations of the little locust, philosophically explained, have triumphantly exploded the wave-theory of sound—yet how slowly the professors of acoustics in our colleges yield to this unmistakable discovery. No man who has well mastered the pros and cons of this subject, noted for scholarship, dare risk his rep-

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utation in a labored defense of the wave-theory; yet the wave-theory is taught in our literary institutions the same as in centuries past.

When will Harvard and Yale become sufficiently advanced to accept what is as plainly demonstrated as the rotary motion of the earth? Haeckel, Tyndall, Huxley, Mayer, and their *confreres*, can neither be coaxed nor driven to re-examine the basis on which their theories rest. The sound of the resurrection trumpet would not suffice to bring them to the front to rebut the arguments against their pet theories furnished by the Substantial Philosophy. No dynamite ever made more destructive work than Substantialism has made with their premises. The church looks on with amazement at the formidable strides materialistic atheism is making, but her chieftains are slow to seize and use the weapons the Substantial Philosophy furnishes.

Not long since I was asked, "Who is A. Wilford Hall?" My answer was, "It is enough to say he is the author of a work entitled the 'Problem of Human Life,' and it is a discredit to the thinker or scholarly man who has not read and mastered its contents."

It is related of the English Gen. Braddock, in early colonial times, when he drew up the English forces in solid phalanx, after the European method, his defeat was most disastrous, in encountering Indians behind every tree and stump. Col. Washington, afterward known as Gen. Washington, then under his command, suggested the folly of thus exposing his men in solid phalanx when pitted against the savage foe. Said Gen. Braddock, "Is it to be supposed an old experienced English officer is to be taught by a young Virginia buckskin?"

The author of the "Problem of Human Life" may not wear as many collegiate titles as do some reputed scholars, but he has hopelessly overthrown the baseless wave-theory of sound, and inaugurated a new era in speculative thought concerning some of the most momentous theories of the day. It is a mistake that all things remain as they were when the fathers fell asleep. Let the false scientists be driven to the wall, and may their places be filled by men true to the latest revelations of science.

THOUGHTS ON DEISM, ATHEISM, EVOLUTION, ETC.

BY JOHN C. DUVAL, ESQ.

I can see no good reason, as the materialist does, for believing that life and intelligence are the mere results of particular combinations of matter, when operated upon by the laws controlling it. Thousands and tens of thousands of combinations of matter have been made, chemically and otherwise, by man, but the result, whatever it may have been, had no properties or qualities other than those pertaining to matter. Oxygen and hydrogen, when combined in certain proportions, form the fluid we call water. Joined together in these proportions they produce a substance very different from either of its constituents, but no property or quality except those pertaining to matter has been developed by this combination. Matter, we know, in its normal condition does not possess the properties of life and intelligence; therefore life and intelligence (at least on this earth) are merely joined to or connected with matter, or else matter has the power of originating or creating other properties than those it possesses itself. But the latter supposition the materialist himself must oppose, as otherwise he would be compelled to deny the truth of that doctrine on which depends the very foundation of his creed, namely, "that matter is eternal—as it was it is, and ever will be; that it was not created, and can never become a creator."

But if the materialist contends that life and intelligence are simply the results of certain combinations of matter, he must perforce admit that matter has proved itself to be, under certain circumstances, a "creator," by the creation of properties and qualities far superior to any belonging to or pertaining to itself in its normal state; and as it is just as impossible that there should be properties and qualities without *something* to refer them to as it is that there should be an effect without a cause, *ergo* (according to the belief of the materialist), matter has created a *something* in every way superior to itself.

Unless, therefore, it be conceded that matter has the power to originate or create properties or qualities differing in all respects from those pertaining to matter in its normal condition, I would like to know where there is any opening for those things we call life and intelligence to come in. Matter, the materialist says, is eternal and unchangeable (atomically), and therefore its properties or qualities must be eternal and unchangeable also, and no combination of its atoms could develop or create such as did not exist in these atoms separately. But I perceive in some small portions of matter (the bodies of men and animals), that entirely different properties from those belonging to any of the atoms of matter have been developed or created, and I am forced to the conclusion that they have been created and connected with matter by some power controlling both. The admission that properties or qualities not known to matter in its normal state can be created by any combination of material atoms, is an admission that the basis of the material creed is false—"as it was it is, and ever will be."

We cannot conceive of the possibility of converting *something* into *nothing*, even though that something has none of the qualities of matter. Mind or intelligence is unquestionably something (to whatever we may attribute its origin), and a something that constitutes wholly the individuality of man; for no one, I presume, will contend that the material atoms of a man's body constitute any part of his individuality, as they are continually changing, and the old ones replaced by new ones. Here, then, we have an individuality, a something (whatever its origin) that *exists*, and we cannot conceive of the possibility of converting this something into nothing, any more than we can conceive of the possibility of converting a pound of iron into nothing. It *was*, and therefore it must be! Try by a mental effort to conceive of the possibility of converting anything (material or not) that exists into nothing, and the absurdity of such an idea will be apparent.

We have no grounds for supposing that there is no existence except it be a material one, or rather one that is cognizable to our material senses. On the contrary, we know that things do exist that are not material. Space has none of the properties of matter, and yet we know that it has existed as long as matter. If, as is affirmed, matter has existed eternally, then space must have existed a *little longer*, for it had to be before matter could be. Truths have existed, and will continue to exist eternally. Though all the matter of the material universe should be totally annihilated space would still remain, and the truth that "two halves are equal to the whole" would still be a truth.

Therefore it follows that if there be *things* wholly disconnected with and independent of matter, there must be other than material existences; which is one reason why I believe that mind or intelligence is a *something* of itself, though joined to or connected with matter on this earth; and the more especially because I perceive that its manifestations, properties, or attributes are totally different from those pertaining to matter, and that the laws that govern matter do not control it. It is just as easy for me to suppose that matter can be annihilated, as it is to suppose that *something* can be created out of *nothing*. Therefore, if mind be simply a result of matter, we are forced to the conclusion that all the faculties or attributes of mind, memory, imagination, hope, reason, etc., etc., are dormant or latent in matter itself, although our investigation and knowledge of it all go to prove the contrary. Consequently it seems more reasonable to me to suppose that mind is a *something* of itself than it is to suppose that it is a mere result or creature of matter. You might have the best constructed mill in the world, with ample power to work it, and keep it going for a life-time, but you would never get a grain of flour from it unless you put some wheat in the hopper. But the materialist, in his "material mill," will grind you out hope, love, imagination, memory, wit, genius, etc., in fact, all the numerous attributes of mind, although nothing of the sort was ever put in the hopper! This beats the miracle of the "loaves and fishes," at which the materialist is wont to sneer, for there were a few little loaves and fishes to begin with, as a foundation for the miracle.

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IS MATTER HETEROGENEOUS OR HOMOGENEOUS?

BY HENRY A. MOTT, PH. D., F. C. S.

(*Continued from December number.*)

As the explanation given of the last argument relating to the piling together of 700,000,000 plates of copper and zinc was inadvertently incorrect, it will be necessary to explain what changes would really take place, if it were possible to try such an experiment. As soon as the corners of the plates would be brought in contact there would be an electrical attraction between the plates, and when the plates would be allowed to come in actual contact the substantial force of electrical attraction would be converted into the substantial force of adhesion and the substantial force of heat, which latter would immediately act upon the substantial force of cohesion, the copper and zinc would expand, and the substantial force of cohesion would be under the necessary subjection which would permit the substantial force of adhesive attraction to draw the two metals intimately together to form an alloy. It must be understood that when the substantial force of heat is applied to a body the mass and every particle or portion of it expands, and the substantial force of cohesion, which tends to draw every particle together, is overpowered to the extent of the substantial heat force applied. When water is converted into steam, a given volume of steam would only contain $\frac{1}{1728}$ as much of the substantial force of cohesion at work in it as the same volume of water, as water is attenuated (thinned out) by the action of the substantial heat force to such an extent that one volume of water yields 1728 volumes of steam. The 1728 volumes of steam, however, contain exactly the same amount of the substantial force of cohesion as did the one volume of water, which can be demonstrated by simply removing the difference of heat units between the two, when the steam will become water. The substantial force of cohesion, therefore, is not changed into any other form of manifestation in this experiment.

Another method, designed to show the heterogeneity of matter, is founded upon the forces employed in drawing out a film of a liquid—as in blowing a soap-bubble. The film of a soap-bubble acts to a certain extent like an elastic membrane, which requires work to be spent upon it in order to stretch it. Prof. Tait says: "But just as a gas has no superior limit to its expansion, a soap-film has no inferior limit to its contraction." It is possible to calculate what amount of work would be required to pull out a single drop of water until it was made into a film of any given thickness. The amount of work is, in fact, numerically the product of the tension per linear inch into the area of the surface. It is found (in accordance with the fact that the surface-tension of water diminishes as the temperature rises) that in pulling out such a film, making it thinner and thinner, it must become colder and colder, and that it would require a constant supply of heat in order to keep it at the temperature of the air. Data is therefore furnished from which can be calculated how much work would be required to pull out a drop of water into a film of a given thickness, keeping it always at a constant temperature. "This calculation," says Prof. Tait, "has been made in terms of the thickness of the film, and it appears that if you pull it out to a thickness of the $\frac{1}{1000000000}$ part of an inch (supposing that could be done), you would require to spend upon it, besides the amount of work requisite to overcome the molecular forces, about one-half as much energy in addition, in the form of heat, in order to keep its temperature from sinking; so that, on the whole, including the heat which had to be communicated to it, the quantity of work spent upon it in the operation would be such that if it had all been applied to the drop of water in the form of heat, it would have been capable of raising it to a temperature of somewhere over 1100° C. (2012° F.). Now, this amount of heat would of course wholly volatilize the water in an instant. It is therefore perfectly inconceivable that a film of water can be drawn out to such an excessive thinness without very great reduction of the molecular tension. But if the molecular tension is reduced, obviously we are coming to a state in which there are but a few molecules, or particles, in the thickness of the film, because as long as the film contains a great number of particles in its thickness, the whole tension of the film will remain sensibly unaltered.

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"Thus the only way of reconciling these two inconsistent things is by supposing that we have erred in assuming that, when we have made the film very thin, there still remains the original amount of molecular tension in it. Hence, a film drawn out, if it were possible to draw it, to anything like the $\frac{1}{100000000}$ part of an inch in thickness, cannot contain more than a very few particles of water in its thickness."

The conclusion arrived at by the method of reasoning stated above and expressed in the last few lines, is one that every one would be apt to agree with, namely, if a film be drawn out to the $\frac{1}{100000000}$ part of an inch in thickness, such a film could not contain many particles in its thickness, that is to say, compared (for we only know one thing from another by comparison) with a film of greater thickness. What the above argument has to do with showing, however, that matter is heterogeneous and not homogeneous, is difficult to conceive.

If 1100° C. of heat were applied to water, in a film or otherwise, it would naturally be converted into vapor, and the reason would be that the substantial heat force would entirely and at once overcome the substantial cohesive force which holds the particles of the water together; or if by blowing a soap-bubble it should finally burst and go to pieces, a critical investigation would show that the mechanical force applied is utilized in part to expand the film, while some is converted into heat, which is radiated off by the largely increased surface, until the force applied had sufficiently reduced the cohesive force so that the film would fall to pieces. Some of the cohesive force being liberated and returning to the force-element of nature, while the remainder is retained at work in the particles of water into which the film was disintegrated.

If a piece of elastic cord be stretched and stretched, the force applied will overcome the cohesive force at the weakest point, and the elastic will break in two pieces, each piece flying back and assuming its original condition. If it were possible to overcome the cohesive force in other places at the same time, then the elastic would break up into a number of pieces.

In the soap-bubble, instead of the force applied to expand it operating on one point, as in the elastic cord, the force is distributed over the whole inner surface of the film, hence the film breaks to pieces (other things being equal) all over and at once, and this happens the minute the force applied overcomes the cohesive force which tends to hold the particles together.

Speaking of the diffusion of gases, Prof. Tait says: "We have absolute proof that gases consist of particles (molecules) of matter which are perfectly free and detached from one another, and which are constantly flying about in all directions. The best and simplest proof that we have of this is obtained by considering the process of mixture of one gas with another—the way in which one gas diffuses through another—as, for instance, when any volatile substance in the form of vapor or gas is allowed to escape into a room, we find that it gradually mixes itself thoroughly with the air of the room. This diffusion takes place even if currents of air are prevented, so that at last there is almost uniform distribution of such gas or vapor throughout the whole of any mass of air however great."

By allowing gases to pass through a porous substance, the relative rates at which they go and come out can be ascertained. And from such results Prof. Tait and others think that, besides showing the rate at which the particles (molecules) are moving, it is also a complete demonstration of their comparative freedom from one another, except at instants when they come against each other in their motions.

It is difficult for a substantialist to see the necessity of a gas being composed of particles (molecules) "perfectly free and detached" from one another, in order to explain the diffusion of gases; and if this can be shown, the idea of the "absolute proof" which Prof. Tait speaks of vanishes.

When two gases are brought in contact with one another, two things may happen, depending upon the affinity between the gases, as also other conditions—*i. e.*, they may combine to form a compound possessing totally different properties from the constituents, or they may mix together, or diffuse through one another, making a mixture which responds to tests directed to detect the presence of each gas.

Chemical attraction, or chemism, is the name given to the force which is exercised when two elements combine. Experiment and observation have shown that

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this force is controlled and modified by three forms of the force-element of nature —heat, light, and electricity.[1]

The electricity produced by a small galvanic battery can effect the decomposition of water, as well as a very large number of other compound substances.

In like manner heat will decompose limestone (calcic carbonate) and drive off the carbonic acid; it will also decompose potassic chlorate, potassic nitrate, and, in fact, the larger part of all chemical compounds.

Light, though acting with less intensity than the two forces just mentioned, nevertheless produces analagous effects and decomposes many substances—the decomposing of the various colors of bodies, and especially the power it gives to the leaves of plants of decomposing carbonic acid.

On the other hand, these three forces will often effect the union of substances which under ordinary circumstances refuse to combine.

Thus one volume of oxygen and two volumes of hydrogen will remain mixed, yet uncombined for years; but if the smallest particle of any substance in active inflammation be applied to the mixture, they will unite instantaneously with a violent detonation, at the same time forming water.

The same is true of carbon and oxygen, but if the carbon be heated red hot combination will immediately ensue, and proceed with great intensity. In like manner electricity, if made to pass through the same mixture of hydrogen and oxygen just stated, will cause them to unite with a violent explosion, and produce water; and if a succession of electric sparks be transmitted through a mixture of oxygen and nitrogen, they will combine and form nitric acid (N_2O_5).[2] In the same manner, a beam of bright sunlight, allowed to fall on a mixture of equal volumes of chlorine and hydrogen, will cause them to combine with a violent explosion, forming hydrogen chloride (hydrochloric acid), while if these two gases are brought together in the dark, they simply mix but do not combine.

It is evident that the chemical arts chiefly consist in the modification of the so-called force of chemism by the other forces—heat, light, and electricity.

No chemical process, whether performed on a great scale in nature, or on a small scale in the arts, or in the laboratory, can be carried on without the development or the action of these three forces, which are different manifestations of the one force-element of nature. The rapidity of chemical union, or decomposition, is assisted by the application of heat. In some chemical unions great heat is produced; in others, currents of electricity are set in motion; and often the result of both is the production of vivid light, and very often contraction of mass.

From what has just been stated, it is evident that to produce chemical union between two substances, the force of chemical attraction (chemism) has to be assisted by some other force, either by heat, light, or electricity. Isolating one illustration given above, namely, the formation of hydrogen chloride by simply exposing a mixture of hydrogen and chlorine to a beam of substantial light—if the mixture were kept in the dark, as stated, no such chemical union would take place.

We have sufficiently considered, then, the formation of chemical compounds; let us now consider the diffusion or mixing of gases together, which, Prof. Tait says, shows "absolute proof" that matter consists of particles (molecules) detached from one another.

If oxygen and hydrogen gas are brought together, they will diffuse through one another, so that after the diffusion is complete there will not be a portion, *however small*, of the mixture which will not contain some oxygen and some hydrogen. The explanation for the diffusion is perfectly simple, We bring together two gases—one positive, the other negative—and the minute they come together the substantial force of attraction compels one gas to impregnate the other, and the rapidity of the diffusion will depend to a great extent on the attenuated condition of the gases. While there is a great deal of cohesive force in the solid, less in the liquid, and still less in the gas, there is always some, which, however, is held under subjection by the substantial heat force, which tends to expand the gas. The attenuated condition of matter is therefore entirely abnormal, and depends upon the success heat force has in overcoming cohesive force.

Now let us bring together a plate of copper and one of zinc. There is exer-

[1] See Pynchon—"Chem. Phys.," p. 19.

[2] Strictly speaking, nitric acid is HNO_3.

cised between these plates a force of attraction, but they do not impregnate one another simply because cohesive force has sway, and this force must in part be overcome to permit of one plate entering the other. This is accomplished by melting the same; and if the substantial heat force be in sufficient quantity, the molten mass of copper and zinc will become more attenuated and assume a vaporized condition, and in the vapor there can be detected the presence of copper and zinc diffused through one another.

The normal condition of hydrogen and oxygen is the solid, a condition in which they would be found if there was no substantial heat force in the universe. Their existence as a gas is only by sufferance, and depends upon the substantial heat force overcoming the substantial cohesive force to the extent necessary for any attenuated condition in which they may be found.

Solid hydrogen and solid oxygen could not diffuse through one another, no matter what the attraction. In the gaseous form they diffuse, for the reason that the cohesive force has been overcome sufficiently by the heat force (which permits them to exist as gases), and which enables the substantial attractive force to pull the two gases together, and thus diffuse through one another. This force of attraction is also able to counteract the substantial force of gravitation; sufficiently so that the gases may diffuse through one another, for no matter how dense the gas may be, compared to another, they will diffuse through one another in spite of gravitation. The necessity, therefore, for molecules, separated from one another, to explain the diffusion of gases has no foundation.

The pressure of a gas exercised in an inclosed vessel is attributed to the velocity with which the molecules move. Joule has calculated that the velocity of the hydrogen molecule must be about 6055 feet (over a mile) *per second* at 0° C. This velocity, it is seen, is far higher than that of a cannon ball. As in a cubic inch of space there are supposed to be 300,000,000,000,000,000,000 (3×10^{20}) molecules, no one particle can ever find anything like a free path from one side of a cubic inch of space to the other. It is certain to be met over and over again in its course. Knowing the rate of diffusion of a gas, the number of collisions which take place in a second has been calculated, which enables the believers in molecules to calculate the average distance which a particle moves through between two successive collisions. One of the results arrived at by Boltzmann is that in a mass of hydrogen, at ordinary temperature and pressure, every molecule has on an average 17,700,000,000 collisions per second with other molecules; that is to say, 17,700,000,000 times in every second it has its course wholly changed. And yet the molecules are assumed to be moving at a rate of something like seventy miles per minute.

The results arrived at by several inquirers who have considered the molecular motion of gases, is that the average distance between the several molecules of a gas at the ordinary temperature and pressure of the air must be something between the $\frac{5}{10000000}$ part of an inch and the $\frac{10}{10000000}$ part of an inch. With the data given above it is now *theoretically* possible to calculate how large each particular molecule is in comparison with the average distance between any two of them. This is calculated from the theory of impact of elastic particles, or of particles repelling one another, according to a high inverse power of their mutual distance. As a result of the calculation, it is found that the diameter of a molecule cannot be very different from $\frac{1}{2500000000}$ part of an inch.

From this it appears that if we could magnify a drop of water to the apparent size of the whole earth, as seen from the distance at which a single plum is just visible, we could just see its grained structure. About two millions of molecules of hydrogen in a row would occupy a millimetre (0.03936 inch), and about two hundred million million million of them would weigh a milligram (0.01543 grain).

Clerk Maxwell says: "The determination of the mass of a molecule is a legitimate object of scientific research, and that this mass is by no means immeasurably small."

We have now presented the various arguments which have been advanced, not only to show that matter is heterogeneous, but to show the diameter of the molecules composing it and the distances at which they are separated from one another, and we have also touched upon the atom. Each argument has been answered in turn by the light of the Substantial Philosophy, except the last argument, which

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attempts to account for the pressure exercised by a gas against the walls of a vessel inclosing it.

It will be remembered that in several parts of this paper we alluded to the fact that the solid condition was the normal condition of all material substance, and that a gaseous condition was an abnormal condition, and depended upon the amount of substantial heat force present for its existence. This being the case, and since it is well understood that it is by the application of heat that a body expands, the pressure of any gas against the walls of a vessel inclosing it is due simply to the temperature of the gas or to the amount of substantial heat force present. No better proof of this can be given than the fact that as the temperature increases, so does the pressure. Remove the heat, and where would be the pressure? Heat is the great antagonist of cohesion. If it were not for the presence of heat, there is no telling how condensed a given amount of matter would be, which had its particles held together by the substantial force of cohesion alone. We really know matter only in its attenuated condition—even in the case of solids.

The solid state of water is ice, but the solid state referred to above is much more compact than ice; for if ice at 32° F. be removed to an atmosphere having a temperature of say 20° below zero, it would have to lose 52° of heat before it would be adjusted to the surrounding conditions. To obtain its normal condition, all heat must be removed—this, of course, experiment has been unable to accomplish. Experiment has shown that the coefficient of expansion of all gases, when raised from 0° to 1° C. (32° to 33°.8 F.), is $\frac{1}{273}$ (law of Charles). Hence it is argued that if it were possible to cool a body of matter down to — 273° C. (— 456° F.), it would be deprived of all heat. Whether or not this law is absolutely correct it remains for more experimental data to determine.

So far in this paper we have considered the various arguments advanced by physicists to show that matter is composed of molecules, and is not homogeneous, and we have answered each one in turn. It now remains for us to examine carefully what the chemist has to say on this subject.

(*To be continued in the February number.*)

THE LOCUST AND THE HEAT PROBLEM.

Reply to Robert Rogers.

BY THE EDITOR.

(*Concluded from last number, page 139.*)

Having already shown, according to the current theory of acoustics, that the *locust*, which is able to fill four cubic miles of air with its *sound*, ought also to fill the same air with *heat*, whether its stridulating force sent out shall result in sound or not, we now come to another phase of the discussion, namely, the real effect of atmospheric condensations and rarefactions, as relates to the heat and cold observed in the same; and we have no hesitation in promising the critical reader in advance one of the most, if not the most, important scientific discussions in this connection which we have ever had the honor of producing in these pages.

At the very threshold of the argument, therefore, we venture to announce what we, as well as others, regard as a new and most revolutionary law in physical science, to wit: *that the heat observed, when a mass of air is suddenly condensed, is not "generated" at all by such act of condensation, as the present theory teaches, but that it was already in the air and to the same amount precisely before the condensing operation was commenced, its apparent "generation" being only the concentration of this substantial heat to a smaller space, thereby intensifying it in the same ratio as the air containing it was reduced in volume.*

If this law be true, it necessarily overturns the present theory of "*heat* as a mode of motion," and demonstrates heat to be a real substantial entity, or objective existence, as much so as is the air, only that *heat* is an *immaterial*, while *air* is a *material* substance. For surely if *heat* is capable of being condensed, and thereby concentrated to greater intensity, the same as is the air containing it, it must in all reason be as really a substantial entity as is the air itself.

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The present theory teaches that the heat observed, when confined air is compressed, is actually "*generated*," or comes into existence, by the conversion of the mechanical force which was expended in compressing the air; not one single physicist having conceived the idea, so far as the record shows, that by putting two volumes of air into the space of one we necessarily put the two volumes of substantial heat contained in the air into the space of one, thus doubling its intensity. This position, therefore, if true, is so revolutionary and startling, in the very face of the present theory of "heat as a mode of motion," that it cannot be too carefully analyzed and impressed upon the reader's mind.

We do not wish it to be inferred, from this assumed law, that we discard the fact of the conversion of mechanical force into heat, as well as into light, electricity, sound, magnetism, and even other forms of force. In the usual experiment of compressing air into a tube by means of a tightly-fitting piston, there is no doubt that a slight but inappreciable amount of heat is generated by the friction of the piston against the sides of the tube, and also by the friction of the air particles against each other in the act of being compressed, which trifling heat may be properly attributed to the conversion of mechanical force; but this is by no means the intense increase of heat observed in the compressed air, nor has it anything to do with the heat claimed to be "generated" in such experiments, as taught by the whole scientific world. This will be shown so clearly as to satisfy every attentive reader.

The current theory, which teaches that the heat, as thus observed, is "*generated*" by the conversion of mechanical force, is elaborately urged and illustrated by Prof. Tyndall in his popular work entitled "Heat as a Mode of Motion." He insists, and tries to show by various experiments and illustrations, that the observed rise of temperature in the air when suddenly compressed, is thus "generated," and is due alone to this conversion of the mechanical force expended in the act of compression.

He carries his experiments so far as actually to set fire to the fumes of *bisulphide of carbon* in a glass tube by driving a piston suddenly into it, and thus compressing the air into a very small compass. On another occasion he sets fire to a piece of punk, or amadou, by the same means, and then insists that this intense heat in the compressed air is "generated," as he repeatedly expresses it, by the conversion of the muscular force of his arm into heat in the act of compressing the air. ("Heat as a Mode of Motion," first edition, page 43; "Lectures on Sound," first edition, page 28.) His words are:

"Into it [the tube] this piston fits air-tight, so that by driving the piston down I can forcibly compress the air underneath it; and when the air is thus compressed *heat* is suddenly *generated*," etc.

"By pushing the piston down I condense the air beneath it, and when I do so *heat* is developed. Attaching a scrap of amadou to the bottom of the piston, I can ignite it by the *heat generated by compression*," etc.

Now we declare, upon the evidence of the new law which we are discussing, that there is not one word of scientific truth in all this teaching of Prof. Tyndall, notwithstanding he devotes much of his large volume, "Heat as a Mode of Motion," to this very fallacious principle of physics, and in fact makes his whole book hinge upon the correctness of that position. He never, for one moment, thought, while making his experiments, nor has any one else thought while repeating them, so far as we have ever seen, that this sensible or observed heat, so far from being "generated," was already in the air to its full amount before compression began; and that instead of his muscular force being changed into heat, it is actually *stored up* in the compressed air, and retained there through the property of atmospheric elasticity, ready to react with the same mechanical energy, minus friction, in the act of restoring the air to its original form, when the outside pressure is removed. And after this mechanical force has thus done its double work of action and reaction, it returns or resolves itself into the original force-element of nature, where, according to Substantialism, it is conserved as crude energy for remanifestation in the same or in some other form of force.

We assert that any experiment, properly made, will show that as the piston is pressed into the tube the heat will increase in intensity in the same ratio that the air becomes concentrated into a smaller bulk, and that the intense heat which sets

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fire to the amadou *was all in the air as actual substantial heat before the piston began to move, just as our law sets forth.* It was simply concentrated so suddenly into a small space by a blow of the piston, that it had no time to escape by radiation before setting the punk on fire. Such increase of heat, therefore, can be accurately calculated in advance by the exact amount of atmospheric compression to be produced, since, according to the law here announced, the concentration of the substantial heat must of necessity keep pace with the atmospheric compression or concentration of the air. For example:

If we have a tube sixteen inches long, and the normal air of the room, with which the tube is filled, is at 80° F., then by pushing the piston down one-half the distance (eight inches) the heat will necessarily double in intensity (160°) just as the air doubles in density. By pushing the piston down one-half more (four inches further) the heat will increase to 320°, but if pushed down fifteen inches in all, the heat must necessarily be so concentrated and increased as to reach 1280°—vastly more than enough to melt lead, could it be retained at that intensity for a short time without radiation.

That the mechanical force thus expended in compression is not converted into heat, as here supposed by Prof. Tyndall, except the inappreciable amount which is caused by friction, as just explained, can be demonstrated in several different ways. The force which compresses the air in a tube surely cannot be converted into heat, since this so-called "generated" heat may all radiate from the tube into the surrounding air, and still *the very force which makes the compression, as just hinted, remains stored up in this air as actual mechanical energy, ready to do the same amount of work by reaction, minus friction, and also minus a slight expansive force of the air in consequence of its concentrated heat lost by radiation.*

But here is the proof, in a simple experiment, that no appreciable conversion of mechanical force into heat takes place in the performance of this compressing work, or in the stoppage of the air's motion. Let, for example, the receiver of an air-pump be exhausted of air (and necessarily also of the heat which the air contained), and then allowed to stand till it absorbs heat from the surrounding air sufficient to make it of equal temperature. Now open the valve and allow the outside air to rush in and fill it. Here is actual mechanical energy expended under an outside pressure of fifteen pounds to the square inch, doing its work of forcing the air into this vessel, where its motion is suddenly brought to a stop. Yet not the perceptible fraction of a degree of heat is generated in this rush of air and stoppage of motion, *notwithstanding the same mechanical force is exerted upon it by the outside air in forcing it into the receiver that we would expend in forcing a second atmosphere into a vessel already containing one atmosphere.* Why is there no augmentation of heat observed in the air after its rush into the receiver by the mechanical force which injected it? Simply because the air within remains of the same density that it had when without, and not being condensed in bulk, its contained quantity of heat is not concentrated into a smaller volume, and therefore its heat is of the same intensity as it is in the air outside.

The startling truth is, Prof. Tyndall did not understand the experiments which he was trying to explain to his audience, and we can demonstrate it right here. For example, he had a vessel of condensed air which had stood for hours till all its augmented heat had radiated, making it the same temperature as that of the outside air. He then let some of this cooled air (still containing its stored-up *mechanical force,* remember, after its heat, "generated" by conversion, had entirely radiated and disappeared!) rush out against the thermo pile, and of course it chilled it, turning the galvanometer in the direction of *cold.* Prof. Tyndall now explains it by saying that the condensed air, in rushing out, had to do mechanical work, and that it thereby used up some of the heat contained in it, thus making it colder than the outside air as it struck the pile! (See page 27.) This to us is simply surprising. How plain is it that as soon as this compressed air got outside of the vessel it was free to *expand,* and thus distribute its contained heat over more space, thereby lessening its intensity and causing it to be cooler on striking the pile than the surrounding air!

On the next page he reverses this experiment, and drives the normal air of the room against the sensitive pile by means of an ordinary bellows, thereby warm-

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ing it. Now, how is this warmth caused? Look at Prof. Tyndall's explanation in his own words:

"In the case of the bellows, it is my muscles which perform the work. I raise the upper board of the bellows, and the air rushes in; I press the boards with a certain force, and the air rushes out. The expelled air strikes the face of the pile, *has its motion stopped, and an amount of heat equivalent to the destruction of this motion is instantly generated.*"

We again declare that there is not the least scientific truth or rationality in this kind of explanation. If the motion of the air, sent out from the nozzle of the bellows, was changed into its equivalent of heat by being suddenly stopped, why was not the motion of the air, as just shown, that rushed into the exhausted receiver, and which was suddenly stopped under a pressure of fifteen pounds to the square inch, also changed into heat? Here is the real and only solution of Prof. Tyndall's bellows difficulty: On forcing the air from the nozzle he necessarily sent it out slightly condensed, and thus brought its contained heat into a smaller compass, thereby intensifying it. In this condition it struck the sensitive pile before it had time to expand and thus dilute its heat. Of course the galvanometer was deflected in the direction of heat. It is the same as we raise the mercury in a thermometer by simply fanning it, since the *slightly condensed* air from the fan's swing strikes the bulb of the thermometer with its contained heat also *slightly condensed,* and intensified in the same ratio. How plain and beautiful! Yet Prof. Tyndall failed to see, when conducting these very simple experiments, what he should have guessed with a moment's reflection, that by putting two atmospheres suddenly together into the space of one, he necessarily must put the two volumes of heat which the air contains into the same space of one, thereby intensifying such concentrated heat accordingly!

Inexcusable as such an oversight would seem to be, it is the very foundation-wall upon which that great scientific superstructure—"Heat as a Mode of Motion"—was built; and this very elementary oversight forms the basis of all there is known or taught of heat to-day in all the colleges and universities in this land. Is it not time, therefore, that there was at least one institution of learning in all this country armed and equipped by Substantialism to teach science as it ought to be taught? No wonder Prof. Tyndall, in view of his manifest confusion of ideas on heat, should express himself in the following words on making the foregoing explanations to his audience:

"And should you at present find it difficult to form distinct conceptions as to the bearing of these experiments, I exhort you to be patient. We are engaged on a difficult and entangled subject, which I hope we shall disentangle as we go along." Again: "Do not be disheartened if this reasoning should not appear quite clear to you. We are now in comparative darkness, but as we proceed light will gradually appear, and irradiate retrospectively our present gloom." (Pages 26, 43.)

How prophetic! Light has appeared in this very new law of physics with which to irradiate the gloom, and in strict keeping with the Substantial Philosophy has, in a new and unexpected way, demonstrated heat to be a substantial entity or a real, objective existence, as much so as is the air which contains it. The cause of all Prof. Tyndall's "darkness," "gloom," and "entangled" maze of difficulties would have been entirely avoided had he been fortunate enough to have grasped heat as an immaterial substance. His making it a "mode of motion" of a gelatinous nothing—*ether*—was the source of all the mischief. But for this he would naturally, and almost unavoidably, have run into the simple truth, which no "darkness" or "gloom" would have obscured, namely, that by putting two substantial *airs* into one volume, he must also and necessarily put two substantial *heats* into one volume, since they were both contained in the two *airs* before their condensation. How beautiful!

It follows from this reasoning, and the law of physics upon which it is based, that atmospheric heat must exactly double in *intensity* by thermometric test, though remaining the same in *quantity,* whenever two atmospheres of any given temperature are compressed suddenly into the space of one, allowing for slight radiation, which begins to act instantaneously. This, of course, is exactly as it should be, according to Substantialism, since it is self-evident that heat, being

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an entity, must increase in intensity in the exact ratio of its concentration, as is the case with substantial light, sound, electricity, etc. How could it be otherwise if heat is an entity as much as is air itself, and making its residence therein? Under such circumstances we must concentrate the heat just as we concentrate the air, and thus augment the *intensity* of the one as we augment the *density* of the other.

In like manner the production of *cold*, or, more strictly, the lessening of *heat*, in the air, when expanded (as when a piston is moved forward and backward in a closed cylinder, thus alternately condensing and rarefying the air on the opposite sides of the piston), proves our new law to be absolutely correct, since the heat in the rarefied air decreases in intensity to a degree corresponding exactly to its augmentation when the air is condensed. This is also just as it should be, if our position be true, for the heat of the normal air is simply concentrated, or else diffused on the opposite sides of the piston, in exact proportion as the air is condensed into a smaller compass, or else expanded into a larger bulk, somewhat as a flavoring extract is weakened in intensity by dilution or intensified by evaporation. How beautiful and consistent, as well as harmonious with reason and natural law, is the true solution of any physical problem!

But let us now compare this rational view of the case with the solution given by the current theory. If the heat observed in the compressed air is really "generated" by the "*conversion* of the mechanical force" expended in compressing it, *why should not the same amount of mechanical force when used to expand the air by means of a piston be also converted into heat?* Instead of generating *heat* in the expanded or rarefied air, this so-called converted force actually "generates" *cold.* How funny, that mechanical force expended in one way (compression) should be converted into heat, and expended in another way (expansion) should be converted into cold! The truth is, neither the increased heat nor the diminished heat (called *cold*) comes from the conversion of mechanical force, but the heat observed was all in the normal air before it was disturbed, and was simply concentrated with the condensed air, and dilated with the rarefied air, thus manifesting different degrees of intensity according to volume, just as our law prescribes. No wonder that "darkness," "gloom," and "entanglement" should whelm a theory which involves such incongruities of science as the conversion of mechanical force into both heat and cold! If Prof. Tyndall should contrive some way to convert the present theory of heat into common sense, he would be doing a service to the world.

But this principle is so important in settling forever the theory of heat as now taught in our colleges, that it deserves additional illustration. Suppose that we apply mechanical force and suddenly compress a block of soft rubber into one-half its bulk; it is plain that we must, according to the new law, concentrate its contained heat also into one-half its previous volume, thereby doubling its intensity, though it remains the same in quantity. Then suppose we remove this outside mechanical pressure and allow the stored-up force to react, thus restoring the rubber to its former volume before its concentrated heat has had time to radiate; it is equally plain that this heat, thus increased by concentration, will also be restored to the exact intensity it had before compression. But suppose that we again apply the original mechanical force, and instead of compressing we expand this rubber to double its normal bulk, is it not manifest that the normal heat contained therein will be diffused throughout the expanded rubber and thereby be correspondingly weakened in intensity; or, say, reduced to one-quarter the intensity it showed when compressed? It is true that the rapid alternate stretching and contraction of a rubber string will sensibly augment its general temperature by the constant friction of its particles, since in this operation its volume is not changed. What it gains in length is balanced by its decrease in thickness.[1] This, by the way, is a good illustration of the generation of heat by the conversion of mechanical force.

From the foregoing illustration of a rubber block we reach the important point in our argument. If it takes precisely the same mechanical force to expand the rubber block to double its normal bulk that it takes to compress it to half its nor-

[1] In stretching a metal wire, its decrease in thickness does not keep pace with its elongation, and therefore its contained heat, being diffused through greater volume, shows a diminution of intensity, notwithstanding the slight additional heat it receives from frictional conversion.

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mal bulk, why in the name of science does not the expansive force thus expended generate heat by conversion if the heat observed in compression is thus generated, as the present theory teaches? Neither Prof. Tyndall nor any other physicist can explain this observed *heat* by the mechanical force of *compression* and this observed *cold* by the mechanical force of *expansion*, according to the present theory of "heat as a mode of motion," nor can it be accounted for on any other principle than that of the new law here laid down. For clearly, if heat is "generated" in compression by the conversion of mechanical force, as urged throughout the entire volume of Prof. Tyndall, *then the same intensity of heat should be "generated" in expansion, since it requires the same expenditure of mechanical force in the one case as in the other.*

It is self-evident, therefore, that this single argument, thus elaborated and illustrated, puts an everlasting quietus upon the theory of "Heat as a Mode of Motion," and demonstrates at the same time the correctness of the law we have announced, namely, that the condensing of the air by mechanical compression simply concentrates the heat already contained in it into a smaller compass, thus intensifying it, while the rarefying of the air by mechanical expansion just as naturally diffuses the heat already in it throughout more space, thus weakening its intensity.

It is a simple fact, easily demonstrated and observed, that the extent of this concentration or diffusion of heat, as previously hinted, exactly keeps pace with the extent of the mechanical compression or expansion of the air which takes place in every experiment that can be tried, thus proving that heat is a real, objective entity, existing in the normal air, just as the Substantial Philosophy teaches; and that the *apparent* "generation" of heat, in the act of compressing the air, could only have had such appearance to minds superficially engaged in framing or defending a theory without any due regard to the natural relations existing between science and truth.

But still further: as the temperature of air always rises in exact proportion to the extent of atmospheric compression, compared with the temperature at the start, and *vice versa*, it must follow, scientifically, that air, however reduced in temperature, *still must contain some heat to be thus intensified by concentration into smaller volume.* Even the coldest air ever encountered by an arctic explorer, more than 70° F. below zero, contains easily observed heat, *since by compressing it into a smaller bulk its temperature always rises!* Our lamented and noble friend, Capt. Hall, gave us this information, as the result of his own personal experience, while he was lecturing before the Geographical Society in this city, just before starting on his last and fatal venture to the polar regions.

How clearly, also, but incidentally, does this prove that *cold* is not a substantial force, or entity, as some believe; since, if it were an entity, or anything but the mere absence of heat, as darkness is the absence of light, the air ought to contain at least some *substantial cold* at about 70° below zero, and of course such cold ought to be intensified by concentration on compressing this cold air, just as sensibly warm air becomes hotter by the same process. But instead of intensifying the *cold* by such concentration, in compressing the coldest air ever known, *the temperature always rises by compression;* and we here predict, on the basis of the law we have announced, that such rise of temperature will bear the same proportionate relation to that which existed before compression, as it does in the like process of compressing air at summer heat or any higher temperature. That is to say, *the resident heat in the coldest air will simply be doubled in intensity by reducing the air to one-half its volume.*

And here we may safely conclude that if air were absolutely deprived of all heat it would shrink to a solid condition, after first settling to a liquid state of the density of water. Indeed, this important deduction, with which Dr. Mott fully concurs, corresponds exactly with the general law we had the honor first of announcing, to wit: *That the normal condition of every material substance in the universe is that of a solid, the various forms of liquid, gaseous, vaporous, or aeriform substances being abnormal, and only caused by the phenomenal presence of heat.* (MICROCOSM, vol. iii., page 214.)

Finally, in reply to the closing inquiry of Mr. Rogers, we would say that in basing our calculation of $\frac{1}{570}$ increase of temperature upon Prof. Mayer's famous

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$\frac{1}{875}$ increase of density in the compressed half of the sound-wave, we were only making a very liberal concession to the wave-theory in assuming the increase of heat to be so small as this authoritative increase of density would make it. Had we been disposed to handle the theory as roughly and hold it as rigidly to account as its demerits warrant, we should have made the increase of heat in the condensed half of the sound-waves at least 87° F., instead of the $\frac{1}{875}$ of the air's normal temperature. Why? Simply because this supposed increase of heat, according to the formula of Laplace, actually is claimed to add 174 feet a second to the velocity of sound above that which it would have were there no such augmentation of temperature. (See Tyndall on "Sound," pages 28, 29, etc.)

Now, since sound is known to increase its velocity in air when the whole mass is heated, at the ratio of two feet a second for every additional degree of rise in temperature, it ought, as we have just stated, to require 87° of heat in the condensed half of the sound-wave to give the 174 additional feet of velocity attributed, by the theory, to the heat generated by the passage of the sound-waves themselves. No man can question the reasonableness of this; for surely common logic ought to tell us, whatever "science" may teach, that it would require at least as high a temperature in half a wave to add 174 feet a second to its velocity as it requires in the whole wave! Or in other words, *it ought to require at least as great a rise of temperature in one-half the mass of air permeated by sound* (the *condensed* half) *as we know it to require in the whole of it, namely,* 87°, *to give an increase of* 174 *feet in a second!* Hence, we naturally thought we were doing a very generous thing toward the wave-theory in basing our calculation, for the degrees of heat generated by the locust, on Prof. Mayer's $\frac{1}{875}$ increase of density, instead of the 87° of rise, as we had a just right to insist upon.

As Sir Isaac Newton demonstrated by the application of his formula of density and elasticity, that sound ought to travel in air at a velocity of 174 feet a second *less* than observation actually shows, thereby mathematically overturning the wave-theory of sound; and as there was no possible escape from this demonstration for wave-theorists, except by resorting to the astounding assumption sprung by Laplace that the heat generated in the condensations of the sound-waves increased the elasticity of the air sufficient to make up this deficit of 174 feet a second, what could be more natural and logical than to infer that the condensed half of the air must of necessity be raised at least as much in temperature as we know the whole air to require in order to add the same velocity? To teach that an infinitesimal fraction of that increase, in the condensed half of the air, will answer every purpose, as wave-theorists do when pressed, is to trifle with the common intelligence of mankind. Better honestly and frankly to give up the theory and have done with it, as we feel sure would have been done by Sir Isaac Newton had he at that juncture caught but a faint glimmer of the great truths of the Substantial Philosophy, as continually set forth in this magazine. But his eyes were holden so that he could not at that time see these simple truths, even when he had the most overwhelming reasons for so doing in his own absolute demonstration of the fallacy of the wave-theory. This single recorded example of a great mind still persisting in a false theory of science, even after demonstrating its fallacy and proving that it flatly contradicts observation, is a startling illustration of the hold which an established doctrine of science secures upon even the most eminent of investigators.

RELIGIOUS HINTS FROM SCIENCE AND PHILOSOPHY.—No. 2.

BY J. W. LOWBER, M. A, PH. D.

THE EPICUREAN PHILOSOPHY.

And when they heard of the resurrection of the dead, some mocked.—Acts xvii. 32.

Although Aristotle was no sensualist in phylosophy, he did place so much emphasis upon sensation as the source of knowledge, that he prepared the way for a return to sensualism. With Plato and Aristotle, philosophy comprehended in its circle nature, humanity and divinity; but in the systems of Epicurus and Zeno,

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moral philosophy is the only subject worthy of the attention of thinkers. Educated men either belonged to the school of Epicurus or to that of Zeno, until the coming of Christ.

Epicurus was born B. C. 342, and died 270 B. C. He purchased a garden within the city of Athens, and commenced teaching philosophy at the age of thirty-six. Although he wrote many books, none have been preserved. The outlines of his ethical system have been preserved by Diogenes Laertius. The writings of Lucretius have also thrown much light upon the philosophical theory of Epicurus. The psychology of Epicurus was evidently borrowed from the Ionian school, which taught that sensation is the source of all knowledge, and the standard of all truth. His physical system was derived from Democritus; for with both, all things were from atoms. In ethics, he agreed with Aristotle that happiness must be the end of a practical life, if absolute good be not the end. According to Epicurus, the grand object of philosophy is the attainment of a happy life. Truth with him was merely a relative thing, and its pursuit for its own sake, he considered useless.

The following are some of the proofs given by Epicurus to show that pleasure is the chief thing:

1. All animals from birth are delighted with pleasure and offended with pain.
2. All men like pleasure and dislike pain.
3. Men deliberately, and animals instinctively choose pleasure.

Epicurus made two divisions of pleasure: first, those of excitement; second, those of tranquillity. He taught that there are pleasures which we should avoid, in order to gain greater pleasure. Epicurus did not dispense with virtue, but used it as a means of securing happiness. The difference between the philosopher and common man, he taught, was the fact that the common man sought those things that give immediate pleasure, while the philosopher sought the greatest pleasure for a lifetime.

Epicureanism was pure materialism, for it taught the eternity of matter; that vegetable and animal life originated in a fortuitous concourse of atoms, and that the primitive state of man was one of pure savagism. Man is represented as wandering naked in the woods, feeding on wild fruits and acorns, and quenching his thirst at the rivulet in company with wild beasts. Modern materialists and atheists use almost precisely the arguments used by Epicurus and Lucretius. Observe the arguments used by Epicurus to prove the materiality of the soul, and see if they are not the same as now used by materialists:

1. The action and reaction of the soul and body upon each other prove them to be of similar substances.
2. The mind is produced with, and grown along with, the body.
3. The mind is diseased along with the body, and needs medicines.
4. Some faculties are impaired before others.

According to Epicurus, this teaches that the soul is divided and composed of different atoms; these are dissolved with the body, and man has no conscious existence after death. The doctrine of an eternal sleep is not, then, one of modern invention.

Epicurus acknowledged the insufficiency of matter to explain sensation and thought, that a nameless substance must be supposed. May not that hidden substance be an immaterial principle? So far as Epicurus knew, it had as well be called spirit as matter. May not the union of matter and spirit be the cause of sensation and thought? for where all is matter there is no cognition. There is an invisible and responsible agent connected with man that guides the body; it feels, it thinks, it acts, and there is as much reality in its phenomena as there is in the properties of matter. That agent we call spirit; and as soon as it leaves the body there is no longer motion in the body.

It is not surprising that the Epicureans mocked at the doctrine of the resurrection; for in their philosophy there was no future life. Paul taught the true spiritual philosophy and the pure system of religion. Life and immortality were made manifest in the Gospel, which dispelled the darkness that so long overshadowed the nations. The Gospel is the true light of man.

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CAMPING TOUR TO THE YO-SEMITE VALLEY AND CALAVERAS BIG TREES.—No. 14.

BY PROF. I. L. KEPHART, A. M., D. D.

SOUTH GROVE, AND "HOMEWARD BOUND."

Having determined to devote Friday, July 18th, to visiting the famous South Grove, we set everything in readiness therefore, the preceding evening, and were around in the morning at any early hour. The women, having been fully satisfied with their attempt to "foot it" to Glacier Point, consented to ride horseback, and for their accommodation we procured two good side-saddles at Mr. Sperry's stables. So at 6.30 A. M. we took the trail for South Grove, Mrs. Klinefelter mounted on Daisy, and Mrs. Kephart and Lizzie mounted on Jake, the professor leading the former and I the latter.

The trail left the main road a short distance below camp, wound around the fence, up a tolerably steep hill, crossed the mountain wagon-road that passes up the divide, and led down an immensely steep mountain, to Beaver Creek. On the brow of the mountain, where the trail crosses the main road, we had a magnificent view. Far away the summit of the Sierras towered aloft, twelve thousand feet above the level of the sea. Looking eastward and southward we could see, apparently near by, the snow-capped peaks of the range, and between us and them were spread out in grand array the great, timber-filled ravines, clothed in their beauteous robe of never-fading verdure. The descent to Beaver Creek was very steep, and the abilities of the women were taxed to their utmost, so great was the effort required to enable them to stick to the horses.

Beaver Creek is a crystal mountain stream six yards wide, and was at that time considerably swollen by the melting of the snow in the vicinity of its source. The scenery along its shores is most romantic, and its waters go hurrying on toward the valley in a continuous series of whirlpools, cascades, and cataracts. Here the disciples of Isaac Walton find a perfect paradise, for in this creek the famous speckled trout abound in great numbers, and snap the hook almost as soon as it touches the water.

Having crossed the creek on a rickety bridge, we ascended a mountain, and then descended to the banks of the roaring, foaming Stanislaus River, the boundary line between Calaveras and Tuolumne Counties. The sides of the mountain lying between the creek and the river above mentioned are very steep, and the climb and the descent very long; consequently our strength was severely taxed in this journey. The river was forded by the horses, and the Professor and I crossed on a foot-bridge. The scenery in these parts is grand; immense pines, firs, and oaks, and a great variety of shrubbery, prominent among which is chaparral, dogwood and mansaneta.

Having crossed the Stanislaus, we climbed another immense hill and then began to descend into the valley that contains the South Grove of "Big Trees." From the top of the hill we could look into the valley and readily distinguish the tops of some of the *Sequoias gigantea.* On we went, rapidly descending into the valley, our trail skirted on either side with hundreds of immense sugar pines, some of which were as much as ten feet in diameter, until by 10:30 A. M. we struck the first *Sequoias* of South Grove. This has been christened "Correspondent," in token of the immense amount of laudable effort put forth by knights of the quill to describe these kings of the forest. As said before, this is by far the largest grove of "Big Trees" in the world. It extends three and a half miles and contains 1380 large trees, and any tree less than fifteen feet in diameter is not considered large. The grove, containing 1000 acres, is owned by Mr. Sperry, the proprietor of the North Grove, and if once this region is "tapped" (as it soon will be) by the S. J. and S. N. R. R. the timber in these groves will be quite a fortune.

Passing "Correspondent," we soon came to "Fred" and "Electra," which seem to stand as the outposts of the great army that stands behind them. Their diameter is 15 feet each, and their height 250 feet. Next we passed "Gen. Custer," a splendid tree, having a diameter of 26 feet, and a height of 320

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feet. Beyond these we passed two celebrated Canadians, "Sir Francis Hincks," measuring 20 feet in diameter and 300 feet high; and "Dr. J. W. Dawson," measuring 18 feet in diameter and 300 feet high. These trees are fully 100 feet without a limb and as straight as a rifle barrel. All the large *Sequoias* trees bear marks of a great fire that must have swept through this region fully one thousand years ago. The "Dawson" has a cavity burned out of its base large enough to hold several men. Beyond these we passed "Dr. Eugene Nelson," which has a diameter of 21 feet and is 300 feet high; and beyond this stand a stately pair of trees, named the "Two Lovers." The next tree passed was "Massachusetts," 33½ feet in diameter and 380 feet high. Not far from this one stands "Ohio," 34 feet in diameter and 328 feet high. Beyond this one stands "Connecticut," 32 feet in diameter and 300 feet high, and not far from Connecticut" stands "Garfield," 30 feet in diameter and 340 feet high. "Gen. Hancock" stands not far distant from "Garfield," but its diameter and height were not marked, hence I cannot give them accurately; but it is nearly as large and as tall as "Garfield."

"New York" measures 35½ feet in diameter and 340 feet high! Surely words fail utterly to convey an idea of the enormous size of these trees. They must be seen in order to realize how wondrously large they are. Twenty yards east of "New York" stands "Beaconsfield," with a circumference of 68 feet and a height of 325 feet. Next we come to the "Cyclops," a monster, standing, *live* tree, with an immense cavity in its base, *in which* it is said that *twenty-four men on horseback* all formed at one time, *mounted on their horses!* Now I cannot vouch for the exact truth of this story. It sounds like a fairy tale. But this I do know, that it has three large openings in its sides, through the smallest of which a man can ride on horseback, and that when we came to this tree, the women both rode right into it—both at the same time—turned their horses around, and dismounted there, without being in the least hampered for the want of room! Let the world beat that for a "*big tree*," if it can.

Here, at 11 A. M., we halted, ate our lunch, and rested. At 12.30 we "moved again," heading in the direction of the upper end of the grove, and soon came to the "Palace Hotel," 100 feet in circumference and 300 feet high. This tree is named after the Palace Hotel in San Francisco—the largest hotel in the world—and has a cavity burned out in its interior that is 15 feet across and extends upward 90 feet. The immense cavities burnt out in the "Palace" and the "Cyclops" indicate the dreadful fiery mutilation to which these giants have been subjected, and still "they are alive, thriving, and doing well." Moving on, we pass the "Knights of the Forest," "Noah's Ark," and a host of unnamed, but splendid trees, till we come to "Old Goliath." The last two named are fallen. "Noah's Ark" is a monster. It has a large, long cavity, caused by fire, in which two horsemen could ride side by side, as it lay on the ground. The upper part of the shell has been, but recently, broken in by a heavy bed of snow. "Old Goliath" is the largest fallen tree in the grove. It measures, as it lies, 105 feet in circumference, and has an unbroken length of 261 feet! One of its limbs measures 12 feet in circumference! Near by is "Smith's Cabin," a tree so named because an old hunter and guide, by the name of Smith (and, by the way, we had the satisfaction of seeing the old pioneer at a distance, in Squaw Hollow, working at making "shakes," or clapboards, but did not get near enough to speak to him), who lived in its burnt-out base for two years. This tree is still "alive and doing well," notwithstanding the cabin, which actually measures 16 feet in one direction, and 21 in the other direction! Smith says that he was in this cabin during the great hurricane that threw down "Old Goliath," and declares that its fall shook the ground like an earthquake. We proceeded beyond "Smith's Cabin" half a mile, northward, to the upper end of the grove, where we halted for a rest, and then commenced to retrace our steps—a long, weary, but intensely interesting march, up and down those tremendous hills.

By 6 P. M. we arrived at camp, the most completely "giv out" set you ever saw. The Professor and I could scarcely drag ourselves along, and the women, not accustomed to horseback riding (and especially not over such trails), were completely "used up." Arriving at camp, we found our cooking utensils appropriated by two young men (campers), who had been fishing in Beaver Creek. They were jolly, gentlemanly, whole-souled fellows, and being "loaded down"

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with speckled trout, they insisted on giving us a fine lot in return for the use of our cooking utensils. Soon I was fully enlisted in the "fish-cleaning business," and in due time we were seated around and partaking of a supper of mountain trout which, for savoriness, would have tempted the appetite of the most fastidious epicure.

But, a word more about the "Big Trees." Scientific men of note pronounce the oldest to be from two to four thousand years old. They are surely safe in placing the largest as high as 3000 years. This can be established by the yearly growths of the trees, which are very marked. These growths average an eighth of an inch each, which would make a tree of thirty-six feet in diameter 3168 years old. So it is quite certain that there are trees *now standing in these groves,* that had already commenced their growth when King Solomon ascended the throne of David; and that were more than five hundred years old when Socrates was born; and doubtless some of those monsters whose partially decayed trunks we have looked upon commenced their growth about the time that Joseph interpreted Pharaoh's wonderful dream. The wood is very easily worked, receives a very fine polish, and for beauty is very little below mahogany. The foliage is of a beautiful pale-green color, and in texture and make-up resembles the foliage of the red cedar; and the bark is very soft and spongy, much more so than cork, almost as much so as an ordinary sponge, and on some of the trees the bark is as much as twelve inches in thickness.

All the large sequoias show marks of fire near the base. To this there is no exception; and the fact that the great sugar pines, ten feet in diameter and 250 feet high, some of which stood along-side of sequoias, bear no marks at all, is quite conclusive evidence that a great fire must have swept these mountains as much as a thousand years ago, and that at that time already the sequoias had attained to an immense size.

Friday the 19th we spent partly in camp and partly strolling through the grove; and on Saturday, about 10 A. M., having made all necessary preparation, we bid adieu to the Calaveras "Big Trees" and drove down in the direction of Murphy's, about three miles, to Woodruff's ranch, a good place to procure milk, butter, bread, and hay. Here we halted, purchased supplies of butter, milk and bread, prepared and ate a good dinner, and then continued our return trip to Murphy's, where we arrived about 4 P. M., and laid in a supply of provisions. Not wishing to travel on the Sabbath, we desired to find a good place for camping and procuring hay. This we thought we had found about five miles below Murphy's, where we went into camp beneath some spreading willow trees on the banks of a small creek, and procured an abundance of good barley hay at a reasonable price from a rancher near by. Intent on remaining here over Sabbath, we made ourselves very comfortable, cooked and ate with a relish and slept soundly. But this is a world of uncertainty and trouble, and so it proved to be in this case. On Sunday, about the time the women had a good dinner under way, they suddenly noticed several caterpillars crawling over our neat white table linen. Whew! In a moment our camp was all commotion! A general inspection was instituted, and, "the saints save us," the willow trees were crawling with these disgusting creatures, and they seemed to be traveling in every direction. A number of them were already in our wagon, and the women were standing on tip-toe, shaking their skirts, and afraid to move.

A council of war was immediately called, and the decision was that the camp must be "vamoused" in the shortest possible time. Soon dinner was over (no one seemed to have any appetite), the "goods" packed, our surplus hay crowded into empty sacks and "roped" to the hind end of the wagon, and in a remarkably short time we were rolling down the grade in the direction of San Andreas. After a drive of three hours, we found a reasonably good place to camp, within nine miles of the above-named town, where we passed the night quite comfortably, after a little fright over the fire's nearly breaking away from us. The following day we passed through San Andreas, the county seat of Calaveras County, and passed the night two miles below Wallace; and on Tuesday, July 22d, at 4 P. M., we drew up in front of our homes in Woodbridge, a somewhat tired, but thoroughly satisfied party.

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THE CHEMISTRY OF WHAT WE DRINK.

BY HENRY A. MOTT, PH. D., F. C. S.

TEA.

Tea is the prepared leaf of different varieties of the species *Thea*, a section of the genus *Camellia, Camellia thea* (*Link, s*)—*C. theifera* (*Griffith*). *Natural order* —*Terno-trœmiacœ.*

The varieties produced by long cultivation were formerly regarded as distinct species, and described as *Thea Bohea, T. viridis, T. stricta, T. sinensis*—*T. Chineusis*—Chinese plants and *Thea Assamica* which is indigenous to Assam. These are the different plants from which the tea of commerce is prepared. The real difference, as will be shown, results from the selection and grading of the leaf connected with the final treatment, and does not depend so much on the variety of Thea, from which the leaf is obtained. The tea-plant has been successfully introduced into the United States. It bears white axillary flowers and roundish triangular, three-celled and three-seeded capsules.

On examining the structure of the tea leaf, the border will be seen to be serrated nearly, though not quite up to the stalk. From the mid-rib the primary vein is seen to run almost to the border. The microscopic appearance of the epidermis, which, especially the lower side, exhibits numerous small stomata formed of two reniform cells of an average length of ·00075 inch, and average breadth ·000588 inch, is the diagnostic mark of the tea-leaf. Around the stomata are seen elongated and curved epidermic cells. This appearance has not been met in the leaf of other plants. Stomata are infrequent on the upper surface, the epidermal hairs are simple. The tea-plant is indigenous in China, Cochin-China, Japan and the northern parts of the eastern peninsula of India, and has been introduced into British India or the southern declivities of the Himalayas, Java, the Kong Mountains, in Western Africa, Brazil, Madeira and other warm and temperate countries. It is capable of flourishing in all latitudes between 0° and 40°.

Thea Sinensis, mentioned above, is closely allied to the Camellias. The leaf is, however, more pointed, and is lance-shaped, and not so thick and hard as the Camellia.

In North and South Carolina and California, in this country and in Australia, where the tea-plant has been introduced, the following plan has been adopted:

Fresh seeds are planted in spots so that the plants will be about five feet apart, one acre requiring about six pounds of seed.

Holes are made about one foot deep, then filled with loose earth, when the seed is introduced, so that it will be sticking about three inches below the surface. This planting is done at the commencement of the winter rains, as the moisture assists germination, which requires from four to six weeks, sometimes longer, depending on the quantity of rain.

The plants should be covered with manure at night and exposed to the sun in daytime. When three inches high, they should be weeded.

Plants are often raised directly from layers and cuttings, which are obtained when the sap is running.

The plants should be trimmed from lateral shoots, so that they may become thick and bushy and have an abundance of leaves.

In China the tea-plant is cultivated on the hill sides at an elevation extending to 4000 feet, where the soil is rich and deep, the drainage good, and sunlight abundant through about 11° of latitude. Tea which grows further than 24° or 35° north and south is not so valuable. The old wood bearing tough leaves is continually trimmed out.

The plant is kept about three to five feet high, although it could grow as high as thirty or forty feet. The full-grown leaves measure about five to nine inches. An acre yields about 1280 lbs. of green leaves, which on treatment produce about 380 lbs. of dry tea.

In April the buds, or youngest leaves, are picked, and yield Young Hyson—the leaves having a greenish color and delicate flavor, they are difficult to prepare for keeping, and as the wealthy residents generally purchase them for immediate consumption, on account of their superiority, they rarely, if ever, leave the place of their growth. The petiole of the leaf at this period and portions of the delicate stalk are often used.

The value of the leaf depends on the juices, and the leaves are as perfect at the first rise of sap as in the middle of the season; hence, the more tender the leaf or the younger, the better it is. As the tannin increases in the old leaves the delicacy of flavor diminishes. A woman will gather from 16 to 20 pounds of raw leaves a day, each leaf being picked separately. The second gathering of leaves is during the month of May. As the showers of spring bring on fresh leaves, this is the most important picking, from a commercial standpoint. A third and last gathering is made during June and July; but the leaves are very inferior. Both green and black tea can be, and is often, made from the same plant, although preference is given to the preparation of green tea from the younger leaves, and to certain plants in different localities. Both green and black tea, however, as stated, are made from the same plant, as the difference is really in the method of preparation.

To prepare green tea the *young* leaves are, within an hour or two after gathering, roasted in pans, over a brisk wood fire. After four or five minutes' roasting they are rolled by hand, when they are returned to the pans and roasted for an hour and a half.

The quick roasting preserves the green color, the tint of which seems to satisfy the Chinese but not the Americans, so the tea is placed in cylinders, and revolved with a coloring powder, composed of Chinese white, Dutch pink (yellow) and Prussian blue, which imparts to the leaf any shade of green desired; the revolution of the leaves in the cylinder also polishes the leaf and throws off any excess of coloring matter.

During the process of preparation the leaves are sorted according to size—the smallest leave is called *Pha-ho,* the second size *Pow-chong,* and the third or largest *Toy-chong.*

In the preparation of *Black Tea,* the leaves are piled into heaps and allowed to lie for ten or twelve hours, or until they undergo a sort of fermentation, when they are tossed about till they become soft and flaccid, after which they are rolled and heated, then rolled and heated a second time, and this is kept up for four or five times, when they are ready to be dried over a charcoal fire.

From the above description it can be readily seen how inferior tea can be made. Old leaves and carelessness in the method of preparation open wide channels for fraud. With a careful selection of the leaf, and proper skill in the preparation of the same, good tea can be prepared—but such teas cost money. As a rule, cheap teas are inferior.

The teas retailed in this country are sold from twenty cents to three dollars a pound, the latter being composed of carefully selected tea-leaves, rolled up in bundles of about one-half an inch thick, and tied with silk. Such tea, however, is very difficult to procure.

The Chinese often adopt a plan of scenting some kinds of tea with various flowers, such as roses, jasmine, and orange-blossoms. Such odors are evanescent, but delicate and agreeable. The scenting, however, is frequently added to inferior teas to improve their flavor.

Teas are divided in three classes: Green, black and scented, and each is subdivided according to the size of the leaf, but the names vary from time to time.

THE GREEN TEA CLASS contains: Gunpowder, Hyson, Young Hyson, Imperial, Twankay, Japan, Java, etc., which are colored or uncolored.

THE BLACK TEA CLASS contains: Congou, Moning and Kaisow, Souchong, Oolong, Pekoe, Canton, Foo Choo, Caper, etc.

THE SCENTED TEA CLASS contains: Scented Caper, etc.

With regard to Indian teas, Dr. Smith states, it has been recommended to classify them under eight heads, viz:

1. Fine Pekoe, or all flowery leaf.
2. Pekoe, little flowery, with small leaf.
3. Pekoe Souchong, large leaf, few ends.
4. Souchong, large leaf, without ends.
5. Congou, all coarse, dark, leafy sorts.

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6. Broken Pekoe, siftings of fine Pekoe, Pekoe.
7. Broken black siftings of Pekoe Souchong, Souchong.
8. Fanings, siftings of Congou old leaf.

Very inferior tea is also manufactured.

LIE TEA is a spurious article, which is made from dust of tea leaves, sometimes foreign leaves and sand made up by means, of gum or starch into little masses, which is colored black or green.

The leaves which are said to be used to adulterate tea are the willow, sloe, oak, valonia oak, plane, beech, elm, poplar, hawthorn and chestnut in this country and England, while in China *Chloranthus incouspicus* and *Camellia Sasauqua* are said to be used. The willow and sloe resemble the tea-leaf and are the only leaves which do.

As bulk and weight differ materially, the amount of tea that should be used should be regulated by weight.

Prof. Edward Smith, in 1861, prepared the following table to show the relation of bulk to weight:

Kind of Teas.	*Weight of a moderate-sized caddy spoonful. Grains.*	*Number of such spoonfuls to the pound.*
BLACK TEAS.		
Oolong	39	179
Congon, inferior	52	138
Flowery Pekoe	62	163
Souchong	70	100
Congou, fine	87	80
GREEN TEAS.		
Hyson, skin	53	120
Twankay	70	100
Hyson	66	106
Fine Imperial	90	77
Scented Caper	103	68
Fine Gunpowder	123	57

(*To be continued in the March number.*)

GENIUS NOT ALWAYS APPRECIATED.

BY MRS. M. S. ORGAN, M. D.

It is a popular belief that genius will always assert itself, command the attention of the world, and exert an influence commensurate with its innate power.

But this, like many other popular beliefs, is but a superficial view based only upon incidental results; it has no foundation in the laws of mental science or of sociology.

Genius is simply a large and intense development of one or more special faculties of mind; this strong intensified development will necessarily give a certain impelling force that the individual would not otherwise possess; for the natural tendency of a strong and quickened faculty is to reach out into the universe of mind, grasp new truths, assimilate them into soul-structure, and then give the result of this force to the world.

Genius being but a highly developed power of one or more elemental faculties of mind, it is but a philosophical deduction that it will require the same physical, mental, and social environments as other faculties for its full unfoldment, and consequent influence. An individual possessing genius must have a strong determined will, well-developed self-esteem, and that animus of force which comes from the combative propensity, in order to propel its way, coerce the world to acknowledge its worth, and bow to its behests. Nor is this all that is essential for the complete evolvement of its potential energy. The leisure and opportunity which material wealth can secure, social conditions, the spirit of the age, all have their modifying influence.

The testimony of many competent observers and judges is, that some of the world's most original and profound thinkers have passed their lives in comparative

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obscurity, appreciated but by a limited few. They occupied this position because they lacked that self-confidence and energy of combativeness necessary to assert their power and master antagonistic forces.

The world is conservative, jealous, exacting, and selfish; it has no sympathy for genius in its struggles for recognition and appreciation; it gives no encouraging word or helping hand. Only when genius, through the impetus and aid of its other elemental powers of mind, hews its way through obstacles, acquires strength to wrench victory from defeat, and plants itself on a commanding eminence, will the world bestow its favors and shower its blessings.

These thoughts have been suggested by a review of "Graham's Science of Human Life." The original and profound thought there presented shows a giant intellect, comprehending the forces of Nature, and wringing from her secrets that had never been discovered by the powers of the human mind—analyzing principles and laws hitherto unrecognized, and with a prescience wonderful in its scope, suggesting great primal principles which the science of to-day has fully established. Yet the power of Dr. Graham's genius has never received the appreciation commensurate with its intrinsic supremacy. In fact, the current belief is that he was a "dietetic crank," who promulgated the one idea of the healthfulness of unbolted wheaten flour. The world knows not the fact that his expressed ideas of correct diet and sanitary principles were the result of more than forty years' careful and extensive research, and were based upon the principles of physiological, psychological, and hygienic science; it knows not of that mighty intellect, that lofty moral and philanthropic soul, who trod alone the wine-press of popular bigotry, prejudice, and antagonism.

A few extracts will be given from the "Science of Human Life," to show the forceful grasp and penetrating power of his mind. The principles enunciated in these extracts were given by him in his public lectures as much as seventy years ago:

. . . . "But, although modern chemistry has distributed matter into more than fifty elements, or simple substances, yet is it not evident from what has been advanced on the present occasion, that the elements of nature must consist of a much smaller number? and do there not appear to be many and strong reasons for believing that there is but a *single original element,* or essence of all matter? How extremely subtile, refined, and sublimated that material essence in itself may be, or what may be its distinction from, or proximity to, a *spiritual substance,* is not for us to form a clear conception, nor even for our imagination to shadow forth a distinct idea! Moreover, it is an interesting and important truth, that there is not a single known property or law of matter of which human science can with certainty affirm, that it is *essential to the nature of matter.* Even gravitation, the most universal and all-pervading property or law of matter known, may only pertain to certain forms and conditions of matter, and not be in any degree an *intrinsic property of its essence.* And this is true of magnetism, and electricity, and molecular affinity, and every other known property.

Indeed, we know no more of the *nature of matter, and of what are its essential properties, than we do of spirit.* To some extent, we can appreciate its forms, and the laws which govern their motions and changes, but beyond this our knowledge does not extend."[1] . . . . "Those substances which we now call *elements* are probably the result of many combinations of the primordial atoms, and although most of them have hitherto resisted the powers of analysis in the hands of man, it is almost certain that they are decomposed by the vital energies of organic forms, and perhaps also in many of the operations of inorganic nature."[2] . . . . "While, therefore, we cannot, from our knowledge of things, affirm what the *essence of life is,* we know as certainly as we can know anything concerning matter, that it could not spring from any of the powers or properties of inorganic matter, and that its relation to the organization of matter is of necessity in the *nature* of things, and has ever been since the first establishment of the vital economy in connection with organized matter, that of a *cause* and not of an *effect.* Hence it may be boldly affirmed that no man possesses knowledge which justifies the assertion that the power which governs the organization of the nervous system of animal bodies, and constitutes the substratum of all its powers and properties, is not a

[1] Page 32. [2] Page 33.

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substance essentially different from matter." . . . . "Purely as physiologists, then, with all the light of science around us, we can, with at least as much philosophical propriety, affirm that *the substratum of the sensorial power of the human brain is a spiritual substance,* as any one can affirm the contrary, and the truth of our affirmation is infinitely more probable than it is that mind and moral feeling are the results of organized matter."

These extracts are given as indices of the philosophic principle presented, and with the hope that some will be incited to read this work so pregnant with moral and scientific truth.

PHOTOGRAPHING SOUND-WAVES.—No. 2.

An Explanation of the Mechanical Telephone.

BY THE EDITOR.

Last month we discussed the claimed possibility of photographing sound-waves by taking advantage of the refraction of light in passing a ray from the normal air into the condensation of the sound-wave, which condensation is supposed to occur as the effect of a sound-pulse. The impossibility of such an achievement (even admitting the truth of the wave-theory), for which Prof. Toepler, of Germany, claims the credit, was sufficiently shown, we think, to satisfy the most exacting scientific mind, as the reader will see by turning to page 115, last issue of The Microcosm, and reading that article, if he has not already done so.

We now take up another phase of this claim of photographing sound-waves based on something more tangible, real, and visible than the infinitesimal refraction of light which takes place in a sound-wave, even if there are such things as atmospheric condensations in the passage of sound, as claimed by wave-theorists. The achievement we now consider, though a *misnomer,* as having anything to do with so-called sound-waves, is nevertheless a real scientific triumph, of great value to physical investigations, and of real credit to the ingenious photographer who succeeded in accomplishing it, and who was none other than Mr. G. G. Lockwood of this city.

It seems that Mr. Lockwood had familiarized himself with the rumored process of photographing sound-waves by the refraction of a ray of light in passing through a sonorous condensation, as attributed to Prof. Toepler, and we believe that he tried the experiment as described in the German publication giving an account of it; and being totally disappointed in the result, he was too conscientious an investigator to indorse this "refraction" achievement when no such result as claimed was possible. Still, being a man of inventive genius, he determined not to be foiled in his purpose, and that since there were no such things as real atmospheric condensations to be reproduced on the sensitive plate by aid of refracted light, he resolved to produce a photograph of a phenomenon which does actually occur as the result of sound, and which by a considerable accommodation of language he terms a "sound-wave."

Let us now briefly as possible try to describe Mr. Lockwood's achievement, and the process by which it is accomplished. Instead of having anything to do with air-waves, it relates entirely to the well-known vibratory motion of a disk or diaphragm, such as that of the common mechanical telephone, which vibrations are really produced by the impact of sound-pulses against it. These vibrations, small as they are and almost invisible to the naked eye, are nevertheless very sensible to the touch, and could be easily seen under a magnifier, or if enlarged and thus represented upon a photograph plate. This was the aim and result of Mr. Lockwood's ingenious contrivance, which he describes substantially as follows:

An electrical wire point is secured to the center of one of these tensioned diaphragms, the other end of this wire being connected with one pole of a battery. Near to this point and almost touching it, is another similar point, its wire leading to the opposite pole of the battery. These points are in such close proximity to

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each other that the vibrations of the diaphragm by words spoken against it will bring the electrical points into actual contact, and if the battery is charged so that a current will pass over the wire, it will happen, as the sound continues and the diaphragm continues to vibrate, that every time the wire points touch each other and separate an electric spark will be generated. Now, should the room be otherwise darkened, this rapid succession of sparks will brilliantly illuminate these wire points; and then by employing the well-known instantaneous photographing process (such as that used by Mr. Muybridge at the Zoological Gardens in Philadelphia, for taking the various positions of the wings and even of the individual wing-feathers of birds while flying), Mr. Lockwood easily takes a succession of instantaneous photographic views of the points of these wires, not only in actual contact, but, by the persistence of the flashes for an appreciable length of time, also the various distances the points will be apart during the different vibrations at the instant the different impressions are taken.

It is plain, therefore, that if a sufficient number of photographs of these points are produced, while a certain sustained note is directed against the diaphragm, the extreme widths of the vibrations for that note will thus be shown on the sensitive plate, and so with any other pitches and intensities of sound. By measuring under a microscope (or with the views greatly enlarged) the various distances the points are apart, from actual contact to the extreme of their separation, under different adjustments and as the effect of different sound-intensities, the actual width of swings of various kinds of diaphragms can be determined upon with absolute accuracy, thus incidentally aiding in determining the best form and material of diaphragm for the mechanical telephones now rapidly coming into use for short distances.

It thus turns out that this creditable and useful scientific achievement, though in no true sense the photographing of sound-waves, and in no way favoring the atmospheric wave-theory, is a step forward in real scientific discovery, which will certainly secure a degree of fame to the patient and ingenious investigator. Would that as much could be said of the rumored achievement of his brother investigator, Prof. Toepler.

We have hinted that this discovery of Mr. Lockwood may be of practical use in the proper construction of the mechanical telephone. Possibly it might not here be out of place to add a few thoughts by way of information upon the scientific principles involved in the discoveries by which articulate speech and other sounds can be transmitted from place to place by means of two diaphragms and a wire or cord connecting the same.

It has long been known that two diaphragms, thus connected, will transmit speech to considerable distances, even as much as a mile under favorable conditions, and to the nicest shades of articulation, intonation, inflection, or modulation of the voice, by simply speaking against a diaphragm secured to one end of such stretched wire or cord. This process of conveying speech (where no electric current is needed, as in the Bell telephone system) has long been known under the name of the "lover's telephone," or more recently, as brought to greater perfection, as the "mechanical telephone" to distinguish it from the magnetic or electric telephone, and thereby signifying that the sounds and words of the speaker are conveyed by the mechanical means of the vibrations of the diaphragms and the conductability of the wire connecting them.

Yet what it is that thus really causes the minutest shadings of articulate speech produced against one diaphragm, to be conveyed through a stretched wire to a distance, to be reproduced in another diaphragm so as to be distinctly heard, is perhaps one of the most difficult problems to solve known to acoustics or perhaps to modern physics. It has heretofore been supposed that diaphragms, like stretched strings, would only vibrate in response to sounds in unison with them, or having the same vibrational number; in other words, that they would only vibrate *sympathetically*. This was the opinion of Prof. Helmholtz, the greatest living sound expert, as quoted in the "Problem of Human Life," page 200. Speaking of his method of separating combinational tones, where a chord of two sounds are produced together, he says:

"Their objective existence in the mass of air can be proved by vibrating membranes tuned to be in unison with the combinational tones. Such membranes

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are set in sympathetic vibration immediately upon both generating tones being sounded simultaneously, but remain at rest if only one or other of them is sounded."—"Sensations of Tone," page 235.

But Prof. Helmholtz was manifestly mistaken, and, following the lead of that great physicist, we fell into the same error in some portions of the "Problem." The operations of the mechanical telephone, with which Prof. Helmholtz was not then acquainted, conclusively prove that any pitch of tone will cause the diaphragm to vibrate, and thus communicate its sound-effect to the line wire, and through it to the distant diaphragm, where it is reproduced in speech, whether said transmitting diaphragm is in unison with the exciting words or not; and that, too, when these words are spoken against it from such a distance (often fifty feet away) as utterly to preclude the possibility of mere air-waves causing such effect. Is there any consistent scientific explanation of this state of facts? We believe there is, and that it will soon be forthcoming, as the result of new experiments now in the process of being conducted, though we have not yet reached the *ultima thule* of the *eclaircissement.* One thing we are sure of: that such tremors or vibrations of a diaphragm, in response to all possible pitches or keys of tone, and with about the same uniform degree of amplitude, or loudness for each key, cannot be the result of a successson of air-waves sent against the diaphragm, *since by common consent of all the authorities on sound, in their explanations of sympathetic vibration as caused by the supposed dashing of air-waves, no diaphragm can respond to such purely mechanical waves unless its own vibrational number corresponds with that of the instrument producing the tone—that is to say, unless it is in unison with it!* In the case of strings, forks, and *stretched* diaphragms (such as oiled silk, skins, etc.) this rule of the necessity for absolute unison between the sympathizing and actuating instruments very nearly conforms to theory.

It is plain that Prof. Helmholtz in his experiments with resonators, for separating combinational tones from two fundamental sounds of an instrument, as just quoted, employed diaphragms of some sort of stretched fabric, which he was enabled to "tune" to the pitch of tone he desired to isolate from the mass of sounds. Such diaphragms, being capable themselves of producing the sound of the pitch to which they had been tuned, will not respond fully or loudly by sympathy to sounds of different pitch from that of themselves. Hence, such stretched diaphragms cannot by any means be the best for mechanical telephones where pitches of tone of all shades of variety, as in articulate speech, singing or whistling of tunes, etc., must be equally produced in the diaphragm spoken to, then be conducted over the wire, and finally reproduced in the receiving diaphragm at the far end.

But we have the pleasure of recording here another scientific discovery which will, as we trust, be of interest to acousticians, and that is, that a merely *tensioned* diaphragm, such as a flat piece of wood, metal, mica or other substance (where no *stretching*, or *tuning* thereby, is possible) is the the only practicable disk for a mechanical telephone which is to admit of the transmission of words uniform in volume or intensity, and without any reference to the pitch of voice or other sounds employed. This radical difference in the acoustical character of these two classes of diaphragms has never before, we believe, been pointed out. At least it is certain that Prof. Helmholtz had never made the observation.

Now the question recurs, why is it that these *tensioned* (but not *stretched*) diaphragms of mechanical telephones vibrate contrary to the law of sympathetic action, as laid down in all works on sound, and thus convey speech and other sounds equally well in all shades of pitch or vibrational numbers? The wave-theory positively remains dumb in the presence of this problem; for it only attempts to explain such sonorous effects by the successive dashing of the mechanical air-waves, of which the exciting tone is supposed to be constituted, against the diaphragm or other instrument to be started to vibrating sympathetically, *and in such rapidity of succession as exactly to correspond to the normal tendency of said sympathizing instrument to vibrate.*

This is the mechanical method of explaining sympathetic vibration as the result of sound, and the only way it would be possible for mechanical air-waves to accomplish such sympathetic result. But here is a case of sympathetic vibration or an analogous result, in a *tensioned* diaphragm not tuned to make any given tone, in

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exact contradiction to the mechanical principle of the successive beating of material waves, and which can only admit of a possible explanation on the supposition that sound is something more than mere air-waves, that it has a substantial existence, and by some occult action, as an immaterial force, produces vibration or tremor in a *tensioned* diaphragm in a way that will not cause action in a *stretched* or sounding instrument according to theory.

It may be said in reply, that the theory of substantial sound-pulses, which so fully explains sympathetic vibration in sounding instruments, as shown in the "Problem of Human Life," must also fail in accounting for such vibrations in a tensioned diaphragm. This is true, when considered as the mere successive impacts of substantial pulses or sonorous discharges from a sounding body, conducted against the tensioned diaphragm. But while nothing is possible by which to help out the solution of the difficulty according to the simple mechanical air-wave theory, there is abundance of room for vast exploration, and for much new research and discovery in the action of an immaterial force, like that of sound or electricity, upon the correlated force of cohesion or tension in such a sensitive and sympathetic membrane.

New things are now especially in order, and are being unfolded every day in the action of the recondite immaterial, but substantial forces, as witness the interesting series of papers now appearing in this magazine on the subject of electricity, from the very critical and cultured pen of our associate, Dr. Mott. Indeed, we have had the pleasure of witnessing, within the last few days, a practical exhibition of electrical phenomena, from the new discoveries and new methods of manipulation, by Prof. J. D. Culp, of this city, which totally removes electricity from the supposed physical conditions of molecular materiality, and demonstrates such marvelous results, in its correlation with other immaterial forms of force, that no mere mechanical compacts or motions of material particles, however small, can begin to explain them. So it is, doubtless, with the analogous and correlated force of *sound* in its action upon the tensioned diaphragm of a mechanical telephone, and to a slight extent upon all diaphragms, which will require the aid of more intricate laws and principles to account for than can ever be drawn from gross and well-understood mechanical actions among material bodies, as so patent in the crude effects to be expected in the mere dashing of air-waves.

The revolutionary work which Substantialism has already accomplished in elevating the physical forces to the higher plane of substantiality, thus removing them from the groveling and crude character of mere modes of motion, of corporeal molecules, has exalted science to the very throne of God, and made the concomitant correlation, conservation, and interconvertibility of the forces not only consistent and possible, as theoretic necessities in science, but it has coerced the physical laws, through their invisible operations, to reveal more concerning God, and to affirm and confirm more for the truths of religion, and in support of an immortal future for humanity, than all the science of the schools has furnished from the time of Pythagoras down to that of Helmholtz. Yet this unfolding of the invisible and immaterial entities of the universe, which the Substantial Philosophy has inaugurated so triumphantly, is now even less than in its infancy. Indeed, it shows but the earliest embryonic development, so to speak, of a representative scientific giant who shall, before this generation has passed away, clasp the universe in his embrace, and equally mastering the mysteries of material and immaterial entities, shall lay bare the secrets of nature to its pulsating heart, reconcile the perplexing discrepancies of physical science, and demonstrate that the immaterial, the intangible, and the invisible are always the *real* throughout universal existence.

Returning from this digressive thought to the mystery of the mechanical telephone, we now add, as another reason why the transmitting diaphragm when spoken to does not and cannot vibrate by the impact of air-waves, namely, the fact, as demonstrated in recent numbers of THE MICROCOSM, that the sounds observed in our sensations from different instruments, are out of all proportion to their vibratory action on the air, thus showing that sound is a substantial form of force generated by different bodies, and radiated in quantity and intensity according to the sonorous quality or nature of the body producing it, and not in any way according to atmospheric disturbance. We refer the reader back to the overwhelm-

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ing argument based on the sound of the locust, which is audible for a mile in all directions, and the sound of a tuning-fork or stretched string which is not audible for a distance of more than about six feet; yet the vibratory tremor of the fork or string produces from ten to one hundred times greater mechanical effect upon the air than that caused by the scarcely perceptible tremor of the insect! We have challenged, and coaxed, and almost offered to hire physicists to answer this argument if they could; but by their silence they manifestly admit it to be unanswerable. (See MICROCOSM, Vol. IV., p. 318; Vol. V., p. 40.) Clearly and positively when a certain amount of vibration in one instrument produces "80,000,000" times as much sound as the vibration of another instrument producing 100 times the mechanical effect in the shape of air-waves or atmospheric pulses, as actually demonstrated to be the case with the locust and tuning-fork in the articles referred to above, it shows to all men of intelligence that the mechanical effects produced on the air, which accompany sound, are in no sense the cause of sound, but are merely an incidental effect of the motion which produces the sound-generation.

Hence, we declare unequivocally, upon the evidence of the demonstrations above referred to, that the effect produced upon the transmitting diaphragm is in no way the result of air-waves, but is produced by the impact of sound as one of the substantial forces of nature. And this conclusion is further strengthened and confirmed by the fact that no amount of vibration of the air, six feet away, that does not produce audible sound at the diaphragm (as in the case of the tuning-fork held in the fingers) will effect such diaphragm in the slightest degree. Surely, and according to every principle of mechanics and physical law, atmospheric waves or pulses should produce exactly the same effect upon a material diaphragm, whether accompanied by sound or not. Yet a thousand powerful tuning-forks, sounding and vibrating at full amplitude six feet from the diaphragm, will not stir it, not because they do not send forth mechanical air-waves the same as any other sounding body of like amplitude, but because they do not radiate pulses of substantial sound-force which reach and strike the diaphragm as *sound* instead of *air-waves!* What can be more conclusive than this?

Thus sound itself causes the diaphragm to vibrate, which motion is also communicated to the wire, and in addition, the substantial sound-force is conducted along the wire, unloading its cargo of words at the receiving diaphragm, where it again becomes audible. No air-waves or any other form of mere mechanical motion can account for this remarkable acoustic effect—nothing, in fact, but the action of a substantial immaterial force analogous to electricity.

We have been led into this general explanation partly from the fact that in our early departures from the wave-theory we were nothing like as clear on the true nature and cause of the vibrations of such diaphragms as we believe we are now. In fact, we were not even aware of some of the facts in the case which the mechanical telephone and phonograph combined have so clearly brought to light, and we are glad to know that we were even then, in our mistaken ideas, in such good company as that of Prof. Helmholtz. We expect to continue right along in learning new things, and taking back old errors, as our investigations and means of research expand. One thing we must be allowed to say here, and upon which to congratulate the reader: namely, that every mistake we detect in our first and more hasty conclusions, only tends the stronger to confirm us in the absolute truth of the Substantial Philosophy.

Indeed, the public is beginning at last to comprehend the reason why the sound-discussion has played such a conspicuous part in our various presentations of the claims of Substantialism in this magazine. One of the latest accessions to the cause of the new philosophy, and one of the ablest scientists and most prominent educators of the country, when he first yielded adherence to the general correctness of Substantialism, but without having thoroughly read up the arguments on the subject in the preceding volumes of THE MICROCOSM, insisted that so rational were the grounds on which the philosophy was established, we might safely surrender our position on the sound-question, as against the wave-theory, and still logically insist on the correctness of Substantialism as a system of philosophy. We proceeded to show him that this is a radical mistake, and that with the absolute truth of the wave-theory established and admitted the entire Substantial Philosophy breaks down, and must fall to the ground. With sound proved to be but the motion

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of the air and of the auditory organs, it is entirely manifest that heat and light can be nothing but the similar motions of ether and of the corresponding sense nerves, as Huygens and Newton had to admit; and with heat, light, and sound thus proved to be but modes of motion of material particles, what folly to talk of any other of the phenomena-producing forces of nature as substantial and objective entities! Surely, no profound and consistent thinker would try to make electricity. gravity, magnetism and cohesion substantial or objective things after heat should be resolved into the mere motion of a jelly-like ether, as Prof. Tyndall and all modern authorities claim to have determined. And with these modes of motion must of necessity be included the vital and mental forces which move and govern organic beings, making them, as the learned and consistent Profs. Haeckel and Huxley insist, but the mere vibratory motion of the material molecules of the nerves and brain.

As certain, therefore, as that no sound, nor light, nor heat can exist after the motions which constitute these so-called forces cease, just so certain must the mind, life, soul, and spirit cease to exist as soon as the motions of the molecules of brain and nerve, which constitute them, cease at death. Hence, no man who believes in the motion theory of sound, and, as a logical consequence, in the mere motion theory of all the other natural forces, can, by any mental stretch, believe in the immortality of man, since there is nothing immaterial in man but *motion* to be saved; and since motion is not entitative, but merely the name which we give to the change of an entity from one place to another, all motions, of whatever name or character, including life and soul motion, must necessarily cease to exist as soon as the moving bodies, let them be great or small, shall come to rest.

Whatever view may be taken of the constitutional and intrinsic difference between the immaterial but substantial organisms constituting the vital and mental powers of men and the lower animals, one thing is certain, that no atom of the life-force or mind-force of any living creature, down to the lowliest moneron, can, by any possibility, according to Substantialism, be annihilated. All such substantial force must of necessity persist after the death of the being, whether in its conscious form and possessed of its personal individuality, or as constituting a fraction of the original fountain of force into which it subsides at death, and out of which it primordially came; and these states and conditions of the vital and mental organisms of all beings, from man down, depend entirely upon the mental and vital association, relation, and status here of each living organism as originally ordained and designed by the Infinite Intelligence. This phase of the Substantial Philosophy was treated elaborately in many parts of the "Problem of Human Life," but especially from pages 468 to 471, which the reader can examine.

THE PROSPECTIVE UNIVERSITY.

BY REV. J. I. SWANDER, D. D.

The question of founding an educational institution devoted to the defense and promulgation of the Substantial Philosophy is one which has been before the readers of THE MICROCOSM for several months. It is consequently presumed that the matter has been pretty thoroughly considered by those who not only apprehend the truth as set forth in time's most revolutionary system of thought, but who also desire to see it triumph gloriously over the many false teachings of much modern science. It may, therefore, not be out of order for the writer of this paper to frame his own partially matured thoughts upon the subject, and submit them for the candid consideration of any who may be disposed to entertain positive and progressive views concerning this prospective enterprise.

First of all, we announce our want of enthusiasm for the project. This absence of such mental excitement and kindled fervor of soul is nothing new in our personal experience. Indeed, we have no burning zeal for anything within the compass of human impulse and action. Even in Christianity we are too much of a stoic ever to kindle the fires of a holy crusade against its enemies. If we ever awaken to the enjoyment of different emotions, or pass the pearly portals of a

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more excellent glory, it will be by virtue of some foreign and vivific influence whose secret fountain and hidden spring lie deeper than the constitutional immobility that grounds itself in the icebergs of our phlegmatic temperament. For this reason our manifest want of enthusiasm in the matter of the proposed university should not be taken by its more zealous and demonstrative friends as a fair measure of its great importance.

We do not believe that the continued spread of Substantialism depends upon the founding and maintenance, at this time, of such an institution as has been intimated of late through the columns of THE MICROCOSM. There are other means and methods by which the truth as it is in the new departure may be made to shine in the caverns of materialistic darkness, and the cause pushed forward toward the accomplishment of its beneficent mission among men. From the birth of Substantialism to the present time, during a period of less than eight years, it has had no such institution of learning through which to promulgate its principles in a regular academic or collegiate curriculum of study, and yet it has moved forward by its mighty sweep of power, in the face of derision and opposition, until it already numbers its disciples by thousands, some of whom are sufficiently well schooled in its radical truths to go forth as apostles to the materialistic gentiles. The little MICROCOSM, even when less pretentious than in its present form, supplementing the "Problem of Human Life," has done more real scientific service for the truth than all the universities upon the planet. Let the good work go forward with the same astonishing ratio of increase, and the growing army of Substantialism will soon be numerous enough to outflank the foe and put their shattered ranks to flight.

But mere victory is not the purpose for which we fight. We wish to save our opponents from the consequences of their own unscientific folly. We have nothing but the powder of philanthropy in our magazine. Holding this view of the mission which Substantialism has in the world, we claim consistency in advocating the *desirableness* of an educational institution in which the work of evangelization may be done in such *systematic* and *thorough* form as to make disciples of all honest, thinking men, and swell our ranks in the future by the accession thereto of those who shall rejoice with us in our common emancipation by the truth. The times of this ignorance God winked at; but now he commandeth all men who are thirsting for a *genuine* scientific education to start with a recognition of the *first impulse* of being. This start must be made from the recently discovered standpoint in philosophy. From this standpoint the rudimentary principles of science must be taught. To do this a new order of educational institutions is a *necessity*. The fallacies of false reasoning may be exposed on paper; logical arguments may be made in the form of incisive articles printed and circulated to the discomfiture of error, and the glory of the truth; but there are some things connected with God's ordained methods of advocating and advancing the verities of science and religion which require different means of communicating that mysterious force which is always found fontally in the truth itself, and which must be applied according to its own law of dynamics in order to sweep away any refuge of lies that may be found fortified in the ignorance and prejudice of men. The primary and preparatory work which Substantialism has to do is in the sphere of physics. The chemical laboratory and polytechnic appliances are therefore indispensable. This is more emphatically true in view of the false trend of much modern thinking. Truth requires that the biased mind should be taught to unlearn all that it has learned amiss. This is fearfully and wonderfully the condition of the scholastic world at the present time. Greater effort is required to remove the rubbish of the crumbling castle of materialism than to erect the superstructure of substantial truth in its stead. These obstructive elements must be removed, and the appliances for their removal must be adapted to the peculiar nature of the work in hand. If materialistic fallacies were advocated only through the popular magazine literature, the little MICROCOSM, with its mighty charges of unanswerable reasoning, would soon fire them out of existence. But as long as plausible error poisons the blood of our popular text-books, and propagates itself through the current teachings of the schools, there will be a demand for text-books of a different character, and corresponding schools of scientific truth, in order that such truth may be brought more directly, at all points, into antidotal contact with the widespread

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evil. Thus where error abounds will it be possible for truth to much more abound.

The general principle advocated in the foregoing paragraph has been amply demonstrated in the history of Christianity. Look at its conflicts with Judaism and the religions of the world! The Founder of our holy religion was obliged to labor harder to root out the false notions entertained by the Jews than to accomplish the more positive work of planting the substantial principles of the Christian faith. He therefore commanded his followers to *go teach* all nations. Such teaching required the personal presence of the Apostles, the sacramental signs and seals of Christianity's invisible force, as well as the oral communication of the truth through the foolishness of preaching. They were not commanded to merely send out a few pieces of parchment inscribed with precepts all divine, but to *go* and enlighten the nations with the radical and revolutionary truth of which they were made the bearers. The narratives of the Evangelists, with all their pathetic echoes of tragic Calvary; the Pauline Epistles, with all their array of facts and deductions of inspired logic, would have proven inadequate for the accomplishment of such a work.

The foregoing argument is more applicable to science than to religion. Science propagates itself more through the force of human demonstration, while religion relies largely upon the dynamic power of divine proclamation. In the past, religious teaching has relied too exclusively upon the imaginary dynamics of moss-covered dogmas. Theology and the pulpit must become more scientific, without becoming less scriptural or less systematic. This is now possible. There is no longer an insurmountable obstacle, or an impassable chasm between revelation and science. Substantialism has pontooned the streams and pioneered the forests of nature. The student of divine mysteries may now pass over and have his hopes confirmed with something better than mere propositional theology, while the believing child of Heaven may feel assured that he is justified by something more substantial than the forensic fancy of abstract jurisprudence. "Science," says Prof. Drummond, in probable allusion to the teachings of the Substantial Philosophy which had already begun to shake the hills of old Scotland—"science has paved the way for one of the most revolutionary doctrines of Christianity: and if Christianity refuses to take advantage of the opening, it will manifest a culpable want of confidence in itself." In this field of newly-discovered facts, which may be made to contribute to Christian knowledge and comfort, appropriate schools are required. The rudiments of the new scientific faith, and the truth as it is to be seen only in the light of such new scientific faith, must be taught and demonstrated in the use of all the appliances usually found in other schools, except the clapping of Tyndall's books for the purpose of blowing out the candle by sound, the agency of the omnipotent little cricket, and other instruments of unscientific jugglery formerly used by the undulatory advocates of ancient nonsense.

In a recent private discussion, a gentleman of intelligence inquired whether it were not unwise to make such a radical break from the ranks of "the world's progressive men," such as Tyndall, Herbert Spencer, and others; and if we desired to advance the cause of the Substantial Philosophy by calling to its assistance a school of learning, whether it would not be better to "endow a chair" in some college already established, rather than attempt the founding of an institution *de novo*. This twofold question provoked a sentiment of merriment in our mind, and caused a classic smile to roll across the sedate countenance of our venerable and scholarly friend, Dr. Kost, who was prominently present in the conference, conducting a most masterly management of the discussion on the part of Substantialism. Chancellor Kost replied that Tyndall, Spencer, and that whole school of philosophers moved in the materialistic trend of thought, that the longer they advanced the farther they got from the essential truth, and that they were progressives only in a sense quite similar to that in which the Jews progressed until they reached the ultimate point of progressive degeneracy in the crucifixion of incarnate Truth. Dr. Kost then vigorously replied to the second point of the inquiry by affirming that the teachings of Substantialism would not be tolerated in any of our old institutions now committed to the very opposite theories of science.

The Chancellor's position was impregnable, and his argument unanswerable. It would be just as reasonable to talk of endowing a Christian pulpit in a Jewish

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synagogue, or a Protestant service in the cathedral at Rome. More so, indeed. Catholics and Protestants have some things in common: they are not diametrically opposed at every point. In the present great scientific controversy it is different with the parties engaged. Materialism and Substantialism, as two distinct philosophies, are in mortal conflict with each other. The latter involves and demands a radical reversal of many theories hitherto regarded as infallibly fixed, and the utter demolition of many cob-houses hitherto looked upon and foolishly admired as monuments of architectural glory. Materialism professes to work in from without and up from below, while Substantialism works primarily down from above and out from within. Much which has been claimed as mere properties of matter has recently been proven to be the proprietors thereof. This conflict between theory and fact would make it impossible for the two to dwell together in the same institution. Any board of regents tolerating the teaching of Substantialism in an institution whose property they hold in trust, and whose false glory they are expected to promote, would soon be suspected of having too much love for the truth to be continued with any such trust.

Hence it would be unreasonable for the friends of the new philosophy to expect any toleration of the truth in the temples of error. Their managers know very well that only "as long as the strong man armed keepeth his palace his goods are in peace, and that when a stronger than he is come upon him he taketh from him all his armor wherein he trusteth." The armor of many accepted theories consists largely in material molecules, favorable combination, ignorance, prejudice, and jugglery. The truth, as first advocated by A. Wilford Hall, the great apostle of our profession, is the "stronger" man. This substantial truth has already captured the outposts of the enemy; and its mission is to storm all the citadels of error until it takes possession of the great palace of nature, where the very devil of unscientific fallacy has enthroned himself for ages, and from which, like Milton's Lucifer, he must be hurled to darkness and perdition. For the accomplishment of this great work there should be schools, and especially one *central institution*, where truth may plant her irresistible catapults for the battering down of the "strongholds." When that point has been reached, look out for the crumbling of materialistic masonry.

Who will now step forward in financial wisdom and wealth to show that a greater than Solomon is here? The divine call is to the men whom Heaven has made the temporary custodians of wealth. They are confronted with an opportunity to build a monument for the perpetuation of their memories—

"When the moon is old,
And the stars are cold,
And the books of the Judgment Day unfold."

We confidently believe that such a man will soon appear from the ranks of the elect, and with one noble stroke of munificence perform the act that shall send joy to the hearts of thousands now living, and the echoes of his own great name and fame, down the ages, embalmed in the moral heroism of his magnanimous deed. Senator Stanford, of California, has given $20,000,000 for the founding and maintenance of a State University. A fraction of that amount now laid upon the altar of Substantialism would chase the sluggish years away, and help to usher in the earliest light of the millennial morn. Where is the individual who has been waiting for an opportunity to write his name in characters that may be read after marble monuments and granite obelisks shall have fallen to the earth? He may not possess the means to speak in the language of such royal munificence, neither is it necessary or desirable that he should. Too much endowment has often invited indolence of professorial intellect, and the consequent unconscious approval of error in science. Though money is necessary, it can never be made to fill the purpose of brains; neither can money and brains combined become a suitable and successful substitute for truth. If Senator Stanford's munificent gift is to stimulate the current teachings of science, he had better dump his $20,000,000 into the Pacific Ocean. Indeed, it is quite probable that Christianity would make more rapid strides in the accomplishment of her mission if her essential power and glory could be more generally felt and seen and admired and applauded in something better and more substantial and durable than the monumental ostentation of architectural piety and cathedral spires. Yet houses of worship are desirable: so are

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schoolhouses and colleges. A university building, with appropriate surroundings and corresponding educational appliances within, is exceedingly desirable at this time, in order that Substantialism may teach the unadulterated truths of nature's God under its own vine and fig-tree, where none will dare to molest or make it afraid. The man who founds such an institution will write his name not merely for the present generation to admire, but for all future ages to applaud. Thus written, that name will be echoed to the end of time, and hallowed in the teachings of "Time's noblest offspring"—the Substantial Philosophy. Such a philanthropist will stand before God and the rational universe as entirely worthy of the immortality after which he aspires. We may not just agree with Dr. Hall in calling it "selfishness." Such beneficence is the evidence of self-respect, rather than the exudation of sordid self. It is that God-given power in the use of which mortals may legitimately seek and secure the "glory and immortality" of righteous fame. The joy that is set before them is the prospective satisfaction of seeing the truth prevail, to the happiness of man and the glory of God. It is a laudable ambition, and stands out and up in beautiful contrast with the miser's "mountain devil in the heart." It is an ambition which, in man, as created in the image of God, reflects, as Heaven designed it should, that essential trait in the character of Jehovah himself, by which he ever seeks to glorify his own being in all the works of his beneficence and in all the imperishable monuments of his mighty power.

There is also another class to whom the God of truth is now speaking from the holy place in the innermost sanctuary of nature. While the call comes to men of means to make for themselves friends of the mammon of unrighteousness, the same voice is speaking to the young men of this age who may wish to be properly panoplied for the scientific and religious conflicts of the near future. Let them know that the decisive campaign is actually begun. Let them inform themselves as to the real momentous question at issue. In no age of the world's history have young men had a better opportunity to immortalize their names. The ability to embrace an opportunity is the greatest power and rarest faculty that Heaven ever gave to man. Young gentlemen, do any of you possess that coveted gift? Then strike for scientific glory now, and map your own ascending paths to imperishable eminence and a substantial heaven. Confronted by such a splendid opportunity, all aspiring students of nature are now earnestly challenged to enter this most inviting theater of noble independence in science. Do not postpone the important action. Rare opportunities soon pass away. The fullness of the time has come. The crisis is at hand. God's scientific people are already marching out of the materialistic Egypt. The time past is sufficient to have wrought the will of Pharaoh. Let the swelling numbers now press forward to the Promised Land. There they will no longer be compelled to make scientific brick without the straw of truth; but reaching their sickles forth they shall reap the whitening fields of the substantial Canaan, and "pluck the ripening clusters from the vines of God."

The friends of the new philosophy already consecrated to the cause are fully confident of its success. Several different localities have already offered the proposed university a home, in consideration of the great blessing that such an institution is sure to carry with it into the fortunate community that shall secure its presence, and reap the immediate advantages of its beneficent power in their midst. One of these properties has already been inspected by the writer, and another point he expects to visit before this paper shall appear in print. The outlook is encouraging. Before this generation shall have passed away, our cause—*Heaven's* cause—will be snugly domiciled and ready for its mighty mission in the world. This confidence does not ground itself primarily in the supposed self-interest of any human community. It rather plants itself as a most rational faith in the manifest character of Him who will have all men come to the knowledge of the truth. Substantialism, which is now the most rational apprehension of the truth, is a movement so obviously upon the line of the divine purpose, as revealed in the grand system of human redemption, that it is difficult for any intelligent mind to see how the one can be a failure and the other prove a success. And while it is certain that Christianity will ultimately triumph, it is equally certain that it is not to be triumphant without hearts, and hands, and men and means. All these were originally nominated in the bond. The same is true of the Substantial Philosophy. Let cowards to the rear, and courage to the front! He who hath begun the good

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work will carry it forward to the day of victory. The day of victory, whether in science or religion, is the day of the Lord Jesus. When money is necessary, according to the divine purpose, it will be forthcoming. God may not send out a decree after Cæsarean style that all the world should be taxed, because he will leave room for the *cheerful giver;* but at the proper time the money will be found, not probably in the mouth of a fish, or any other scaly thing, but in the purse, and hand, and princely donation of some MAN after God's own heart; and when thus manifested it will bear the image and superscription of a greater than Cæsar. Not only will the money be forthcoming, but other men will step forward and harness themselves voluntarily to the chariot of the new philosophy, and speed its progress with such rumbling of its mighty wheels as to make the old materialistic stagers know that the scientific judgment day is at hand. Such men are now stepping forward in powerful tread and quick succession. Dr. Mott had scarcely been introduced to the readers of THE MICROCOSM until Dr. Kost arises from the anxious-bench of philosophy, and, wiping the perspiration of great intellectual conflict from his scholarly brow, sends greeting from the land of flowers. Rev. J. Kost, A. M., M. D., LL. D., needs no formal introduction to intelligent Americans. Neither is he a stranger to scholars and scientists in Europe. Having traveled over England, Scotland, and the Continent, visiting the universities, and lecturing on various scientific topics, comparing notes with other eminent thinkers, he is abundantly able to size up both the intellectual giants and pygmies of the nineteenth century, and weigh their several systems and theories in the recently discovered scales of truth. The announcement of his having embraced the new philosophy will give the good cause a new impetus across the Atlantic, and stimulate its friends to deeds of heroism in the land of its birth.

M. PASTEUR'S CURE OF HYDROPHOBIA.—PROBABLE ORIGIN OF THE DISCOVERY.

BY THE EDITOR.

One of the most exciting topics in scientific circles at the present time, both in this country and Europe, is the claimed discovery of a real cure for *Hydrophobia*, by M. Pasteur, of Paris.

No other single question of science begins to monopolize so much of public attention, or to take up so much room in the press dispatches and discussions as this. Persons of high and low degree, who have encountered mad dogs, are pouring into Paris from every civilized country, and putting themselves unreservedly into the hands of the great histologist to be cured, if possible, of the dreadful disease to which they have been exposed by the unfortunate bite of a rabid animal.

Already his laboratory is overcrowded with anxious patients, and the cases are accumulating so rapidly that a movement is now on foot for hastily establishing an hospital for *rabies* on a mammoth scale, to accommodate the patients who, according to present indications, will soon be congregated in Paris.

From all the evidences so far accessible, it appears reasonable that this cure of hydrophobia, for the first time in the history of the medical treatment of this disease, has proved to be a genuine antidote to this hitherto incurable infection. Under such circumstances it is not surprising that a *furor* should be the result of the announcement of success in mastering the most terrible of all afflictions to which humanity is liable.

There are not, perhaps, at this time any greater number of mad dogs in any part of the world than there always have been, on an average, during the present century. But hitherto no special public mention of a bite from such a dog, or even of a death from this frightful disease, has been deemed necessary, unless in the case of some prominent individual, or else merely local notices in the vicinity where the unfortunate victims chanced to reside.

The discovery, however, by M. Pasteur, and its successful application in numerous instances, have given a character of public importance to every dog in the

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whole country that seems to go mad, and especially to every person, young or old, who is bitten, whether the dog was really rabid or not.

This circumstance has also, most justly and fortunately, inaugurated a war of extermination against the thousands of useless curs that infest both city and country, and which are liable at any time to go mad from causes peculiar to the canine race, at present unknown to science, and thus unnecessarily expose human lives to this horrible disease.

There is no doubt but this mad-dog scare, sprung upon the world in a way before unthought of, by the startling discovery of the eminent French investigator, will decimate the various species of useless dogs to a degree never before witnessed, not only in this country but throughout the civilized world. And this is in accord with the demands of humanity. A single human life is worth more than all the dogs in the nation, the philanthropic Henry Bergh to the contrary, notwithstanding, and surely a dog that is worth keeping at all, is worth keeping muzzled, or otherwise secure against any possible depredation upon human existence by such an unfortunate and dreadful peculiarity of that race of animals.

The taxing of dogs, as done by law in many parts of the world, and then allowing them to run at large through the streets of cities and villages, as the well-to-do owners are abundantly able to do, does not meet the public demand at this exciting crisis upon the subject. Nothing short of a bounty (as in the case of wolves in olden times), and a liberal one at that, offered by government for the scalp of every dog of a certain age found at large without a muzzle, will do this work of extermination effectually.

The discovery of M. Pasteur thus will work most advantageously in two ways: first, by curing those who chance to have been bitten; and second, in preventing the cause of such exposure by creating a publicity, and thus arousing a general feeling of alarm, and an interest in guarding against the danger by a decided decimating of the number of useless dogs.

The chief interest, however, of scientific minds, is now directed to the course of reasoning on the part of the French scientist, by which such a discovery was made possible, and as to what the process consists of which so effectually fills this chasm always known to exist in medical practice. Jenner did not comprehend the rationale of his own great discovery of the value of vaccination for small-pox. It was no doubt more by accident than by a scientific course of reasoning, that the English physiologist was led to an achievement which has made his name immortal, and which ought ever hereafter to stop the mouths of bigots, who shout "crank" at the very first announcement of a new discovery in science, especially until the most careful and searching investigation into all the facts and circumstances of the claimed discovery shall have been made.

The case of M. Pasteur is entirely different. By the aid of the vastly improved microscope of recent times the histologist is now enabled to resolve the germs of certain diseases into bacteria or living parasites which take possession of the human organism, and by incubation and multiplication produce the disease of which they are the specific representatives. This is distinctly demonstrated in the case of trichinosis, from the eating of raw pork, in which such living parasitic germs have, through at present unknown causes, obtained a foothold. A microscope of ordinary power is sufficient to reveal living and crawling *trichina spiralis*, in the human muscles, after such disease has become seated in the system.

It was inferred, therefore, that all infectious and contagious diseases might be of the same character and source of origin, and that small-pox was but the action of a peculiar species of bacteria so small as to float in the air from the breath or exhalations of the patient, and be inhaled into the lungs of exposed persons in turn, and thus, finding suitably sensitive soil for growth, commence multiplying until the disease would culminate in its regular form.

From this the reasoning extended to cholera, yellow fever, consumption, pneumonia, measles, whooping-cough, itch, syphilis, etc. Why not bacteria, or living germs, peculiar to each particular case, also be the cause of these various diseases? This was the scientific inquiry. And it was but a natural step to include *hydrophobia*, and even the virus of poisonous serpents, could we but analyze it under microscopes of sufficient power to separate the living germs which really may cause the disease.

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Then what process of reasoning connected the vaccination or inoculation of the patient with the possible cure of the disease? From recent interviews with M. Pasteur by different reporters, the rationale of this has come to the surface. If the disease really consists of living microscopic animals, organized for the battle of life, it is plain that they must be overpowered and destroyed, or driven out of their home by other animals more powerful for such conflict, but less harmful to the organism in which the battle is to be fought. Thus the vaccine for small-pox consists plausibly of subdued or tamed bacteria, so cultivated in habits by course of breeding as not to prove dangerous to the human system when they take possession, but so opposed to their lineal ancestors and so improved in courage and prowess as to be able to exterminate them or drive them from their lodgement! Something as we cure the disease of caterpillars in our foliage, or frugivorous birds in our cherry-trees by inoculating our grounds with English sparrows! The sparrows are a disease and a nuisance, but are less harmful than that which they prevent or destroy.

This reasonable solution of the problem, however, which led M. Pasteur to the idea of vaccination with a cultivated and improved virus for hydrophobia, and for other infectious diseases, was not his own original discovery, though he deserves none the less credit for carrying it into practical operation. The whole process was explained on the basis of this very scientific theory, in THE MICROCOSM of September, 1882, marked copies of which we sent to Prof. Tyndall, M. Pasteur, Prof. Helmholtz, Prof. Haeckel and several other prominent investigators of disease germs in this country and Europe. And as a matter of simple justice, in order that due credit for the first suggestion of any scientific discovery, or theory which leads to it, may be given, we conclude this brief paper by copying verbatim our remarks referred to:

"As to the transmission of diseases from parents to children there is a great mystery involved. Mental diseases must manifestly depend upon the mental organism alone for transference. Physical diseases, such as consumption, scrofula, syphilis, etc., which, as now generally believed, are spread through organic substances by self-propagating organisms or bacterial parasites, may depend chiefly on the physical substance which, however small the quantity, descends from parent to child, and, by multiplication of such poisonous animalcules, may continue in the system resisting displacement, and thus finally bring about death. In the case of small-pox and the well-known beneficial effects of vaccination, we have a theory which we have long held provisionally, and will here give for what it is worth. We suppose the virus of small-pox, which exhales from the diseased body and passes off into the atmosphere or clings to clothing, to be living germs of bacteria which in suitable soil, or blood having the proper affinity for the disease, will hatch and multiply by throwing off similar living germs till the whole body becomes diseased. If the blood of a person be not in the physiological condition to furnish suitable soil or nourishment for propagating these germs, he may inhale them with impunity and even sleep in a pest-house without danger. But if the blood have the right affinity for the bacterial germs a single inhalation of impregnated air will start the disease by starting the bacteria. Now inoculation (by putting into the circulation bacteria of a milder type of disease), tends to ward off the more dangerous type, on the same principle that a city garrisoned by friendly soldiers tends to counteract the enemy's forces by fighting them off or destroying them if they chance to enter the gates. Though the friendly garrison is a curse to the city, it is less so than it would be to suffer devastation by the enemy. The same may be considered true of all infectious or contagious diseases, and we see no reason why consumption, scrofula, measles, scarlet-fever, cholera, and even whooping-cough—all of which originate no doubt in bacterial germs—may not be prevented by suitable vaccine, could it be found, containing a garrison of a milder or less unfriendly type of bacteria which would protect the blood from invasion by these different hordes of dangerous enemies. We need not be surprised to learn before the present generation passes away, of the discovery of a perfect vaccine for counteracting the various physical diseases that flesh is heir to, and that vaccination for small-pox was but the entering-wedge which will ultimately drive from existence all kinds of contagious and infectious diseases."—(MICROCOSM, Vol. II., page 45.)

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EDITORS' TABLE.

DIFFICULTIES TO BE ANSWERED.

Editor of THE MICROCOSM:

I am not a philosopher, nor a scientist, but am reading as carefully as I can THE MICROCOSM, and I do feel grateful for much I find in its pages; but, with some other of its readers, I am *not* clear as to some of its teachings. I have read as carefully as I can your explanations of the difficulties presented by Dr. Stone in the September number, but there are difficulties still in my way.

I will present them as plainly as I can, and, if they are only imaginary, drop this in the waste-basket, and I will wait further developments and hope for light.

DIFFICULTY I.

It seems to me you limit God's power in denying his acts of creation, representing him merely as a great "manufacturer" rather than a creator.

You say: "As against the self-evident impossibility on its face of creating metallic and mineral bodies out of nothingness," page 376. Again: "And surely it would be a more difficult task to change immaterial nothing into solid matter than to accomplish the same result with immaterial something."

Now, in either case, you represent God as merely *changing* and not *creating*. I read in Genesis—"In the beginning God created the heavens and the earth."

You misrepresent by giving to "nothing" an existence, then declaring the world was made "out of" it. We do not believe God made the world "out of" nothing, but simply that God created the world. How, is not to mortals known; but we have no right to limit God's power, and of two things beyond "finite comprehension," we have no right to claim one more reasonable or easy than another.

DIFFICULTY II.

Can God be perfect and infinite, and yet have parted with a part of himself?

If "the being or essence of God embraced, prior to the creation of matter, all the substance there was in the universe, and of whatever grade, without matter having yet come into existence." and if there has been no creation since, except that "which has been synthetized from the immaterial substance of God's exterior nature," it seems to me one of two things must be true, either of which presents to me a difficulty.

I. This universe must still be a part of God, which leads to pantheism, materialism, etc., which we are compelled to meet with their attendant evils; or—

II. If this universe has been formed from God's substance, and is not now a part of God, then God must be less than he was; hence less than infinite—hence not perfect, and this is contrary to revelation.

If not unworthy of your consideration, by throwing a little light upon these difficulties you will greatly oblige Yours truly,

J. A. PARSONS,
Pastor M. E. Church.

KANE, Pa.

If Mr. Parsons will reflect for a moment he will see that his difficulties bear with as much force against his own statements and arguments as against our opinion—that it was impossible for God to create a material world out of nothing. Let us analyze the question for a moment.

Mr. Parsons asks, in substance, what right we have to "*limit*" God and assume that he could not create a world out of nothing as well as out of something? We reply, in the first place, that we do not "limit" God by merely stating a fact concerning him that is true in the very nature of things. We do not limit a man because we declare it to be impossible for him to travel to the moon in a balloon. The man is limited already by the nature of his existence.

We do not limit God when we say it is impossible for him to *lie*. We have nothing to do with God in the premises or in the facts involved, but merely state what is morally and rationally true in itself. Do we limit God when we say it is impossible for him to exist and *not* to exist at the same time? Is not such a proposition self-evident? Would Brother Parsons feel that he was limiting God's power to create if he should deny God's ability to make another God equal to himself, and then himself cease to exist? Not at all. Our correspondent would not for a moment think he was limiting God's omnipotence by asserting that it would be impossible for him to put an absolute end to duration, or to fix an absolute boundary to space, so that there should be no space beyond a certain fixed limit. Is not such a proposition axiomatic? What is our rational intelligence for, even admitting that we are finite, if it does not permit us to form conclusions upon ultimate and self-evident facts, even though they cannot be comprehended.

But our friend admits the correctness of our whole ground of right to judge of the possibility or impossibility of certain things on the part even of an infinite God, for he absolutely proceeds to *limit* God in the very sense in which he charges us with doing it. Here is the proof: He says if God created the material universe out of a part of his own exterior being, as we have supposed, then "this universe *must* still be a part of God," or else "God *must* be less than he was—hence less than infinite, hence not perfect"!

Now, how does Brother Parsons know that God "must" be reduced in size after parting with any amount of his exterior substance? How dare he thus limit the Almighty by affirming that he "*must* become *less*" if he should create a world out of his own substance? Did the loaves and fishes become *less* in consequence of more than five thousand men and women making a meal off them? No; they became *larger*, or increased in magnitude! Dr. Stone, of Omaha, Nebraska, our esteemed contributor, and the ablest defender of the "*nothing*" theory who has yet written on the subject, contends that these loaves and fishes were actually augmented in size "out of nothing" by the miraculous power of Christ. (See MICROCOSM, vol III., page 243.) Why could not the Creator make the universe out of himself, and then instead of becoming "less," as Brother Parsons says he "must," augment himself in size to keep up the deficiency, or even add new substance out of *nothing*, if it were necessary?

Our sincere contributor honestly thinks that we "limit" Deity when we insist that He must have some substance out of which to create the world before he could thus make it; yet he never suspects that he is limiting God when he asserts that He *must* cease to be infinite and that He *must* become less in size and less in perfection should He make a material body out of His own substance. We retort by logically asking, How does he know what *must* and what *must not* be the size and condition of God after such supposed creation takes place? How does he know that bodies thus made from God's substance "must" still remain a part of God after creation, when there is an almighty power behind them to make any changes necessary? Surely it is Brother Parsons who is amenable to the charge of limiting God's power, unless he quits employing the term "must" so liberally.

We should consider ourself presumptuous in a culpable degree should we assert that God "must" become less perfect or less infinite in his power or attributes, should he create even a thousand million worlds out of his infinite exterior substance. Surely infinite substance, like infinite space, cannot be made less by taking any amount from it. It is still limitless. Theologians who venture to charge us with limiting God should be very careful that they do not do the same thing on a larger scale in shaping their arguments against us.

If the whole universe is full of the immaterial force-element, out of which the various substantial manifestations of force emanate, as we assume it to be, and if God should see fit to synthetize an in-

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finitesimal fraction (comparatively) of such substance as constituting his exterior nature into the present material universe, what has that to do with *lessening* the *being* of God as the *moral*, *spiritual* and *personal*, creator and upholder of all things? No more than would the clipping of a lock from a lady's hair make her *less* as a lady, or reduce her identity as an individual and intelligent person. Nor would such hair, when made into a watch-chain, still remain any part of such intelligent personality. (See "Problem of Human Life," page 66.)

The distinction between manufacturing and creating is, to our mind, unwarranted. Surely manufacturing is as good a word as framing or making, or forming, and the apostle says He "formed our bodies," and that "the worlds were *framed* by the word of God." Heb. xi. 3. We create towns and cities by framing, making, or forming houses. Did not God create Adam? And is it not positively declared that He "formed" him out of some previously existing substance? If there was not another proof in existence against the notion that God ever created anything out of *nothing*, the "creation" of Adam's body settles the question as to God's method of creating, since it is a definition which no Christian man will dispute. How unwarranted, then, to force people to subscribe to an article of faith, inculcating a doctrine that is not only without a single proof to support it, but which is flatly contradicted by the inspired definition of *create*, as given in Genesis. (See the article on Creation of Something out of Nothing, by Robert Rogers, present volume, page 45.)

But our correspondent says: "We do not believe that God made the world *out of nothing*, but simply that he *created* the world." All right. Then he does not believe in the catechism, and so we are together again, after all the argument! Why try to work into a controversy when there is really no difference between us? Of course we do not know *how* God created anything, not even Adam's body, though we do know that He created him out of something. The general proposition is enough. Why not stop there and conclude that, as this was God's way of creating in one case, as Scripturally defined, it is quite probable that He never departed from that sensible method. At least those who claim to believe otherwise should give us the proof.

Something Out of Nothing.

Several subscribers to The Microcosm, among whom is the Rev. D. Craig, of Palmyra, Iowa, have written us to know whether or not the rejection of the notion that God created all things out of nothing is an essential article of faith for adherents of the Substantial Philosophy. We answer once for all, No! It has nothing to do with the essential faith of Substantialists. If a man or woman can intelligently, or satisfactorily to himself or herself, believe that God made the universe out of nothing, we surely, as a firm and uncompromising believer in Substantialism, have no objection. This is a free country, as well in all matters of personal and individual opinion as in other personal and individual rights. Let every man be fully persuaded in his own mind in this abstraction, as well as in what kind of meat he shall eat, what days in the week he shall eat it on, or whether or not he shall eat it at all. If a man should believe that the universe always existed in its material elements, and that God made the world out of such pre-existing matter, as he made Adam's body out of pre-existing dust, such man could not and should not suffer excommunication from the substantial brotherhood if our vote and protest could have sufficient weight to prevent it.

Scientific Repetition.

Old readers of The Microcosm need not be surprised if, in the continued discussion of the various phases of the Substantial Philosophy from month to month in this magazine, some of the fundamental facts and arguments should be presented over and over as the phases to which they belong are wrought into new relations. The fact that new readers are constantly purchasing single copies from the news-stands all over the country, and reading these new articles, makes it necessary that each new treatment of any subject relating to Substantialism should be much fuller in its statements by the way of details than if all our readers were old and permanent subscribers. Unless this repetition be indulged on the part of the editors as well as contributors, such articles (by taking for granted and for understood all that has previously been set forth) would often be no more instructive to the new reader than so much Esquimau. Old subscribers will lose little by this license on our part, while new readers will lose much without it.

MICROCOSMIC DEBRIS.

—In a recent lecture on caisson disease Dr. A. V. Meigs relates that a visitor once opened his brandy flask while in the compressed air chamber, and re-corking it placed it in his pocket. When he got back to the outer air the flask exploded with considerable violence. "No more telling story could be told," said the doctor, "than that of the brandy flask to show what must occur with every liquid and gas contained within the human economy on coming out of the air chamber. While under pressure none of the workmen were attacked; but on leaving the chamber they were all "chilled to the bone" and their vital energies paralyzed. The men are now kept under strict medical control while doing this work, and the percentage of mortality is stated to have been very largely reduced.

—At a meeting of the French Society of Medical Jurisprudence, a case was reported of a child who had died—so stated the certificate—of strangulation, which had also caused a rupture of the heart; and the latter fact was confirmed by the autopsy. The father of the child was accused of having strangled it, and was placed under arrest. The court was not satisfied with the medical evidence, and summoned Professor Brouardel, who stated that the rupture of a healthy heart can never take place after strangulation. The professor then examined the heart and found ulcerations and an aneurism in its wall. The father was at once acquitted.

—Few places are identified so conspicuously with the salient landmarks of English history as Ankerwycke Hall, near Windsor. It includes in its grounds the island of Magna Charta, in which King John granted the liberties of the land to his barons in 1215. It has been an oft-repeated question whether the charter was signed on the island or on the adjacent Surrey meadow of Runnymede; but, at all events, a one-time lord of the manor decided in favor of the former in 1834, and built a room close to the landing place, in which he deposited a copy of the charter.

—The Lynchburg (Va.) *News* says that, although the lynching of Henry Mason, colored, recently, for the murder of Mr. Hammersley, is the first occurrence of the kind in Campbell County, the very name of "lynch law" was derived from a native of that county—old Colonel Lynch, who was in the habit of administering summary punishment to marauders and miscreants of every description without paying any attention to the ordinary processes of law. Hence he was called "Judge Lynch," and this, it is said, is the true origin of the terms "lynching" and "lynch law."

—An object of public curiosity, near New Philadelphia, Ohio, is a man who never shears the wool from his sheep, or plucks his geese, or "rings" his swine. He says it is sinful to interfere with nature. His own hair and beard are never shorn, nor are his nails cut. Every utensil about the farm is home-made.

—The business of painting the huge signs upon fences and barns which assault the eye in all parts of the country is in the hands of a few contractors

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in New York and Chicago. One firm in this city spends from $10,000 to $20,000 a year in this way, paying from one and one-half to two cents a square foot for the work. The bigger the sign the better. Many can be found reaching 300 feet in length, and the biggest of all (at Newark, Ohio) is more than 800 feet long and contains only one word.

—A peculiar accident occurred recently at South Abington, Mass. The Brockton branch train, when running around the Y curve, jumped the rails, ran quite a distance on the sleepers, and then, striking a patent switch, took to the rails again in good style, without doing the slightest damage to the train, merely giving the passengers a good shaking up.

—The residents along a lumber flume in the mountains above Chico, Cal., have a novel way of getting their mail. It is started on a raft from the head of the flume at regular dates, and the people below watch for it, take out what belongs to them, and then send the raft with its precious cargo on the way.

—A club for deaf and dumb people has been formed in Paris. It is called the "Club of the Silent," and nobody who is not deaf and dumb can be a member. The waiters and other servants are also deaf mutes. There are over fifty members, all wealthy, and all great whist players.

—Ordinary army signaling, by waving flags or torches, can transmit only ten words or so a minute, spelled out by letters; but an adaptation of the Morse telegraphic alphabet, now generally employed, has more than doubled this rate of speed.

—During the recent cold snap at St. Louis men were watching along the levees all day and night ready to step on the ice the moment it was able to bear them, and stake out a "claim" to an area for cutting. Such claims are always respected.

—A Chicago street corner lot that was bought thirty years ago for less than $9,000, has just been leased for ninety-nine years at an annual rental of $35,000. A ten-story building, to cost a round million, will be erected upon it.

—It is believed that in ten years Yankton, D. T., will be an inland town. In front of the city, where the river ran twenty feet deep five years ago, there are now 100 acres of land six feet above high water mark.

—The physicians of Sanford, Fla., have signed an agreement not to visit any patient who will not pay their bills on the first of each month. Those failing will not be attended until the bill is settled.

—Adelaide Neilson kept a copy of every photograph of herself which had been published, and the number of these in the various sizes was found on her death to be 609.

—A rustic visitor to Burlington, Vt., spent Thanksgiving Day on the horse railway, making the trip of four miles twenty-two times.

—The fruit trees in Santa Barbara are being dug up and English walnuts planted in their stead.

Making Raisins.

The Operation as Conducted by the Largest California Packers.

It is claimed that the best grade of Orange raisins will this year equal any in the market, and it is confidently expected that our product will gain a very enviable name and footing in the East this year. Unusual care is being taken to pack and grade in a manner that will reflect credit on Orange's products, and the result will certainly be a strong demand in the future. The grapes are picked by crews of men under experienced foremen, and are placed in trays or wooden frames, which are piled on top of each other in wagons and taken to the scales, weighed, and then taken to the drying grounds. These consist of about sixty acres of land, smoothed and cleaned like a brickyard, and the grapes are spread out in long rows to dry in the sun. Ten days or two weeks from the "laying down" is usually about the time required to dry them, and then those thoroughly cured are taken up and put into the sweat boxes. Probably one-third are not yet cured, and these are turned over and placed in narrow rows until the action of Old Sol has made them ready. The enormous quantity of grapes handled by one firm can be estimated when it is known that at one time this sixty-acre plot was covered and a portion of it has been covered a second time. Teams are continually coming and going and a small army of men are employed to care for the grapes and keep the teams on the move. Many women and girls are also employed picking up the loose raisins which have fallen from the stems. The trays are of a number and capacity to hold 300 tons of grapes. When properly dried the grapes are taken up and put into sweat boxes, probably 75 or 100 pounds to the box, and hauled to the packing-house, where they are piled from floor to ceiling in the large front room.

They are left here some days and passed through a sweating process. the object being to equalize the moisture contained in them. When placed in boxes some are much drier than others, but when ready for the packer the intention is to make them, as nearly as possible, equal and uniform in that regard. Four layers are placed in a box and each layer is weighed by the packer, and the whole must make exactly the twenty pounds required. When a box is filled the packer takes it to the scales near the door, presided over by an expert in the business, who carefully weighs and examines it, and if all right it is carried to the next room, where it is nailed up and the corners smoothed off, and it is ready for shipment. The most of the packers are Chinamen, and, as usual, they become very expert at the business, putting up from ten to twelve boxes a day. White men fill the responsible stations, it evidently being considered necessary to keep a close and vigilant watch over the "heathen" to keep him from resorting to "ways that are dark." Occasionally a box goes back to the packer and is upset on his table as a gentle reminder that first-class work must be done all the time. The box lids are branded by a powerful cylinder press, run by horse-power, and it is rather amusing to a printer to watch the *modus operandi* of this coarse-grained printing. Checks are used in every department—a packer receiving a check for each box delivered at the scales. The whole business seems to be systematized thoroughly and moves along like clockwork. The work promises to last until Christmas or New Year's before the whole crop is disposed of, but the favorable weather which the raisin-makers have been blessed with will facilitate operations, and if it continues for another month they will have most of the work done.

Forced Merriment.

Remarkable Effects of the Inhalation of Naphtha.

A remarkable effect was produced the other day on some thirty young women employed at a large india-rubber works by inhaling the fumes of naphtha used on the premises. One after another they began to dance, while uttering shrill peals of laughter and throwing their limbs about in extraordinary fashion. The infection rapidly spread among those who had not come under the influence of the naphtha, and in a few minutes the whole place was in an uproar. The manager sent in all haste for half a dozen doctors. On their arrival the excited workwomen rushed on them, laughing like maniacs, and before they were aware of it these venerable practitioners were dragged and pushed into the workroom, where they were forced against their will to join in the frantic dance, waltzing, polkaing, jumping and whirling in spite of their vigorous protests. On recovering from their surprise, they

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made tremendous efforts to get away from the mad crowd. Most of the women had to be carried out by main force and conveyed home in cabs. On getting into the open air, their excitement gradually calmed down; but work had to be suspended at the factory during several hours.

Suspended Animation.

Living for Weeks in a Trance Condition—The Case Described.

A remarkable case of suspended animation is reported from a farm six miles northeast of Columbus, Neb. The victim is Miss Minnie Dishner, daughter of a farmer. She is a handsome and intelligent girl, twenty-one years old. Monday morning October 26, she arose and assisted with the washing, but about noon complained of severe headache and unusual drowsiness, which became so oppressive that she was finally overcome altogether. She lay down, and at once dropped off into a heavy sleep. After several hours her mother attempted to awake her, but found it impossible. The girl seemed to hear her mother's voice, and to try to rise, but was helpless. As if by a prodigious effort of will power, she finally struggled to her feet, opened her eyes, and tried to speak. Her lips moved convulsively, but no sound was uttered. She was powerless to move her body, and in a few moments she again fell on the bed and relapsed into a comatose condition, in which she has remained ever since. Her limbs are as rigid and cold as a dead person's and she has not eaten food, spoken nor moved in the three weeks that have intervened. For the past few days she has wept at frequent intervals, the tears trickling silently down her cheeks. This, and the faint evidence of breathing and pulse are the only signs of life that have been exhibited. All medical devices to arouse her have proved unavailing. The family have kept the matter quiet, and visitors are not allowed to see the unfortunate sleeper.

Egg Festivals.

Manner of Their Observance in the Celestial Empire.

To the traveler who affords himself time for leisurely observation of the countries in which he travels, there is a peculiar fascination in the common, every-day life of the streets of every Chinese village, not only because of its many quaint and picturesque features, but also as affording curious glimpses of parallelism with or contrast to the customs of the Celestial Empire and other lands.

There is at least one custom which the Chinese observe in common with almost every nation under the sun—namely, that of giving and eating hard boiled, dyed eggs at the spring festival. Some of these are artistically painted by hand, with elaborate mythological subjects. They are only to be obtained just at the time of the festival, and though the markets were well supplied with these just at Eastertime, I found it impossible to procure any a few weeks later, as the egg merchants had no notion of supplying such things out of the proper season.

Another variety of egg festival is celebrated during three days in the beginning of February, when, as on our own Shrove Tuesday, everybody, rich and poor, is supposed to eat pancakes. Again, at Ningpo, on the 5th of May, I noticed that every one seemed to be feasting on hard-boiled eggs, which, I was informed, was done with a view to averting headache in the ensuing twelvemonth—an appeal to luck akin to our custom of eating Christmas pies with the same view toward the coming year. But the giving of hard-boiled red eggs is observed throughout China on the birth of a child, or the recurrence of its birthday, and seems to be the recognized symbol of good fortune.

The Proper Weight of Man.

Prof. Huxley gives the following table of what a full-grown man should weigh, and how this weight should be divided: Weight, 154 pounds. Made up thus: Muscles and their appurtenances, 68 pounds; skeleton, 24 pounds; skin, 10 1-2 pounds; fat, 28 pounds; brain, 3 pounds; thoracic viscera, 3 1-2 pounds; abdominal viscera, 11 pounds; blood which would drain from body, 7 pounds. This man ought to consume per diem: Lean beefsteak, 5000 grains; bread, 6000 grains; milk, 7000 grains; potatoes, 3000 grains; butter, 600 grains; and water, 22,900 grains. His heart should beat 75 times a minute, and he should breathe 15 times a minute. In 24 hours he would vitiate 1750 cubic feet of pure air to the extent of 1 per cent.; a man, therefore, of the weight mentioned ought to have 800 cubic feet of well ventilated space. He would throw off by the skin 18 ounces of water, 300 grains of solid matter, and 400 grains of carbonic acid every 24 hours, and his total loss during the 24 hours would be 6 pounds of water and a little above 2 pounds of other matter.

In this connection we read that Dr. Schweninger, of Munich, has discovered a new mode of reducing the bulk of the human frame. It is, never to eat and drink at the same time, but to let two hours intervene. He has, it is said, cured Prince Bismarck of a tendency to obesity in this way.

Fat people have now their choice between four systems: 1. The original Banting, which consists of eating nothing containing starch, sugar, or fat. 2. The German Banting, which allows fat, but forbids sugar or starch. 3. A Munich system, which consists of being clothed in wool and sleeping in flannel blankets instead of sheets. 4. Not eating and drinking at the same time.

The Approach of Age.

How Tears Give the Face an Old Appearance.

The approach of age shows itself about the eyes. Lines come faintly at first, then deeper, until the incipient crow's feet are indicated, developed and revealed. The woman who, looking in her glass, sees these fatal lines diverging from the outer corner of her eyes knows that she has reached an era in her life. She recognizes it with a sigh, if she be a vain, a lovely, or a worldly woman; with a smile, perhaps, if she has children in whom she can live her own youth over again. But it can never be a gay smile; none of us, man or woman, likes to feel youth—that precious possession—slipping away from us. But we should never be on the lookout for crows' feet or gray hairs. Looking for them is sure to bring them, for thinking about them brings them. Tears form a part of the language of the eye, which is eloquent enough when sparingly used, and which should be sparingly used for other reasons than that of adding to their mute eloquence. Tears are a disfiguring expression of emotion, and those who get in the habit of weeping over every small vexation do much to acquire a careworn, miserable expression, and are sure to look old before their time. Excessive weeping has been known not only to injure, but actually to destroy the sight. Few women look pretty or even interesting, in tears, though it has long been a pleasant fiction in poetry and romance to suppose that they do. Many women, some men, most children make most disfiguring and distorting grimaces while crying, and the lady who thinks she can work upon a man's feelings by a liberal display of tears should carefully study a becoming mode of producing them before her looking-glass. Grimaces soften no heart, and tears accompanied by the usual distortions have a hardening effect if not a visible one. In a prettily written work, now probably out of print, purporting to be the story of the

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life of one of Milton's wives, the author makes the poet say of his wife's eyes, after crying, that they resemble "the sun's clear shining after the rain," a very pretty natural object indeed, but during the rain itself the observer is not inclined to be complimentary.

Epitaphium Chemicum.

1791.

Here lieth to digest, macerate, and amalgamate
with clay,
In balneo arenæ,
Stratum super stratum,
The residuum, terra damnata, and caput mortuum
OF A CHEMIST.
A man who in his earthly Laboratory
Pursued various processes to obtain
The Arcanum Vitæ,
Or the secret to Live;
Also the Aurum Vitæ, or
The art of getting, not making, Gold.
Alchemist-like, he saw all his labor and projection,
As mercury in the fire, evaporated in fume.
When he dissolved to his first principles,
He departed as poor
As the last drops of an alembic.
Though fond of novelty, he carefully avoided
The fermentation, effervescence, and
Decrepitation of this life.
Full seventy years
His exalted essence
Was hermetically sealed in its terrene matrass;
But the radical moisture being exhausted,
The Elixir Vitæ spent,
And exsiccated to a cuticle,
He could not suspend longer in his vehicle:
But precipitated gradatim,
Per campanam,
To his original dust.
May the light above,
More resplendent than Bolognian phosphorus,
Preserve him
From the athanor, empyreuma, and
Reverberatory furnace of the other world;
Depurate him from the fæces and scoria of this;
Highly rectify and volatilize
His ethereal spirit;
Bring it safely out of the crucible of earthly trial,
Place it in a proper recipient
Among the elect of the Flowers of Benjamin;
Never to be saturated till the general resuscitation,
Deflagration, calcination,
And sublimation of all things.

Great Fires of History.

Conflagrations in New York, Chicago, and Boston—Other Cities Destroyed.

New York has had its share of the great fires of history. As far back as 1741 there was a conflagration which was traced to incendiaries, and seven persons were hanged. In 1776 a fire destroyed 493 houses in Broadway, laying an eighth of the city in ashes. Two years later flames which started on an East River wharf destroyed 300 buildings. In December, 1804, forty warehouses in Wall and Front Streets were burned. The conflagration of 1835 destroyed the business portion of the city east of Broadway and north of Wall Street. Six hundred and forty-eight large warehouses were burned, and the loss was estimated at $18,000,000. In July, 1845, the same district was visited by another fire, attended with a loss of $5,000,000. In 1848, 500 houses in Brooklyn were destroyed by fire.

San Francisco was destroyed by fire about twice a year regularly from the time of the discovery of gold in 1849 till 1852, owing to the crowded condition of the wooden houses. Columbia, the capital of South Carolina, was burning when Sherman entered it, February 17, 1865, and very little was saved. Richmond was fired when the Confederates evacuated it in April, 1865, and the entire business portion of the city was burned. Charleston, S. C., was reduced to ashes in 1861 by an accidental fire, and in 1865 there was a fire, followed by an explosion of a war powder magazine, and 200 persons were killed. Portland, Me., was half destroyed on July 4, 1866, by a fire which started from the explosion of a fire-cracker.

The most destructive conflagration which ever occurred in the United States was that of Chicago, October 8–10, 1871. It broke out in a shed near the lumber yards in the southwest part of the city. The legend is that Mrs. O'Leary's cow kicked over a lamp when young people went out to milk her at night in order to make an oyster stew. The conflagration swept over 2,100 acres, destroyed 17,450 buildings, and 98,500 persons were made homeless. Two hundred people were burned or killed by falling buildings. The loss was $198,000,000.

Boston was, in 1872, visited by a conflagration second in extent only to that in Chicago. It began November 9 and ended November 11. Seventy acres were burned over, and 800 buildings destroyed. The value of the property burned was $80,000,000. Fifteen lives were lost. It was said to have been started by a hod-carrier dropping a coal from his pipe. London, Paris, Yeddo, Constantinople, Moscow, Copenhagen, and Carthage, Bagdad, and Nineveh have also been licked up by flames in their time.

Reviews of New Books.

Notice to Publishers.

Special arrangements have been made to have all new books sent us carefully reviewed by specialists.

The Physician's Visiting List.

For 1886—Published by P. Blakiston, Son & Co., Philadelphia. We take pleasure in directing physicians to this admirably prepared pocket-book. Just such information as a physician should have with him is contained in this little volume. A valuable table on poisons and antidotes; Marshall Hall's Ready Method in Asphixia; the metric system of weights and measures compared with the apothecaries' weights, etc.; the size of dose of the various medicines given in the French and English system; Sylvester's method for producing artificial respiration; a list of new remedies, and a daily calendar for physicians to enter their engagements, etc., are contained in this pocket-book. No physician should be without it.

The Anglo-Saxon Dictionary.

We have had the satisfaction of examining the unique and rare work published by A. S. Barnes & Co., of this city. Those who do not know what the old Anglo-Saxon language is, in its unadulterated form, would be struck with amazement in running through the columns of this dictionary and carefully noting its strange words from which our own familiar English had its rise. The offspring has very little family resemblance to its progenitor.

Although this work is credited in due form to the regular editors, Messrs. Harrison & Baskervill, we happen to know that its accuracy of typography, as well as general excellence in other respects, must be credited to the painstaking care and critical ability of Thomas P. Peabody of this city, who, perhaps, has no equal in this or any other country as a dictionary compiler and critic.

A Word-Book of Synonyms.

This beautiful book, published by Hurst & Co. of this city, is also from the pen and discriminating judgment of Mr. Peabody, who has put into a condensed form the best work of the kind, without doubt, extant. No student, especially one who writes for the public, should neglect to secure a copy of this valuable help.

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The Microcosm.

February, 1886.

LIFE AND THE BIOPLAST.

BY REV. JOS. S. VAN DYKE, D. D.

II.

In entering upon a formal refutation of the mechanical theory of life, we are prepared to make a few concessions:

1. We concede that the bioplast—a transparent, gelatinous substance, apparently structureless, seemingly the same in every plant and every animal, originating in a pre-existing bioplast, dispersed through all tissues, constituting a large part of every living organism, throbbing continuously, thrusting out one portion of itself beyond another, etc.—is capable of absorbing nutrient matter, which by some inexplicable process is instantaneously converted into living matter, forming a cell-wall and developing a nucleus, and within this a nucleolus; that of the nutrient matter transmuted first into living matter and then into formed matter, it constructs nerves, arteries, veins, tendons, brain, bone, etc.; that it is capable of reproduction by self-division, the division being sometimes through the nucleus, and sometimes not; that without a cell-wall, and even without a nucleus, it can live, move, and transform pabulum into living matter; that it is a morphological unit—that is, it is an ideal unit of the parts of the structure of plants and animals, not an elementary unit of the "vital force," of the personality, in these organisms.

2. We concede all that Dr. Lionel S. Beale (whose knowledge of the bioplast exceeds that of Prof. Huxley, of Prof. Bain, of Prof. Tyndall—indeed, of the entire host of materialists) says in "Protoplasm, or Matter and Life," a volume well worthy of careful study. He affirms:

"Nothing that lives is alive in every part." Page 181.

"It was shown that upon it [living matter] all growth, multiplication, conversion, formation, and, in short, life, depended." Page 184.

"The ultimate particles of matter pass from the lifeless into the living state, and from the latter into the dead state suddenly." Page 185.

"Of the matter which constitutes the bodies of man and animals in the fully formed condition, probably more than four-fifths are in the formed and non-living state." Page 187.

"No language could convey a correct idea of the changes which may be seen to take place in the form of one of these minute particles of bioplasm, when alive." Page 207.

"Though nuclei and nucleoli are living matter, they do not undergo conversion into formed matter, except as regards the very thin envelope." Page 212.

"The living matter, with the formed matter upon its surface . . . . is the anatomical unit, the elementary part, or cell." Page 217.

"Each mass of bioplasm increases in size by the absorption of nutrient matter." Page 221.

"What is essential to the cell is matter that is in a living state—bioplasm, and matter that has been in the living state—formed material. With these is associated a certain proportion of matter in solution, and therefore not visible, but which is about to become living—the pabulum, or food." Page 225.

"The new centers (nuclei) may divide and subdivide, as well as originate anew in already existing bioplasm; but bioplasm destitute of nuclei and nucleoli may divide, so that these bodies are not essential to the process." Page 233.

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"If we could only make fluid flow through the cell after its death uninterruptedly in the same direction, and with the same force as it is made to flow during life by the action of the living matter, ciliary movement, I think, would continue, although the living matter of the cell was actually dead." Page 238.

"At every period of life in every part of the body, separated from one another by a distance little more than $\frac{1}{1000}$ of an inch, are little masses of living matter which are continually absorbing nutrient materials, and undergoing conversion into structures." Page 304.

Dr. Beale, who is competent authority in reference to the marvelous powers of the bioplast, is a determined opponent of materialism and of the mechanical theory of life, as any one on examining his able work will soon perceive.

3. There is mechanism in every living organism, from the trilobite to the elephant, from the lichen on the ice-fields of the arctic zone, or the algæ in springs whose temperature is 200° Fahr., to the philosopher in the process of constructing a new theory of light, or to the theologian reverently bowing at the footstool of THE UNFATHOMABLE.

We deny that the following statements have been established by satisfactory proof:

1. Matter may possess spiritual properties. We affirm, on the contrary, that the properties of matter are material, being such as are included in the commonly accepted conception of matter.

2. Life is mere mechanism; "living things are machines in motion." We affirm: No one has proved that the several tissues of living organisms become mutually adapted to each other by the operation of purely physical forces. The ultimate arrangement in adult animals must have been foreseen. Preparation for the attainment of a definite purpose must have been made before tissue of any kind was produced. The materialistic hypothesis fails utterly in explaining how each part became so nicely adjusted to every other part. Though some of the phenomena of life can be explained by mechanism and some by chemistry, the ultimate results require the hypothesis of "vital force," distinct from and superior to mere physical forces. More is included in the term life than is contained in the aggregate of elemental units. The formation and growth of tissue—the building up and breaking down, addition of matter thereto and removal of matter therefrom—cannot be fully explained by mechanics and chemistry. The movements in and by organized beings are unlike anything that is known to occur in non-living matter. Growth by the assimilation of food taken within is totally diverse from growth by accretion. Attraction cannot account for the passage of nutrient matter toward and into the living matter; and no known physical force is competent to transmute this nutrient matter into living matter, the elements being not only rearranged, but so far altered that compounds which may be detected in the nutrient matter are not present in the living matter. The physical and chemical changes of which we have knowledge are totally dissimilar to the changes which are designated by the term life. In not one single instance have the phenomena of a living organism been explained by physical forces. Those who believe in "molecular modifications" have not explained what they mean by the expression, nor have they shown us what agencies produce these "molecular changes." It has not been proved that life is in absolute dependence upon mechanics; nor has it been proved that no forces are operative in the formation of bodily structures except material forces, nor even that these forces act exclusively through the bioplast. Certainly the matter of man's body is arranged, directed, and controlled as material forces nowhere else direct and control matter. The matter of the human organism comes and goes; the power remains substantially unchanged. Vital force suspends the action of chemical affinity; it defies the force of gravitation, carrying material to the top of the tallest cedar. It even controls electrical currents. Are such results possible to mere aggregations of infinitesimal bioplasts, no one of which has any discoverable organism, or any machinery whatsoever?

3. We deny that, "If an entirely organless mass of matter may have life, either actual or potential, then life must be molecular arrangement effected by ordinary forces." If the bioplast is structureless—which has not been proved, and is apparently almost inconceivable—then it is seemingly indispensably necessary to assume the existence of a vital force if the phenomena are to be satisfactorily ex-

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plained. If we are to concede, as we are assured we must, that the organless condition of the bioplast is proved by the fact that the most powerful microscope fails in detecting any organism, then, as is apparent, the difficulties are greatly augmented, instead of being diminished. Can an organless mass build up a complicated organism? In degrading the bioplast to such an extent as to characterize it as a structureless mass, its warmest friends have seemingly tempted us to pronounce it totally unequal to the arduous tasks imposed upon it. Admitting, however, that a "totally organless mass may have life," inconceivable as it seems, does it follow that life is necessarily "molecular arrangement effected by ordinary forces"? We are compelled to say we do not see that it does. May it not be an independent "force"? Moreover, it seems like labor lost to take so great pains in attempting to prove that infinitesimal masses of bioplasm are the elementary units of life, and then, after striving to induce us to accept this as an ultimate fact, immediately proceed to assure us that after all life is not an aggregate of bioplasts, but is a particular arrangement of the atoms of ordinary matter, the arrangement being effected by "ordinary forces"—that is, as we suppose, by some one or more of the physical forces. Has it been proved that physical forces are capable of so arranging the molecules of matter as to impart life to them? No. Has it been proved that the only difference between a living and a dead organism is the way in which the molecules are arranged? No. Has it been proved that physical forces can originate life by arranging material molecules in a particular way? No. Has it been proved that at the death of an organism some extraordinary force has prevented these "ordinary forces" from acting any longer as they have acted since the birth of the organized being? No. If these ordinary forces act in a certain way for a protracted period, what prevents them from continuing to act in the same way? Seemingly, if life is not an independent force, there must be some force whose nature is as yet unknown beyond the simple fact that it controls "ordinary forces" to the extent of preventing them from continuing the existence of the living organism. So, then, if life is not an extraordinary force, death, apparently, must be so regarded.

4. We deny that bioplasts can perform their marvelous work without a directing agency. We affirm: If bioplasts build up all living organisms, there must be in every organism a power which directs their working, or there must be an intelligence over and above the kingdom of life, which intelligence employs bioplasts as instrumental agents in constructing organisms. If, as we believe, there is a directing agency in every organized being, we see no objections to denominating it life. If there is not a directing agency in every organism, then quite manifestly there must be such an agency external to each—God must be "working all in all." An organization without an organizer is seemingly an impossible conception. Life is an independent entity, owing its existence to the same cause which originated matter; or God, without the intervention of a secondary agent, is the life of the universe. The latter, or pantheistic conception, finds its refutation elsewhere, leaving reason free to assert: If bioplasts build up living organisms, something, which we may as well denominate life as anything else, must direct their working.

SLEEP—DEATH.

BY J. G. BURROUGHS.

There are two systems of motion in the animal economy—the voluntary and the involuntary; whilst in the vegetable there is but one system—the involuntary. It is this additional system in the animal economy that constitutes one of the marked and essential differences between the animal and vegetable.

In creation, the vegetable was the first vital organism to make its appearance upon the theater of action, various schools of philosophy to the contrary notwithstanding. Its basis was mineral, or inorganic matter, a basis without motion. Upon the vegetable kingdom, as a basis, was built the animal economy. This no philosopher can successfully deny.

Sleep, in the animal economy, is the cessation of voluntary motion. All the

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voluntary organs are then at rest. The will-power is no longer at work. It may see visions and dream dreams, but it has no power over the body. In sound sleep the body is motionless; hence death is often spoken of, in the Scriptures, as a a sleep. There is a striking similarity. Sleep and death are much alike in the two following particulars, viz.:

I. The motionless condition of the body.

II. The unconsciousness of the mind to what is occurring or going on around the body.

In these two particulars sleep is a fit representative of death. In sound sleep the body is wholly unconscious, but the mind is active. So in death. The body is wholly unconscious, but the mind remains active. But there is a vast difference between sleep and death. This difference may be explained in a few words. Sleep is the cessation of the voluntary system of motion. Death is the cessation of the involuntary system of motion. Vegetables never sleep. They die. Their closing and folding up is for a different purpose. It is for the digestion and assimilation of food taken into the vegetable system during the hours of opening.

In the cessation of the involuntary motion, there is, of course, in the animal, a cessation of both systems of motion. The voluntary organs of motion, or, in other words, the organs of voluntary motion, are under the control of the will, whilst the organs of involuntary motion are under the power of law only. The organs of involuntary motion are the heart, lungs, and general circulatory system. These all continue active from the first inception of life to the end of life—the life of the body. They are, therefore, busy through the hours of sleep and wakefulness, sickness and health, labor and rest. With them it is perpetual motion. There is no rest to these organs until the heart ceases to pulsate. Their rest is death. It is very different with the voluntary organs. Their rest is sleep—a temporary cessation from labor. Sleep is sweet and refreshing. It is produced by the predominancy of the involuntary system over the voluntary, and, *vice versa*, wakefulness is the predominancy of the voluntary system over the involuntary.

The involuntary system of motion is the bond of organic union with the source of life. Hence, when this bond of union is destroyed, death is the result. In the vegetable, this system of motion constitutes the bond of organic union with the mineral kingdom—the source of vegetable life. In the animal economy, this same system constitutes the bond of organic union with the vegetable—the source of animal life. As the mineral kingdom forms the basis of vegetable life, so the vegetable kingdom forms the basis of all animal life. Hence, the vegetable possesses two natures—the vegetable nature, which is peculiarly its own, and the mineral nature. The animal also possesses two natures—the animal, which is peculiarly its own, and the vegetable nature.

Man possesses three natures—the vegetable, animal, and human. The human nature is peculiarly his own.

The cessation of involuntary motion, as we have already seen, is death, to either vegetable, animal, or man, because its cessation is the end of organic union with the source of life.

Sleep, then, is a cessation of all voluntary motion. Death is a cessation of all involuntary motion. In the animal and vegetable this cessation ends all. Not so with man. Man possesses a nature that is above the two former. He has a nature but a little lower than that of angels. He has a nature peculiar to himself, and essentially different from those below him. When, therefore, the involuntary motion ceases with him, the organic union with the source of life is dissolved, as with the vegetable and animal, but he does not cease to exist. In this dissolution body and spirit are separated. The body passes to dust, while the spirit passes to realms of life and consciousness until the grand awakening and reunion of parts.

From all the foregoing it is evident that the commonly received definition of death is incorrect. We must give it a new interpretation—the cessation of involuntary motion.

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THE MEANING OF THE SOUND-DISCUSSION.
THE ORIGIN OF SUBSTANTIALISM.

BY THE EDITOR.

Few readers of THE MICROCOSM have failed to observe that the discussion of sound has been, and continues to be, a prominent feature in these monthly issues. The fact of making any one scientific theme an apparent hobby for continuous criticism, investigation and controversy in a monthly magazine, surely ought to have some special meaning or unusual signification which would not appear to the uninitiated, but which should be susceptible of an explanation that will justify a proceeding so unique and out of the line of ordinary journalism. We propose, therefore, to give an explanation in this paper which we believe will fully justify so anomalous a proceeding to the judgment of every unbiased reader; and if we do not succeed in convincing such readers that the importance of this persistent discussion of sound has not been overestimated by the management of THE MICROCOSM, we shall consider ourself very badly mistaken. And furthermore, if we do not, by the time we close this editorial, satisfy the attentive reader that this same dry, uninteresting, and apparently monotonous discussion involves matters of infinite importance to all classes of mankind, even outside of scientific circles, we shall freely confess our inability to form any true estimate of what constitutes valuable discussions for a scientific, philosophical, and general magazine.

This surprise at so much writing upon the sound-question has not been confined to new readers of THE MICROCOSM. There are many persons, even among substantialists, who do not yet grasp the full scope and signification of the present sound-controversy, many of them asking with the utmost sincerity: Suppose the present undulatory theory of sound be true, how would such fact interfere with the great truths and principles of the Substantial Philosophy? Such questions have frequently been put to us by persons who do not hesitate to accept Substantialism as the foundation of all true science, philosophy, and religion. But manifestly those who can conscientiously ask such questions have not yet been fully initiated into the basic ideas upon which the new philosophy has been founded.

If there is one proposition more than another, upon which Substantialism, as a system of philosophical belief, depends for its very existence, it is that every natural force or phenomenon-producing cause, by which our sensuous consciousness is affected or our reason addressed, is and must in the nature of things be a *substantial entity*. It matters not whether such entities are material or immaterial substances, if they only produce effects which constitute the basis of a rational concept or in any manner affect our sensuous recognition, they must be objective and actual entities, as really substantial as is the water which turns the wheel or the steam which moves the piston. Indeed, the water which turns the wheel would be absolutely powerless to produce any effect, except for the equally substantial though immaterial force of gravity, which pulls the water to the earth; while the steam or aqueous vapor which moves the piston would be as ineffectual for such work as would be a London fog, but for the substantial mechanical energy stored up in this confined vapor by the equally substantial force of heat. Thus we catch a glimpse of the very foundation principle which led to the Substantial Philosophy. (See "Problem of Human Life," page 36.)

That substantial entities, even in the physical realm, can be *immaterial* as well as *material*, was the very first generalization which led to Substantialism. Such a broad duality and such a natural classification of the entities or objective existences of the universe was essential even to the very first step toward a universal Substantial Philosophy. That this broad classification is one of the great axioms or self-evident truths of the universe, we will try to make plain to the reader in subsequent papers, if not in this.

Since, therefore, our general proposition, that every phenomenon-producing cause by which our sensuous or rational observation can be addressed must be an entity, lies at the very foundation of the Substantial Philosophy, it becomes entirely plain that to leave *sound* out of the category of the substantial forces would be to open the floodgate of logical objection to the entire system of reasoning upon which

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the new doctrine of Substantialism is founded. For most surely if sound is a mere undulatory motion of the particles of the air, or of other body which conducts it, and consequently is not an objective thing or entity, of what use would it be to urge considerations in support of light, or heat, or magnetism, or electricity, or any other form of force as necessarily anything more than the analogous vibratory motion of the material particles involved?

Surely Huygens was right in assuming, and Newton was right in finally accepting the undulatory theories of light and heat which so logically grew out of the universally conceded wave-motion theory of sound, even though the former philosopher had to invent an all-pervading *ether* out of which to manufacture light and heat waves in order to complete the parallel. Manifestly, if one sensation-producing cause (sound) is absolutely known to be mere wave-motion, as was at that time universally conceded, it was every way right and logical to conclude that the two other sensation-producing causes (light and heat) should consist of the wave-motion of some other material body. Indeed, we do not see how it could have been avoided, or how Newton could consistently have held out against the views of Huygens as long as he did in trying to maintain his material emission theory of light, with its most intimate analogue (sound) nothing at all but the wave-motion of some material substance. And how natural that other physicists, such as Tyndall, Helmholtz, Sir Wm. Thomson, and modern scientists generally, should be driven by the logical necessity of the case to include electricity, magnetism, and gravitation in the same category of modes of molecular motion.

We have always been unable to see the least bit of logical reason in the substitution of a material "jelly"-like ether having the property of "inertia," as Prof. Tyndall describes it, for Newton's material light-particles having similar inert properties. Suppose this *inert ether* actually to fill the space between here and the sun; it is impossible for a vibratory or wave-motion to be produced in such a mass of ether on this earth without the exertion of a mechanical force proceeding from the sun sufficient to overcome this ethereal inertia. Hence, whatever mechanical *energy* it takes to produce this agitation of the *ether*, called light, at the sun's photosphere, *must travel ninety-five million miles and be actually present here as a real* (*and as reason ought to teach us*) *substantiat energy or force in order to stir or displace this inert material substance called ether.* Surely no inert material substance can move itself.

Then, if there is the slightest reason in support of the supposition that light, here on the earth, consists of the wave-motions of an inert *ether* extending to the sun, it follows that the substantial mechanical energy which has to come all the way from the sun here in order to agitate this inert mass, might just as well be considered the light itself, and thus save such a useless circumlocution. Surely these waves or pulses of mechanical energy, sent off from the sun, ninety-five million miles away, in order to agitate the ether on the earth and throw it into undulations, ought itself to produce just as good "waves of light" as would the material ether after it was thus thrown into undulations by the previously present energy or force which produced them.

And further, if *waves* are actually needed, as the undulatory theory teaches, by which to explain certain phenomena of light, particularly in spectrum analysis, that cannot be explained by corpuscular emissions as held by Newton, such as convergence, dispersion, aberration, refraction, diffraction, reflection, calorescence, fluorescence, phosphorescence, etc., why in the name of simple science do not these theorists accept our suggestion of the mechanical *force* or *energy* itself, which must be present from the sun in order to produce these ethereal undulations, and merely suppose, which is so easy to do, that light, as a real substantial force, is issued from the sun in the form of pulses, *waves*, or *spherical shells?* Surely the waves of *light-force itself* ought to serve the same purpose, in solving luminiferous problems, that the waves of ether or some other supposed substance would serve, which cannot be thrown into undulations or displaced at all without the previous presence of this very mechanical force which the present theory so absurdly ignores!

Such is a specimen of the endless involvement in which wave-theorists find themselves, in their roundabout efforts at explaining physical difficulties by inventing waves of material *ether*, when waves of this very light-force, which is required to shake the ethereal mass, would have answered every purpose!

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But physicists did not stop their undulatory innovation with light and heat based on the then inexplicable appearances in sound as a mode of motion. Even the force of *cohesion*, which, in holding the minutest portions of an inert body together, seems to be static or still force, had to be changed to another mode of motion to suit the prevailing tendency of physics; and the only way such a marvelous scientific feat could be accomplished was to invent, as the counterpart of *ether*, the notion that all material bodies were composed of ultimate molecules and atoms which are normally many times their diameters apart, and that, as the *result* (or possibly the *cause*, who knows?) of cohesive force, such molecules and atoms are in continual agitation among themselves, and inherently bombarding each other.

This materialistic theory that molecules and their inherent motion constitute all there is in a living body, is one of the most mischievous, as well as one of the weakest, doctrines ever taught for science. The very notion that the ultimate material molecules of a body are normally separated hundreds of times their diameters apart, and that they are inherently in ceaseless motion, flying hither and thither, without some real and substantial force filling the spaces between them, as the medium of motion or the *cause* of such movements, is so puerile and irrational a supposition that it is simply inconceivable how physicists of sufficient intellectual capacity to conduct a scientific experiment could have fallen into it, much less have been satisfied with it after it had been adopted. Let us illustrate:

Had the inventor of the molecular theory chanced to see a simple enlargement of his idea exhibited by some ingenious mechanic, in the shape of a thousand cannon balls flying with an enormous velocity hither and thither, criss-cross, and every way throughout a ten-acre field, at the same time constantly clashing with each other and glancing off in new directions, but with no let-up to their pell-mell bombardment, is it supposable for one moment that, as an intelligent investigator, he would not have suspected that such movements of inert material masses must of necessity be produced by some substantial energy-producing cause, such as that of compressed air, steam, gunpowder, tensioned springs, or other source of adequate mechanical power? Would he, with less logical intuition and acumen than the most untutored savage, look on at such a marvelous exhibition of mechanical energy and skill, and without even a grunt of reflective inquiry, not suspect that an invisible but substantial cause, as real as the cannon balls themselves, was doing all this work of hurling them with such force and velocity, and without which it would have been impossible for them to move at all?

It seems to us that a child old enough to walk would suspect, on seeing an exhibition of this kind, that some power would be necessary, even if invisible, to produce such wonderful physical results, and at the same time that such *motions*, in the nature of things, cannot be the *power* or *energy* which produces them! Yet the originator of the molecular theory simply pushed this very exhibition of cannon balls so far back into the invisible as to satisfy his intellect that the reduced missiles, which he now terms *molecules* and *atoms* (just as inert and incapable of moving themselves or of being moved without adequate force as would be cannon balls or even mountains), actually propel themselves without any substantial cause, or else that they generate, by their *motion*, the very force by which the *motion is produced!*

The chased and wearied ostrich which solves the problem of its pursuer and annihilates the hunter by thrusting its own puny head into the sand, deserves credit for logical perspicacity, compared with the scientific investigator who can so far reduce the size of these flying cannon balls, by shutting out the light of reason from the problem, as to believe that by their motion they generate the force that moves them, or else that they move themselves inherently without any outside mechanical force or energy by which to overcome their inertia.

It was Sir Isaac Newton himself who really originated this peculiar molecular idea when he attempted to explain in the "Principia" the observed 174 feet a second of sound-velocity in excess of theory, by first supposing the air constituted of solid particles, each of a diameter of about one-ninth their distance apart. He then supposed that the time for the passage of sound through the air was all consumed in traversing these spaces between the solid molecules, and consequently that the sound-pulse passes through these molecules instantaneously, thereby causing the pulse to gain enough on the formula of atmospheric density and elas-

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ticity to equal observation, and thus explain the discrepancy of 174 feet a second. (See "Principia," page 368.)

This singular explanation by the greatest scientific investigator of any age, was probably the foundation of the present molecular doctrine, which has been since carried out by Dalton and others. Yet the whole thing, as thus initiated by Newton, is calculated to provoke one's amazement, if not one's amusement, at its strange incongruity. Let us look into its teaching for a moment.

In the first place, it is clear that Newton had no true conception of sound-propagation through any medium except *air*, and of this latter the reader will soon be able to judge. He actually supposed that sound traveled through *solid bodies* instantaneously, since this erroneous belief was the basis of his attempted explanation of the 174 feet discrepancy between the observed and the calculated velocity of sound. But we will let this pass, and consider the probable value of his authority as a sound-expert, based on the merits of his novel explanation as to atmospheric sound-conduction.

As the air is constituted of solid particles, separated by nine times their diameters, what is it that fills these spaces between the solid air-particles, since it cannot be air? If they are empty spaces, or contain *nothing*, how was the sound conducted by material wave-motion from one solid molecule to another, and without some substance as a medium, since sound does not travel at all in a vacuum? If there was some other gaseous substance filling these spaces between the hard air-particles, through and by which the sound was conducted in waves, what propriety was there in applying the density and elasticity formula for air to this inter-molecular substance by which theoretically to determine the velocity of sound? Surely this inter-molecular substance, whatever it was, should have first been isolated from the solid air-particles, its *density* and *elasticity* ascertained, and the great formula should then have been adjusted to it! What theoretic license to apply the formula of density and elasticity for air to absolutely vacant space, or else to a medium of which nothing is known, existing between the air-particles!

But if this substance filling the spaces between the solid air-particles was also air in a rarified or highly gaseous form, why could not the solid particles of Newton's theory have been dispensed with altogether; or, in other words, why could not the whole air get along without solid particles as well as the vast portion of it existing between them? Clearly, if the medium, filling the spaces between the solid air-particles, was something different from the air which is constituted of these very particles, according to Newton, then his whole formula based upon the density and elasticity of the *air* breaks down as a laughable miscarriage, since, according to his theory, *the entire time of the travel of the sound was consumed in passing through something that was not formulated at all—merely the spaces between the air-particles!*

If, however, such solid air-particles had no existence in fact, but were only introduced by Newton as a provisional hypothesis to give a theoretic show of explanation for the observed excess of 174 feet velocity over the formula upon which the wave-theory of sound depended, what reason had Newton for objecting to the *gelatinous ether* of Huygens as an equally amiable attempt, without any facts to support it, to explain and defend the wave-theory of light?

In addition to these overwhelming difficulties in the way of the very formula of density and elasticity upon which the wave-theory rests, there is no end to the list of perplexities that might be suggested. For example, if both the solid particles and that nondescript medium which fills the spaces between them constitute air, what part in such a mixture do *oxygen* and *nitrogen* play in the manipulation of the solid particles? Or do the solid particles belong exclusively to one of these elements, and the inter-molecular medium, which is not solid, to the other? If so, how is it that the known proportion of *one* of oxygen to nearly *four* of nitrogen in our air is maintained, when the proportion of Newton's solid part of air is less than one to three thousand (in bulk) of the interstitial element? If, on the other hand, the solid particles of the air are constituted of both elements in due proportion, as also the medium filling the spaces between them, it would imply a compound both mechanical and chemical in the composition of air, whereas it is known to be only mechanical.

In all candor, leaving these specimen difficulties to round out the tableau of

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absurdity in which Newton's whole formula had involved him, would it not have been vastly to the credit of his great intellect (when he found that his "density and elasticity" theory, as applied to air, had collapsed) had he frankly abandoned the whole undulatory doctrine as a conspicuous failure, instead of persisting in such trifling efforts to harmonize it, as exhibited in this "solid-particle" explanation?

From the foregoing facts and considerations, the reader must begin to apprehend that the entire brood of molecular modes of motion, as applied to the forces of nature, must logically and necessarily have grown out of the first and representative undulatory theory of science, namely, that of *sound*—a theory so apparently self-evident on its face that Newton, as well as every scientist since his time, was not able to discard it, even after he had completely overturned it and shown it to be false, by the very formula of science upon which it had been established!

Under this prevailing conviction of the absolute truth of the wave-theory of sound in the minds of all the scientists previous to and since Newton's time, the tendency has gradually become stronger year by year to make every other force of nature harmonize in this particular with the sound-theory, namely, as some sort of molecular vibration. As sound was only the wave-motion of the air, and not a substantial entity, as universally apprehended, it would have been unworthy of logic or reason long to have persisted in teaching that any other force of nature could be a real substance. The very harmony, uniformity, and consistency of the physical laws precluded such irrationality as the supposition that one form of force could be substance while another form was an absolutely insubstantial mode of motion.

Hence, it mattered not how strong the appearances were in favor of heat, light, electricity, magnetism, etc., as substantial entities, or however cogent were the reasons for making them objective existences (and there were many), yet the fact that *sound* stood like a lion in the path of science, an unimpeachable and incontrovertible mode of undulatory motion, settled the question to every logical mind that all the other natural forces, however they might superficially appear to be substantial, must also be resolved into some form or mode of molecular vibration, unless all pretense at consistency in science was to be abandoned. It mattered not how heat could melt down cities at its touch, or how electricity could shiver forest trees to splinters by its resistless bolt, even such tremendous facts could not maintain and defend the substantiality of these forces in the face of scientific consistency, and with sound indisputably only the wave-motion of the air.

Thus sound became the legitimate mother of all other theoretic modes of motion, while light, heat, electricity, cohesion, magnetism, and even gravitation under the logical ratiocination of theoretic and scientific necessity, changed their form, stature, and complexion in order to become the lineal descendants of their maternal progenitor. Theoretic science, thus fortified by the one universally admitted undulatory force, could logically laugh at the vaulting ambition of incipient Substantialism in its desperate attempt to overleap sound and to light upon *light* or *heat* as an entity, without stopping to grapple with the first-named theory as a conceded nullifier of all such illogical endeavors.

Hence the inexorable necessity of our case, before trying to frame or formulate the first step in a universal system of Substantial Philosophy, which would thus necessarily have to include all the forces of nature if it included any, that we boldly and successfully attack and overturn the wave-theory of sound, and thus demonstrate that even this overwhelming appearance of undulatory motion was a mistaken conception of scientists, and that sound, no less than heat, electricity, and magnetism, was an objective entity.

Moreover we saw, as among the earliest necessities of the case, that unless the physical forces, such as light, heat, electricity, cohesion, magnetism, and gravity, could be shown to be substantial entities by utterly wiping out sound as a mere undulatory motion of the air, and as the mother of all the other so-called modes of motion, it was worse than futile to attempt to oppose atheistic materialism which defiantly denies the entitative existence of the soul, life, mind, or spirit, and does it, too, most logically upon the universally admitted science of the schools that all the other natural forces, from which result the various observed phenomena around us, are but modes of molecular vibration. If heat is but the vibration of the ma-

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terial molecules of an inert substance—*ether*—and, as mere motion, necessarily ceases to exist as soon as the vibrating particles come to rest, what folly, says Prof. Haeckel, to claim that *life*, which exhibits analogous phenomena, should have any existence in a substantial sense, or except as the molecular vibration of the nerve and brain particles; and that like sound-motion, heat-motion, or light-motion, such life-motion or soul-motion must of necessity cease to exist as soon as the vibrating molecules which produce it cease to move!

No man has ever pretended to answer this appalling argument of the materialists of the recent atheistical school against the Christian's hope, until it was annihilated by the breath of Substantialism. No man can answer it, nor produce any effect upon it, except to confirm its correctness, unless he first repudiate the teachings of modern science and accept the teachings of the Substantial Philosophy in their stead, namely, that every force of nature or phenomenon-producing cause, including sound, is a substantial entity or objective thing. Let this basic principle of philosophy be intelligently accepted and courageously employed, and a child could drive Haeckel and his entire cohort of materialistic disciples from the field, by planting itself invincibly upon the impregnable rock of truth, as here set forth, namely, that the soul, life, mind, and spirit are as really substantial entities or objective existencies as is the corporeal organism they inhabit.

Joseph Cook, the profoundest thinker upon this subject in America, attempted to escape the force of Prof. Haeckel's materialistic argument, but he ingloriously gave the cause of human immortality away to the logical atheist, and floundered not only helplessly but pitiably in the meshes of the very difficulty he was trying to meet, and for the sole reason that he accepted the wave-theory of sound as true science, and as a necessary consequence the other forces of nature as but modes of motion. (See our demonstration of this fact in the "Problem of Human Life," page 71.)

Yet after such overwhelming evidences as here given of the value of this new departure in crushing out the very bacterial germs of materialism, it is marvelous to reflect that even ministers of the Gospel, standing speechless and paralyzed in the presence of this otherwise unanswerable argument of the materialistic philosopher, still persist in rejecting, or at least paying no heed to, the Substantial Philosophy which so conclusively furnishes the only means of escape!

What marvel is it, therefore, that the heaviest artillery of Substantialism should be incessantly trained upon the wave-theory of sound which has done all the mischief in decoying the world from the true and substantial paths of physical science, and as a legitimate consequence has almost neutralized the force of religion by filling the earth with rampant materialism? Is it any wonder that intelligent substantialists should cry aloud and spare not on this basic question of the nature of sound? Was it any wonder, at the very start of Substantialism, that we did not expend our energy in specifically attacking the *heat* and *light* theories—the mere offshoots or outgrowths of the wave-theory of sound—when the mother of the whole brood of physical fallacies lay coiled in her secure strength to hiss defiance at all such futile and misdirected efforts? To have done such a weak, not to say silly thing, would have been to call down upon our head the scoffs and merited ridicule of physicists at so arrant a want of scientific perspicacity. We saw better than to pursue such a profitless course, and we now thank Providence for the guiding light which so fortunately led us to comprehend the situation, and to see at the start the paramount importance of laying the ax at the very root of this upas-tree of materialistic philosophy, and which had held its poisonous sway over all scientific minds from the time of Pythagoras down to that of Helmholtz. Hence it was at the root of this very tree where we pitched our war-tent as the proper point at which the substantial campaign should open.

Thus do we answer the question so frequently asked by partially-informed substantialists, as well as by those wholly uninitiated: "What is the meaning of this persistent crusade against the wave-theory of sound in the pages of THE MICROCOSM?" In answering this we also give the origin of the Substantial Philosophy, so frequently inquired about. No less distinguished a friend and champion of the substantial cause than Eld. Thomas Munnell asks us to give, in a concise form, these preliminary facts, circumstances, and considerations which paved the way to

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the formal avowment of Substantialism as a definite system of philosophy. In a private letter he says:

"I hope you will not forget, at the proper time, as I suggested to you two years ago, to give us in THE MICROCOSM a brief history of your first thoughts that led the way to the Substantial Philosophy as now progressively developed. Not only the present friends of the cause would read such a narrative of facts and circumstances with eagerness. but our successors in after generations will want to know something about the source and headwaters of this great stream."

In presenting, as we have here done, the reasons why Substantialism would lose wholly its character of universality as a system of philosophy should the discussion of the sound-theory be omitted from its formula, we have incidentally, but fortunately, and before thinking of it, answered the request of our excellent contributor as copied above. And for the reasons here given, the sound-discussion not only becomes a *sine qua non* in the premises, but it amounts to more for the intrinsic defense of the Substantial Philosophy, than any amount of discussion of all the other forces put together, however important such discussions may prove to be. And we venture to reassert what we stated in a recent number of this magazine, that if the current doctrine of acoustics be true, then the Substantial Philosophy is totally without foundation either in reason or the laws of physical science.

And we go even further than this: if Substantialism, as a universal system of philosophy, be not true, then there is no truth in the existence of life, soul, mind, or spirit as substantial entities, or as anything more than the mere motions of material molecules, as Prof. Haeckel so consistently teaches, which motion, as simple material phenomena, must necessarily cease to exist as soon as the moving bodies come to rest. Hence, by what we regard as the severest test of logic known to scientific investigation, we proclaim it from the house-top as among our maturest convictions that upon the correctness or incorrectness of the wave-theory of sound, and, as a consequence, of the Substantial Philosophy, rests all rational belief in the doctrine of the immortality of man! This we aver most solemnly and unhesitatingly, and with the same positiveness with which we assert *that Substantialism cannot be true unless the wave-theory of sound is false.* The reasons for so believing we have given in detail in this paper, and we submit them as the very first lesson which a young substantialist should learn after accepting the new philosophy.

WHENCE COMES MODERN MATERIALISTIC ATHEISM?

BY COL. JOHN M. PATTON.

In August, 1853, there passed away from earth one of the greatest thinkers of modern times—the Rev. Frederick W. Robertson. In one of his sermons he expressed his belief that every great error by which large masses of men have been entrapped, had, or seemed to have at bottom, some great fundamental truth, which alone could render acceptance of the error possible. He illustrated by the errors of the Romish Church. Mariolatry—the worship of the creature—he said, would have been impossible, under the Christian dispensation, but for the fact that the Church had so exaggerated the divine side of Christ's nature, at the expense of the human side, that the *man*, Christ Jesus, with all his human tenderness and sympathies, had been removed, to the apprehension of the worshiper, into the infinite and inconceivable companionship of the Father; and that thus that very human element which was designed to attract men to him was deprived of its power. Men thus bereaved of the necessary human sympathies, in their approach to the Throne of Grace, sought them in the tenderness of woman, and therefore worshiped the blessed Mary, the human mother of the divine Jesus. The fundamental truth lying at the basis of this shocking error was the necessity of a daysman between the divine and human. So in regard to that horrid and humiliating doctrine of auricular confession and absolution. The fundamental truth at the bottom of it is the need of *assurance* of pardon by faith in the Son of God; but

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men, though lacking faith, still desire this asssurance, and are content to receive it from the articulate human voice as a substitute for faith.

And so we may say it is with that hideous nightmare of communism. How is such a thing possible? The fundamental truth at the bottom of it is the fraternity of the human race, revealed by God as the consummation of the Gospel, and instinctively felt by men to be coming in some "golden age;" and so they urge it on prematurely, and insist on applying principles in the present state, which are only possible of application when "the knowledge of God shall cover the earth as the waters cover the sea," and when all men shall really be brothers, each desiring the happiness of others equally with his own. The result of this premature attempt to realize the ultimate good must introduce wherever it is set in action a very hell upon earth.

Now, there is one frightful error, spreading with a wide-reaching speed that is absolutely appalling. We have called it materialistic atheism. It has taken possession, of late years, as never before, of great numbers of the most intellectual and the most learned of men. It is an amazing phenomenon. Is there any seeming truth that excuses or explains it? It is the object of this paper to suggest such a seeming truth (though in reality a prodigious error) which may at least diminish our wonder at it, and which may enable us, by a new departure, to mitigate the evil if we cannot end it.

Some one may say that the whole reason of atheism is that men are unwilling to know God, lest they be put by that knowledge under personal restraints of obedience and homage; and that if they had not this unworthy motive, they would "seek after God if haply they might find him," according to that text in Scripture, "If a man will [is willing] to do the will of God, he shall know of the doctrine whether it be of God." Undoubtedly this is a sufficient motive with some to deny God, and it probably is more or less influential with all. But it cannot be the whole reason, for some at least of the materialistic and other atheists, so far as we can see, are doing the will of God in moral respects as faithfully as many Christians. Some of them, whatever else may be said of them, are of the class "*integer vitæ, sceleris que purus,*" and cannot be justly charged with getting rid of God in order to indulge their passions without restraint. In their case, at least, there is some other cause for their blindness. Let us endeavor to discover it.

One of the fundamental principles of human nature is reverence for authority. Within its due limits it is also one of its most valuable principles. It is both natural and sanctioned by the divine command. But what are its *just* limits? It embraces, of course, all that is commanded by God, such as reverence to himself, to parents, to civil authorities, to teachers, and superiors generally; and in so far as it is truly given to these, one cannot err therein. Error in the application of the principle will probably spring only from a misjudgment of the objects of this reverence—and in this there is room for boundless error.

For example, if there be indeed an infallible vicegerent of God on earth, neither Romanist nor Protestant can err in giving reverence and obedience to him, for he is thus giving reverence and obedience to God through him. But if there be an alleged vicegerent of God upon earth, who, in his name, undertakes infallibly to rule the wills and consciences of men *ex cathedra;* who requires them to accept all truth and to solve all doubts and difficulties from his lips alone, not even permitting to them the privilege, except at his will and under conditions, to search for truth in God's word itself; who claims that, as such vicegerent, his absolution, his extreme unction, his *vade mecum* of any kind is the sole warrant of their salvation in this world or the next; who affirms the right to give them "indulgences" to unlawful acts for money or other compliances; who claims the right to relieve them from sufferings in the purgatory of a future world, or to mitigate their tortures for money, and in proportion to the money paid; who claims that these and such like things are done by authority of God himself—then reverence for and obedience to such pretended authority would be fatal to truth, fatal to all true reverence for God.

Again, though reverence for a superior in knowledge or character is, in its due measure, a good thing; yet if it be exaggerated, if it sanctions an absolute submission to the authority of such a superior, when due study and effort might enable one to weigh it, it would be an undue reverence. Or, if unable to weigh

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the authority of any specialist in science or other study, the individual should not only give him reverence in that branch of learning, but should so exaggerate the authority of that specialist as to follow him blindly, not only in his specialty, but in other branches of knowledge in which he is not eminent—thus saving himself the trouble of search about these other branches—his folly could not be exaggerated; for he would thus cease to be a truth-searcher, and would become the willing recipient of any error which such authority might impose upon him. This has been remarkably displayed in the "Problem of Human Life," where the author shows that much of the skepticism with which the doctrine of evolution has deluged the world has sprung from this very error—from accepting absolutely the authority of great names in science for even scientific truths; and far more and far worse, from transferring the legitimate scientific authority of those great names to religious or other subjects which these scientists have not studied, and with which, perhaps, the victim of this idle or pernicious deference to authority is possibly more familiar than these scientists themselves.

These remarks apply not merely to the scientific materialism of Darwin, Haeckel, Huxley, and their compeers, but also to the logical materialism of James and John Stuart Mill, George Grote, George Henry Lewes, and their compeers.

Thus the great principle of reverence for and submission to legitimate authority becomes, through false applications of it, the source of unending error, even of wide-spreading materialistic atheism.

But there is a reverse view of it. This universal principle of deference to authority affects likewise those who have been relied on so disastrously as authorities themselves, whether they be scientific or logical materialists. Take, for example, John Stuart Mill, the greatest of his school. This grand logician and philosopher was not only raised as an atheist by his father, James Mill, but all religious knowledge or teaching was carefully excluded from him. In his own words, he "was brought up from the first without any religious belief." Though he was of wonderful genius and an encyclopedia of learning, he grew up to the full exercise of his great powers as ignorant as a heathen of the Scriptures, or of the Christian system. Nevertheless he afterward wrote largely of religion, as he looked at it (essays on religion), and on theism. Of course he had to rely, and it was inevitable that he should rely for his view of God and the Christian religion, on the authority of their exponents—the Christian churches. Supposing them to be acquainted with the God they professed, he relied absolutely on their view of him for the purposes of his examination.

And this was the portrait of God which they drew for him: God, they said, is an infinite, all-wise, and omnipotent being, who created and upholds all things for his glory. He is just and loving, and his tender mercies are over all his works; and yet, at the same time, he is a God of wrath, indignation, and inexorable vengeance against all who offend him. His wisdom and beneficence are displayed in the creation of immortal beings made "in his image, after his likeness," who, after passing through a probation on earth of some seventy years, in a scene of constant trial and temptation in the midst of human frailty, will be called before this Infinite Creator to give account of the deeds done in the body—deeds which, if good in the sight of God (though in no case have they ever been found to be thoroughly good), will meet his approbation for the sake of Jesus Christ our Lord, in the cases of all who believe in him, and trust in his great sacrifice. His wrath and vengeance are displayed by the fact that in the cases of all who do not believe and trust in the Mediator, not only will they not be approved or pardoned by him, but the offenders, whether great or small, will be driven away into a place of unspeakable torment, where they will be doomed to an infinite continuance of these intolerable tortures, so long as God himself shall exist, without a hope of their cessation, either through his mercy or through the merits of his Son. And this although he knew when he created mankind in the beginning, that of all the myriads of the race there would not be a single one who would fail to incur this infinite penalty, and moreover that the great majority of these myriads would surely fail to avail themselves of the means of pardon. In the features of the portrait thus far drawn, all christendom, with insignificant exceptions, united with one voice. But a very large part of christendom maintained (and still maintains) that the Creator ordained from all eternity that some should be saved, and the

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rest should be damned—having in the very act of creation elected some to salvation, and the rest (probably the great majority) to perdition, without any reference to the merit or demerit of those thus disposed of, but simply for his glory. One of this school—the gentle Melancthon—once maintained that "God wrought all things, evil as well as good," and that he was the "author of David's adultery and the treason of Judas, as well as of Paul's conversion." Others have quite logically held (from this premise) that there are "infants in hell a span long." While one of the greatest names of the school—Jonathan Edwards—in a sermon on "Sinners in the hands of an angry God," uses such language as this: "He will crush you under his feet without mercy; he will crush out your blood and make it fly, and it shall be sprinkled on his garments so as to stain all his raiment. He will not only hate you, but he will have you in the utmost contempt."

As an humble Christian, who cannot hope that his voice will sound loud or penetrate far, I nevertheless cry out both to heaven and earth, and solemnly protest that in spite of all christendom, in spite of all the angels and archangels of the universe, should they agree with christendom, I cannot accept that portraiture as a true one of "him who dwelleth in the heavens." Nay, I denounce it as a caricature of "our God, our Father in heaven."

Think what must have been the effect of such a portraiture on the mind of John Stuart Mill. It was not his fault that he did not concern himself either with religion or theism until long after the maturity of all his powers; and when, as a searcher for the truth, he turned to the only authority he knew—the judgment of christendom—he found himself confronted with the caricature of God above given. It offended every sentiment of justice and morality in his nature, and his judgment and feelings about it were thus expressed in one of his famous passages: "If, instead of the 'glad tidings' that there exists a Being in whom all the excellencies which the highest human mind can ever conceive exist in a degree inconceivable to us, I am informed that the world is ruled by a Being whose attributes are infinite, but what they are we cannot learn, nor what are the principles of his government, except that the highest human morality which we are capable of conceiving does not sanction them, convince me of it, and I will bear my fate as I may. But when I am told that I must believe this, and, at the same time, call this Being by all the names that express and affirm the highest human morality, I say in plain terms that I will not. Whatever power such a Being may have over me, there is one thing which he shall not do. He shall not compel me to worship him. I will call no Being good who is not what I mean when I apply that epithet to my fellow-creatures; and if such a Being can sentence me to hell for not so calling him, to hell I will go." (Examination of Sir William Hamilton's Philosophy, pp. 123–4.)

It is not only logical atheists like John Stuart Mill, and materialistic atheists like Haeckel, who are thus educated into atheism, but the long roll of men who desire for any reason to get rid of God are thus provided with a golden bridge for their retreat, and the more easily substitute some blind force, some law of atomic repulsion and attraction, some dizzy molecular round dance, for the God of heaven and earth—because, as described to them by christendom, he is unacceptable to them or odious to them.

Suppose, on the contrary, that instead of the above hideous misconception of God, christendom had truly represented him to the world as he is described in Scripture—as an infinite, all-wise, and omnipotent Being, who created and upholds all things for his glory; as one who is just and loving, and whose tender mercies are over all his works—and though he is described in the letter of Scripture as a God of wrath, indignation and vengeance against all workers of iniquity, yet that these terms are not to be held to represent emotions similar to those of men, for that they are consistent in the divine mind with *the most tender contemporaneous love and mercy* to the worst offenders. That his wisdom and beneficence are shown in the creation of immortal beings, made "in his image, after his likeness," who are placed here for a brief period of seventy years to learn, through experience of sorrow, temptation, and sin, the true secret of life and the path toward holiness, and thus to be educated for a higher state. That after this brief life is ended they will be judged according to the deeds done in the body; and that those who have done righteously, or accepted the redemption provided for them through his Son Jesus Christ, will receive a glad welcome home to their

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eternal state in God's gracious and loving presence; while those who have lived unrighteously and rejected this redemption will reap the due reward of their offenses, suffering the inevitable pangs which even in our experience in this life result, in the nature of things, from violated law. That these pangs, however, are designed by eternal justice and love to be, *not vindictive, but reformatory,* and that thus "in the fullness of the times," in some blessed "golden age," *all* will, through reformatory sufferings, be restored to the favor of God in Christ—having, like him, been made "perfect through sufferings" (Heb. ii. 10); and that thus God will "make peace" ultimate and eternal throughout his entire universe, and restore all things to himself, by this overthrow of all evil. And that then, though not till then, the kingdom shall be delivered up to God by Christ, and so God shall be "all in all." That thus evil shall triumph in *no* case over God, but he shall triumph in *every* case over evil.

Suppose christendom should stop teaching mediævalism with its Moloch, and teach as the Scriptures teach of our God and Father in heaven. His gracious, loving portrait would leave no room for false gods, or false first causes, in atoms, molecules, or forces.

It thus appears that christendom is itself responsible for much of modern materialistic, or logical, or other atheism. Let christendom beware lest itself be justly chargeable, if not with atheism, with misunderstanding and misrepresenting the God and Father of the universe.

DESCRIPTION OF NEW ELECTRICAL APPARATUSES.[1]

BY HENRY A. MOTT, PH. D., F. C. S.

The apparatuses to be described have been invented by Prof. J. D. Culp, and possess sufficient originality, we think, to interest the readers of THE MICROCOSM. We will therefore proceed directly to the description of the same.

One of the inventions of Prof. Culp consists of a new device for accumulating and discharging electricity and in exhibiting new electrical phenomena, and especially in producing electric discharges which are visible to the naked eye, and by means of which new device, or apparatus, discharges can be made to pass in plain view into and through that class of substances called dielectrics, such as glass, shellac and vulcanized rubber.

The principal part of the apparatus just referred to is called an "accumulator," which is constructed in two principal parts.

The inner part consists of a hard rubber case, containing a compact bundle of rolled sheets of hard rubber which have been covered on one side with sheets of tin-foil somewhat smaller than the rubber sheets. The rubber sheets are about fifteen inches wide by 120 inches long, and are rolled together so as to form a coil in such a way that the two layers of tin-foil are separated. This bundle, or coil, is then inclosed in the hard rubber case, the lower end of the case being secured in an insulated platform of wood.

The outer case, which is larger than the inner one by about two inches in diameter, has a *single* layer of insulated wire wound around the inside thickness of hard rubber of which it is composed. This wire coil begins at about one-quarter of the height of the case and is wound about one-half the length of the same, ending at about three-quarters of the height. The ends of this wire extend to two binding-posts, one on top of the case and the other on the outside platform on which the case rests.

A wire of or between No. 32 and 36 is generally used. If a sheet of tin-foil is used instead of the wire coil, an intense heat will be developed at the terminal points, and the conducting wires will not be luminous. If larger wires be used than the numbers mentioned, a short, thick spark will pass a short distance between the terminal points and the conducting wire will not be luminous. The platform on which the outer case rests has an aperture in the center large enough

[1] Through the courtesy of the New York Electric Novelty Co. we have been supplied with cuts which enable us to illustrate the electrical apparatuses they are prepared to offer to the public.

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to permit the inner case to pass through. On the platform there are several binding-posts. From one of these posts a wire runs down across the bottom so as to come in contact with the inside end of the sheet of tin-foil of the inner cylinder, and then returns upon the opposite side to another binding-post, where it terminates in an adjustable air-spark terminal.

Another wire, starting from another binding-post, also descends across the bottom, and is made on its way to the opposite side of, coming in contact with the sheets of tin-foil referred to nearest the outside of the coil, whence it passes up to its binding-post, where it terminates in another adjustable terminal. The discharge of the two sheets of tin-foil is only through the air-spark terminals, as the sheets of tin-foil do not touch one another in the coil, nor do the two wires just alluded to come in contact with the same sheets of tin-foil.

Fig. I.

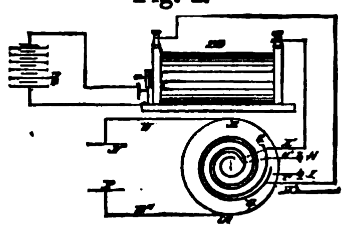


Fig. II.

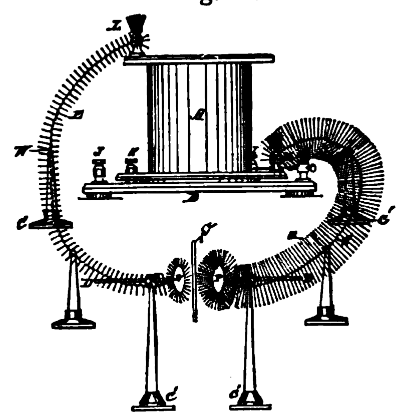
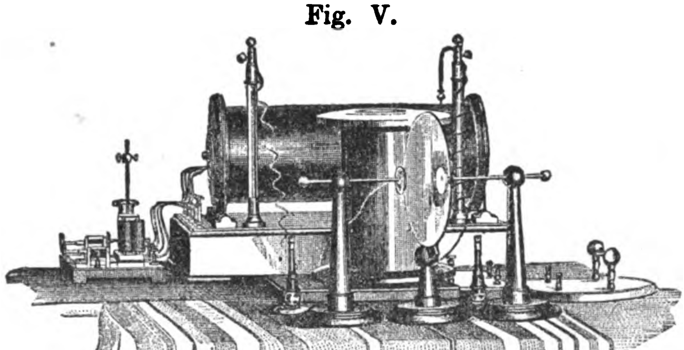


Fig. I. shows a ground plan of the accumulator in the field for action, and Fig. II. shows some of the attendant phenomena.

In Fig. I.—I C represents an ordinary induction-coil with circuit-breaker *a*, and the primary wire of which coil is charged by a battery *b*. The wire-terminals of the secondary coil pass to the two sheets of spirally-wound tin-foil G G, and thence to the air-spark terminals H and I, while the coil of wire surrounding the tin-foil condenser is shown at E, from which the wires W W' are let off and terminate in disks N P.

If the adjustable air-spark terminals at H and I are placed in contact with each other, a continuous closed circuit from the induction-coil would be formed by means of the wires K' H' and J' I' and no effect would be produced by the accumulator. By adusting the air-spark terminals with their points some distance apart, the electrical current is interrupted and the electricity will begin to accumulate upon the sheets of tin-foil in the case C.

Fig. V.



This accumulation of electricity upon the sheet of tin-foil will continue to increase until it is discharged by a spark passing between the air-spark terminals

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H I. This process will be continued and the amount of induction upon coil E will depend on the capacity of the induction-coil, the manner in which the condenser is constructed, and the distance apart of the points of the air-spark terminals H and I.

The phenomena are also varied by varying the construction of the shell A.

Fig. III.

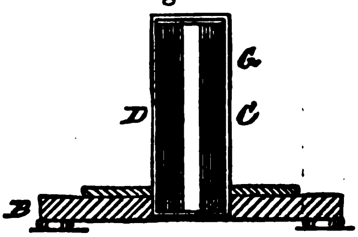

Fig. IV.

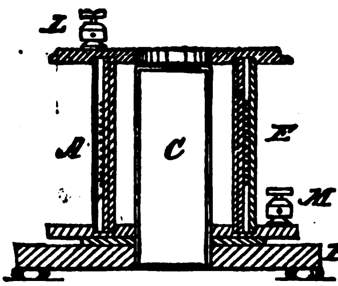

Fig. III. shows a sectional view of the condenser or inner coil.

Fig. IV. shows a sectional view of the inner and outer compartments of the accumulator.

Fig II. is designed to show how the electric force is radiated from the wires and terminals, which is accomplished by the introduction of a dielectric between the two terminals or brass disks. The amount of current and resistance in the circuit make them visible, and it is a fact that the lines from the positive wire are seen to be about twenty-five per cent. longer than the lines from the wire of − potential.

The following is a fuller description of the arrangement of the wires and disk:

One end of a wire W is attached to the binding-post L, and the other end is extended to the terminal disk N. One end of another wire W' is attached to the binding-post M, and the other end to the terminal disk P. These wires W W', and the terminal disks N and P are supported on the insulating posts C', or by any other properly insulated support. By placing the disks N and P a short distance apart, and properly adjusting the air-spark terminals H and I, and allowing the induction coil to work in connection with the "accumulator," *the electrical discharges become visible along the wires and at the disks*, as at E. The luminous lines appear to be separated from each other; this apparent separation, as also their apparent diameters and lengths, can be varied by varying the distance and consequent rapidity of discharge between the air-spark terminals H and I.

If a glass plate, p^2, or other dielectric, be stood vertically between the disks N and P, with its faces parallel with the faces of the disks, the luminous lines from the disks N and P will be plainly seen to pass into and through the glass.

The closer together the disks N and P are the less luminous will be the lines along the wires W. The radiating lines along the wire W', which connects with the terminal disk P, are intended to represent the longer luminous lines which project out around the wire when the disks N and P are set further apart, while the corresponding radial lines around the wire W, that connects with the disk N, are intended to represent the shorter luminous lines that appear to bristle around the wires when the disks N and P are set closer together. Wherever the terminals are placed, however, when the luminous lines are produced along the wires W W', such luminous lines will be much longer along one of the wires, W', than they will be along the other wire W.

In conducting the above experiment, as also the other experiments as yet to be described, it has been found desirable to use a primary current from ten Bunsen cells.

Electricity from an induction coil is said to be composed of pulses alternating in opposite directions, and a current is supposed to pulsate along the wire of the induction coil in one direction when the circuit is closed, and in the opposite way when the circuit is broken.

Electricians have thought if these alternating pulses could be separated, all of the positive pulses sent by themselves in one direction, and the negative pulses

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sent by themselves, that the effects of a current from an induction coil would be greatly intensified, and perhaps new phenomena produced. Just this result Prof. Culp claims to have accomplished. We will discuss this point at some future time.

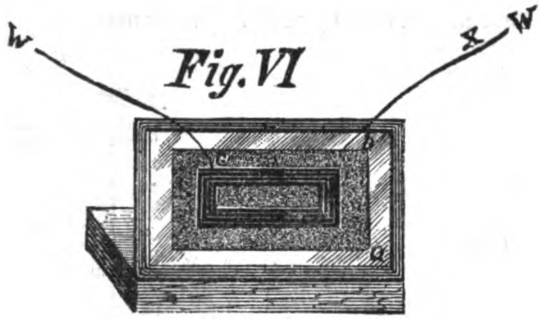

Fig. VI. is an apparatus designed to show the supposed electrical whirl of electricity. It consists of a plate of glass, *a*, set in a frame of wood. On the back of the glass is attached a sheet of tin-foil, *b*, and on the front of the glass a rectangle is made of strips of tin-foil, *c*. The apparatus is then placed in the circuit and the + potential wire W' is connected with the tin-foil on the back of the glass and the — potential wire W is placed in connection with the tin strips on the front of the glass. At once will the electric lines of force which project themselves at right angles from the strips seem to revolve around and round the same, illustrating the whirl of electricity which some scientists seem to think takes place. As the corners of the rectangle are dark, it is claimed a proof is offered to sustain this view. While this is not conclusive to my mind, the experiment is a very interesting one and worthy of careful study and consideration.

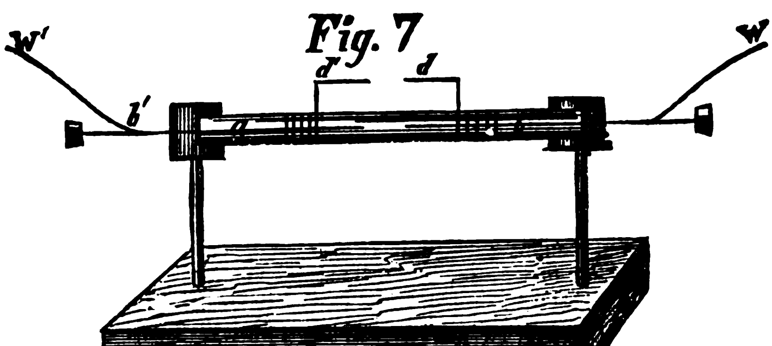

Fig. VII. is a form of apparatus designed to show the passage of electricity through glass and the formation of sparks, and it is only necessary to introduce it in the circuit shown in Fig. XI., first removing the two disks marked N and P, as also the dielectric p^2, by attaching the wire *W'* to the wire *b*, and the wire *W* to the wire *b'*, it will be ready for action.

The apparatus consists of an insulated glass tube, *a*, through which from both ends run two copper wires, b and b', which can be adjusted at any desired distance apart. Outside of the tube two copper wires are wound around, as shown at d and d', which can also be adjusted so that the two ends above the glass can be pushed nearer or farther apart. From this explanation it is plain that the outside wire has no connection with the inside wire. When the current passes the electricity may be made to jump from the ends of the wire, b to b', and the spark is several inches in length; by adjusting the outside wires, d and d', the same thing takes place. It is possible to adjust the inside and outside wires so there will be a spark both inside and outside, or either one can be shown separately. By this experiment it is clearly shown that the electricity must pass directly through the glass from the inside wires to the outside.

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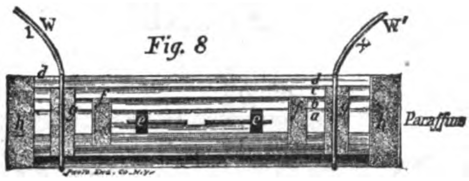

Fig. 8

Another apparatus is shown in Fig. VIII., wherein there are five jumps or sparks, as well as a passage of electricity, through four thicknesses of glass.

This apparatus consists of four glass tubes, *a, b, c, d,* one within the other, but not touching, the outer tube being about ½ inch in diameter. In the inner tube, *a,* will be seen two short copper wires of about one inch in length, separated from each other by about ¼ of an inch, and held in position by two pieces of gutta-percha, *e, e'*. The next tube in order, *b,* has a strip of gold-foil wound around it in two places, *f, f'*, about two inches in length; and around the next tube, *c,* are also two strips of gold, attached as shown at g and g', of the same length, the three tubes being inside of the tube d.

By winding the + wire W', and — wire W, around the glass tube, the same is then in the circuit, and the electricity is seen to pass directly through the glass and make altogether five distinct jumps. From d to g', from g' to f', from f' to e', and from e' to e, then from e to f, to g, to d. The sparks show up to great effect in a darkened room.

Fig. 9

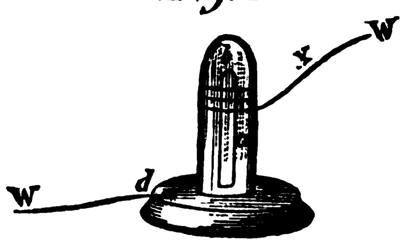

Fig. IX. is another apparatus directed to show the passage of electricity through glass.

This apparatus consists of a cylindrical piece of wood, *a,* covered with tin-foil outside, and over which is placed a closed glass cylinder, *b,* somewhat larger in diameter. The whole resting on a platform, *c.* When this apparatus is placed in the circuit, the + wire W' is wound around the glass as shown, and the — wire W is connected at the bottom through the platform with the tin-foil cylinder. The electricity immediately passes through the glass to the tin-foil and shows a continued series of sparks, which can be lengthened or shortened by simply moving the glass cylinder up and down. The effect is very striking, and the experiment one of interest to show to students.

If this apparatus be taken out of the field and a person should take hold of the wire W or W', the electricity will pass all through him, and lines of electricity, though invisible, pass out from him in all directions, which can be demonstrated by bringing a Geisler tube within three or four feet of the electrified person, when the tube will glow with electricity. This makes a very beautiful experiment.

Another interesting experiment can be conducted by bringing a wire, bent in a circle and having its ends fitting into a poor conductor or insulator, in the vicinity of the condenser (or more properly diffuser), shown in figure III., when the same is placed in the circuit.

If held over this apparatus electricity is at once taken up by the wire, and by crossing the same back and forth sparks will at once be formed. If the loop of wire surrounds the apparatus at the center of the same, yet not touching it, the sparks formed will be produced in great quantity.

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Fig. XIII

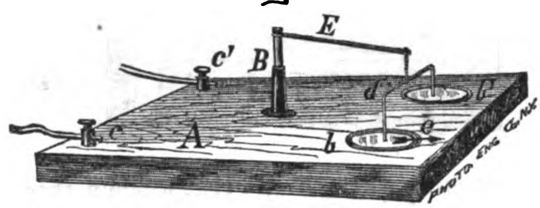

Fig. XIII. is another apparatus designed to show the so-called "whirl" of electricity; in other words, to show that + electricity appears to revolve from left to right, and – electricity from right to left.

A is a wooden platform in which are set two hard rubber cups, *b* and *b'*, which have a brass pin in the bottom, around which wires are bound, which terminate in the binding-posts c and c'. The cups are filled with mercury, and the top of the cup projects over somewhat, so as to present a perfectly flat surface of the metal.

B is a post, having an extended arm, E, at the end of which is suspended by a silk thread a wire, *d*, bent so that one end will dip in the mercury of cup b, and the other in the mercury of cup b'.

The – potential wire from a battery is connected with the binding-post c, and the + potential wire with the binding-post c'.

The apparatus is then ready for experimenting with.

If the north pole of a magnet be presented to the right of the wire which dips in *b*—the wire will immediately be repelled, *i. e.*, move in the opposite direction of the arrow, *e*, and if the same north pole of the magnet be presented on the opposite (or left) side of the same wire in the same – potential cup, it will be repelled or pushed in the direction of the same arrow, *e*.

If the edge of the north pole of the magnet be presented to the same wire on a line with the other wire which dips in cup b'—the motion of the wires in the cups will be up and down, and continue so as long as the magnet is held in that position.

This experiment is apparently contrary to conceived ideas on electricity and is well worthy careful study and investigation.

Fig. X.

THE ELECTRIC ROCKER ATTACHMENT.

Prof. Culp deserves great credit for this ingenious device, which takes advantage of the to-and-fro motion of the chair when rocked, by converting some of the force expended in rocking directly into electricity. There can be but little doubt that the electricity generated by this chair attachment will be the means of relieving, if not curing, many disorders, and possibly deformities of the system in a countless number of persons soon after this invention is properly presented to the medical profession.

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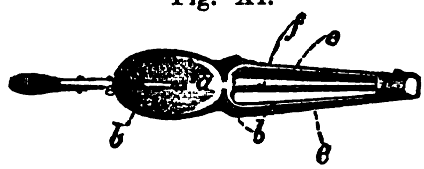
The fig. X. shows the attachment, which consists of a metal plate, *a*, which has attached to its under surface a sheet of tin-foil—and a plate of the same size of hardened polished rubber, *b*. These two plates are hinged together at *c*. The plate *a* has a spring attachment to the chair, which permits it to rise and fall as the chair is rocked. When the two plates come in contact and separated electricity is generated, which can be conducted along wires held in the hands, one wire should be connected with the rubber plate and the other with the tin-foil plate; at the ends of the wire the ordinary attachments can be connected, which contain a moistened sponge. By applying the sponges at different parts of the body a current of electricity may be made to flow, and thus produce the desired effect.

Fig. XI.



THE ELECTRIC GAS-LIGHTER.

Fig. XI. shows an electric gas-lighter.

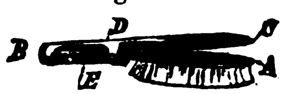
It consists of a metal framework, *a*, *c*. *A* is a metallic disk, on the under side of which is attached a sheet of tin-foil. This disk rests against a flat rubber frame, *b*, on the other side of which is a metallic disk, which connects with the metal rods $e\ e^1$; from the rubber frame runs a rod of rubber, *f*, between the two metallic rods.

In one of the metallic rods, *e*, at the top is placed a small brass screw which is adjusted so as to project toward the rubber rod, *f*, and come within about $\frac{1}{8}$ of an inch of a metallic point placed opposite in the hard rubber rod.

By raising the brass disks, *a* (on the inside of which, as stated, was tin-foil) from the hard rubber disk, electricity is immediately generated, and a spark is at once formed between the end of the brass screw in the rod *e* and the metallic point in the hard rubber rod *f*. Just as often as the metallic disk is brought in contact with the rubber disk and separated, just so often will a spark be generated, and each spark is capable of lighting the gas.

The great advantage of this extremely simple form of apparatus arises from the fact that a spark will always be generated in wet or dry weather.

Fig. XII.



THE ELECTRIC HAIR AND FLESH BRUSH.

One form of the Electric Hair and Flesh Brush is shown in Fig. XII., which will serve to illustrate the various forms which are made, as the same principle is adopted in all cases.

Referring to this figure it will be seen that the brush consists of four parts, three of which are made of hardened rubber. The lower portion containing the bristles A B, has imbedded in the handle a metallic strip which works in a swivel at B. The upper portion, C B, is a plain piece of hard rubber, having on its under surface an oval piece of tin-foil attached, so as to cover the top surface of the under portion of the brush, limited, however, to the portion containing the bristles.

The handle of the brush, E, in which the lower portion, A B, is attached as described, has a rubber pin which works up and down in an inclined groove, and thus adjusts the height at which the top of the brush, C B, can be separated from the lower portion, A B, these two portions being held together in the handle by a metallic band shown in the figure, which band is pointed on its upper surface, the point being directed to several little strips of tin-foil which are separated from one another and attached to the upper surface of the portion C B. There is also inserted close to the strip of tin-foil in the upper portion a round brass pin, which

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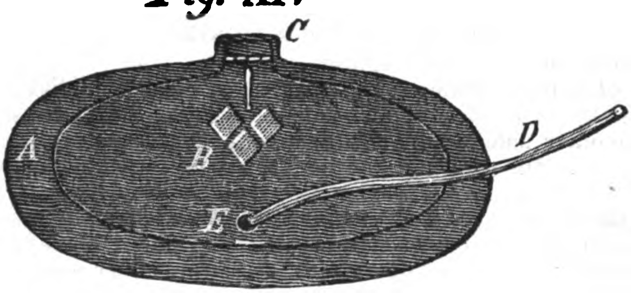
does not project above the surface. When all the parts are properly put together, any motion of the brush brings together the top portion, on the under surface of which is tin-foil, against the hard rubber face of the lower portion, and then separates them, in consequence of which electricity is produced—and if the brush be used to brush the head or body the electricity passes at once to the part brushed. From the point alluded to in the metallic band to the strips of tin-foil and to the brass pin there will be a continuous series of sparks, showing plainly that electricity of high tension is generated. If the bristles be tested by means of pith balls they will be seen at once to be charged with electricity. As artificial irritation of the skin is recommended to promote health and incite the growth of hair, and as electricity does produce such irritation, this simple mechanical brush will certainly meet with great favor.

As the amount of electricity generated will depend on the distance that the top and lower portions are separated, the pin referred to in the handle adjusts such distance, so as to regulate the production of electricity for persons of different sensibilities.

Fig. XIV



OZONE APPARATUS.

Fig. XIV. shows the ozone apparatus. It consists of two disks of hard rubber, A and B. On the under surface of B is attached a sheet of tin-foil of the same shape as B, but slightly smaller. The disk B is connected to A at C by a brass hinge. At E in disk B is a pin, to which can be attached a rubber cord, D, so that by taking hold of this cord the disk B may be raised and lowered at will. Electricity is generated by simply separating and bringing together the two disks, and is in turn discharged, converting the oxygen of the air in the immediate vicinity into active oxygen or ozone.

By arranging a series of these disks and operating them by mechanical means, such as a sewing machine or some other convenient device, a room can in a very short time be impregnated with ozone.

The device is simple and produces ozone in large quantities, especially when a series of plates are used. The importance of ozone is due to its intense activity rather than to its amount, as the air never contains, according to Honzeau, more than $\frac{1}{700000}$ of its bulk.

Ozone is active oxygen, three volumes of oxygen being condensed into two volumes, thus forming an allotropic condition of oxygen. Its chief source in nature is by the action of atmospheric electricity, and, as minor sources, the action of aromatic plants and flowers, etc.

Ozone is a very powerful oxidizing agent. It can corrode coke, paper, animal membranes, and other organic substances, and therefore destroy the lower forms of life floating in the air, or puts the air in an unfavorable condition for their existence and development, so that they leave for more favorable conditions. H. Carey Lee is clearly of the opinion that ozone is a germ-destroyer, as simple vegetable substances, such as mold, are completely destroyed when exposed to an atmosphere containing ozone.

Wolffhugel states that ozone is seldom found in inhabited rooms. The reason for this is undoubtedly due to the continued utilization of the ozone as rapidly as it is made in oxidizing or destroying the effete matter exhaled from the lungs and which impregnates the air. Air containing $\frac{1}{8000}$ of ozone, according to Barker, will purify five hundred and forty volumes of air.

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While oxygen, according to Redfern, containing $\frac{1}{210}$ of its volume of ozone is rapidly fatal to all animals, death occurring very rapidly.

This goes to show how powerful ozone is even in small quantities.

In cholera epidemics, when ozone is present in the air, according to Dr. Wm. A. Hammond and many other distinguished scientists in this country and in Europe, the cholera disappears; but in the absence of ozone or the complete utilization of ozone present in the air, the epidemic rages with great activity. There can be no doubt, from what has been said, that the continued presence of ozone in the air, though in but extremely minute quantities, is evidence of the purity of the air; for if the air contained impurities the ozone would rapidly disappear, as it would have work to do.

It is therefore desirable to assist nature as much as possible in the production of ozone, and as the Ozone Apparatus here offered to the public is calculated to produce ozone when operated, in sufficient quantities to impregnate the air of a room or the air in the vicinity of its production, there is no reason why we should be compelled in the future to breathe impure air having intermingled with it germs of disease. As the odor of ozone is pronounced and smells like chlorine there is no difficulty in detecting its presence.

THE PHILOSOPHY OF THE STOICS.

BY J. W. LOWBER, M. A., PH. D.

The word stoic* is from the Greek *stou*, which means a porch. It has reference to the place where Zeno, the founder of the school, gave instruction. This eminent philosopher was born at Citium, in the island of Cyprus, about 358 B. C., and died in Athens about 260. According to Diogenes Laertius, his father was a merchant, and he followed the same occupation until he lost a rich cargo. After that he devoted himself to the study of philosophy. About 310 B. C. he opened his school of philosophy, and attracted the attention of some of the greatest men of his day. The King of Macedon attended his lectures, and Ptolemy Philadelphus, of Egypt, had the exact words taken down. He was at the head of the Stoic school for half a century, and was much respected for the boldness of his language and austerity of his life. Zeno attained to the advanced age of ninety-eight, and at his death was honored by the Athenians with a golden chaplet and a public tomb in the Ceramicus.

The Stoics were among the greatest philosophers at Athens in the days of Paul. In fact, they wielded much more influence than did the Epicureans. At the conclusion of Paul's celebrated discourse on Mars' Hill, the Epicureans mocked and the Stoics went away indifferently, saying: "We will hear you again concerning this matter." They were too polite and too moral to mock, as did the Epicureans.

One of the greatest faults in the Stoical philosophy is its influence in reference to indifference. The Stoic was equally indifferent in reference to both the pleasures and sorrows of life. His doctrine was directly antagonistic to the teaching of the Gospel on those subjects, and also the teaching of true science. Science, as well as the Bible, teaches us to rejoice with those that rejoice, and weep with those that weep. The spirit of true science is in harmony with the Bible, in its condemnation of indifference. How can a man who thinks be indifferent to the great problems of life?

Although some take a different position, I am fully satisfied that the Stoics were Pantheists in philosophy. While some of them, doubtless, believed in a personal existence in the future, a large majority believed in the final absorption of the individual into the great soul of the universe. Dr. Draper, of New York, who was a Pantheist, told me that he believed in the conscious existence of the individual in a future state. The greatest philosophers of the past have favored the position of a futuer existence for man. It remained, however, for the Gospel to fully demonstrate the fact that there is a life and immortality beyond the grave. While philosophers endeavored to make provisions for the spirit, they could not tell what

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became of the body. Paul, by the spirit of God, clearly teaches that the body and soul, as well as the spirit, are to be preserved blameless, until the coming of Christ.

As the moral influence of the Stoics is not generally understood, I want to call attention to it, so that, with all their faults, we may be able to do them justice. During the first Christian century the Roman Empire was cursed by tyranny and corruption. Then reigned Tiberius, Caligula, Nero, and Domitian. At the death of the last-named emperor, A. D. 96, Gibbon says, began the history of the world, during which the human race was most happy. The statement is too broad, yet it contains much truth. Eighty-four years, until A. D. 180, reigned Nerva, Trajan, Hadrian, and the two Antonines, all of whom, according to Gibbon, delighted in liberty. Archbishop Trench, in his lectures on Plutarch, speaks in high terms of their period. This period may be called the reign of the Stoics. The five emperors mentioned were all students of Stoicism. This philosophy was doubtless the cause of the moral character of their reigns. No one who properly studies Stoicism can question its moral influence upon its advocates.

With Marcus Aurelius Antoninus closed the reign of the Stoics. He is pronounced by historians as one of the greatest and most pious of the Roman emperors. Matthew Arnold pronounces him the most beautiful figure in history. Merrivale says that he was the noblest soul that ever lived. During the reign of the Stoics the position of woman was elevated. They taught no esoteric views; for women, and even slaves, were admitted to the lectures. The death of Marcus Aurelius consummated the glory of Stoicism. It had something of the same effect that the death of Cromwell had upon Puritanism. The emperor did not fear death, for he said: "Come quickly, O death! lest I, too, forget myself." He said to his friends: "Why do you weep for me, and not think rather of the pestilence and common death?"

Seneca, the Roman moralist, was a Stoic. He was born at Cordova, Spain, a few years before the Christian era, and died in Rome, A. D. 65. He studied rhetoric and philosophy in Rome, then traveled in Egypt and Greece. He was afterward the tutor of Nero, but did not succeed in impressing his philosophical maxims upon the mind of his pupil. He was finally executed by the order of the infamous Nero. Seneca has been called an Atheist, but his writings clearly teach that he was a Deist. Tradition states that he was favorable to Christianity; that he was acquainted with the Apostle Paul, and wrote several letters to the apostle.

Cicero, the celebrated orator, was a Stoic. In his "Tusculan Disputations," and other works, he has presented to the world some beautiful thoughts on philosophical subjects. He maintained that the Stoics were largely the followers of Aristotle, and opposed to Plato and the doctrine of innate ideas. That he was correct in this is shown from the fact that Plutarch always treated the Stoics as the opponents of his master, Plato.

There are scientific discoveries which many attribute to a late date that were known to the Stoics. They believed in the rotundity of the earth, and in the force of gravitation. An early Stoic says: "It is probable that all bodies have their first motion, according to nature, toward the center of the world." Marcus Aurelius uses language very similar. Plutarch ridiculed the Stoics for their belief in gravitation and the spherical form of the earth, and accused them of a position which taught that men stuck to the earth like wood-worms or lizards, with their heads downward. We may safely say that gravitation was known long before the days of the celebrated Newton.

CHANCE AND LAW.

BY PRESIDENT I. L. KEPHART, D. D.

Chance, as defined by authorities, signifies that by which events happen, transpire, or take place fortuitously, accidentally—without being contrived, intended, designed, or expected. It is the opposite of rule, or law. Law, according to Blackstone, "in its most general and comprehensive sense, signifies a rule of

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action; and is applied to all kinds of action, whether animate or inanimate, rational or irrational. When the Supreme Being formed the universe, he impressed certain *principles* upon matter, from which it can never depart, and without which it would cease to exist. When he put matter in motion he established *certain laws of motion*, to which all movable bodies must conform. This, then, is the general signification of law, a rule of action dictated by another."

"Laws," says Montesquieu, "in their most general signification, are the necessary relations derived from the nature of things. In this sense, all beings have their laws; the Deity has his laws; the material world its laws; the intelligences superior to man have their laws; the beasts, their laws; man, his laws. God is related to the universe as Creater and Preserver; the laws by which he created all things are those by which he preserves them. He acts according to these rules because he knows them; he knows them because he has made them; and he made them because they are related to his wisdom and power."

Law is not a being of itself. It, of itself, has no power. We may personify it, and speak of it as a self-acting agency, but this is an error. Law does nothing. It is only a rule of action. In scientific strictness, God's laws are simply the manner in which God acts—in which he creates, upholds, commands, warns, rewards or punishes.

In this sense the whole universe is permeated with his infinitely wise, righteous, benevolent laws. The paramount relation which he sustains to all created things is that of law-giver. He has made laws for whatever he has created, from the most vast constellation to the tiniest atom—from the brightest archangel to the smallest microscopic insect—all are thoroughly permeated, bound in and bound down by the laws which God has stamped upon their being. There are laws of health and laws of disease, laws of obedience and laws of transgression, laws of growth and laws of decay. These are often called laws of nature; but, as law of itself never does nor can do anything, so the laws of nature, of themselves, do nothing, but are only the rules by which the Infinite God created and preserves and upholds the universe.

These laws are unchangeable. "I am the Lord; I change not." In his infinite wisdom he decided, in the beginning, upon the best methods of creating and upholding all things. These he adopted, and in accordance with these he continues to act, *because they are the best.* Take as an illustration the law of gravity. It is only the method by which the Creator holds the heavenly bodies in their orbits and regulates their motions; and it is the same to-day that it was when first "the morning stars sang together." All through the past ages God has been exerting this part of his power in this particular way; and because he, in this particular, changes not, if the best saint in the world, being on a high scaffold, loses his balance or misses his footing, he is dashed to the ground with the same violence that the greatest sinner would be. Not that God is angry, or disposed to be cruel, but because his method of upholding the movements of the heavenly bodies and preserving order in the material universe is founded in infinite wisdom. He knows it is best not to suspend that method to prevent harm coming to the man who loses his balance on the scaffold.

Shall we say, then, that chance threw that man to the ground and dashed out his brains? Not at all. Law did it; or, rather, he and God did it. While he preserved his equilibrium he was under God's law of supported base; but when he lost or failed to preserve his equilibrium he came under God's law of *un*supported base—a law or method of God's acting that is infinitely wise, and in complete harmony with the best interests of the entire universe, man included—and he was dashed to the ground.

While we observe the laws of health the organs of the body perform their respective functions perfectly, the body is subject to and in harmony with the laws of health, and the result is exemption from disease and pain. But when the laws of health are transgressed the body of the transgressor passes out from under the dominion of the laws of health—departs from that domain in which God executes the laws of health, and goes over into the domain of the laws of disease—places himself where the laws of disease are being executed, and suffers the extreme penalty of his transgression. Nor is the consequent pain and suffering an accident, or the result of chance. It is only the natural and rightful result of the steps taken;

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and so long as the Infinite God continues to execute his infinitely wise laws, such steps must result in the same way.

The same invariable exactness obtains in the moral world. It is not possible for the thief, the libertine, the murderer to carry in his heart the joys and innocency of the one who is careful to cheerfully observe the divine requirements of honesty and righteousness. This is so because God's moral laws carry with them a divine sanction—that is, the culprit, having transgressed the moral law, God does not have to resort to the expedient of employing detectives to ferret out the crime, and then send officers to arrest him, bring him to trial, pass sentence on him, and turn him over to an executive to inflict the penalty of the law; but he is his own detective, executive, and executioner, and no sooner is his moral law transgressed than he, acting through conscience, speaks to the culprit, tells him he is guilty, and depicts the evidence of his guilt in the culprit's countenance. Just as when arsenic is swallowed into the stomach, the punishment which God has attached to such transgression of physiological law soon follows, without his having to send an officer to arrest the transgressor, so does the punishment, in the form of an accusing conscience, speedily follow the willful transgression of moral law.

Just as, in scientific strictness, God's laws are only the manner in which God acts, so, in scientific strictness, there is no such thing as *chance*. This is a necessary deduction from the indisputable postulate that God governs and controls all things by fixed laws. True, many things transpire, the causes of which are far removed beyond the reach of man's discerning and comprehending powers; but this is no evidence that they are the result of chance. When the sea-captain says he is beyond soundings, he does not mean that he has reached a point where the ocean has no bottom, but only that he has gotten to where his plummet will not fathom the depth. So when we speak of an event happening by chance, the most that we can mean is that the causes which, acting in accordance with fixed laws, brought the event about, are beyond the reach of our faculties. The statistician may not be able to tell correctly the number of males and females, respectively, in any particular family you may name; but he *can* tell you with a great degree of accuracy that, in any given kingdom or country, the number of males and females are nearly equal, the females being a little in excess of the males. So, he may not be able to foretell correctly the number of murders that will be committed in any one particular county during the coming year; but he *can* tell you with a great degree of correctness the number that will be committed in the whole United States. Now, this only indicates that even those things which seem to us to be, in the greatest degree, the result of chance, are nevertheless the result of law, or determined by some invariable rule which to us, for the present at least, is not understood.

But, in connection with this train of thought, the question arises, if all things are under the direction of fixed and irresistible laws, where is there any sphere for moral agency? If man is everywhere bound in and bound down by the laws which his Creator has stamped upon his being, how can he be in any way responsible for his behavior? The answer is, that man is given a limited freedom—the freedom by which he is permitted to choose the kind of causes that he will set in motion. But so soon as he has chosen and set in motion a particular cause, it immediately passes beyond his jurisdiction and comes under the jurisdiction of the Almighty's immutable laws of cause and effect; and he is so faithful and so reliable that the appropriate effect must and will follow. In many instances the effect follows so closely upon the cause that no time is allowed for setting in motion a new and different cause to annihilate the first one and prevent its effect from following, as when a man aims a revolver at the brain of his fellow and pulls the trigger. In other cases the effect follows more remotely, as when a man resolves to commit murder by poisoning, but before the poison is eaten the murderer repents and removes it. In this case the premeditated murder is not consummated; not because God's laws of cause and effect were suspended, but because a new cause was set in motion by the voluntary agent, which annihilated the first.

Viewed in this light, how glorious, and yet how terrible, the responsibilities that rest upon man as a moral agent! Upon the choice he makes as to the causes he will set in motion depends his eternal destiny. The Infinite God rules over a

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substantial universe by the operation of substantial laws. His plan and modes of operation include a place for free moral agency. Nothing is left to chance or accident. Infinitely wise and never-failing laws pervade his entire universe. By these he governs and controls all things. Man is free to choose as to the causes he will set in motion. In the moral domain there are two kinds of these—the one, if set in motion, is taken up by God's invariable and substantial laws and work for him an eternity of bliss; the other, if set in motion, is taken up by the same substantial laws and work for him an endless heritage of woe. "Be not deceived. God is not mocked; for whatsoever a man soweth, that shall he also reap."

THE REQUIREMENTS OF THE SICK-ROOM.

BY J. VARNUM MOTT, M. D., BOSTON, MASS.

In presenting so graphic a subject to the readers of THE MICROCOSM, it will be necessary to separate the three principal factors, and consider them in detail.

We recognize three elements, namely: hygiene, nursing, and food.

During the past few years a great deal of attention has been paid to hygiene, and its great value is becoming known throughout the world. To sanitary engineers great credit is due for the marked advances in their department, and by this progress they have become very valuable adjuncts to the medical fraternity. Sanitariums are advertised very extensively, and some of them are models, whilst others lack the essential safeguards, and are totally unworthy of support.

In large cities the plumbing is generally surveyed by competent men, whilst in the country every man, in a measure, is his own sanitary engineer. Hence it is that a law must soon be passed that will compel all owners of buildings to avail themselves of the best precautions, and thus tend to prevent sewer and other deleterious gases from permeating the dwelling. Supposing a house to be well guarded against these gases, the room selected for an invalid should be in the upper story. Experience has proved very conclusively that a patient thus placed is at once in the most favorable surroundings. The three important points are: complete ventilation, sunshine, and a moderate supply of heat. Every sick-room should be thoroughly ventilated once during the twenty-four hours, and a steady current of air should be so introduced as to be effectual in removing all odors consequent on illness, and at the same time the patient should be protected from the slightest draught. Now, how is this to be accomplished in an ordinary room without the outlay of considerable expense? If the room has a fireplace, or chimney leading to the roof, a current of air is readily established by opening the upper sash of the window furthest from said fireplace. The temperature of the atmosphere will of course indicate the degree to which this should be carried. In severe winter weather the window could be opened, but to a very limited extent, whilst in summer the contrary would be the rule. In hot weather the ventilation is very materially assisted by burning candles arranged for the purpose, previously placed in the grate. In winter a wood or coal fire is, according to my views, a very valuable accession to the sick-room, and in connection with the opening of the window as suggested, at once places the room in a sanitary condition. The temperature should be maintained at an even basis, as far as practicable, and should not exceed 68° Fahr., unless other indications demand a higher temperature. In addition to establishing a permanent current, the patient should be protected, and the room thoroughly aired every morning. This can be done in most cases with perfect safety, and is often of much value and benefit. Sudden changes should be zealously guarded against, but a clear atmosphere must be obtained and maintained, otherwise serious results will follow. When advisable, this general airing can be repeated. At night, just prior to seeking repose, this is particularly desirable, and applicable to all chronic cases, and to those who for a long period are confined to their bed. Insomnia in numerous instances is caused by an insufficiency of oxygen, and I can record pleasing results when patients have regularly reduced the temperature of their room previous to retiring. Medication will prove worthless, if the ventilation is not properly enforced.

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SUNSHINE.

To this blessing we are greatly indebted for all that is bright and beautiful, and in contrast how dark and dreary a room seems into which no ray of sunshine ever enters! The sun is capable of giving life, and is a boon to which every invalid clings, deriving comfort, courage, and cheer from its rays, whilst regaining strength. Then, if possible, we would always select a room with "sunny exposure," or at least make arrangements so our patient can enjoy a sun bath at least once a day without unnecessary fatigue. Every physician can testify as to the feelings of their patients, influenced by the sun shining. When such is the case the very atmosphere undergoes a decided change, and it is not surprising that the effect should be beneficial and exceedingly gratifying to our patients. The windows should be protected with blinds or shutters, so as to exclude all light when it is desirable for our patient to sleep. After a sound sleep, or even period of resting, every possible ray of sunshine should be admitted, so that a cheerful aspect may be ever present. We bear in view that there are numerous conditions that would indicate a subdued light, but according to my belief those restrictions apply much more forcibly to artificial light. If our patients are kept wide awake during a reasonable time, the chances of their obtaining a natural sleep are very materially enhanced. As soon as deemed expedient let them be wrapped in a blanket and placed where the sun will shine directly on them, allowing them to remain until somewhat fatigued. During this time willing hands will be preparing their bed, and on their return a decidedly pleasant change will be noted.

ARTIFICIAL HEAT.

It will be found necessary during ten months of the year to supply heat to the sick-room, in order to equalize the temperature. Hot-air furnaces, steam heaters, and open fires are our only resources, and either one has to be depended on entirely. The open fireplace is, as has already been referred to, by far the very best means to rely on when available, for it serves a two-fold purpose (ventilates as well as heats), and is very much more readily regulated and controlled. Next in order would rank a small stove, with plenty of water being freshly supplied to the vessel above it, to insure evaporation. Steam heat answers very well when well supplied, but is open to the great objection that its supply is not under complete control of those in charge of the sick-room, but they are dependent on the boiler in the cellar being kept to a certain standard, and consequently cannot cope so advantageously with the sudden changes peculiar to this climate. A grate or wood fire has another very decided advantage—that of cheerfulness; and as we desire to contribute in every possible way to our patient's comfort, we would very naturally choose this fire in preference to all others. If, perchance, we are obliged to depend on a hot-air furnace, we should supply plenty of moisture to the room. For this purpose the old-fashioned camp-kettle operates effectively, and is very readily manipulated by any one. The escape-tube can be brought close to the bed and the patient inhale it directly, or the steam can be permitted to diffuse itself throughout the room. In pulmonary or throat affections the former method would be advisable, whilst the latter would apply to ordinary illness. The room should be very plainly furnished; all unnecessary articles should be removed, and the bed narrowed so as to permit the attendants to easily move the patient, and to readily change the linen. In contagious diseases, all hangings, carpets, pictures, etc., should be removed, and extra precautions taken to secure a perfect quarantine from the other members of the household. Disinfectants should be very freely used around the room at stated intervals. In addition to having the fluid in receptacles exposed to the atmosphere, it is my custom in all contagious diseases to have sheets over the door, and direct they should be regularly kept moist. All linen, clothes, napkins, etc., should at once be placed in a strong solution, then boiled most thoroughly. All articles, such as handkerchiefs, napkins, and other appendages that come in direct contact with the patient, should be burned. In order to do so, such articles should be old and of little value. All discharges should be received in appropriate vessels, in which some of the disinfectant has previously been placed, and its contents should at once be removed from the room and properly disposed of.

Having briefly considered the best sanitary conditions under which to place

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our patient, we are now prepared to accept certain directions as to the care of the sick.

It is a well authenticated fact that physicians would much oftener be placed *hors de combat* were it not for valuable services so often rendered by competent nurses. I do not refer exclusively to "trained nurses," for we often witness satisfactory and most excellent nursing at the hands of one who is a perfect novice, never having had instruction or experience. I have often been asked: What are the most essential requirements of a nurse? This question is a hard one to answer, because the desired elements are "legion," and as perfection is seldom found in any earthly pursuit, we could hardly insist on making an exception, and refuse employment to all save perfect nurses. Each year, in various cities, the different training schools graduate trained nurses, who, like members of all professions, strive to make their living. You engage one of these aspirants, and in a certain sense you feel secure, being conversant with their previous training, and yet that very one may be wanting in many desirable qualities. It is one thing to care for a hospital patient under strict discipline, and quite another matter when called on to officiate in private cases at their own homes. Hence it is that some of the nurses who excel in the wards of a hospital, prove totally incompetent when introduced to your homes. To be a successful nurse, independent of any training, a woman must be of an equable temperament, possess sound practical common sense, and anxious to serve the best interests of her patient, independent of all other motives. Such a woman would soon be sufficiently competent to intrust important cases to, and would not, in the exercise of her office, attempt to override all with whom she comes in contact, the physician included. It is my custom to instruct my nurse to carry out my injunctions to the very letter. and to rest content, feeling that she was doing her full duty to her patient. Cheerfulness is a very essential factor; and how easily a pleasant, bright, happy face wins our confidence, when the reverse would cause an aversion that even time would often fail in removing. Cleanliness in each detail cannot be too strongly insisted on, and nothing will attract the attention of the physician more speedily to the competency or incompetency of the attendant. I know many nurses have fallen into the way of dressing up their patient in advance of the physician's calling, and thus put the "best foot forward," but very often I have called when not in the least expected, to observe the general appearance of the room; and a few such practical admonitions will often remedy any carelessness or thoughtlessness on the part of the nurse. A nurse must work in entire unison with the physician, never doubting or questioning the expediency of any of his directions, and never permit herself to prescribe on her own responsibility, unless dealing with an emergency that has not been foreseen —and then only if her previous instruction and experience should warrant it—but in the event of any such action the physician should at once be notified. A nurse should possess a strong constitution, one equal to the many trials and weary struggles which she is liable to undergo, and if she can thrive with only a little sleep she will prove particularly desirable to a large class of patients. Whilst these points are essential, still the patient owes a certain amount of consideration to the nurse, and should not be too exacting relative to length of hours of service, or expect a tired and weary woman to cater to his whims and caprices with angelic resignation. So, then, the patient and nurse must work in perfect harmony, and yet, when the question of yielding arises, the nurse's authority must hold full sway, as she represents the medical man. It is customary in very severe cases to have two nurses, one for the day and the other at night; but this can only be necessary when the case is serious, for generally some member of the family is sufficiently competent to relieve the nurse for a stated interval, when she should seek nature's greatest restorer for all physical and mental ills, namely, sleep. A room in a quiet part of the house should be allotted to her use, and a proper sense of peacefulness should pervade the household when she is thus resting. Those who have tested nursing as a profession will tell you the position is no sinecure, and I have often wondered how nurses stand the mental strain under some circumstances, whilst with some patients it would seem a pleasure that they would seldom tire of. We all like to have our efforts appreciated, and a few kind, well-chosen words at an opportune time will tend to cheer a weary nurse, and serve as a stimulus to further devotion. All directions of the physician should be written by the nurse, and a

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tabulated form kept of the day's progress, so that at a glance the physician can become familiar with the record since his last visit, and under no circumstances should any nurse attempt to memorize instructions. A competent nurse will study the idiosyncrasies of her patient, and very shortly will be able to anticipate the many wants. Surprises in the form of delicacies will often tend greatly to brighten and cheer the patient, and are often more acceptable presented in that form, for it evinces an interest and desire to please on the part of the nurse.

FOOD.

We are called on from the very hour of birth to furnish appropriate food for nourishment, and when sickness occurs the two-fold importance of this task is justly appreciated. Whilst, as a rule, each disease requires a special diet, dependent on several physiological indications, it will not be possible for us to consider more than very generally this subject. Milk ranks among the first articles ever known for sustaining life, and is generally liberally supplied by the natural laws; and when a woman fails to be able to supply her offspring with this essential commodity, there is something radically wrong. The beasts of the fields are thus enabled to nurture their young, and the first instinct developed is to seek that nourishment at the maternal fount. Hence milk is known to possess very valuable properties, and yet a milk diet is not to be directed for an adult without very careful consideration, and its use must be very strongly indicated. Many are unable to properly digest milk unless diluted with lime water, and hence it is, although we recognize it as being very valuable, still it is capable of giving rise to certain functional disturbances which it is our duty as medical men to guard against. Beef tea will always very justly have its advocates, and for adults it is to be preferred to milk. Beef extracts, meat juice, etc., are favored by the profession, and are used as experience dictates. The very best preparation that I have extensively used is known as "Valentine's Meat Juice." It possesses the great advantage of always being ready for use; it serves best when taken cold, and I have yet to meet a case where the stomach will refuse to retain it, providing it be administered diluted (one teaspoonful to a wine-glass of cold water), and fed to the patient by a teaspoonful at intervals of every two or three minutes until the above quantity is given, when a small piece of ice may be allowed. There are numerous medicinal foods that are much vaunted, and all have their adherents. The "Imperial Granum," in my hands, has seemed to meet with all that is claimed for it, and experience has brought me to rely on its use where its special properties are indicated. In infantile diseases it has proved very efficacious, and I always direct its use when a child is being weaned. Koumyss has within the past few years been added to our list, and in some cases of gastric disturbances it has proved very valuable. Cocoa has been largely prescribed during the past few months, and whilst it undoubtedly is a valuable tonic, still it should not be expected to take the place of food. Alcohol and various drugs are capable of exerting a stimulating effect, but should be used with great care, for there are many who to-day are addicted to its abuse who first indulged at the order of their physician. So in dealing with alcohol and opium there is a moral aspect that should enter into the consideration, and if possible, I consider it much better policy to disguise its character when obliged by certain symptoms to employ it. Water is not very generally considered as food, but it certainly is under certain circumstances, and often can be retained when meat and everything else is rejected, and it serves the purpose of temporarily quenching the thirst in a case of fever. Eggs raw, or slightly boiled, are valuable adjuncts, and are very largely employed throughout the land, combined with milk. This is very sustaining and highly nutritious, and in most cases should be taken *without* any alcoholic addition. It is the duty of the nurse, as we have already observed, to attend the wants of the patient, but nourishment comes directly under the directions of the physician, and the nurse is looked to for their being properly carried out. We must never permit a patient to take a large quantity of food at any one time, but on the contrary he should be encouraged to rely on a small amount often repeated. Care should be taken that it be prepared in a manner calculated to tempt the appetite. Coaxing should of course be indulged in when necessary. The approximate amount of food and the time administered should be carefully tabulated. Absolute cleanliness should be observed in each detail, and each article

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should be prepared with great care, ever having it in view that it is for the patient. Fruit is indispensable to the sick-room, and many there are who would thrive in every way on what might be termed a fruit diet. There are very few conditions that would of necessity prohibit the use of at least some kind of fruit, and generally this will prove more grateful and acceptable than anything else. In the present century we are enabled, at no very great expense, to avail ourselves of imported fruits during our winter months, so a very decided advantage is thus held over our ancestors, who, per force of circumstances, were unable to obtain any save native fruits. When broths are to be given let them be sufficiently hot, although not absolutely boiling, and have them carefully seasoned. When, on the contrary, cold drinks are ordered, care should be taken to insure their being reasonably cold. Nothing is so apt to discourage a nervous patient as bringing to his attention unpalatable food or drink; and in this we cannot exercise too much care, for we must remember the patient is fully supported in his objections and contempt at such edibles by the instruction given in Revelations iii. 16: "Because thou art lukewarm, and neither hot nor cold, I will spew thee out of my mouth."

SUBSTANTIALISM OF FINANCE.

BY CHARLES HARRISON.

The principal difficulty which stands in the way of a clear understanding of financial principles is the failure of political economists to comprehend the dual nature or characteristics of that which is known to business men as "property." Whether political economy should or should not be classified as a science, is not a matter of so much importance as to discover wherein its teachings are so defective as to be wholly unsatisfactory to those in practical life. There are two distinct classes of political economists, the materialistic and the socialistic; the former maintaining that material wealth is the only subject of its study or province of its inquiry,[1] while the latter insist that it is a branch of sociology, itself a department of anthropology, or the science of man,[2] and includes for this reason, ethics, law, and government. Others do not draw the lines so distinctly between material as the only reality and the reality of the intangible, but in their writings necessarily incline to one side or the other of this broad distinction which is found at the root of the study, as for instance Prof. Perry, who defines it to be the "Science of Sales."[3] They all, however, appear to meet on this common ground that "all trade is barter"—in other words, that there is no real difference between barter and sale.

Until the mind grasps the reality or substantial nature of certain intangible things it is impossible to point out the distinction clearly. It is a well-established principle in the law that an allegation of sale cannot be supported by proof of barter, and elementary writers on that science agree that there are three ways of transferring property by act of the parties: 1, gift; 2, barter; 3, sale. Hence, barter and sale are not identical in the law and are identical according to the teachings of political economy. This conflict between the lawyers and the economists has been going on for fifteen hundred years, as the principle was decided in the early days of the Christian era by the courts; as the principle has been by them uniformly held ever since, under all forms of orderly government throughout civilization, and the opposite view is maintained by economists to-day with as much pertinacity as it was urged before the days of Justinian. While the reasoning of the court may not have been all that could be desired in making the original decision, and the failure of judges in modern days to fathom the real distinction involved has led to some obscurity, there cannot be a question, it appears to me, in the mind of any person who can comprehend the reality of things not susceptible of investigation by the physical senses or the implements of material science, that the courts have rightly decided, and that the economists are laboring with an error

[1] Prof. Laughlin, of Harvard, notes to John Stuart Mill's "Political Economy."
[2] Prof. Thompson, of University of Pennsylvania, "Political Economy," p. 1.
[3] "Political Economy," p. 18.

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which proves of serious inconvenience to themselves. In the "Institutes of Justinian" the subject was presented thus:

"The price of anything bought should consist of cash or money told; for it hath been much doubted whether the price of goods can be said to be paid, if any other thing is given for them but money; as for instance, whether a slave, a piece of ground, or a robe, can be paid as the price of a thing. The lawyers Sabinus and Cassius thought that a price might consist of anything, and from hence it has been commonly said that *emptio venditio, i. e.*, buying and selling, is contracted by commutation, and that this species of buying and selling is the most ancient."

The advocates for this side of the question quote Homer, who relates, in the following lines, that a part of the Grecian army *bought* wine by giving other things for it:

> "Wine the rest *purchas'd* as their proper cost,
> And well the plenteous freight supplied the host;
> Each in exchange proportion'd treasures gave:
> Some brass or iron, some an ox or slave."
>
> "Iliad," 7.—POPE.

But the lawyers of another sect maintained the contrary, and declared that commutation was one thing and *emptio venditio* another; for otherwise, said they, in the commutation of any two things, it can never appear which is sold and which has been given as the price of the thing sold; and it is contrary to reason that each should appear to have been given as the price of the other. And the opinion of Procullus, who maintained that commutation is a species of contract separate from vendition, hath deservedly prevailed; for he is supported by other verses from Homer, and has enforced his opinion with the strongest arguments; and this is the doctrine which our predecessors, the emperors Dioclesian and Maximian, have admitted, as it appears more at large in our digests. *Just.'s, lib.* 3, *tit.* 24, *sec.* 2.

It is thought that the passage referred to as having been quoted by Procullus, is in the sixth "Iliad," where Diomed and Glaucus exchange their armor:

> "For Diomed's brass arms exchang'd his own,
> Though wrought with gold, and worth an hundred beeves."

"But," says Vinney, "if the poets were to be regarded in this dispute, little could be collected from them: *quippe, dum metro serviunt proprietatem sæpe negligere coguntur*, and if we attend to the suggestions of truth and right reason, we must soon be convinced that the contracts of buying and selling can never be strictly said to exist without the intervention of money, which was undoubtedly in use long before the Trojan war."

The distinction arising from the intervention of a definite price, which is thus dimly shadowed forth in the language of the "Institutes," is held by the courts to be the fundamental difference between barter and sale now as then. That the distinction given by the jurists is not the best which may be suggested, is no reason why their conclusion should be doubted. Or, as Coleridge said to the sensible lady: "Madam, I accept your conclusion, but you must let me find the logic for it."

To every man engaged in business there is no more difficulty in comprehending that there is a difference between barter and sale, than that there is a difference between either barter or sale and a gift. Yet there is a point of similarity in all three methods, viz., property is transferred in either case. When a barter or a sale is made, it is in consideration of some other commercially valuable thing; when a gift is made, it is in consideration of a substantial but an immaterial thing—usually affection. This distinction of consideration is so broad that the act of gift appears to be of an entirely different species of transaction from barter or sale, yet the difference is not in the transfer of the property but in the consideration for which the transfer is made.

Now, property itself consists of two elements: one material, the other substantial; one the body of the property, the other the title—corresponding to the physical organism and the vitality of living beings.

All material is not property. Natural productions are not property until title attaches. Wild beasts, the air, the sun, etc., are instances of physical existences which are not property. As soon as title attaches, that to which it attaches becomes property. It is the vital element, the substantive of property. This being

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comprehended, the difference between sale and barter becomes as clear as the distinction which makes a gift so conspicuously separable. Property passes with the passing of the title, and not otherwise. In gift and barter no title passes without a delivery of the material or physical being. In sale, the title passes immediately upon the making of the contract—which, by the way, is another immaterial substantial existence, called into being by the invisible operation of two minds meeting—and the delivery of the material thing is a subsequent and entirely distinct transaction. This legal principle is so well established that it is entirely unnecessary to cite authorities.

The law of compensation is never lost. When the title passes, something must come back to the person who parts with the title. In barter he has in hand the consideration, because there is a mutual delivery. In sale the compensation is that immaterial substantial existence called a debt. No debt is created by barter. The debt of gratitude is created (or should be) by gift. The commercial debt is created by sale. Commercial debt is the beginning of finance. There is palpably no room for finance under trading by barter, even though the bartering be conducted with the material substances gold and silver, either as shekels of weight or coined money.

Following the same idea, if all sales were "for cash"—in other words, immediate payment—they would amount to no more than barter. The creation of a debt, then, is what distinguishes a sale from a barter, and the creation of a debt is what makes finance possible.

A sale is a sale, whether payment is to be made then and there or at some future time. Time sales and cash sales are only distinguishable by difference in the time in which the debt created is to be liquidated or satisfied. The methods of doing this, the complications which frequently arise in business from the contingencies which arise between the sale and the delivery of property, between the time the title has passed and debt created and the full consummation of the transaction, are not within the purpose of the present article.

Substantialism gives a firm ground on which to stand in the discussion, and a clear light by which to comprehend the subject of finance—a subject which is utterly inexplicable to material philosophy.

IS MATTER HETEROGENEOUS OR HOMOGENEOUS?

BY HENRY A. MOTT, PH. D., F. C. S.

(Continued from January number.)

Reviewing briefly some of the points we have considered, and elaborating when necessary, we find that, according to the present teachings of science, matter is supposed to be composed of *molecules*, and these in turn of *atoms*, the molecule being defined as the smallest particle of a substance that can exist and still retain the properties of the substance. When divided by chemical processes (*i. e.*, by the action of some force) the constituents of the molecules are liberated and form molecules of each, the atoms having no isolated existence except in or during a chemical change.

It is claimed that if we had a microscope and a means of illumination sufficiently adapted for an examination, we would see little bodies (molecules) of about $\frac{1}{250000000}$ to $\frac{1}{6000000000}$ of an inch in diameter flying about *at an enormous velocity*, depending on the temperature of the body—*i. e.*, the mean velocity of the hydrogen molecule is supposed to be 6097 feet *per second*, and of oxygen 1524.25 *feet per seeond* at 32° F., and that one cubic inch of the substance in the form of gas, when the barometer marks 30 inches and the thermometer 32° F., would contain one hundred thousand million million million molecules, or 10^{23} molecules.

The molecules would be seen to be separated one from another, and attractive and repulsive forces acting between them. Inside of the molecule we would see the atoms also flying about, but united together at a distance by the force of chemism.

Matter, therefore, by this view, is a mechanical structure built up of mole-

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cules separated from one another, and the molecules built up of their constituent atoms separated from one another, the molecules being held together by the force of cohesion and the atoms by the force of chemism.

By the definition given of a molecule it is evident that an atom cannot exist separately. The molecule has also been defined by Barker as "a group of atoms united by chemism."

The fallacy of such a definition is at once shown in the case of zinc, cadmium, barium, and mercury, where the molecule only contains one atom, and the atom must necessarily be the molecule, and as an atom has no parts, according to the present teaching of science, no force of chemism can be exercised in such molecules (atoms) of these different substances. If there was only one element, whose molecule contained one atom, or was in fact the atom, this might be fairly claimed to be due to some error in observation, but when four elements are found to be thus constructed such an excuse can have no value attached to it, and we are compelled to doubt our premises and look for a more consistent explanation.

Before proceeding further, it must be borne in mind that neither the molecule nor the atom has ever been seen. They are the result of speculation, directed to account for the phenomena of nature, both of matter and force, and their general acceptance can only result in the furtherance of materialism and the complete annihilation of any belief founded on a power superior to nature constantly sustaining it. It must also be borne in mind that such scientists as have given *particular* study to the constitution of matter—in fact, made it a specialty—regard molecules and atoms as simply the x's and y's of mathematics, to be discarded after their usefulness in the deduction of certain problems has expired.

Prof. W. N. Hartley, in his researches on the relation between the molecular structure of carbon compounds and their absorption spectra, states:

"It appears that a molecule is a distinct and individual particle, which cannot be represented by our usual chemical formulæ, since these only symbolize certain chemical reactions, and fail to express any relation between physical and chemical properties."

In considering the aromatic hydrocarbons, he says:

"Here . . . . we have evidence of the constitution of matter which is inconsistent with the individual existence of atoms within the molecule; and it appears from this consideration alone that our chemical formulæ do not in any way express the constitution of the molecules of the substances they are intended to represent, but only give us a concise and useful statement of the origin of the substance and the chemical reactions which it is probably capable of undergoing, or to which it has been subjected; all such statements being referred to mass."

Prof. Cook, of Harvard, says, speaking of the atomic theory:[1]

"Beautiful and consistent as it appears, [it] is only a temporary expedient for representing the facts of chemistry to the mind. Although in the present state of the science it gives absolute essential aid both to investigation and study, I have the conviction that it is a temporary scaffolding around the imperfect building, which will be removed as soon as its usefulness is passed." And Prof. Mattieu Williams[2] says: "The atoms invented by Dalton for the purpose of explaining the demonstrated laws of chemical combination, performed this function admirably, and had great educational value, so long as their purely imaginary origin was kept in view; but when such atoms are treated as facts, and physical dogmas are based upon the assumption of their actual existence, they become dangerous physical superstitions." And S. Cannizzano,[3] in an admirable paper on the progress of the atomistic theory, tracing its history through Dalton, Berzelius, Laurent, Gerhardt, and others, and bringing the discussion down to the present day, says that some of the followers of the modern school push their faith to the borders of fanaticism—"they often speak on molecular subjects with as much dogmatic assurance as though they had actually realized the ingenious fiction of Laplace, and had constructed a microscope by which they could detect the molecule and count the number of its constituent atoms." This, as I have already said, has never been accomplished, and the existence of molecules and atoms, if they have such existence, is purely in the imagination, having no existence in point of fact.

[1] The "New Chemistry," p. 103—1876. [2] *Quar. Jour. of Sci.*, 1876
[3] *Gazette Italiana*, No. 1—Jan. 1876.

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The chemist does not deal with molecules, but with sensible masses of a substance. Imagine a chemist taking a particle of matter $\frac{1}{500000000}$ of an inch in diameter and uniting it with another mass of that size. The chemist deals with masses—a ton, if necessary, or some fraction of a grain—but never with such minute masses as the size of a supposed molecule; in other words, he deals with an aggregation of molecules, provided there are any molecules to aggregate in the matter. So the work of the chemist does not prove the existence of either molecules or atoms.

Chemists have discovered about sixty-eight substances, which are supposed to be simple substances for the reason that by no process as yet discovered can they be dissociated into simpler bodies. These substances are the alphabet of chemistry, and are called elements.

Compounds are supposed to be substances containing two or more of these elements, and which can be dissociated into the elements composing them. Now the question which is of great interest is, whether the various substances obtained by the decomposition of a compound body are not the result of the conversion of the substance of the compound body into them, and that the substances thus obtained are not present as such in the compound body; or in other words, when two or more elementary bodies are made to unite by the force of chemism, the elementary substances are entirely destroyed, *as such*, and a new substance is prôduced which, when acted upon by certain forces, can be converted into the elements which were used to produce the so-called compound body.

Experiment has, I think, pretty clearly settled this point in favor of the view that the elements are actually present. In the first place, it is a well-established fact that up to the present time it has been shown to be impossible to convert one element into another—as, for example, to convert oxygen into hydrogen, or *vice versa*, as one force may be converted into another.

When two volumes of hydrogen and one of oxygen gas are brought together and united by the force of chemism, through the agency of a spark of electricity, water is produced. Now it is true that water does not resemble the constituents out of which it was formed as they existed as gases; the union, however, could probably have been brought about had the hydrogen been reduced first to the liquid form, and the oxygen also. In such a case we would have the uniting of two liquids to produce another liquid possessing a property (liquidity) more or less identical with the constituents.

Still, the characteristic properties of water, for example, are different from either liquid hydrogen or liquid oxygen—a new substance has originated by their union. It would hardly do to say that this new substance, water, does not contain the hydrogen and oxygen linked together, and that both of these forms of matter have been annihilated as such, and can only be produced by the decomposition, or more properly, convertibility of the new substance into hydrogen and oxygen by the action of a force, because, as stated before, the chemist has never been able to destroy an element, except in so far as to destroy some of its properties in the formation of a compound. No element has been converted into any other element, and from no compound, however treated, can any other substance be obtained than the elements used to produce it.

The argument, then, that a compound—such as water, for example—does contain in its substance, and as integral parts of the same, the hydrogen and oxygen which, on combination, produces the water, seems well founded in fact.

Another strong argument which can sustain this view is offered by almost every element in the formation of its oxides. Sulphur, for instance, forms two oxides—*i. e.*, sulphurous and sulphuric oxide. In the first of these compounds, sulphurous oxide, which is formed by simply burning sulphur in oxygen, we have a less highly oxidized substance as a result than in the case of sulphuric oxide, which has one part more oxygen combined with the sulphur than in the case of sulphurous oxide; and it is a fact when sulphurous oxide gas is dissolved in water, that under the influence of light and time it is further oxidized, and sulphuric acid results—a more highly oxidized compound of sulphur. From this it would appear that while the sulphur and oxygen have lost their identity in the product sulphurous oxide, that the sulphur must exist as sulphur in the sulphurous oxide, and is ready to be

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further oxidized; or in other words, take up more oxygen under appropriate conditions and form sulphuric oxide, a completely oxidized product of sulphur.

Again, it can be shown in the case of nitro-glycerine, which, when decomposed by analysis, yields $C_3\ H_5\ N_3\ O_9$—that there must be a structure, so to speak, as the oxygen cannot be combined directly with the hydrogen and carbon, but must be combined with the nitrogen, as there is not sufficient carbon and hydrogen to utilize all of the oxygen, and it must be borne in mind that the elements only combine by the force of chemism in fixed definite proportions which never vary. Sulphur may combine with oxygen in two ways, but in always fixed multiple proportions, as for example, 32 of S to (16×2) 32 of oxygen, forming SO_2, or sulphurous oxide, and then it can combine to form SO_3, or sulphuric oxide, composed of 32 of S and (16×3) 48 of oxygen, making SO_3. Neither can 32 of sulphur combine with 31 of oxygen in the one case or 49 of oxygen in the other—always some multiple of 16, the weight of a given volume of oxygen compared with the weight of hydrogen, taken as unity.

In a class of bodies called *Isomeric* we have an interesting state of things to account for. Ammonium cyanate, for example, $C\ H_4\ N_2\ O$ (or, as usually formulated, $(NH_4)\ CNO$) has exactly the same constituents and in the same proportion as are found in urea, which is also $C\ H_4\ N_2O$, and still the two substances are totally different from one another, so far as properties are concerned, and the ammonium cyanate can be converted by heat into urea. Racemic and tartaric acid have the same composition; the latter rotates the plane of polarization of a ray of polarized light to the right, while the first is optically inactive.

Another fact to be considered is, that at the instant of liberation of an element from a compound by decomposition, the element is said to be in the nascent state—that is, it is capable of acting far more energetically than when they are employed in the natural state. Hydrogen gas in its natural state will not combine directly with other substances, in many instances, unless some force is employed to assist it, whilst, when it is being produced by the action of acid on iron filings, it can unite at once.

As regards the so-called elements, there are numerous arguments which can be advanced, and which tend to show that the elements are only different degrees of concentration of one primordial substance held together by cohesion. This is the view entertained by the Substantial Philosophy, and the following arguments will strengthen this position, and are certainly worthy of careful consideration.

Take, for example, the large list of fusible alloys which melt at a very much lower temperature than any of their constituents when they are tested separately. Wood's metal is a fusible alloy, composed of four parts bismuth, two parts lead, one part tin, and one part cadmium, and it melts at 60°.5 C. (149° F.), while the melting point of bismuth is 270° C. (518° F.), of lead is 334° C. (636° F.), of tin is 235° C. (455° F.), and of cadmium is 315° C. (599° F.)

Surely the force of adhesion which unites these metals so as to form an alloy possessing a melting point far below the melting point of any of the constituents must be a *substantial force*, and not a mere mode of motion.

The fact that, if what is called the atomic weights be multiplied by the specific heats of the elements, a constant number is obtained, would seem to argue strongly in favor of the view that the elements are different degrees of concentration of one substance held together in different ways by the substantial force of cohesion. Boron, carbon, and silicon are the only exceptions out of some sixty-eight elements, which latter give on the average the constant number 6.2. In the exceptional cases mentioned, it is evident that either their atomic weights (their weight compared with hydrogen as unity) has been incorrectly determined, or the number given for the specific heat is not accurate.

Again, as Dumas has shown, the atomic weights which are accurately ascertained may be practically arranged in two groups:

1. Bodies which are represented by multiples of a whole number of the atomic weight of hydrogen.

2. Multiples of the number 0.5 of that of hydrogen.

It has also been shown that in several instances where two elements are in close chemical relation to each other, they have atomic weights which are identical, which happens in the case of cobalt and nickel, 59; lanthanium and cerium,

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92; rhodium and ruthenium, 104.2; platinum and iridium, 197.2. In other cases the ratio of the atomic weights is as 1:2: Oxygen, 16; sulphur, 32; aluminium, 27.5; manganese, 55.

Again, where these elements belong to the same natural group, the atomic weight of the intermediate element is frequently equal to the mean of those of the two extremes. This is true in the case of

$$\begin{array}{l} \text{Lithium} = 7 \\ \text{Sodium} = 23 \\ \text{Potassium} = 39.0 \end{array} \quad \frac{7+39.0}{2} = 23.00$$

the number for sodium being the arithmetical mean of those of lithium and potassium. Other groups agree very closely, and the difference can fairly be attributed to fallacious methods in the determination of the atomic weights:

$$\begin{array}{l} \text{Calcium} = 40 \\ \text{Strontium} = 87.5 \\ \text{Barium} = 137 \end{array} \quad \frac{40+137}{2} = 88.5$$

$$\begin{array}{l} \text{Sulphur} = 32 \\ \text{Selenium} = 79.5 \\ \text{Tellurium} = 129 \end{array} \quad \frac{32+129}{2} = 80.5$$

An extremely strong argument in favor of this view is obtained from ozone, a gas which possesses remarkable properties peculiar to itself and not possessed by oxygen, and still only containing or being able to be converted into oxygen. It is supposed to result from the condensing of three volumes of oxygen into two volumes under the influence of a certain force.

Mere compression of oxygen will not produce it; it only results by the action of some other force, as in one instance the passage of a succession of electric sparks in oxygen produces it. Ozone has a greater density than oxygen, and if heated to 290° C. it is converted into ordinary oxygen.

Ozone has been called active oxygen, because it oxidizes substances which have only a feeble affinity for oxygen.

We have also in the case of sulphur and phosphorus some very curious conditions. Sulphur is known to exist in several allotropic modifications. In nature it occurs in large yellow transparent octahedra, and in sulphur chambers it has been found crystallized in the rhombic form—in fact, there are no less than thirty different crystallographic modifications. The specific gravity of rhombic sulphur at 32° F. is 2.05. Sulphur melts at 114°.5 C., forming a clear yellow liquid, which has a specific gravity of 1.803. It solidifies at 111° C., which is below its melting point.

When melted sulphur is further heated it changes color and becomes more viscid, until at a temperature of from 200° to 250° C. it becomes almost black, and is very thick. If the temperature be further raised, the liquid becomes less viscid, although its dark color remains. If this be poured into cold water the sulphur assumes a semi-solid, transparent, elastic mass which can be drawn into threads—this is *plastic sulphur*. Its condition is unstable, and on standing becomes opaque and brittle.

The vapor of sulphur between 860° and 1040° has a density of 32.11. Flowers of sulphur dissolves in disulphide of carbon, but on standing in the sunlight an insoluble form of sulphur separates out.

Common phosphorus is colorless, or slightly yellow, and crystallizes in octahedral form. Its specific gravity at 10° C. is 1.83, and it melts at 44°.3 C., forming a slightly yellow strongly refracting liquid, having a specific gravity of 1.764. Red or amorphous phosphorus is obtained by the action of light and heat on ordinary phosphorus. When the yellow phosphorus is heated from 240° to 250° C. the red phosphorus is rapidly produced, but if the red phosphorus be heated above 260° it is converted back into the white or slightly yellow phosphorus. Hence, the passage from one allotropic condition to another is more readily shown in the case of phosphorus than in that of any other element. The red phosphorus is also formed when ordinary phosphorus is heated in closed vessels to 300° C., or about 10° above the boiling point.

Red phosphorus is a compact solid substance, has a metallic iron-gray luster, specific gravity 2.106, powder looks like iron oxide. It is tasteless, odorless, insoluble in the solvents which dissolve white (or yellow) phosphorus, and is not poison-

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ous. Can be exposed to the air for years without undergoing any change. Friction does not bring about its oxidation, and to take fire it must be heated to a temperature of 240° C. The red phosphorus conducts electricity fairly, while the white or yellow phosphorus does not, so far as can be ascertained.

Metallic or rhombohedral phosphorus is obtained by heating ordinary phosphorus in sealed tubes, in contact with metallic lead, at a temperature approaching a red heat. This is a third modification of phosphorus. The phosphorus thus obtained is a bright, lustrous, dark crystalline mass, which in thin plates possesses a red color, and consists of microscopic rhombohedra. Its specific gravity at 15°.5 is 2.34. If heated to 358° C. it is converted into ordinary phosphorus. This variety is also formed when red or amorphous phosphorus is heated under pressure to a temperature of 580° C.

The numerous illustrations given, it seems to me, should be sufficient to satisfy any inquiring mind as to the real nature of the so-called elements—that they are, as stated, different degrees of condensation of one primordial substance held together by a *substantial force*.

It becomes difficult for some people to understand how the force of chemism and cohesion act in a compound body, if the body is considered perfectly homogeneous throughout in the sense of not being composed of molecules, as they cannot conceive of the constituents existing in a compound, unless each have a fixed size, however small, and are held together in groups by chemism and the groups by cohesion; for when a compound body is broken it is not decomposed, only the cohesive force is overcome. Still, such a thing can be understood if we remember that, even admitting the particles to be infinitely divisible, we can only divide them this side of infinity—in other words, to a finite degree—the particles then would still have size, and could be divided by the infinite to infinity. It appears to me that it is the state in which the constituents would be, if divided to infinity, which troubles and confuses the mind in this case—as it will always trouble and confuse the finite mind to comprehend infinity.

By admitting that the constituents do exist in the compound, and that they are held together and modified by the force of chemism so as to produce a substance possessing properties peculiar to the resulting compound and differing from the constituents, it is difficult for some still to understand how the force of cohesion acts, and how we are able to break the body in two and still not decompose it. The fact is that the substantial force of chemism extends to infinity, and no mechanical force can get at it to overpower it. It can only be put under subjection by some substantial force like heat, electricity, light, etc., as the case may be. Mechanical force can overcome cohesion, but not chemism. Bearing this fact in mind, the apparent difficulty is shown to be no difficulty at all.

As a result, therefore, of the investigation we have conducted and set forth in the two preceding articles, as also in the present one, it must be admitted that neither physics nor chemistry offer any arguments in favor of the view that matter is heterogeneous, which will stand the test of a careful analysis under the light of the new philosophy. Matter must, therefore, be considered perfectly homogeneous, the whole or any portion of it being subject to infinite divisibility. It must not be forgotten, however, that matter is porous to a greater or less extent. With sufficient pressure water may be forced through the pores of gold, just exactly the same as water can be made to pass through the pores of a sponge—the matter, however, of the gold or sponge is perfectly homogeneous. Regarding the forces of nature as different forms or manifestations of the substantial force-element of nature, and matter as a perfectly homogeneous substance, all the various phenomena of nature can be explained and elucidated in a clear and comprehensible manner.

It must be borne in mind that the word substance is a generic term, and embraces immaterial as well as material substances—all matter being substance, but all substance not necessarily material.

Because that mysterious something called gravitation, which pulls a weight toward the earth, can neither be seen, heard, felt, tasted, or smelt, is no proof that gravity is not an immaterial substance as really and truly as water, iron, or platinum are material substances, only the substantial particles or attenuated threads of gravity are of such a nature that we cannot recognize them except

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through our higher faculties of reason by what they accomplish. We must, therefore, judge of the substantial or entitative nature of anything of which the mind can form a concept, not by its recognizable or unrecognizable qualities through the direct evidences of our finite senses, but by its demonstrable effects upon other and known substances under the exercise of our rational faculties in judging, analyzing, comparing, etc.

MEASURING THE HEAT IN SOUND-WAVES.

PROF. MAYER CROSS-EXAMINED.

BY THE EDITOR.

Our associate, Dr. Mott, hands us the following extract, which he has copied *verbatim* from Prof. A. M. Mayer's article on Sound in Appleton's "American Encyclopedia," and requests us to reply to it in THE MICROCOSM, which we proceed to do. The following are the Professor's words:

"To determine the relative or absolute intensities of sounds of different pitch is one of the most difficult of experimental problems. The writer has recently succeeded in reaching approximate measures of the absolute intensities of sounds by measuring the amount of heat produced when the sound-vibrations are absorbed by india rubber. By knowing the exact fraction of the whole energy of the sound absorbed and the specific heat of the india rubber, the mechanical equivalent of the entire sonorous vibrations in fractions of a Joule's unit, can be calculated. It was thus shown that the aerial vibrations produced by a treble C fork mounted on its resonant box and vibrated during ten seconds, will, if entirely converted into heat, raise the temperature of one pound of water $\frac{1}{100000}$ of a degree, or, in mechanical effect, will raise fifty-four grains one foot high."

The further we go into this investigation of the wave-theory of sound, and the more closely we scrutinize the teachings of the great physicists upon its collateral bearings, the more are we astounded at the weakness of their reasoning as well as at the baselessness of their conclusions. If, therefore, in commenting upon the above extract, we should appear somewhat incisive in our criticisms upon the amiable Hoboken Professor, neither he nor his friends must consider us on that account wanting in the milk of human kindness. Like M. Pasteur, we make such unavoidable incisions for introducing the living germs of truth, thereby to counteract the rabies of pernicious science, and not at all from any want of the utmost friendliness of feeling.

First, then, we ask, why is it that Prof. Mayer studiously, as it appears to us, avoids giving the experimental process, or any possible clew to it, by which he claims to have reached such an important result in physical science as here placed on record? Why is it, after he has "succeeded in reaching *approximate measures* of the absolute intensities of sounds *by measuring the amount of heat produced*," that this high authority on acoustics does not give the facts of his experiment, which he could have done in two or three short sentences? Did he wish to leave the critical reader to infer that he did not wish to submit the experiment to scientific inspection, lest it should turn out as fallacious as has his "$\frac{1}{470}$ increase of atmospheric density in the compressed half of a sound wave"?

How easy it would have been, for example, for him to state in plain language the size of the piece of rubber which was heated by these "aerial vibrations." Then he could have told us in another short sentence how far away from the "treble C fork" he placed this piece of rubber; and lastly, with what vibrational force, or at what amplitude of swing the fork's prongs were moving. He could then, in another sentence or two, easily have informed us that he used a delicate thermometer, with its bulb imbedded in the mass of rubber, by which he was enabled to record "the $\frac{1}{100000}$ of a degree"; or possibly that he employed a galvanometer, pressing it against the rubber, thus to indicate the rise in temperature by the deflection of the needle, etc. How simple, and scientific, and business-like would have been such information for an important encyclopedia article, instead of merely hinting at his remarkable discovery and then leaving the anxious student

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to hunt for the details of the experiment in some obscure publication, if published at all.

But suppose all this information had been given, how was it possible for the Professor to record the heat in the distant piece of rubber obtained from the "aerial vibrations produced by the treble C fork," when it is a well-understood fact, as the wave-theory is careful to teach us, that no resultant heat can be produced at all by such air-waves, since each *condensation* of a sonorous wave sent off from a vibrating instrument is accompanied by a corresponding and associated *rarefaction* just as much *cooler* than the mean temperature of the air as the condensation is *warmer*, and consequently that the two always neutralize each other, both in the air and, as a matter of course, in any other body in which these supposed sound-waves are conducted? That the reader may not have to trust alone to our statement, here are the words of Prof. Tyndall:

"*The average temperature of the air is unchanged by the waves of sound.* We cannot have a condensed pulse without having a rarified one associated with it. *But in the rarefaction the temperature of the air is as much lowered as it is raised in the condensation"!* "Lectures on Sound," p. 29.

How, then, was it possible for these supposed "aerial vibrations" from the fork to heat the rubber at all, when the heat of each condensation, as soon as striking the rubber, must be neutralized by the cold of its associated rarefaction, thus, as Prof. Tyndall declares, keeping the air, and of necessity the rubber, at their specific normal temperature? Prof. Mayer knows most surely that this is the teaching of the wave-theory, and that to attempt to heat a piece of rubber at a distance from the source of sound by employing "the *aerial vibrations* produced by a treble C fork," while the *heat* in each wave is neutralized by the associated *cold*, was simply to impose upon the reader and to stultify himself as well as every book that had been written on acoustics.

But the weakest phase of this claimed discovery is yet to be examined. Prof. Mayer takes particular pains to tell us that his estimate of the amount of heat generated in the rubber was based entirely upon the "pitch" of the tone on which he was experimenting, namely, upon the "aerial vibrations produced by a *treble C fork,*" without the slightest reference to the *intensity* or *loudness* of the sound produced, or in other words, without even a remote allusion to the *amplitude of the fork's vibrations,* on which alone, as all know, according to the wave-theory, depends the amount of atmospheric condensation and consequent generation of heat!

Strange as it must appear, Prof. Mayer really seems not yet to have grasped this elementary principle of the accepted theory of acoustics, namely, that the "*pitch*" of any given sound, such as that of a "treble C fork," has nothing whatever to do with its *intensity,* from which alone such supposed *heat* is to be deduced. Had he known anything of the published laws of acoustics, according to the received theory, he would have understood that the supposed *heat* generated by sound must be in exact proportion to the amount of atmospheric *condensation* which takes place; while this condensation must be in exact proportion to the *extent of amplitude* or width of swing of the sounding instrument, upon which alone *intensity* or *loudness* of sound depends; while the quantity of such supposed heat has nothing in the world to do with the *pitch* of the sound, which depends alone upon the *number of vibrations in a second* made by the sounding instrument, and without the remotest reference to the *amplitude* of such vibrations or the *energy* they exert upon the air.

Prof. Mayer has yet to learn, judging from this pretentious article, that the sound of a mosquito's wing, with its almost inconceivably minute expenditure of mechanical energy or condensing power upon the air, may be of the same pitch ("treble C") as the sound of a steam-siren that is heard distinctly a distance of ten miles away! Yet this highest American authority on sound, while making a grave calculation about sound-intensity, for an encyclopedia article, as to the amount of mechanical energy expended and thus converted into heat, deliberately specifies the "pitch" C, without a single syllable as to the loudness or intensity of such pitch—whether it were that of the fork when first bowed or struck, and thus sent into its fullest condensing amplitude, or after it had been vibrating *four* minutes, and had consequently almost died out! Such want of the elementary knowl-

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edge of acoustics, while gravely treating a subject requiring it—knowledge, too, lying on the very surface of the theory of sound as everywhere taught—we have never seen exhibited in all our reading in that direction.

This want of scientific intelligence, however, is not a mere mental lapse on the part of our eminent physicist, but is chargeable chiefly to the inherent incongruity of a theory of science false to the very core. Daniels, of Scotland, the author of the ablest text-book on physics ever published, and which has recently been issued, falls into the same prodigious error in trying to account for the wonderful difference in loudness of various sounding bodies, which, as observation assures us, is out of all proportion to the mechanical effects they exert upon the air, and which so clearly conflicts with modern science. Being wholly unaware of the aid which Substantialism renders in such cases, and without one ray of light from the wave-theory to help him, he grasps wildly in the dark at the only straw in reach, namely, that the observed loudness of certain insects, for example, *is due to their pitch—that is, to their great number of vibrations in a second!* (See Daniels on "Principles of Physics," page 368.) Had this high authority chanced to read the "Problem of Human Life," or several recent articles in this magazine on that question, he would have been informed to his surprise that the famous locust, which can be heard a mile, makes the loudest part of its stridulation at the pitch of A (440 vibrations in a second), at which pitch a naked tuning-fork, with more than ten times as much mechanical effect upon the air as that exerted by the insect, *cannot be heard six feet away, and consequently can produce but the* $\frac{1}{80000000}$ *as much volume of sound as does the insect!* (See MICROCOSM, Vol. IV. pp. 318, 381; Vol. V. p. 38.)

Had Prof. Daniels stopped to reflect, he would have been overwhelmed with confusion by the simple fact that a very small tuning-fork held in the fingers, or a very fine, short wire stretched over rigid iron supports, *when vibrating four thousand times in a second, can be heard no farther away than when vibrating one-fiftieth as often, or only eighty times a second!* Indeed, the facts in the case are directly the reverse of what Prof. Daniels sets forth, since the tuning-fork of very high pitch cannot be heard nearly as far as one of a vastly less number of vibrations! How neatly would this simple little fact have wiped out his "insect" illustration of the supposed cause of the marvelous loudness of such sounds based on their supposed pitch! Yet that famed authority was not capable of evolving so simple an overturn to his fallacious explanation.

His oversight, however, was manifestly due to his theory, and not to his intellect. He was prevented by the misleading nature of that theory from grasping the essential LAW of physical science: *that sound, instead of being the mechanical effect produced upon the air by the vibrating instrument, and conveyed through it in pulses or atmospheric waves, is a real substantial, but immaterial force, and depends for its intensity or quantity upon the sonorous character of the sounding instrument itself vastly more than upon its mechanical motion, just as the amount of substantial electricity issued from a dynamo machine depends chiefly upon the electrical quality of the magnetic apparatus, and secondarily upon the mechanical rotation given it.*

This important law we have given in substance in the different editorials to which we referred a moment ago, but we have not before emphasized it as we now do, as an impregnable *law* of science, upon which the substantial character of sound as one of the forces of nature may alone rely without the fear of successful assault. It stands, as a new and overwhelming discovery, in the same relation to *sound* that the law announced last month (page 160) occupies in relation to the substantial nature of *heat,* and these two laws should be placed side by side in the ultimate formula of the Substantial Philosophy.

We thus begin to realize the revolutionary value of the fact so frequently reiterated in these pages that the locust with one-tenth as much vibratory action on the air as that produced by a tuning-fork of the same pitch, can be heard 880 times farther away, while it actually generates 80,000,000 times as much sound! This beautiful revelation of science, which has been hidden from the eyes of the world through ages past, remained for the Substantial Philosophy to unfold. No better proof of the far-reaching value of Substantialism can be required than the marked

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contrast thus pointed out between the best outgivings of modern science and the new departures in the realm of physics here unfolded.

In the light of such discoveries (and this is but one in a score equally important recently announced in THE MICROCOSM), how invincibly must the Substantial Philosophy appeal to the intelligence of mankind in its mighty sweep through the bewildering mazes and mysteries of physical science! Substantialism sees no more difficulty in solving the seeming inexplicable problem of the vastly varying intensities of different sounds, without any reference to atmospheric disturbance, against which Daniels, Mayer, Tyndall, and Helmholtz stagger and turn pale, than it originally saw in correctly explaining the blowing out of a candle by the clapping of two books at one end of a long tin tube, or in solving the mystery of the breaking of windows by a "sound-pulse" miles away from a magazine explosion, upon which Prof. Tyndall found himself and his theory totally at sea. Had the great physicists we are noticing possessed the magnanimity and fairness which should characterize all true scientific investigators, they would long since have cheerfully accepted the aid in their perplexing physical researches which the Substantial Philosophy alone can give.

Is it any wonder, then, with such a serious physical problem as we have here been analyzing, coolly staring the wave-theory in the face, that Prof. Mayer, with nothing but that theory to help him, should go all to pieces in his fruitless attempt to render intelligible the present doctrine of acoustics by mistaking the *pitch* of sound for its *intensity* or *amplitude of vibration?* There is no doubt but the criticism here offered will be the very first intimation he has ever received that this same "treble C fork," which he chanced to select, is capable of expending upon the surrounding air *millions* of times more mechanical energy or heat-producing force, during the *first* "ten seconds" of its vibration, when heavily bowed or struck, than during the twenty-fourth "ten seconds" before it will finally quit sounding. This was conclusively shown to be a physical fact in Capt. Carter's famous experiments in carrying out our newly-discovered method of measuring the prong's enormously slow motion while still sounding. (See MICROCOSM, Vol. III., p. 154.)

Yet, startling as the statement seems to be, Prof. Mayer, in trying to estimate the *energy* which a fork must exert upon the air and convert into heat, mistakes its *intensity* for its *pitch,* absolutely supposing that the loudness of its sound (or what is the same thing, its amplitude of swing and energy exerted) *depends upon the number of its vibrations in a second—namely, its "pitch"!* He thus wholly ignores the fact that the "treble C fork" may swing at each vibration the full $\frac{1}{16}$ of an inch as when first bowed (exerting a corresponding energy and compressing force upon the air), or it may swing but "the $\frac{1}{4000000000}$ of an inch" at a motion before ceasing to vibrate, as shown by Capt. Carter; or in other words, that this fork may exert 4,000,000,000 times more energy or compressing force on the air when commencing to vibrate than it does near the conclusion of its sound. But remaining totally oblivious to this enormous difference in the amount of energy exerted and heat produced by the very same fork under different amplitudes of swing, Prof. Mayer fastens his pretended discovery upon the "pitch" of a "treble C fork," which has nothing to do with his problem, and lets its 4,000,000,000-fold difference in intensity, energy, and heat go to the scientific dogs!

We submit this as a fair specimen of the general reliability of modern physics as set forth in the text-books and as taught in all the colleges and schools of the country. Who, then, dares to upbraid THE MICROCOSM for its persistent crusade against the monstrous teachings of modern science, based as they originally were chiefly upon the fallacious principles of the undulatory theory of sound?

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THE CHEMISTRY OF WHAT WE EAT.

BY HENRY A. MOTT, PH. D., F. C. S.

COD-FISH.

In North America eight species of cod are found. The American cod (*Morrhua Americana*) is found along the New England coast from New York to St. Lawrence River. The cod is a genus of soft-rayed fishes belonging to the family *gadidæ*, characterized by an elongated smooth body, compressed toward the tail; three dorsal fins, vestral fins pointed; abdominal line white; two fins behind the vent; the lower jaw with one barbule on the chin.

The color of the back in the living American fish[1] is a light olive-green, becoming pale ash in dead specimens, covered with numerous reddish or yellowish spots, the lower part being a dusky white; but the colors of the species vary considerably. They sometimes reach a weight of over one hundred pounds, their average weight being about eight pounds.

The common or bank cod (*M. Vulgaris*), well known as an article of food, is taken on the Grand Bank, in the deep water off the coast of Newfoundland, Nova Scotia, and Labrador. It is a thick, heavy fish, sometimes reaching a weight of ninety pounds.

The color varies considerably, but is generally a greenish-brown, fading into ash in the dead fish, with numerous reddish spots; the belly is silvery opaque white, the fins pale green, and the lateral line dead white.

The tomcod is a small species found along the coast from New York to New Brunswick. It is caught from the wharves and bridges, by almost any bait. It is from six to twelve inches in length.

The cod is abundant along the North Pacific coast, especially in the region of Alaska. It is also plentiful on the west and north shores of Norway and Sweden, and on the southwest of Iceland. It is an exceedingly voracious fish, devouring indiscriminately everything in its way in the shape of small fish, crustacea, etc.

The cod is very prolific, and specimens of the female have been caught with upward of 8,000,000 eggs; but as only a small portion of these are fertilized, and a still smaller portion ever reach maturity, the numbers remain about stationary. The cod is of slow growth, and is about three years of age before it begins to propagate. The exhausting of the cod-fisheries is a question of much interest, but as yet there is no perceptible decrease in the Bank fisheries after three and a half centuries of ceaseless fishing. It is claimed, however, that at certain points in the shore fisheries there is beginning to be a scarcity of the fish. These fish are not migrative, as once supposed, but merely move from the feeding to the spawning grounds, and from deep to shallow water. It seems that the cod lives in colonies in certain places adapted to them, and here they live and die without mixing with the adjoining colonies. In fact, the peculiarities of the fish enable it to be told from what particular locality it is caught.

Cod-fishing is an important branch of industry, the cured fish finding a ready sale in all parts of the world.

The great resort of the American, Nova Scotian, and French fishermen is the Grand Bank of Newfoundland, and the banks east and southeast of Nova Scotia—the most western of these banks being known specifically as the Western Bank. Massachusetts ranks first in its cod-fisheries, Maine coming next—Gloucester being the great fishing port of the country. Southeast of Massachusetts is a fishing bank known as George's Bank, from which we derive our Georgia Bank cod. The cod is taken by means of a hook and line, and on favorable occasions a single man will catch from 300 to 400 in a day.

Most of the Massachusetts vessels use *trawls*, which are set and hauled periodically. The trawl consists of a long line, anchored and buoyed at each end, with hooks—generally several hundred in number—adjustable at intervals. The trawlers use fresh bait—herring, mackerel, or squid. The hand-liners use salted clams for the first part of the season, but afterward obtain squid.

The fish, when brought aboard the vessel, are dressed and scaled in the hold.

[1] See "What the Grocers Sell."—P. H. Felker, p. 65.

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Upon arrival home they are taken out, washed and dried on flakes or platforms of wickerwork on the shore.

The process of dressing them is reduced to a system, and is performed with great rapidity. The throater, usually a boy, cuts the throats and rips them open; the header removes the entrails and the head; the splitter splits the fish, removing a portion of the backbone; while the salter piles them in tiers and sprinkles them with salt.

The dried fish are sold by the quintal of 112 pounds.

Cod-fish are sometimes cured by being kept in a pile for two or three months, after salting, in a dark room, covered with salt grass, after which they are opened and again piled in a compact mass for about the same length of time. They are then known as dun-fish, from their color, and are highly esteemed.

From the liver of the cod oil is obtained, which will be considered below.

The tongue and sounds are frequently preserved in pickle. From the sounds, preserved and dried, isinglass is obtained.

Boneless Cod is a form prepared for market by taking out the bones, and packing the cod thus prepared in boxes, in strips or in rolls.

Much of this form of fish is inferior in quality, and consists of the *hake* and the *haddock,* fish closely related to the cod.

Dried haddock may be distinguished from the cod by its lateral line being black. that of the cod being white.

The number of persons engaged in the cod-fisheries in the United States is from 12,000 to 15,000, and in Canada and Newfoundland from 40,000 to 50,000.

The quantity of cured cod brought in by American ships for the year ending June 30, 1875, was 756,543 cwt., valued at $3,664,496.

The fishing grounds on the high seas are free to all nations, but the coast and river fisheries are regulated by special treaties.

Analysis shows the cod to have the following composition:

COD-FISH.

Water	78.0
Fish solids	22.0
	100.0
Nitrogenous matter	18.1
Fat	2.9
Salts	1.0
	22.0

From the analysis given it is seen that the percentage of fat in cod-fish is very small; it is, therefore, as an article of diet, inferior to mackerel, eels, salmon, and trout, which contain considerably more fat, or carbonaceous matter.

Cod-fish varies in quality; some of it is extremely hard, tough, stringy, and indigestible. When in season, the flesh, which is arranged in flakes, becomes opaque on boiling. The juice between the flakes produces layers of curdy matter which is undoubtedly coagulated albumen. When the fish is out of season the flesh remains semi-transparent and bluish, and the curdy matter is absent.

Boiled cod-fish requires two hours and a half to digest—it is, then, difficult to digest. Pavy thinks that when the curdy matter is absent, on account of the fish being more watery and soft it is more easily digested—still it is not so nourishing. By an actual test it was shown that only 72.39 parts of boiled cod-fish was digested in the same time as 100 parts of boiled beef—and still beef contains from 25 to 26 per cent. of solids, while cod-fish only contains from 18 to 18.5 per cent.

The length of time required to digest fried trout is only one hour and three-quarters.

The cod, therefore, is less digestible than most white fish, and is unquestionably more trying to the stomach than is generally believed.

Cod-liver Oil.—Oil is extracted from the fresh liver of the cod by the application of a heat not exceeding 180°. The species from which oil is obtained are: Gadus Morrhua, Linn.—G.; Callarnes—G.; Carbonarius—G.; Molva.

Three varieties of cod-liver oil are found in commerce, which are distinguished by their color—light, pale brown, and dark brown. The first two are the purest.

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Cod-liver oil contains oleine, palmitin, stearine, certain coloring matter of the bile, phosphoric acid (.09 per cent.), sulphuric acid, salts of lime, magnesia and iron, free phosphorus (.02 per cent), iodine, and bromine. The proportion of iodine in the dark oil, as determined by De Jongh, is 0.029 per cent., and in the light oil 0.040 per cent. De Jongh regards the acid reaction of cod-liver oil as being due to butyric and acetic acid. He also showed the presence of biliary acids, coloring principles, and gaduin.

Cod-liver oil gives, in common with all oils of hepatic origin, a lake or crimson color when heated with sulphuric acid.

Cod-liver oil is said to be extremely adulterated, and the adulterations are difficult to detect.

At 15° C. (59° F.) the specific gravity of light cod-liver oil is 0.92 to 0.925, of the dark colored about 0.930. Cold alcohol dissolves not over 2.5 per cent. from the yellow, but about 6 per cent. from the brown oil.

Cod-liver oil is essentially a fat-producing agent, and thereby it retards that waste of nitrogenous tissues which is a characteristic of the disease in which it is most serviceable. Cod-liver oil excels other oils in digestibility, the presence of biliary matter assisting digestion.

Cod-liver oil will not cure consumption, but is very valuable in prolonging the lives of the victims of this disease, and enables them to take advantage of hygienic measures.

It is used for chronic gout, rheumatism, rickets, and scrofula.

The average dose of cod-liver oil is a tablespoonful three times a day, an hour or two after meals. It is better to commence with half this quantity. It is best to add a little lime-water to the oil before taking it, or to take emulsions of cod-liver oil and lime-water. When the system is run down, cod-liver oil emulsions are very strengthening as well as fattening.

EDITORS' TABLE.

ANOTHER DESTRUCTIVE "SOUND-PULSE."

On Friday evening, January 15th, an explosion of about 250 pounds of dynamite occurred on the line of the new aqueduct in Westchester County, in this state, near Tarrytown. The concussion was so great that it was felt and its effects observed for fifteen or twenty miles around. The *World*, in giving an account of it, says:

"Many persons, therefore, decided that they had experienced an earthquake and were afraid to retire again. Every pane of glass was broken out of windows for fully a mile around, and even in Tarrytown, four miles away, glass was broken and houses rocked."

Now it is a fact, which the record of all acoustical science corroborates, that up to about eight years ago physicists universally supposed that this crushing of windows miles away from an exploding magazine was the result of the *sound* or *noise* of the explosion, not one syllable having been suggested that the great volume of gas generated by the exploding powder had anything to do with these destructive effects. This, without doubt, is one of the most marvelous oversights caused by the misleading influence of a false theory of science ever recorded in history. Yet that superficially false apprehension of the facts in the case has prevailed for centuries, all writers on the subject supposing that it was the actual "sound-pulse" which did the damage, and without reference to the condensed air wave driven off by the instantaneously added volume of gas.

Of course as soon as this gas is generated the air has to get out of the way, and to do so it is densely compressed next to the gas, which compression must necessarily travel away in all directions with a velocity at the start proportioned to the volume of gas thus instantly added, but whose velocity will decrease just in proportion as the compressed circle expands and the condensation weakens by taking in more air. Not so, however, with the *sound-pulse* generated at the same instant. It travels by another law at one uniform velocity from the start to the limit of audibility, namely, at about 1120 feet a second in summer temperature. Hence, as we distinctly predicted on the principle of scientific ratiocination ("Problem of Human Life," page 115), the compressed air-wave, caused by the explosion of a very large quantity of powder, would at the start vastly outstrip the sound-pulse, while at the distance of a dozen or so miles away the sound would have overtaken and passed the condensation, and would reach the observer some seconds before the atmospheric shock would be felt. We have urged upon scientific institutions to test this matter by a duly prepared explosion, and thus verify or overturn our prediction, as the case may merit. But so far there has been no response.

We have asserted and urged from the start that this condensed air-wave has no relation to the sound, *per se*, but that it would cause the same destruction precisely at a distance if the explosion should be unaccompanied by any sound which could be heard even a mile away. This condition could easily be provided by spreading, say, the 250 pounds of powder loosely over the surface of the ground and exploding it. While very little sound would thus be heard at even a short distance, yet the windows of distant houses would be broken all the same, since the quantity of gas added to the air would be exactly the same as if the powder had been exploded in a confined condition, and should thus also generate a deafening report. How plain and yet how simple is the truth!

In presenting this new scientific disclosure upon the effects of magazine explosions in the "Problem of Human Life," and thus for the first time in acoustical investigations correcting the error under

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which physicists had always labored, we took occasion to copy Prof. Tyndall's description of the explosion which occurred near the village of Erith, in which that great scientist deliberately declared it to be the *sound-wave* or *sound-pulse* which did all the damage! The moral of the whole thing is this: Is it likely that a theory can be true in science which logically and naturally not only incorporates, but tolerates such a prodigious error—one which has been so identified with the theory that it has defied the whole scientific world to make the discrimination, till it was hastily pointed out in the "Problem of Human Life"? (See pp., 103 to 108).

State Geological Survey of Florida.

We are glad to see it announced that the Governor of Florida has appointed Chancellor John Kost, M. D., LL. D., of the Florida State University, Chief Superintendent of the State Geological Survey now commencing. This important work, in connection with his duties in the chancellorship of the university, ought to keep the doctor out of mischief. We need no better proof of the confidence reposed in that great scientist than these honors and responsible duties heaped upon him so lavishly. We should be only too glad could we accompany him in his scientific wanderings over the flowery State as one of his assistant geological investigators.

MICROCOSMIC DEBRIS.

—The improved kind of explosive recently brought to notice in foreign journals, and known as cocoa powder, is said to possess such superior value for many purposes that it has been introduced in the famous Krupp factory. It is asserted that, with equal pressure, this substance gives greater velocity to a ball than can be attained with ordinary powder, while its smoke is found to be less dense and to clear off more quickly. It is brown, or, rather, chocolate colored. In sundry tests about one-seventh less of it was required than of the ordinary kind of powder to produce given results. The merit which is especially advanced in its favor is, briefly, that of beginning its combustion moderately and steadily, and then, when the projectile has started through the bore, burning with great rapidity, and with, of course, tremendous impelling force. The method of preparation and the cost as compared with other explosives are not stated.

—The "Journal of the Society of Arts" gives an account of Prof. Frankland's series of experiments in removing micro-organisms from water by means of filtration. The materials used were green sand, silver sand, powdered glass, brick dust, coke, animal charcoal, and spongy iron, all of them being previously passed through a sieve of forty meshes to the inch. Only green sand, coke, animal charcoal, and spongy iron removed the organisms, and even those would not act longer than one month. Thus the production of sterilized potable water in large quantities is a matter of difficulty and requires constant renewal of materials. But coke and spongy iron will act well for a long time in removing large proportions of the organisms and rendering the water at least fit for drinking.

—A Texas doctor gives the *Medical Bulletin* an account of the ease with which doctors are made in that State. He took a six-hour ride with a Texan villager, who asked him a great many questions about the remedies used for certain diseases then prevailing in the locality. On the following week he had occasion to visit a neighboring village, where he found his recent companion with his shingle out as a full-fledged doctor. He had graduated in the six-mile ride.

—The *Western Druggist* thinks that to prevent the dispensing of morphine for quinine a strip of steel should be firmly riveted over the mouth of the vial containing it, the neck being first plugged with a torpedo so arranged as to explode and shatter the steel when the poison is taken in hand. If the clerk survives he will know that the shock meant morphine.

—Measurements of the heights of clouds have been made at the Upsala Observatory during the past summer. The results are approximately as follows: Stratus, 2,000 feet; nimbus, or rain cloud, from 3,600 to 7,200 feet; cumulus, from 4,300 to 18,000 feet; cirrus, 22,400. Cloud measurements are always somewhat uncertain, but these figures are considered fairly exact.

—It is said on good authority that just before the outbreak of cholera in Toulon the swallows suddenly disappeared from the locality. An officer in the Bengal Cavalry said in reference to this that, during a cholera epidemic in India, he had noticed that, though many of the dead remained unburied, all of the carrion-eating birds had disappeared.

—The American Ornithologists' Union officially recommend that all public fostering of the English sparrow be stopped; that its introduction into new localities be prohibited by law; and that all existing laws for its protection be repealed, and bounties offered for its destruction.

—A frigate-bird may move through the air on motionless, "soaring" wings at the rate of one hundred miles an hour, or he may loiter at only two miles. The velocity seems to depend on will rather than limitations of power. So says a recent student of the phenomena of flight.

—Fresno County, California, is almost twice as large as the State of Connecticut, four times as large as Delaware, eight times as large as Rhode Island, just the size of Massachusetts, and exceeds the entire State of New Jersey by an area of five hundred square miles.

—In the stomach of a thirty-seven-pound codfish sold in the fish market of Hjoerring, Denmark, one day in November, were found another cod fifteen inches long, and a very large and fat duck, perfectly fresh, and apparently swallowed alive and whole. Except for a bite on the neck it was uninjured.

Facts Not Generally Known.

Spinach is a Persian plant.
Horse-radish is a native of England.
Melons were found originally in Asia.
Filberts originally came from Greece.
Quinces originally came from Corinth.
The turnip came originally from Rome.
The peach originally came from Persia.
Sage is a native of the South of Europe.
Sweet marjoram is a native of Portugal.
The bean is said to be a native of Egypt.
Damsons originally came from Damascus.
The nasturtium came originally from Peru.
The pea is a native of the South of Europe.
Ginger is a native of the East and West Indies.
Coriander seed came originally from the East.
The cucumber was originally a tropical vegetable.
The Greeks called butter bouturos—"cow cheese."
The gooseberry is indigenous to Great Britain.
Apricots are indigenous to the plains of Armenia.
Pears were originally brought from the East by the Romans.
Capers originally grew wild in Greece and Northern Africa.
The walnut is a native of Persia, the Caucasus and China.
The clove is a native of the Malacca Islands, as also is the nutmeg.
Vinegar is derived from two French words, *vin aigre*, "sour wine."
Cherries were known in Asia as far back as the seventeenth century.
Garlic came to us first from Sicily and the shores of the Mediterranean.
Asparagus was originally a wild sea-coast plant, and is a native of Great Britain.

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Nectarine is said to have received its name from nectar, the principal drink of the gods.

The tomato is a native of South America, and it takes its name from a Portuguese word.

Greengage is called after the Gage family, who first took it into England from a monastery in Paris.

Parsley is said to have come from Egypt, and mythology tells us it was used to adorn the head of Hercules.

Apples were originally brought from the East by the Romans. The crab-apple is indigenous to Great Britain.

When James Buchanan was Minister to England he had ears of corn, hermetically sealed, sent to him from this country.

It is a curious fact that while the names of all our animals are of Saxon origin, Norman names are given to the flesh they yield.

The onion was almost an object of worship with Egyptians two thousand years before the Christian era. It first came from India.

The cantaloupe is a native of America, and so called from the name of a place near Rome, where it was first cultivated in Europe.

Before the middle of the seventeenth century tea was not used in England, and was entirely unknown to the Greeks and Romans.

The word biscuit is French for "twice baked," because, originally, that was the mode of entirely depriving it of moisture to insure its keeping.

Cloves come to us from the Indies, and take their name from the Latin clauvus or French ekim, both meaning a nail, to which they have a resemblance.

Lemons were used by the Romans to keep moths from their garments, and in the time of Pliny they were considered an excellent poison. They are natives of Asia.

Floral Time Indications.

Various Flowers That Bloom During the Day.

The judge's house was over in the French quarter of New Orleans, unattractive outside; but as soon as you got into the broad hall a cool breeze struck you, laden, without exaggeration, with the balm of a thousand flowers. The hall led right through the house, and opened into a regular fairyland of flowers, a garden the like of which I had never dreamed of. It was surrounded by a high wall and had plants in it from every country under the sun. The white-haired old gentleman and a group of grandchildren hanging about him took us about, and the first thing we stopped at was a large oval plot, set out with small plants around the edge. "This," said the judge, "is my clock. What time is it, Clara?" he asked of one of the children. The girl ran around the plot and said it was four o'clock, and so it was. The four-o'clock was in bloom. "In fact," said the story-teller, the clock was made up of flowers." In the center was a pair of hands, of wood, covered with some beautiful vine, but they had nothing, however, to do with the time telling.

The plan was this: The judge had noticed that at almost every hour in the day some plant bloomed, and working on this principle, he had selected plants of different hours and placed them in a circle, twenty-four in number, one for each hour. For example, at the top of the earthen clock, at twelve o'clock, was planted the portulacca, and he told me it would bloom within ten minutes of twelve and rarely miss. At the hours of one, two and three he had different varieties of this same plant, all of which bloomed at the hour opposite to which it was planted. At four o'clock he had our common plant of that name, and you all know how you can depend on that. At five o'clock the garden hiotago came out, at six the geranium triste and at seven the evening primrose. Opposite eight o'clock he had the bona nox, and at nine the silent noctiflora—all of these blooming at or near the time given. At ten o'clock, if I remember rightly, he had a cactus, at eleven another kind, and at twelve the night-blooming cereus.

Half of the year some of the plants don't bloom at all. The plants opposite one and two in the morning were cacti that bloomed about that time, and at three was planted the common salsify, and at four the chickory, at five the snow thistle and at six the dandelion.

Electricity in Water.

Our conceptions of strength and endurance are so associated with visible implements and mechanical arrangements that it is hard to cast them aside, and yet the stream of electric fire that splits an ash is not a ponderable thing, and the way in which the loadstone reaches the ten-pound weight is not perceptible. You would think the man had a pretty good set of molars that could gnaw a poker like stick of candy, but a bottle of innocent-looking hydrogen gas will eat up a piece of iron bar as though it were a piece of favorite pudding. Mr. Faraday, the great chemist, lays claim to have demonstrated that each drop of water is the sheath of electric force sufficient to charge eight hundred thousand Leyden jars. In spite of teetotal pledges, therefore, the most temperate man is a pretty hard drinker, for he is compelled to slake his thirst with a condensed thunder-storm. The difference in power between a woman's scolding and a woman's tears is explained now. Chemistry has put it into formulas. When a lady scolds a man has to face only a few puffs of articulate carbonic acid, but her weeping is liquid lightning.

Insects Visiting Flowers.

Mr. A. W. Bennett and Mr. R. M. Christy have been reporting to the Linnæan Society of London the result of their observations on the visits of insects to flowers. As respects preference for particular colors, Mr. Bennett has noticed among the Lepidoptera that 70 visits were made to red or pink flowers, 5 to blue, 15 to yellow, and 5 to white; the Diptera paid 9 visits to red or pink, 8 to yellow, and 20 to white; Hymenoptera alighted 303 times on red or pink flowers, 126 on blue, 11 on yellow, and 17 on white flowers. Mr. Christy records in detail the movements of 76 insects, chiefly bees, when engaged in visiting 2400 flowers. He tabulates the same, and concludes therefrom that insects, notably the bees, decidedly and with intent, confine their successive visits to the same species of flower. According to him, also, butterflies generally wander aimlessly in their flight; yet some species, including the Fritillaries, are fairly methodical in their habit. He believes that it is not by color alone that insects are guided from one flower to another of the same species, and he suggests that the sense of smell may be brought into play. Bees, he avers, have but poor sight for long distances, but see well at short distances. Of 55 humble-bees watched, 26 visited blue flowers; of these 12 were methodic in their visits, 9 only irregularly so, and 5 not at all; 13 visited white flowers, whereof 5 were methodic and 8 the reverse; 11 visited yellow flowers, of which 5 were methodic and 6 were not; 28 visited red flowers, 7 appearing methodic, 9 nearly so, while 12 were the contrary.

The Genus Homo.

Brief Facts About Man and His Wonderful Formation.

The average weight of an adult man is 140 lbs. 6 oz.

The average weight of a skeleton is about 14 lbs.

The number of bones, 240.

The skeleton measures one inch less than the height of the living man.

The average weight of the brain of a man is 3½ lbs.; of a woman, 2 lbs. 11 oz.

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The brain of a man exceeds twice that of any other animal.

The average height of an Englishman is 5 ft. 9 in.; of a Frenchman, 5 ft. 4 in.; and of a Belgian, 5 ft. 6¾ in.

The average weight of an Englishman is 150 lbs.; of a Frenchman, 136 lbs.; and of a Belgian, 140 lbs.

The average number of teeth is 31.

A man breathes about twenty times in a minute, or 1,200 times in an hour.

A man breathes about eighteen pints of air in a minute, or upward of seven hogsheads in a day.

A man gives off 4.08 per cent carbonic gas of the air he respires; respires 10.666 cubic feet of carbonic acid gas in twenty-four hours; consumes 10.667 cubic feet of oxygen in twenty-four hours, equal to 125 cubic inches of common air.

A man annually contributes to vegetation 124 lbs. of carbon.

The average of the pulse in infancy is 120 per minute; in manhood, 80; at sixty years, 60. The pulse of females is more frequent than that of males.

The weight of the circulating blood is about 28 lbs.

The heart beats 75 times in a minute; sends nearly 10 lbs. of blood through the veins and arteries each beat; makes four beats while we breathe once.

540 lbs., or 1 hogshead 1¼ pints of blood pass through the heart in one hour.

12,000 lbs., or 24 hogsheads 4 gallons, or 10,782½ pints pass through the heart in 24 hours.

1,000 ozs. of blood pass through the kidneys in one hour.

174,000,000 holes or cells are in the lungs, which would cover a surface 30 times greater than the human body.

Amphibia.

Means by Which Fish Out of Water Can be Kept Alive and Dry.

Amphibious habits on the part of certain tropical fish are easy enough to explain by the fashionable clew of "adaptation to environment." Ponds are always very likely to dry up, and so the animals that frequent ponds are usually capable of bearing a very long deprivation of water. Indeed, our evolutionists generally hold that land animals have in every case sprung from pond animals which have gradually adapted themselves to do without water altogether. Life, according to this theory, began in the ocean, spread up the estuaries into the greater rivers, thence extended to the brooks and lakes, and finally migrated to the ponds, puddles, swamps and marshes, whence it took at last, by tentative degrees, to the solid shore, the plains and the mountains. Certainly the tenacity of life shown by pond animals is very remarkable. Our own English carp bury themselves deeply in the mud in winter, and there remain in a dormant condition many months entirely without food. During this long hibernating period, they can be preserved alive for a considerable time out of water, especially if their gills are, from time to time, slightly moistened. They may then be sent to any address by parcels post, packed in wet moss, without serious damage to their constitution; though, according to Dr. Gunther, these dissipated products of civilization prefer to have a piece of bread steeped in brandy put into their mouths to sustain them beforehand. In Holland, where the carp are not so sophisticated, they are often kept the whole winter through, hung up in a net to keep them from freezing. At first they require to be slightly wetted from time to time, just to acclimatize them gradually to so dry an existence; but after a while they adapt themselves cheerfully to their altered circumstances and feed on an occasional frugal meal of bread and milk with Christian resignation.

How the Earth was Made.

Monsieur H. P. Malet, a French scientist, discusses, in *Land and Water*. the perplexing question of the earth's age and origin. He rejects the Plutonic and Neptunian theories as "controversial and deceptive emanations from false and unnatural data," and evolves a theory of his own, which he expresses in the following series of postulates: (1.) There was a vapor mass floating and gravitating in space. (2.) This mass held in it the bases of present elements. (3.) As the elements are susceptible of light now, so were their bases in the beginning. (4.) The light of heaven fell upon this vapor mass. (5.) The vapor mass was susceptible of light. (6.) The action of flotation was converted into rotation on its axis. (7.) The action of gravitation was converted into revolution around the center of attraction. [These actions of attraction are demonstrated by the radiometer; and under these actions the entire mass became subject to the great law of attraction.] (8.) The entire surface of the mass came slowly under the influence of light. (9.) Under this influence the lightest gases of the mass were attracted from the surface to the light. (10.) The gases which rose highest became air and formed the atmospheric envelope. (11.) The gases which became condensed into liquid formed the water envelope, our ocean. (12.) The residue of the vapor mass became solid molecules, and gravitating to their own center, gradually consolidated into the solid body of this earth, the silicious rocks. M. Malet contends that these postulates were demonstrated by the liquefaction and solidification of gases by M. Cailletet and M. Raoul Pictet, and that they are the inevitable results of the effect of light on the vapor mass, the great womb of time. "This light," he says, "fell in its wavy streams on the wandering vapor, and reduced it to obedience, to harmony, and to love. There are no phenomena upon earth that do not follow on in their natural course from this beginning."

Reviews of New Books.

Notice to Publishers.

Special arrangements have been made to have all new books sent us carefully reviewed by specialists.

"Interior World." By Washington L. Tower. Oakland, Oregon: 12vo., 212 pp.—The first portion of this book is devoted to a romance, illustrating a new hypothesis of terrestrial organization. The appendix sets forth an original theory of gravitation.

The author states, "Of course, no authority can be quoted in support of these strange ideas," and we are inclined to think he is right, and that it is quite probable that he will always fail to find an authority to quote from.

The author introduces a new kind of gravitation called *negative gravitation*, which he says must be inside of the earth, while positive gravitation is outside of the earth. He claims that if a portion of matter on the exterior surface of the earth becomes charged with negative gravitation, it will be repelled and rise from the earth; and he further says, "Strange as it may sound, illustrations of this truth are seen every day! It is illustrated whenever vapors rise in the air." We fail to see why he leaves balloons out in the cold. It would be probably difficult to find a magazine more willing to advance new theories than The Microcosm, provided such theories are based upon scientific truths; but when a writer is not conversant with the elementary principles of science, and advances such crude and unscientific ideas as are presented in this work, we of necessity feel it our duty to denounce the same.

The work abounds in typographical errors, and has evidently been punctuated with the aid of a sprinkling-pot.

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The Microcosm.

March, 1886.

THE SUBSTANTIALITY OF CHRISTIAN FAITH.

BY REV. J. I. SWANDER, A. M., D. D.

The credulous fanatic in religion may say: "I want no philosophy in my faith." If so, he will find the rationalistic intellectualism of the world ready to respond: "I want no faith in my philosophy." In such an issue the two parties are equi-distant from the truth. They put asunder what God has joined together. While true philosophy and true religion are distinct, they are nevertheless inseparable. Separation does equal violence to both. Faith may not be always conscious of the fact that it constitutionally involves elements of philosophy; philosophy may affect indifference, and profess independence of faith; and such mutual disavowal may be continued for a limited period, but final divorcement of the two must always end in common loss. They are twin sisters in the legitimate family of God's ordinations, and must ever complement each other until the two are glorified together.

It is not our purpose in this paper to write concerning the faith of the philosopher, except to remark that any system of thinking which does not concede the entitative existence of an unseen universe must ultimately perish from the earth to make room for something better. We purpose to treat of *faith* as that veritable something predicable of the individual Christian, variously defined in the Holy Scriptures, and answerable to the demands of a sound philosophy.

Christian faith is an *entity*. It is objective in its positive existence, and may become subjective through a manifestation of itself to itself in the form of self-apprehension. It is a creation—not out of nothing, but from the elements already at hand; yet not from these in the sense of evolution, as though the original elements had power to transcend their limited sphere and spring into a higher order of existence. Faith is an entity "born from above," and yet as something conceived in the very womb of human personality. It is not something manufactured to order in heaven and sent in its completeness from the skies; neither can it have birth in the animal or in the angelic constitution. Humanity, as constituted in the image of God, is the only soil receptive of such heavenly seed. This mere receptivity is too generally mistaken for faith itself. Such theology is exceedingly superficial, unscriptural, and unphilosophical. It might just as well call the Virgin Mary's receptivity or conceptivity the veritable Son of God. There is no Christian faith in the human heart until after it has been "overshadowed by the power of the Highest," and quickened by the life of the Highest. Faith is, therefore, the very incipiency of the "new creature" in the being and bosom of the old. This begetting act, and its consequent process of development, does not necessitate the moral visceration of the individual. God does not create a vacuum in a man in order to make room for his heavenly work. The elements at hand are utilized. This is implied in the idea of redemption. The same "old things" which "pass away" "become new." Sin, of course is eliminated, but sin is no essential part of human nature. This beginning of the creation of God in the individuals of the race is faith.

Theology can never solve its most important and interesting problems, and accomplish its God-given mission in the world, until it accepts more heartily the assistance now at hand in the science of biology. In this sphere, and under this view, faith will come to be more correctly viewed as the embryo of the "new creature in Christ Jesus." This embryo, after it is begotten from above, is de-

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veloped according to a vital process of spiritual gestation and growth. Barring the possibility of miscarriage, it passes the stages of its progress, and rises gradually into its higher form of existence, in fulfillment of all the prophecies in the lower orders of being, and in a growing conformity to its own heavenly type. That type is Christ. Such conformity to type is all that the church on earth can ever have, or know, or give as a satisfactory solution of the great scriptural echoes of predestination. Away with mere abstract divinity! The world has had too much metaphysical theology. God "hath chosen us *in* HIM:" and "Ye are complete in Him." That which completes itself in him starts in him. He is the beginning and the end of all principles and processes with which he has anything organically to do—"the author and finisher of our faith." That which starts in him partakes of his nature—of his substance. That which starts organically in him and partakes of his being has life, even as he has life in himself. Life, though not a mere force, is nevertheless always a force. When this life becomes faith, *faith is a force*—the mightiest derivative force in the universe. It is distinct from Christ, and yet as inseparable as it is distinct. The just live by faith, because faith-life is the Christ-life of all whose "life is hid with Christ in God."

That faith is concretely functional we readily allow, but that it is a *mere* function, or faculty of something more real than itself, we cannot admit. Even Herbert Spencer is scientifically orthodox enough to say that "we have next to no power of tracing up the genesis of a function, considered purely as such." Separately considered, there is no such function in existence, and consequently there need be no effort made to trace after its origin. Faith has no being, even as a function, except in its relation to the organ which functionally acts, or rather the organ through which *life* acts in the discharge of *its* functions. The organ is nothing except in the organism of which it is an organic part, just as the organism is destitute of vitality outside of the kingdom or order of being to which it belongs. This assertion will hold true in every department of biology, whether in vegetable, animal, human, or spiritual nature. It *seems*, from a superficial and unscientific searching of the New Testament, that faith is called into existence and consequent exercise before the "new man" is begotten or created, and as a previous condition of such creation; but such, in fact, is not the case. The reverse, rather, is true. This is the very point at which Christianity is called upon to guard against the unscientific heresy of spontaneous generation, of which the popular theology of the age is full. Faith is the introduction into the individual of a new and original factor which makes the new faculty possible. This faculty is generated in man because the new factor brings with it a new order of life and dynamics from the kingdom next above. The kingdom is always behind its peculiar power, and always asserts itself through the agencies of its own creation. We reason not only from cause to effect, but also from the general to the particular, because the general is before the particular in the order of being, and because this is the line of the divine purpose and procedure in all forms of being. "Thy kingdom come" is as really the fundamental law in the Lord's universe as it is the first petition in the Lord's Prayer. In formulating the fundamental truths of the prayer, our Lord was too much of a philosopher—and with holy reverence we may say too much of a Substantial philosopher—to direct his disciples first to pray for deliverance from the negative kingdom of evil, and *then* bring themselves to, or seek for themselves, that positive kingdom by whose substantial powers alone they could hope for such deliverance.

The "king invisible" never asserts his power in either of the several distinct kingdoms of his universal empire, from the mineral up to the mediatorial, without being peculiarly present both in the existence of its elements and in the operation of its laws. If this is pantheism, the Bible is a pantheistic book, and Christianity a pan-Christistic religion. But it is not pantheism. There is no confounding of the creator with the creature. Even the penitent thief, upon the rack of torture, had sense enough to recognize and confess this general philosophic principle as applied to Christianity. In fact, that recognition was an essential element of his faith. The impression made by the regicidal tragedy of the Cross enabled him to exercise his incipient faith in the form of prayer—"When thou comest *into thy kingdom.*" This is no exception to the general law of the empire. The Rock of Ages never crystallized an amethyst without being present in the lapidary of his own work;

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the Rose of Sharon never caused a flower to bloom until he first came in the kingdom to which the flowers belong; and the Redeemer never saved a single son of exiled Adam except as he approached the individual in, with, and through his remedial kingdom.

Such salvation is possible for each individual, because he has already so approached and redeemed the race in its generic sense. The ages bore testimony to the stately steppings of his gradual approach, until it was truthfully heralded forth that "the kingdom of God is at hand." Thus at hand, it involved peculiar forces and functions of its own. While under one view this kingdom which "came down from God out of heaven" was foreign to that of humanity, it nevertheless, conditioned itself to the peculiar constitution and wants of the latter. Scarcely had it appeared above the sin-bedarkened horizon of the race until the challenge of its authority and the saving benefits of its provisions were uttered from the throne within: "Repent, believe; *for* the kingdom of heaven is *at hand.*" This announcement virtually implied that it was the approach of this kingdom which raised the possibility into the power of faith, by laying hold of the only point of contact in man. This point of contact is the *divine image*—defaced, but not destroyed. This involves the *God-consciousness* as a surviving element in the fallen race, and always essential to the constitution of humanity. At this point, in the very center of the individual's personality, may be engrafted "the powers of the world to come," enabling "the blessed and only Potentate" to say in truth to the individual believer: "The kingdom of God *is within you.*" Thus engrafted, the work of Christian growth begins, and the process of individual evolution continues in accordance with the law of spiritual embryology. Thus, "Christ dwells in the heart by faith." The life which the Christian lives is "by the faith of the Son of God." Christ, his kingdom and faith are inseparable, and yet distinct, in the Christian. He spake both of his kingdom and of faith as a grain of mustard seed. We see no escape from such conclusions except by an infidel rejection of God's Word and an unscientific denial of the resolvability, transmissibility, and conservability of force.

Thus faith, whether force, faculty, organ, organism in embryo, or all together, is "the gift of God." As already seen, it is a gift inseparable, yet distinct, from the giver. It is given in a sense somewhat analogous to that in which the sun gives light and vision. The sun not only calls the plant into individual being in the vegetable kingdom, but also calls forth within it the faculty through which it receives the light. The first thing that light finds in the vegetable seed is capacity. So with the possibility of the organ of vision in the animal or in man. The eye is not merely *met* by the light, it is *elicited* before there is any real organ of vision. The truth of this assertion is amply demonstrated in the caves of the earth, where perpetual darkness reigns. In animals long deprived of light there is a tendency to beget a progeny without eyes—or if eyes, without vision. So in the higher and spiritual order of being. Revelation from above is heavenly force coming down. Finding capacity in man, its first creative announcement is like that of Ananias to Saul. "Receive thy sight." *Thus* faith cometh by hearing, and yet it is not faith until it is conceived in the moral protoplasm of the human soul. These two factors must be held in proper relation to each other, in order to a proper conception of the genesis of faith as a substantial and entitative force in the Christian. The kingdom from above, replete with a heavenly purpose, power, and glory, reaches down into the one immediately beneath it in the gradation of being, "touches with its mystery of life the souls of men" "dead in trespasses and in sin," quickens them into a higher order of animated existence, bears them across the otherwise bridgeless gulf between the mere human and that which is divine-human, endows them with its own higher possibilities, and in its own higher sphere of evolution develops within them the new substantial organ of faith—as "a heavenly gift" —by which alone they are enabled to "see the kingdom of God," hear the thrilling raptures of its choral symphonies, taste its savory viands, and appropriate unto themselves that "living bread which cometh down from heaven," and nourisheth them unto that eternal life which is something more and better than mere everlasting duration.

But it may be objected from the stand-point and in the language of John Stuart Mill, that "analogical evidence is but a feeble support, and is hardly ever

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honored with the name of proof." To this Prof. Drummond replies that there is no distinction between natural law and spiritual law; that they are the same, and that there can be no analogy in identity. The rising Scotch philosopher is correct in his claim that there is a "law of laws," and that according to *that* law the same law may deal with *matter* at one end of the universe and with *spirit* at the other, and operate in and through all forces which intervene between the two. Phenomena *may* have analogies; law *must* have continuity. The testimony of analogous phenomena in nature is, therefore, not summoned into court to prove the existence of unseen entities, but into the laboratory to demonstrate the correctness of the rational presumption that throughout the entire range of being force and phenomena sustain the same general relation to each other under the *one* divine-natural law, "whose home is the bosom of God," and whose voice is the harmony of his universal empire. Here beginneth the first lesson in the service of the scientific sanctuary. It is a lesson which theologians must soon study, or fall behind in their silly attempts to keep pace with the pioneer prophets of nature. This being the case, why should scholastic orthodoxy continue to throw up its helpless hands in holy horror when Substantialism announces the discovery of facts, forces, entities, and processes in nature, which, if rightly studied, interpreted and applied, must lead the honest student of God's *one* great handiwork to conclude that the self-revelation which God has made of himself in Christ, and is still constantly making in the experience of the Christian, demands a more scientific consideration and apprehension by the church than has ever yet been possible in all the past history of most earnest search in the narrow field of mere dogmatic theology?

We are aware that some of the views advanced in the foregoing paragraphs are not in exact accord with much modern theology, and that any advocate thereof is in danger of being put out of the synagogue. Very well, gentlemen; but first give us time to shake the testimonial dust from our feet, and to state the real issue herein projected, before you attempt to enforce the ban of our excommunication. We do not allege that christendom has no faith. On the contrary, our theory makes more of faith than yours ever can. Instead of denying, we emphasize the entities of our holy religion. If the Son of Man were to come during this significant watch of the night, he would find much earnest, active faith on earth; but he would never recognize it as a mere mode of either intellectual or spiritual motion. We, rather, allege that this faith does not come to that correct and scientific apprehension of itself which is now possible, owing to the recently-discovered facts, forces, and phenomena in the sphere of physical and biological research. The Church is better than her teachings. Dogmatic statements have ruled her schools; and when the pioneer prophets of truth have undertaken to do a little religious thinking upon their own individual responsibility, they were often unconsciously biased by the prevailing wave-theory of the Gospel, which virtually denies the objective entities of God's remedial kingdom in the world. This mere subjectivism has come to prevail so extensively in the church, because of the false philosophy which for many centuries has ruled in all the regions round about Jerusalem. The reasonings of John Locke and his large school of disciples have not tended to improve the Church's scholastic environments. In consequence thereof, Zion has been led further into the empirical wilderness. Life is too generally viewed as having no reality until it is experienced, and faith as either an effort of nature to transcend its own limits, or a mere mode of motion on the part of the regenerated soul, instead of the very "substance of things hoped for." How unsatisfactory to the Christian scientist! Why? Because such teaching is out of harmony with both true science and God's Word.

What saith the Scriptures? What is the most reasonable rendering of the passages in which the term faith occurs? Limited space admits of inquiry concerning but a few texts. Luke xvii. 6: "Faith as a grain of mustard seed." The reference is not primarily to the smallness of the seed, but rather to the fact that it is the embryonic embodiment of life—that that life is a substantial force, the product of a kingdom behind it, and the possibility of an individual organism before it. Christ was too much of a philosopher to compare faith to a grain of sand. Gal. v. 6: "Faith which worketh by love." In this text faith cannot mean the *action* of the intellect of the individual; neither can it mean the *mere* action of the

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"new creature" formed within him. Action is not predicable of mere action. Back of all and in all there is something more than action. Faith worketh; therefore faith is inseparably distinct from the work—it is an entitative actor. 2 Pet. i. 5: "Add to your faith virtue, knowledge, temperance," etc. Here is a process of addition. Not by outward accretion, or accession of parts, but by development. The seven graces are evolved from the root principle of faith—a substantial entity. 1 John v. 4: "For whatsoever is begotten of God overcometh the world; and this is the victory that hath overcome the world, even our faith." Here is something procreated, generated, even "our faith." It is an entity because it is begotten. Who will dare to step forward and say that God begets *non*entities? It is a force because it "overcometh" some other force. Does not such inspired language justify us in the assertion that faith is the mightiest force in the world, since it *hath* overcome (new ver.) the world? Is there any room left for the meager diet of abstractions so generally served at the crowded table of unphilosophic dogmatics? Out upon this wretched heresy in theology! It corresponds with the untenable theory of molecular motion in physics! No wonder that the faith which is so unscientifically ignorant of its original moorings and entitative existence is often found creeping into its own circular syllogisms without any comforting contents! This is at least one way in which men crawl into the convolutions of their own false logic to indulge in delusive dreams of heaven.

In illustration of the foregoing we ask permission to narrate the following as actually entering into our pastoral observation. We were called to visit an old gentleman in his last hours of earthly existence. He was none the worse for being a Scotchman, and none the better for having imbibed the traditional and transmitted orthodoxy of many generations. He indicated his desire that we should talk to him without reserve. We consequently spoke with freedom and tenderness, as we assured the dying man that Christ was able to save with an everlasting salvation—that whosoever will may come, etc. As we waited a moment for some expression from his lips inspired by the comforting truth of the Gospel, he replied: "I am not afraid to die, because I always had *great faith in belief*." He departed this life with great *faith in the belief* that he was ready for heaven and ripe for glory. The old orthodox father probably passed the pearly portals "as by fire." We are not able to see how he could have gone in by either faith or philosophy.

From what has been shown in some of the foregoing paragraphs, it follows in the way of most logical deduction that faith as a force-entity in the Christian operates in a two-fold activity. It clings to the pure powers that begat it from above, and conflicts with the perverse powers that oppose it from beneath. The Scriptural terms "overcometh" and "victory" imply opposition. These terms would have no meaning in the absence of such "principalities and powers." The "victory" of faith-force implies defeat of *counter*-force. What is this counter-force? Is it something constitutional and normal in the human race, or is it a foreign, adventitious element which the Scriptures denominate *sin?* We affirm the latter. A failure to recognize this truth seems to us the weak point in Prof. Drummond's great book on "Natural Law in the Spiritual World." At least he has failed to emphasize the fundamental fact of the world's substantial forces, normal and abnormal; and for this reason the treatise, which is otherwise a valuable contribution to science, is not worthy to be compared with the "Problem of Human Life." If the great philosopher of Edinburgh has apprehended sin as a force, he has at least failed to apprehend force as a substance. To deny the existence of sin as of such character in the organism of humanity, is to resolve the whole process of human redemption into a sham-battle. Perhaps his eyes were blinded by Supralapsarian theology, held as a mere system of metaphysical abstraction.

But what is sin, concretely considered? The possibility of perversion is not sin. It consists, rather, in the perverse actualization of such possibility. There could never have been such actualization in the sphere of the abstract. After this possibility was actualized in the organism of the race, sin was present, but as something not essential to the constitution of humanity. Although a negative element in its relation to positive holiness, it is nevertheless still a force—a *false force*—in the process of the world's moral evolution. The counteraction and neutralization of this force in humanity is the problem—the work of *redemption*. This is accomplished by that superior life-force which was brought into our nature through the

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incarnation of him who is the "author" of our faith. Even philosophy can see no other way for men to be brought back to the original moorings of their common nature, and carried thence forward to the highest dignity and happiness attainable in the endless ages of the future.

Let the intelligent reader now turn to Dr. Mott's series of excellent articles in the December, January, and February numbers of THE MICROCOSM, on the homogeneity of matter. The great chemist shows most conclusively that the several substantial forces operative in matter counteract and overpower each other. Then let him turn to the August number of this magazine for 1884, and read Dr. Hall's able editorial, in which he reviews Sir William Thompson's earnest effort to discover the sixth sense. That more sense is the great desideratum, even in the Midland Institute, was not the question at issue. Dr. Hall tacitly conceded that five senses were enough for all practical purposes in the economy of nature, but claimed that, in order to perform the legitimate work of science, it was essential that there should be a more general recognition of the world's invisible and substantial forces. Then, to help Prof. Thomson out of his "thin mud" difficulty, the editor announced and demonstrated the fact that one force often neutralized another. That editorial is worth more to the science of theology than whole libraries of platitudenal dissertations from any opposite standpoint. The light of such masterly papers will shine down the ages until they mingle their rays with the rising beams of the millennial morn. Christian seminaries would do well to lay hold of their teachings and apply the principle therein announced and elucidated to the solution of problems found in the kingdom of God. When that is done, the Church, instead of hanging upon the ragged edge of semi-infidelity, will move out of the wilderness and occupy the promised land.

We think that in the foregoing it has been shown that faith, while it is viewed as the substantial germ-principle of evolution in the child of God, must also be apprehended and scientifically treated as a *force element*—a celestial magnetism working by the higher law of affinities—whose mission in part is to neutralize and overcome what may here be denominated the gravital force of sin. New Testament theology will then be more clearly apprehended, consistently held, and logically developed. It will also be more clearly understood by the laity of christendom what Paul meant by the "two laws at war in his members"—"the law of the spirit of *life* in Christ" making him "free from the law of *sin* and *death*."

In the enunciation of such truth, and in the use of such terms, Paul taught Substantialism by inspiration, and applied it to the workings of the force of that "kingdom which ruleth over all." He believed himself filled, surrounded, overshadowed, and uplifted with substantial entities and forces, as he looked for a more enduring substance, and battled for it in the strength of that faith which was the substance of the very things he hoped for and battled for. He clearly foresaw that the last drama of the world would be a splendid illustration of the principles he held and taught: "The Lord himself shall descend from heaven," and "mortality shall be swallowed up of life." By attraction, redeemed humanity "shall meet the Lord in the air," and by repulsion, "death and hell shall be cast into the lake." That will be not only the final catastrophe of terrestrial affairs, but also the grand practical demonstration that true theology is in harmony with the Substantial Philosophy. The saints will shout their anthems through the skies, and give the truth their unanimous approval by a rising vote. Advocates of the opposite theory and teachings will possibly continue to express their dissent by —by moving in the other direction.

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POROSITY.

BY HENRY A. MOTT, PH. D., F. C. S.

In three elaborate articles—"Is Matter Heterogeneous or Homogeneous?"—which have appeared in THE MICROCOSM, I showed that matter was *homogeneous, and not heterogeneous*, and each argument advanced by the physicist and chemist to sustain the latter view was carefully answered in the light of the philosophy of Substantialism, and shown wanting in validity. I stated, however, that while matter was homogeneous, it was more or less porous, and the object of this paper is to consider the porosity of matter.

Porosity is the quality in virtue of which interstices or *pores* exist between the particles (*i. e.*, portions) of a body.

Right at the start, in the consideration of this subject, we are met with a difficulty which has arisen from the application of the word *pore*. As I have previously stated, according to the present teachings of science matter is *supposed* to be composed of molecules, and these in turn of atoms; and again it is *supposed* that neither the atoms nor molecules touch one another. It is therefore *assumed* that there are interstices or pores between these supposed molecules and atoms, the size of which depends upon the dilatation of the body.

Two kinds of pores are therefore admitted: *physical pores*, where the interstices are so small that the surrounding molecules remain within the sphere of each other's attracting or repelling forces; and *sensible pores*, or actual cavities, across which these *supposed* molecular forces cannot act.

Contraction and expansion or dilatation, resulting from variations of temperature, are attributed to the existence of physical pores.

According to this view, then, the cavities of a sponge are not its physical pores any more than the cells of a honeycomb are the physical pores of wax.

Since all bodies are said to be more or less compressible, it is asserted that they must be porous. This, however, is not positive evidence, since we have no knowledge that matter, *per se*, is not compressible *under the ordinary conditions under which experiments are conducted*, independently of the existence of sensible interstices. One fact is certain, however: that an expanded body, under proper conditions, can be compressed or contracted. And right here it will be well for me to state what Dr. Hall first deduced, namely, that the *normal* condition of all bodies is the solid—not the solid we have to deal with, but the solid deprived of all heat. All bodies in our temperature are expanded—whether we consider the so-called solid the liquid or the gas. A liquid or a gas is only in this physical condition owing to the presence of substantial[1] heat—withdraw the heat and a solid results.

Just what the dimensions of a block of iron of one cubic foot dimensions at 60° F. would be, if deprived of all heat, is a problem yet to be solved. One thing is certain, however. When this point is reached, the block of iron could no longer be contracted or compressed to a smaller bulk without disintegrating the mass, assuming no sensible pores. It becomes necessary, therefore, under the ordinary conditions, to distinguish between the *real* and *apparent volume* of bodies, on account of their sensible (not physical) porosity.

The *real volume* of a body is the portion of space actually occupied by the matter of which the body is composed. Its *apparent volume* is the sum of its real volume and the total volume of its *sensible* pores. Of course modern science would make the pores to include both physical and sensible pores, and would state that the real volume of a body is invariable, but its apparent volume could be altered. As, however, I have shown that matter is homogeneous—devoid of molecules and atoms—there can be no physical pores; and since all matter, as we know it, is expanded by heat, it is plain that the real volume of a body, under ordinary conditions, is variable, and not invariable.

Proof of porosity is shown by a piece of chalk, sugar, stone, etc., bodies that will absorb large amounts of water without increasing in bulk. A piece of chalk *is said* to absorb as much as one-third of its own bulk of water, and at the time of

[1] Substantial does not mean material, which latter is only one form of substance.

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absorption air-bubbles are given off. A kind of agate stone, called *hydrophane*, is opaque until wetted, when its pores get filled with water (even to one-sixth of its weight), and under these circumstances the stone becomes translucent, giving a passage to light.

Priestley[2] observed the passage of gases through fine pores in the case of unglazed earthenware retorts, which, although perfectly air-tight, so as not to allow of any escape by blowing in, allowed the vapor of water to pass out whilst air came in, even where the gas in the retort was under a greater pressure than the outside.

Proofs of porosity are afforded even by the metals; for example, many of them become more compact by hammering, as in the case with platinum—and all of them, not excepting platinum and gold, two of the densest forms of matter, however cold they may be, shrink into smaller space when rendered still colder.

From Graham's investigations on the exclusion of hydrogen by palladium, platinum, iron, etc., he says:

"There appears to be (1) pores through which gases pass under pressure or by capillary transpiration, as in dry wood and many minerals; (2) pores through which the gases do not pass under pressure, but pass by their proper molecular movement of diffusion, as in artificial graphite; and (3) pores through which gases pass neither by their capillary transpiration nor by their proper diffusive movements, but only after liquefaction, such as the pores of wrought metals and the finest pores of graphite."

This latter porosity Deville conceives to be an intermolecular porosity due entirely to dilatation. The intermolecular porosity of platinum and iron is not sufficient, he supposes, to admit any passage of gas at low temperatures, but is developed by the expansive agency of heat upon these metals, and becomes sensible in these particular cases about the temperature of ignition.

On the other hand, Rosco and Schorlemmer,[3] when referring to the power of hydrogen to pass through hot iron, palladium and platinum, says:

"Whilst it cannot pass through the metals when cold, probably depends on the fact that this gas is absorbed at a high temperature, and does not require the assumption of anything like porosity in the structure of the metals."

The porosity of cast-iron has been proved by forcing water through a plate four inches thick, and the porosity of gold was demonstrated by the celebrated Florentine experiment made in 1661. Some academicians at Florence, wishing to try whether water was compressible, filled a thin globe of gold with that liquid, and after carefully closing the orifice hermetically, then exposed the globe to pressure, with a view to altering its form, well knowing that any alteration in form must be accompanied by a diminution in volume. The consequence was that the water forced its way through the pores of the gold, and stood on the outside of the globe like dew. Globes of silver, copper, and lead have given like results.

The property of porosity is utilized in filters of paper, felt, stone, charcoal, etc. The pores of these substances are sufficiently large to allow liquids to pass, but small enough to arrest the passage of any substance which these liquids may hold in suspension.

Again, large blocks of stone are often detached in quarries by introducing wedges of dry wood into grooves cut in the rock. These wedges being moistened, water penetrates their pores and causes them to swell with considerable force. Dry cords, when moistened, increase in diameter and diminish in length, a property of which advantage is sometimes taken in order to raise immense weights. Animal and vegetable bodies are the most porous, for internally they are a multitude of interlacing channels, whereby, during life, the nourishing fluids may circulate. Bone[4] is a tissue of cells and partitions, as little solid as a heap of empty packing-boxes. Wood is a congeries of parallel tubes or fibers like bundles of organ-pipes.

Condensed wood is now prepared for various purposes—as for making the pins used in wooden ship-building, for wedges used in fixing iron rails to the chairs—by compressing it laterally to about half its original bulk, and so making it approach the solidity of metals.

It is the buoyancy given by the air contained in the pores of wood that makes

[2] "Observations," etc.—Vol. ii. p. 414. [3] "Treat. on Chemistry."—Vol. i.
[4] See "El. of Physics."—Arnott.

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it lighter than water; for if a log of wood be exposed to the pressure of a great depth of ocean, its pores become filled with water, and it sinks as readily as stone.

PETRIFACTION furnishes a striking proof of the existence of pores in such bodies as wood and bone. The usual explanation given of this natural formation is that at some remote period the wood or bone had been immersed in water which contained silicious or flinty matter in solution, and that this, penetrating through all the pores of the mass, hardened on the decay of the vegetable or animal matter, and at the same time displaced it. In a fossilized substance, then, we have a fac simile—an actual cast—molded by nature in limestone or flint, of the whole system of pores that existed in the animal or vegetable body during life. Just as mercury can be forced through the pores of leather, so it can be forced through the pores of wood.

Another proof of porosity is furnished by diffusion through membranes commonly called osmosis. A thin caoutchouc membrane lying between alcohol and water allows the alcohol to pass through it into the water, but the reverse passage of water into the alcohol is barred. If an organic septum be used, it is wetted, and the water passes into the alcohol. If hydrochloric acid and water be separated by an animal membrane, the hydrochloric acid passes through in greater quantity; both fluids wet the membrane; the hydrochloric acid is most attracted. Hence diffusion can take place through a septum devoid of perceptible pores as well as through one in which observable pores exist.

If the membrane employed be porous, we have the process of osmosis. "The[a] ratio between the amount of water that passes through a porous membrane into saline solution and the amount of salt that passes in the opposite direction is increased by diminution of the pores. This ratio is called the endosmotic equivalent. It is not a constant, but depends on the nature of the membrane; and even with the same membrane it differs according to its thickness or state of freshness, and may be increased by tanning with tannin or chromic acid, which diminishes the size of the pores."

According to Milne-Edwards, for a membrane on one side of which is dry common salt, on the other side water, if the membrane be a piece of cow's pericardium, for every grain of salt which passes into the water four grains of water pass into the salt; with a piece of cow's bladder the endosmotic equivalent is 6. The mechanical structure of a membrane has a marked influence on the process; thus, water will pass more readily inward through frogskin, more readily outward through eelskin.

Heat increases the rapidity of osmosis. An electric current (the "electrodes" being on opposite sides of the membrane) has the singular effect of, as it were, pushing the liquid bodily through the membrane toward the negative electrode.

"Osmose," says Daniel, "is thus related to capillary affinity and to diffusion, but it bears no exact numerical relation to either of these, for it depends on the relation between the pores and the solid parts of the membrane, upon the nature of the material (colloidal or otherwise) of the membrane, upon the width of the pores, upon the temperature and electrical condition, upon the mutual action of the fluids, and in physiological cases (Milne-Edwards' 'Physiologie,' tome v.) it seems to depend on the influence of the nervous system."

The soil is porous, and, owing to its porosity, the ground contains a large amount of air, which is set in motion by the pressure of the air or wind against its surface. The continual movement of the ground atmosphere has an important bearing upon some causes of disease, especially those associated with impurities of the air of our houses derived from the subsoil. Dr. Ford[b] says:

"The cellars of houses, as usually constructed, form no barrier to the escape of air from the subsoil. When artificially heated the force of suction is added to the other forces at work in causing an upward current of air. In this way air may be drawn from a great depth, as well as from a distance laterally, and will convey with it impuritics (it may be diseased germs) derived from the various sources of contamination so frequently present about and under our habitations. In this manner coal-gas, effluvia from privy-wells and cesspools, sewer-gas from defective drain-pipes and imperfectly constructed sewers, and the exhalations from a filth-

[a] "Prin. of Phys."—Alf. Daniel, p. 253.
[b] "Cyc. of Med."—Vol. xviii. p. 406.—Ziemessen.

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sodden soil, which too frequently forms the foundation and local surroundings of dwelling-houses, pollute and poison the atmosphere we breathe."

The porosity[7] of a solid controls to an extent its conductibility of heat—the more porous it is the less rapid will be the conduction. On this account flannel is warmer in winter than silk or linen. It is owing to the air which loose, spongy substances contain that they resist the passage of heat better than those of a closer texture. Thus eider-down and fur make the warmest clothing, because they contain the most air in their interstices. For the same reason cotton-batting is much warmer than the same weight of cotton cloth.

Some curious experiments were made by Count Rumford in 1792, for the purpose of ascertaining the relative conducting power of materials used for clothing. He arranged a thermometer in the interior of a glass cylinder, having a bulb blown at one extremity, in such a manner that the bulb of the thermometer occupied exactly the center of the bulb of the cylinder, and filled the space between them with substances to be examined. The apparatus was then dipped in boiling water until the thermometer marked 212° F. in every case; it was then transferred to melting ice, and the exact time consumed during the sinking of the thermometer through 135° noted. When there was nothing but air between the thermometer and the cylinder the cooling took place in 576 seconds; when the space was filled with twisted silk, in 917 seconds; with fine lint, in 1032 seconds; with cotton wool, in 1046 seconds; with sheep's wool, in 1118 seconds; with raw silk; in 1284 seconds; with beaver's fur, in 1296 seconds; with eider-down, in 1305 seconds; and with hare's fur, in 1315 seconds.

The general practice of mankind is, therefore, fully justified by experiment. In winter the animal heat is retained as much as possible by covering the body with bad conductors, such as woolen stuffs, furs, and eider-down; while in summer cotton or linen is used for the purpose of increasing as much as possible the escape of heat.

The imperfect conducting power of snow also arises from the above cause. When newly-fallen, a great proportion of its bulk consists of the air which it contains, as may be readily proved by the comparatively small quantity of water it produces when melted. Such a provision was designed for the benefit of man, in preventing the destruction, during the cold of winter, of delicate shoots and roots imbedded in the earth. Farmers, in cold climates, always lament the absence of snow in winter, because as a consequence the frost penetrates to a great depth, and does much injury to the grain sown the previous autumn. So great is the protecting effect of snow, that in Siberia, it is said, when the temperature of the air has been 70° F. below the freezing point, that of the earth, under the snow, has seldom been colder than 32° F.

It has been often observed that the heaving of the ground by frost is much less when it is protected by snow than when it is uncovered and exposed. For the same reason many substances which, in the solid state, are quite good conductors of heat, when reduced to powder become very poor conductors. Thus, rock crystal is a better conductor than bismuth or lead; but if the crystal be reduced to powder, the passage of heat through it is exceedingly slow. Rock salt, when in the solid state, allows heat to pass through it with great facility, but common table salt in fine powder obstructs its passage almost entirely. Sawdust, powerfully compressed, allows heat to pass through it with the same facility as solid wood of the same kind, but when loose and unconfined it is one of the poorest conductors known.

Hunter[8] made experiments with charcoal, to determine its absorptive capacity, and found that the volume of the same charcoal absorbed the following quantities of gas at the temperature of 0° C. (32° F.), and under a pressure of 760 m. m. (29,922 inches):

	Vols.		Vols.
Ammonia	171.7	Oxygen	17.9
Carbon dioxide	67.7	Nitrogen	15.2
Carbon monoxide	21.2	Hydrogen	4.4

The more readily the gases are condensed the more is absorbed by the charcoal—which seems to show that the gases undergo, at any rate, a partial liquefac-

[7] See "Int. Chem. Phys."—Pynchon.

[8] *Phil. Mag.*, [4] xxv. 364; xxix. 116.

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tion. Charcoal, less porous, absorbed less gas, as shown by Saussure's investigations.

Melsen[9] found that when dry hydrogen is brought in contact with charcoal saturated with chlorine, a considerable quantity of hydrochloric acid is formed, even when the experiment is carried on in complete darkness; and that when charcoal, saturated with chlorine, is brought into a Faraday tube, and the other limb placed in a freezing mixture. liquid chlorine is obtained. In a similar way ammonia, cyanogen, sulphur dioxide, hydrogen sulphide, and hydrogen bromide have been liquefied. Wood charcoal, like bone charcoal, has the power of absorbing the unpleasant effluvia evolved in the process of decay and putrefaction, as well as the moisture from the air.

Stenhouse,[10] who has investigated this subject, has shown that charcoal not only absorbs these gases and effluvia, but has the power, especially in contact with air, of oxidizing and destroying them—inasmuch as when absorbed by charcoal these substances are brought into such close contact with the atmospheric oxygen, which is also absorbed by the charcoal, that a rapid oxidation is set up, and the odoriferous products of decomposition are instantly resolved into carbon dioxide and water, and other simple compounds.

True pores[11] occur in the walls of vegetable cells, from secondary or ultimate change in their character. They are seen in the cells of the leaves *leucobryum* and *sphagnum*. Other regular orifices are produced in the walls of the cells of many zoospore, producing *confervæ* as *conferva, cladophora,' enteromorpha,* etc. The wall of the sporangial cell of *achlya* present analogous openings, and, according to Cohn, pores are produced in the spore cells of *sphæroplea* to admit the spermatozoids. The pits and interstices between reticulated fibrous secondary deposits are changed into true holes in old cells, resulting from decay of the primary membrane.

From what has been stated it is clear that all solid substances are more or less porous. The absorption of gases by solids being due to the substantial attractive force of adhesion exerted when under the proper conditions, the gas is brought in intimate connection with the solid. In the case of a cubic inch of the metal palladium absorbing, as it does, 935 times its volume of hydrogen gas, it is plain that the substantial attractive force of adhesion controls the substantial force of cohesion and admits the gas, and at the same time condenses the same. The minute that the cohesive force is put under subjection, the substantial heat-force normally present tends to expand the palladium, as part of its work of overcoming the cohesive force is accomplished by the force of adhesion. Assuming the palladium to be only one cubic inch in volume at the start, it is so because the amount of heat it contains has work to do in overcoming cohesion, and therefore can only expand it to this volume.

It naturally follows, as experiment has shown, that by withdrawing the heat from bodies they immediately contract, as the force of cohesion is a substantial attractive force which tends to draw the particles (*i. e.*, portions) of a body together. Heat, therefore, is the great antagonist of cohesion.

Hammering metals will make them smaller, on account of their porosity; but if a body is rendered free from porosity, no amount of hammering or pressure would permanently reduce their volume. Nothing but the withdrawal of heat can accomplish this, and such contraction will only be permanent for some particular temperature in which the body exists.

It must be understood that, according to the philosophy of Substantialism, just as a pound of iron is seen to expand on the application of heat, so will a grain expand—and any fraction of a grain, theoretically, down to infinity, as matter is, theoretically, infinitely divisible; and no experiment or reason has ever shown that a particle of matter, however small, cannot be again divided. The placing a limit to the divisibility of matter, except just this side of infinite divisibility, has neither one experiment nor reason to indorse it. All our knowledge of the disintegration of bodies proclaims to the contrary.

The so-called porosity of liquids and gases will be considered in the next paper.

(*To be continued in the April number.*)

[9] "Comptes Rendus," lxxvi. 81-92. [10] On "Charcoal as a Disinfectant."
[11] See "Micrographic Dic."—Griffith & Henery

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PROF. SCHELL'S PHILOSOPHY OF POVERTY.

BY ISAAC HOFFER.

In a series of papers in THE MICROCOSM Prof. Schell has been philosophizing on the cause of poverty. He takes the position that "the laws of the Creator have been violated, and that the wide-spread poverty over all the civilized world is the result. These laws," he says, "are—first, that a very large portion of the human race has been for ages, and is still, deprived of the *free use of the soil;* and second, that the products of their labor have always been, and are still, heavily taxed." He argues that the free use of the soil is as much a natural right as the free use of light, air, and water.

This argument, unfortunately, is based on an assumption of analogies which have no existence. Light, air, and water are ready for man's use, but the earth is a wilderness full of dangerous animals, and this wilderness must be destroyed, the land prepared for cultivation, and the wild animals subdued, before the earth is fit for man's habitation and use. Comfortable homes and arable soil are not the free gifts of nature like light, air, and water, but they are the product of man's labor; and the one who has transformed the wilderness into a good home, and productive soil for useful plants, is, by all the laws of justice and equity, entitled to the possession of his self-made home, and to the soil which his labor has reclaimed.

The system of holding land in severalty not only violates no law of nature, but is in strict conformity with nature's immutable laws of individuality and of self-preservation, and with the moral laws of justice and equity. Every species of life, and every member of the species, bears the stamp of individuality, and manifests an inclination and disposition for exclusive possession and for self-preservation.

The Professor complains "that the government has given away, or sold for trifling sums, all the land of the country; and at least thirty-five millions of our population, old and young, are deprived of the free use of any of it. In pursuing this course the government has trampled upon the laws of God and the rights of man." This extraordinary statement, and still more extraordinary arraignment of the government, shows a misconception of facts and a contradiction of positions totally out of relation with any logical discussion. The government is condemned for giving the land to the people for nothing, and in the next sentence it is condemned for depriving the people of the free use of it. Such a clear and direct contradiction is unfortunate in a philosophical discussion; but is still not as bad as the total misconception of the facts in the statement "that thirty-five millions of our population, old and young, are deprived by the government of the free use of land."

In the first place, our government always had, and still has, land for the free use of any one who is willing to bring it under cultivation, and make himself a home; and in the second place, there are very few people willing to avail themselves of their "God-given right" to make their living by tilling the soil. The trouble is not with the government, but with the people. Not a single citizen of the whole United States is deprived by the government from the free use of land; on the contrary, the government protects every individual in the right to the free use of the soil, and the home which his labor has secured.

The Professor's unphilosophical philosophy not only deals in self-contradictions, and untenable assumptions wholly out of relation with facts, but confounds the laws and conditions of matter with the actions and works of man, seeks for the cause of poverty in the physical conditions of the earth, and ignores man's responsibility, and human economy, in which alone the cause of poverty can exist.

The whole gist and substance of this poverty of philosophy seems to be opposition to the present methods of civilized communities, and especially to the holding of land in severalty and to the paying of taxes. The paying of taxes is not always convenient, and therefore not always pleasant, but a positive opposition to their payment is wholly inexcusable. The laws of humanity, of sociability, and of moral equity, all unite in making it the duty of every man to give a portion of his labor, or its products, toward securing the protection and the promotion of the

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general good. The chronic growler against taxation, and especially against such taxation as benefits the labor, the industries, and the productions of this country, lacks soundness in public spirit and in true patriotism. It is the spirit of heaven to *give* for nothing, but it is the spirit of hell to *get* for nothing; and Prof. Schell's philosophy partakes entirely of the latter. It wants the free use of the soil for nothing, and objects to paying a fair share of the general expense for the public good.

DIVINE FOREKNOWLEDGE.—No. 1.

BY REV. T. NIELD.

Those who object to the doctrine of divine foreknowledge fall into one or more of three errors.

1. They subject themselves to a course of logical flagellation, and so work themselves into a frenzy of horror, when they indignantly denounce the doctrine; and all this before calmly searching God's Word to ascertain its teachings on the subject. They might better first search and see what it teaches, and then find out what is, and what is not, implied in the doctrine.

2. In forming their opinions of God, they subject him, in a measure, to the limitations of their own capacity. They would comprehend his capacity to know, and what they cannot comprehend they deny. It might be well to concede that he who made the mind can know its motions, and that when he gave the power to will he understood the measure of the gift and what would be the manner of its use.

3. They distort the divine view of duration. There is a sense in which duration—past, present, and future—is an "eternal *now*," a circle seen in its entirety. We do not mean that God does not distinguish the past as that which has been, and the future as that which has not yet been; but that both past, present, and future are, with equal clearness, before his mind. The distant is present to the "mind's eye" of the engineer who is driving to the stations he has seen before. So, in a fuller sense, the future is present to the divine mind. With this fact in mind we can see that, since the Infinite can read man's present thoughts and see the motions of his will, the fact that future thoughts and volitions *are* future does not prevent his seeing them.

That he must have infinite foreknowledge will appear from further considerations.

When a man invents an engine, he intends it to serve some specific purpose in some particular manner; and before it becomes the embodied creation of his brain it is clearly imaged to his mind. In a somewhat similar manner, on a plane of infinite intelligence, the earth was rounded in His mind—complete in all its parts, from molecule to mountain, from animalculæ to man. He who has all duration at command must have predetermined the beginning and the end of time.

In fixing earth's duration, he had a purpose; and he must have known that it would be fulfilled within the bounds of that duration. In seeing that his purpose would be thus fulfilled, he must have known precisely how the various parts would work on which depended the completion of the whole within the measured time; somewhat as the engineer must know the rate of speed at which his locomotive may be driven to know the time when he can reach his destination.

All created things received from him their being. He it is sustains them in their being. He determines their environment, prescribes the laws on which their present and their future are conditioned. Therefore, he from whom, by whom, and in whose hands all things are—who holds the balance of the universe and has appointed when the clock of time shall tick its last—he must know the future acts of men, for whom he made the earth and in whose destiny his crowning purpose is to be fulfilled.

It has been objected to the doctrine of divine foreknowledge that God has chosen not to foreknow human volitions. How the objector probed into the divine mind and brought out that secret we have not been informed. The objection will

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be answered if we try to conceive of the inventor of the locomotive choosing not to know how the pistons will work, or of the watchmaker choosing not to know anything about the movements of the mainspring.

A more common objection is that divine foreknowledge implies human necessity; that what God certainly foreknows will come to pass certainly must come to pass. Therefore, if he certainly foreknows what a man will do, the man can by no possibility do otherwise—the divine foreknowledge determines that he shall do it. Let us apply the argument to another case. I certainly foreknow that my neighbor will die; therefore my foreknowledge makes it impossible for him not to die. In other words, my foreknowing that he will die will be the cause of his death. No; so far is the objection from being founded on fact that the necessity in such cases is on the part of God, not of man. The fact that a man will do a thing shuts God up to knowing just that. He can certainly foreknow only what certainly will be. He could not have foreknown that I would not be born. Therefore we say that divine foreknowledge does not determine human action, but human action determines divine foreknowledge.

Another objection has been stated thus: "If God knew when creating Judas that he would, in the exercise of the will with which *God* was endowing him, certainly betray Christ, and that it were good for that man if he had not been born, then God should have prevented his being born." This objection has a smack of sentimentality that may cause some to overlook its shallowness. Let it be noted that Judas was endowed with no special power, and brought into existence in no extraordinary manner. Therefore, what God ought to have done in the case of Judas he ought to do in all similar cases. Hence, if God should have prevented Judas being born, so as to prevent him committing sin, he ought to prevent *any* being born who will commit sin. To do this he must, in most instances, nullify the law of physical generation and so far destroy the free agency of the greater part of the human race. Nay, he ought not to have made Adam. And thus the doctrine of divine ignorance is invented to save the character of God from being massacred by the savage doctrine of divine foreknowlege. The apology for the Infinite One is, he blundered, therefore he is not to blame!

Without noticing any further objections, we appeal to the supreme authority. He who visited Joseph in his dreams, and symbolized his future, must have foreknown that his brothers would not slay him; that he would be sold and carried down into Egypt; that he would be there exalted to a place of power; and that he would be the means of leading Israel down to Goshen and prepare the way for the enslavement of their descendants. He who commissioned Moses must have foreknown that Israel would receive his message, and that, after refusing for awhile, Pharaoh would ultimately let the people go. He must have foreknown that the infant Jesus would be called out of Egypt; therefore he must have foreknown the course that Herod would pursue, making it necessary for Jesus to be taken to Egypt. He must have foreknown that a price would be set on Jesus; that his garments would be parted and lots cast upon his vesture; that not a bone of him should be broken; that he should be pierced; that he should be numbered with the transgressors, and make his grave with the wicked and with the rich in his death. He who, through his servants, the prophets, foretold these things, must certainly have foreknown them. Indeed, all prophecy is predicated on foreknowledge; for nothing can be intelligently foretold that is not certainly foreknown. And yet all these things were contingent on the actions of men; and since the actions were contingent on the decisions of the judgment and the volitions of the will, he must have certainly foreknown the workings of the mind and will of those with whom the actions originated.

Thus we see that there is a galaxy of Scripture instances in proof of divine foreknowledge. As surely as the Bible teaches that there is a God, so surely does it teach that he foreknows what will be the operations of the mind, the decisions of the judgment, the determinations of the will of his creatures. It is folly to say that he cannot foreknow how a man will purpose and do until the purpose is formed. He knew the denial of Peter before Peter himself thought such a thing possible. And nearly all the prophecies were uttered before the agents in their fulfillment were born; in which cases he must either have foreknown how the will of men yet to be born would act, or he must have predetermined to override their

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will, and so make their actions his own. In other words, since the events that were predicted depended for their fulfillment on the decisions of human minds and the contingencies of many wills, he must have certainly foreknown how those minds would decide and those contingencies of will determine. Therefore, since he has foreknown all that has thus been foretold (and his powers are infinite), his power of foreknowledge must be infinite—foreknowing a part, he does the whole. Or, say that he determined to meet the emergencies as they arose, by the use of effectual means, then the free agency of man is denied, and God is made to assume the responsibility for all that men have thus done under irresistible pressure. Either admit unlimited foreknowledge, or Arminianism out-Calvins Calvin.

THE SUBSTANTIAL PHILOSOPHY.[1]

First Paper.

BY THE EDITOR.

Preliminary Considerations.

The present age, *par excellence*, is one of magnificent strides in human knowledge and human achievement. In a special manner is this true in the domain of scientific and philosophical research and investigation. It is the direct tendency of every new discovery in science, as well as in the mechanic arts, to form thereby another starting point from which to survey new thoroughfares through the unexplored fields and forests of knowledge. Not a single new thought or discovery in any branch of human investigation but sets the compass of the conscientious explorer for new achievements and untrodden paths in new and unthought-of directions. And so it is destined to be forever. This domain for scientific exploration can never be exhausted, as it reaches into the infinite. The further we extend our researches, the more new points of observation in the form of hitherto unknown principles and laws of the physical universe will be established, and the wider, and vaster, and grander will the view into still unexplored regions become.

We make these introductory remarks from our own personal experience, and from our reflection upon the same during the last decade of years. Within that period of time we have seen a score or more of the most cherished and firmly established ideas and laws of physics fade away and become demonstrable fallacies in the simple light of new scientific researches and discoveries. Many of these laws and principles have stood for centuries as established scientific truths, and were considered as immovably correct and settled as were the demonstrated Problems of Euclid. Most of them had been taken for granted by former scientists, under false impressions, as the deceptive results of mere appearances in the contemplation of physical phenomena; and these false impressions, mixed with some truth, having been placed on record in some former text-book, later investigators have been content to accept such conclusions as true, and not to disturb the smooth current of the stream of physical science by going back of such appearances to ascertain the real truth in the premises. Thus have most of the errors in science and philosophy crept stealthily upon the world, till, by a desperate resolve on the part of some reckless investigator, one and then another of these fallacious laws and principles of science have been throttled in their apparently safe retreats in the text-books, and forced nakedly into the light of truth.

Ten years ago we became convinced, by a careful examination of the present teachings of physical science, that a vast amount of what was set forth in the text-books as demonstrated truth was but the reiteration of previous learned guesses which had become sacred from age, and were now regarded as scientific truths from the fact that great investigators had accepted them as such, and had passed them on to other generations with their approval, and sealed with their scientific benediction.

Under the inspiration of this conviction, we began our investigations of the teachings of the text-books on physics, particularly as relates to the nature and character of the physical forces as manifested in the innumerable phenomena of

[1] From the February number of the *Cosmopolitan*.

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the universe around us. We became convinced that upon this fundamental theme the entire scientific world was fearfully at sea; and so radical did we regard the great misapprehension underlying the question of the nature of force, that we conceived, then and there, the absolute necessity of such a revolution in the whole range of physical investigation as would place the teachings of the schools upon an entirely new basis.

It is needless to say, especially to those who have since that time followed us in our different publications, that this early conviction grew upon us with its growth, and expanded at every advanced turn in the investigations which followed, till finally, after a few years, we felt it our duty to the world to announce the *Substantial Philosophy* as a system of rational belief, not only embracing the entire domain of natural and physical science, but extending also to that within the veil, and thereby placing the claims of religion itself beyond either the fear or the favor of materialism.

Previous, however, to this culmination of the new departure in science, in the form of a broad, definitely outlined, and specifically formulated philosophy, we found ourself in the midst of a most formidable scientific warfare, which, for bitterness and severity of attack and obstinacy of resistance, has had few if any equals in the history of scientific controversy. On the circulation of the "Problem of Human Life," containing the initial principles of these scientific departures from the beaten track of physical investigation, the news of its radical assaults and novel positions, so contrary to all the popular text-books of the times, soon spread to the colleges and schools of the country, where the old theories were held as almost sacred truth, and where they were taught to the young students with conscientious scrupulosity. Naturally, such direct antagonism as this book contained to everything that was called science in physical philosophy—and some of it, unfortunately, expressed in anything but conciliatory language, which we now sincerely regret—at once aroused the combativeness of many of the professors who did not wish their classes to suspect them guilty of erroneous teaching; and in less than a year from the first issue of that book, more than two score of the most critical professors of physics in the country had come to the defense of the old theories assailed, and in the most scathing manner had taken exception to both the matter and method of the radical attack. These attempted refutations of the new departures were published in the local and various religious papers to which the different professors chanced to have access, copies of which were invariably sent to us, and sometimes many duplicates were sent by those who had read the book. We are pleased here to say, as a just tribute to proverbial editorial courtesy, that in nearly every case we were not only permitted, but in many instances solicited, to reply to these criticisms. As to the effectiveness of our answers, we have no definite means of judging, save the fact that they usually put an abrupt termination to the controversy in the respective papers involved.

We must not, however, neglect to state here that there were many honorable exceptions among professors in the various colleges, as regards bitter opposition to the new views set forth in the "Problem." We can now, from memory, count on our fingers more than twenty of these teachers, of age and long experience as professors of physics, who became convinced that the old notions concerning the forces (as but modes of motion of material molecules) were entirely erroneous, and that the basic principles enunciated in the new volume which had fallen into their hands, and which were soon to be put forth as the foundation of the universal philosophy of Substantialism, were substantially correct, needing but slight modifications in the details of some of their elaborations to make them completely revolutionary in their effects. These numerous indorsements, which reached us in rapid succession from different points of the compass, and which in many cases hailed with enthusiasm the new departures, proved an encouraging stand-off to the unmitigated opposition and assaults of those who could see but one side to the questions involved, and they were therefore quite unsparingly employed by us and our friends as equally authoritative weapons for silencing such opposition.

This warfare on the one side and approval on the other continued almost unabated for three or four years, using only the local papers of the various vicinities in which the disputants lived as the mediums for presenting to the public both sides of the controversy; until finally a spontaneous demand imperatively shaped

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itself—that the author of this revolutionary crusade against modern scholasticism should have a medium of his own through which to meet all comers, and thus more completely and elaborately to unfold and defend the new departures from the teachings of the schools than was possible to be effected through the volunteer space extended to him in the various newspapers. The result was, THE MICROCOSM was commenced, and, before the first year had closed, it had attained a circulation of nearly twenty thousand copies, thus furnishing ample opportunity for introducing into its pages and extendedly discussing all phases of physical science which bordered on the questions raised by, or in any way involved in, the general scope and meaning of the Substantial Philosophy.

Up to that time the clergy of the different churches had stood comparatively aloof from taking sides on the great questions apparently inseparable from Substantialism, not being sure as to the religious tendency of these radical attacks upon the modern science of the schools. A few of them, however, had shown the patience, perseverance, and fairness of investigating further into the new principles than their brethren generally—had been willing to read—and these impartial examiners wrote to us the most enthusiastic letters of indorsement, many of which were printed in THE MICROCOSM, declaring the belief of the writers that the true key had at last been discovered for the annihilation of materialistic infidelity, and the demonstration of the immortality of man alone from the scientific revelations of Nature herself. These unqualified commendations by the few who had read carefully for themselves the bitterly criticised book, gave courage and hope to others to commence a vigorous investigation of the new philosophy, thereby to know of a surety whether these things were so.

A few of the religious press, in the meantime, in different sections of the country, hearing of the new departures, sent for copies of the "Problem." The result was that reviews and indorsements were forthcoming, the like of which, for unrestrained enthusiasm, was never before read concerning any book on a similar subject. Hundreds of these notices have been collected as a veritable curiosity, in that time, of literary composition. These volunteer advertisements of the book proved to be so effective that it led to the sale of not less than 59,000 copies up to the present writing, an event of the kind without a parallel for that class of work —all because the principles of the philosophy which it foreshadowed, and in part outlined, were what the human soul craves as the absolute antidote to the materialistic tendencies of this age.

These press notices opportunely turned the tide with the clergy—all, at least, who were not too prejudiced to read anything which militated against the scholastic doctrines of science as taught in the various Christian colleges in the land. Such ministers felt sure, even without reading the book, that no new departure in physics could be correct in principle or logic which assailed science and philosophy as taught in these religious colleges and universities, since it appeared to them vastly more probable and rational, on the law of chances, that such educational institutions, with the most learned and cultured divines and scholars in the Church at their heads, must be correct, rather than the sudden announcement of new discoveries by an unknown investigator, who comes without even a credential or indorsement from any recognized seat of learning either in this country or in Europe.

But on the other hand, thousands of equally educated clergymen who had less respect for hoary authority in science or even in religion than they had for their own matured convictions and veneration for absolute truth, after thorough examination of all the facts and arguments in the premises, deliberately resolved that the principles of Substantialism foreshadowed in the "Problem" and elaborated thereafter, were founded in the laws of eternal truth, and that they were so correlated to the principles of all true religion, that even Christianity itself cannot afford to be without the overwhelming arguments furnished by Substantialism from the secret archives of nature in direct opposition to every form of materialistic philosophy. And so fully convinced have become many of the ablest divines, of different religious denominations, of the general correctness of these new principles of science, that they do not hesitate to risk their reputation in the world and their standing in the Church on the final acceptance and triumph of the Substantial Philosophy as a system of religio-scientific doctrine.

Ministers who have thus accepted the new philosophy, as well as scientific pro-

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fessors and teachers, are rapidly increasing in numbers, till it is now claimed by leading and well-informed Substantialists—as the adherents of the doctrine are called—that there are already more than 25,000 firm believers in its substantial scientific principles. This unprecedented spread of a revolutionary departure from the beaten paths of science surely must have its meaning more deeply seated than can be accounted for by any ordinary or fortuitous causes incident to the world's scientific reformations. Its adherents believe in its principles most thoroughly, and have no hesitation in avowing their convictions that Substantialism has come to stay; and so strong is the bond of brotherhood which unites them upon the broad principles of this philosophy, that mere matters of opinion upon outside issues, or even theological tenets, have no disturbing influence whatever among those who have become rooted and grounded in the faith of Substantialism. So fortifying also is this doctrine when fully accepted by an already intelligent mind, that a feeling of invincibility at once pervades it, so deeply laid in the solid cement of truth are its fundamental laws; and then again so rationally and scientifically do these laws interpret every natural mystery, explain the phenomena of the invisible forces around us, and solve the otherwise inscrutable problems of physical science, that an advanced substantialist has no more trouble in viewing mentally the most secret processes going on in the chemical laboratory, or following the intangible play of the attractions and repulsions of magnetic or electric bodies, than would the skilled architect have in watching the developing structure of an edifice being reared according to his own outlined plans and delineations. And still, so essential do the adherents of Substantialism regard these scientific laws and principles for unfolding the mysteries of nature, that they would as soon now attempt to explain the motions of the heavenly bodies without calling to their aid the Copernican system of astronomy, as to undertake an intelligible explanation of the operations and correlations of the physical forces without the light shed upon that subject by the Substantial Philosophy.

The article here presented as introductory to a series of twelve consecutive papers on the subject named, may seem to readers uninitiated into the principles of the new philosophy as prematurely boastful in the tone and manner of its presentation, since up to this point it contains no explanation whatever of the elementary principles of Substantialism, nor even an allusion as to how it is claimed that this philosophy successfully explains natural phenomena, and thereby meets and overturns the conclusions of the materialist: that the soul is but a figment of poetic fancy; that the existence of God is but a myth; and that death, of necessity, ends all. We admit the apparent justice of the conclusion thus intimated; but then we beg of the reader to bear in mind that the plot of Substantialism is an immense and somewhat complex affair; that this is but the opening chapter in a continued story; and that we did not aim in this number to touch upon even one of the principles or laws of the philosophy itself, but merely to enlist the curiosity and interest of the reader by the statement of these preliminary facts and circumstances, so that the principles and laws themselves, when they shall come to be presented. as they will be in subsequent numbers, may be the more likely to command a critical and judicial reading.

We have for years been writing upon the discoveries, facts, and principles of this new philosophy, and upon questions and difficulties having a collateral bearing upon the same subject, until a number of large volumes is the result; and yet, so simple is it, that we could state clearly every law and principle of the Substantial Philosophy in a single page of this magazine, and make it so plain that an intelligent and unbiased reader might easily acquire a knowledge of its peculiar tenets in half an hour. But such a synoptical condensation would fall far short of the absolute necessities of the present status of scientific and philosophical discussion.

It is no exaggeration to assert that scores of collateral questions and scientific themes, involving innumerable problems in physics of a most intricate nature, are so intimately related to, and blended with, the elementary principles of Substantialism, that any brief statement would fall vastly short of giving satisfaction to one who might wish to obtain a broader acquaintance with this subject. We expect, therefore, after this preliminary lesson, to proceed with a series of carefully prepared expositions of the physical laws and principles of science involved, and

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which will be necessary to a full understanding of the new philosophy as here prefaced. We expect, also, as a necessary part of such expositions, to meet and answer any objection which would naturally occur to the mind of an old-school investigator in these departments of physical science.

Such objections, which spontaneously arise in the mind of one who has taught science according to the text-books, and who has had no opportunity of knowing how easily they are disposed of by the Substantial Philosophy, are so numerous and far-reaching, and present such varied phases of physical philosophy, that they have required untold patience on the part of those who have had the labor of formulating these revolutionary principles to properly present them. Such difficulties not only require patience to unfold and analyze them, but they will need an absolute desire for scientific truth on the part of those who would profit by such patient analysis. Although we have given our best energies during the past four or five years of THE MICROCOSM to meeting and explaining these very objections, yet it is not at all to be expected that new readers, who perhaps have never before heard of the Substantial Philosophy, should be aware of the manner of answering them. These papers, therefore, will amply supply such a want; and to all who desire the truth in science, for its own sake—let it cut where it will—we promise a philosophical treat, if they will study carefully this series of papers to the end of the volume. And we do not hesitate to predict that the vast majority of those who shall thus read, with an unbiased singleness of purpose, the arguments we shall have the honor of presenting, will close the series with the conviction that the Substantial Philosophy is substantially true.

A NEW NUT FOR WAVE-THEORISTS TO CRACK.

BY H. F. HAWKINS, ESQ.

Sound is produced by mechanical force. According to the undulatory theory, and as all agree, since it takes force to start the sounding body to vibrating, the vibrating body strikes the particles of air in contact with it and sets them in motion; these act upon the next, and so on to the limits of audibility, according to the theory. If this be true, it is clear that the sound-producing force must follow the same law as all the other mechanical forces of the universe. There must be a constant ratio existing between the force employed and the work to be done or resistance to be overcome.

To illustrate: If two men can lift 1000 pounds, four men can lift 2000 pounds, and one man 500. Now let us apply this law to the wave-theory of sound, and show that there is no relative proportion existing between the force employed and the work claimed to be done by it, and also that it destroys the theory altogether. *The force used is the sounding body* (by its vibrations); and since the motion of the air is the veritable sound itself, or cause of sound, it follows that *setting the air in motion from the center of disturbance to the limit of audibility is the work done.* Suppose a fire had broken out in your city. A fireman lays hold of an engine and proceeds to haul it along the street, but can only proceed at the rate of ten feet in a minute; two, four, or six other men come to his assistance, and the engine is carried along at a run. A train of cars must be moved, and one locomotive can scarcely start it, but hitch on two or three and the train moves off at the rate of forty miles per hour. But the firemen desire to sound an alarm, and ring a bell that can be heard for half a mile. In this case the *force used is the vibration of the bell, and the work to be done is to set the air in motion contained in a hemisphere having a radius of half a mile.* This it actually does, according to the wave-theory of sound, and the motion is transferred from particle to particle of air throughout this hemisphere *at the uniform rate of* 1120 *feet per second from the start to the limit of audibility.* Being anxious to spread the alarm as quickly as possible, the firemen ring six bells of the same size as the first, at the same place and at the same time. Now, the work to be done is the same as when one bell was sounded, and the force used is six times as great; but behold, the sound still travels at the original rate of 1120 feet per second. The additional force used had no additional

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effect, as in the case of the engine and the train of cars. The proportion of cause to effect fails.

Again. When we sound a bell the force employed is its vibrations, and the first shell of air set in motion, say with a radius of one foot, is the work to be done. This is done, according to the wave-theory, at the rate of 1120 feet per second—no more nor no less—since the rate of travel is uniformly 1120 feet per second *from first to last*. The force has, therefore, exerted its full strength on the first shell and produced the air-motion at said rate, and this rate cannot possibly be increased, no matter what the force used. Now, according to all the known laws of mechanics, if it takes a given force a certain time to accomplish a certain amount of work, it ought to take the same force four times as long to do four times the amount of work. Now, our bell set the first shell of air in motion in the $\frac{1}{1120}$ of a second. The sound now passes into the second shell with a radius of two feet, and proceeds to set it in motion like the first. The force used here is the same that produced the motion in the first shell (provided none was lost by the work already done), but the work to be done is four times as great. Since "sound intensity decreases as the square of the distance," etc., it follows that the force employed to do the work in the second shell is relatively only one-fourth as great as in the first, and ought to require four times as long to do the work. Hence, the rate of sound velocity through the second shell should be only 280 feet per second, and in the third shell $124\frac{4}{9}$ feet per second. The fact is, however, that if we enlarge the sphere, or shell of air, until its radius becomes half a mile, containing thousands of times as much air as the first, and thousands of times as much work to be done, yet the same force (certainly no more) sets this in motion as quickly as it did the first shell. If there is such a principle as this in mechanics, it is high time men knew it, and some wave-theorist ought to demonstrate it.

Now, if the premises and conclusions above set forth are correct, and if sound intensity decreases as the square of the distance, on account of the second shell containing four times as much air as the first, it follows as a necessity that the sound-producing force is relatively weakened in respect to the work to be done. The above law must hold good whatever distance be assumed for the radius of the first sphere of air. Instead of taking a foot, let us assume an indefinitely small radius, say one-tenth or one-thousandth of an inch, and I assert *there would be, and could be, no sound beyond the first assumed shell of air, be that ever so small.* Since we know of no sound with a less velocity than 1120 feet per second, we are justified in assuming that any less velocity would not produce sound. Hence, there would be no sound beyond the first infinitesimal shell of air, for want of sufficient velocity. The sounding body would have to be placed inside the ear, in direct contact with the auditory nerve, before that organ could ever be brought within the range of audibility.

There are several other considerations that might be urged, and I might also go on to show how the problem of the uniform velocity of sound is explainable according to the Substantial Philosophy, but space will not permit.

"SCIENCE FALSELY SO CALLED."

BY REV. T. WILLISTON, M. A.

In penning the above words Paul doubtless had his eye on certain beginnings of what was afterward termed Gnosticism—on theological errors then beginning to prevail, the authors of which assumed to be endowed with superior knowledge. But these words are so applicable to, and so well indicate and describe, certain facts with which we are now conversant, that they seem to have had a prospective reference, and to have been uttered prophetically. Paul would seem to have been prophetically aware that in the distant future, no less than then, Christianity would encounter opposition under the guise of scientific research or philosophical inquiry; that under the name of genuine science theories and hypotheses would be propounded which some—the superficial and godless—would eagerly accept as being in their view a triumphant refutation of the Bible, or as giving parts of it,

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at least, a fatal stab. It was not knowledge (gnosis) or science in the true sense of those words that Paul was afraid of, or that he would have Timothy guard against. He very well knew that knowing a thing to be true and merely conjecturing it to be so, are widely different; and knowing that the material world and the Scriptures are the production of the same divine Author, he was sure that between true science and the Bible there could be no possible antagonism. The word science carries with it the idea of certain knowledge. It supposes that the thing affirmed to be true is susceptible of demonstration, or is so obviously true that its truth cannot be disputed. Experience has taught us, moreover, that in the progress of scientific investigation many things have for a time been accepted as scientific truths, which have subsequently proved to be ingenious hypotheses merely. Erroneous and intrinsically absurd as it was, the Ptolemaic theory of the universe was for some 1400 years the accepted astronomical science, so to speak, of the civilized world; and it is but 244 years since Galileo, for the awful heresy of adopting and advocating the Copernican system, and affirming that the earth revolved, was compelled to kneel before the assembled monks in Rome, and with hand on the Bible, say (in Latin): "With heart sincere and faith unfeigned, I abjure, rail at, and abominate the above-named errors and heresies"! And yet the system which Galileo was thus made to verbally renounce—not mentally—is demonstrably true, and is science in the true sense of that word, while the systems of Ptolemy, Tycho Brahe, and Descartes were, at best, but scientific conjectures.

From Newton's time up to within less than a century, the emanation or corpuscular theory respecting light, taught as it was by that prince of philosophers, was almost universally believed to be a scientific verity, and every scholar in optics was made to believe that vision was ascribable to a ceaseless emission of luminiferous matter from the sun and other luminous bodies, and the striking of this matter against our visual organs. Every day our eyes were cannonaded with these solar balls that had an immense distance to go, and that moved with terrific velocity; and all that saved us from having those delicate organs riddled and put out, was the almost infinitesimal smallness of the balls! How Father Sol managed to repair the waste that this constant and long-continued cannonading must have made, or how, in other words, he kept himself from getting out of ammunition, was a wonder which we tyros in science were left to explain as best we could. Ah, how powerless was even Newton's great name to perpetuate this long-believed corpuscular theory of light and vision. And how refreshing it was, both to eyes and mind—through the aid, first of Descartes, and then of Huygens, Euler, Young, and others—to have the theory of undulation take the place of the corpuscular, or Newtonian, hypothesis.

From such well-known facts as the foregoing it is obvious that what passes for a scientific truth at one period subsequent investigation may cause to become an exploded theory. And the lesson we are taught is, that as "all is not gold that glitters," so all is not science that assumes the name, wears the aspect, or employs the dialect of science. We are taught, too, that in science as well as religion we are to "*prove* all things," and "hold fast" only "that which is good;" that skeptics will do well not to clutch too hastily the various atheistic or anti-biblical theories and speculations that are put forth in the name of science, "lest haply" the time may come when "all that behold shall begin to mock," exclaiming: "Spurious science! science falsely so called! These skeptical theorizers began to build and were not able to finish!" Dear Mr. Prussing, not quite so fast. If it be true, as you say (see the *Evangelist* of July 12th, first column of the eighth page), that "that man is a fool who does not *know* that the discoveries of modern science have utterly exploded all the teachings of the Bible," then it is certain that the fools outnumber the sapient few a thousand to one; and it greatly consoles one of the fools to find himself on the side that is numerically far the strongest. But since it is mortifying, after all, to be a fool and always remain one, will you not, dear Mr. Prussing, become my teacher and tell me how I may "*know*"—not surmise, nor conjecture, nor opine, but *know*—"that the discoveries of modern science have utterly exploded all the teachings of the Bible"? Since without being *sure* of this I must remain a fool, please commiserate my ignorance and put me in possession of all the scientific facts and demonstrations whereby the Bible and its teachings are "utterly exploded." Meanwhile, and before the demonstrations come that are

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to annihilate the Bible and all my reverence for it, let me inquire of you, as one familiar, of course, with the Scriptures, and skilled in biblical exposition, the meaning of this very paradoxical passage, lately met with in the exploded old Book: "If any man among you seem to be wise in this world, let him become a fool, that he may be wise." The meaning also of this: "Professing themselves to be wise, they became fools." And of this: "He that sitteth in the heavens shall laugh; the Lord shall have them in derision."

REMARKS ON THE FOREGOING BY THE EDITOR.

The above able and very interesting paper which we print from the pen of our esteemed contributor, Rev. Mr. Williston, was written before he had read the "Problem of Human Life" or THE MICROCOSM. But for this fact, most probably his second paragraph, concerning Newton's corpuscular theory, might have been differently worded, or at least might have contained some additional matter by which a different light would have been thrown on this whole question, and our good friend would not have been left so much in the dark on the theory of light.

Newton's corpuscular view, or his "emission theory," as it was usually called, which taught that light consists of *material particles* emanating from the sun, and entering our eyes at a velocity of nearly 200,000 miles a second, is certainly one of the most irrational theories of science ever entertained by a philosophical mind. To suppose that material particles, however small, could enter the eye at such enormous velocity without impairing so delicate and sensitive an organ is, to say the least, to exhibit a degree of mental weakness wholly incompatible with sound philosophical thinking; and that Newton could ever have entertained such a conception of light is one of the marvelous incidents of his scientific career which tends greatly to discredit his real and most valuable achievements.

Had he chanced to think of the classification of all physical substances into *material* and *immaterial* entities, which was first announced to the world in the Substantial Philosophy, all his difficulties about material light particles, as well as all necessity for Huygens' undulatory theory of *ether*, would have been obviated. His supposed corpuscles of light, instead of being *material* substance, would have been transformed into *immaterial* substance, analogous to other immaterial but substantial forces, such as magnetism, electricity, heat, gravity, etc. With such a transformation there could at once have been had an explanation of the wonderful mystery involved in the passage of light through diamond, the hardest of all crystals, as freely as through air—a fact which is totally inconceivable on the hypothesis of light being material particles.

Is it possible that Newton could have believed that magnetism, had it been constituted of actual material corpuscles, could pass through sheets of glass as if nothing intervened, and seize a piece of iron on the opposite side, lifting it bodily against the force of gravity? He never ventured to assert such an unphilosophical doctrine about magnetic rays, though it would have been no more absurd than what he did teach as to the material nature of light corpuscles and their free passage through glass. His views of magnetism were, no doubt, like those of a former contributor to THE MICROCOSM, who now holds, in opposition to Substantialism, and for reasons best known to himself, that magnetic *force*, which thus reaches out through impervious sheets of glass and lifts iron bars, is only the "*active property* of the magnet"! If this was Newton's view of magnetism, why did he not consistently claim that light was an "*active property*" of the sun, which produces phenomena ninety-five million miles away from the body to which, as a *property*, it necessarily inheres and is confined?

One word more here upon this important distinction, as there may never be a better time or place for it. The sun possesses a luminous *property;* but that is by no means the light-*force* which such property permits to emanate for millions of miles away from the sun. The dynamo apparatus also possesses an electrical *property;* but this is very different from the electric *force* which such property allows the apparatus to transmit over a wire. The bell possesses a sonorous *property;* but this is by no means the sonorous *force* or the *sound* which such property permits to emanate for miles distant when the bell is struck and its peculiar property is thereby taken advantage of. The man who, from splenetic opposition to Substan-

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tialism or incapacity to grasp so simple a truth as here set forth, cannot see that the magnetic *property* of a steel magnet is not the magnetic *force* which that property allows to go forth and lift a mass of iron at a distance, ought immediately to imitate the ascidian and fasten himself permanently to some neighboring rock, as a token that his "active property" of progressiveness has come to an untimely end.

But what did Huygens propose, and what did Newton finally accept, as a substitute for the impracticable material particles which so endangered human eyes? Was either of them fortunate enough to strike the happy mean of an immaterial physical substance that can act independently of all material conditions? Not a bit of it. They invented and accepted as a substitute for material light-particles an all-pervading material *ether*, having, as Prof. Tyndall declares, "the property of inertia" as well as that of a "jelly," and as Sir Wm. Thomson said in his lecture in Philadelphia a year ago last October:

"I am afraid that, after all, I have left you a little in doubt as to what this luminiferous *ether* really is. It is *matter, millions of times less dense than the air, but possessing the most prodigious rigidity in comparison to its density.* This luminiferous ether is an *elastic solid. It has the rigidity and elasticity of a solid,*" etc.

These scientists, then, teach that this "*rigid*," "*solid*" "matter" dashes in waves into our eyes with the velocity previously named, of nearly 200,000 miles a second, and at the prodigious rate of 699,000,000,000,000 impacts a second, and all, too, without our feeling anything "solid" touching our eyeballs. A pretty substitute this for Newton's corpuscular emissions, by which to avoid putting out our eyes! If a more stupendous philosophical fallacy than here set forth was ever framed into a scientific hypothesis, we are not aware of its publication.

We believe that our venerable and excellent friend Williston, when he comes to know what kind of a theory Huygens did really substitute for Newton's material light-particles, will revise his estimate of that champion monstrosity of this age, and select a better illustration for his otherwise masterly argument against "science falsely so called." Should he need any assistance in obtaining such illustrations, let him call on the Substantial Philosophy, at 23 Park Row.

HOW CAN GOD BE EVERYWHERE AT THE SAME TIME? FROM A SCIENTIFIC STANDPOINT.

BY PROF. G. R. HAND, A. M.

From a scientific and materialistic standpoint, the above question is often propounded. Indeed, it is a legitimate offspring of materialism. For, from that standpoint, the idea of an intelligent, substantial entity, empowered with ubiquity, must appear somewhat nebulous, though clearly recognized from a Scriptural view.

The Psalmist says: "Whither shall I go from thy spirit? or whither shall I flee from thy presence? If I ascend up into heaven, thou art there; if I make my bed in hell, behold, thou art there. If I take the wings of the morning, and dwell in the uttermost parts of the sea, even there shall thy hand lead me, and thy right hand shall hold me."—Psalm cxxxix. 7-10.

When the woman at the well suggested the Samaritan idea that Mt. Gerizim was the place to worship God, in contradistinction to the Jewish idea that Jerusalem was the proper place, Jesus announced the ubiquity of God, by saying that the time was coming when it would not be necessary to go to either *place* to worship God, for "God is a spirit."—Jno. iv. 24.

With this divinely-announced proposition, we now step into the fields of science, for illustrations, and meet the skeptical scientist on his own grounds.

1. Entomology.—We take our stand, if you please, in close proximity to a colony of ants, and watch the movements of these diminutive insects as they march in regular order, and perform their work as systematically as if under the guidance of some intelligent superintendence. We take in all their operations at a glance.

But imagine the discussion of these insects, as a little ant, who has passed by and seen you, reports that a living being is standing over there, so large that he can see all of us at once, and see what we all are doing. A little ant steps up and says: "You can't make me believe that. We can see only a short distance, and I can't believe a living being exists large enough to see us all at once." This is only a little skeptical ant, and perhaps you pity him. But we let him pass.

2. Animalcula.—We next visit the animalcula in a glass of water. One drop of this clear water, placed in the focus of a jet of light, in the oxy-hydrogen microscope, will cast upon a screen in view of an audience, its shadow, some fifteen or twenty feet in diameter, in which are the shadows of the living and moving animalcula, of all sizes, ranging from the size of a full-grown hog down to the point of merging into invisibility; and these swimming around and chasing each other, and, with tusks and claws, engaging in deadly conflict.

Now, suppose that little ant comes to the tumbler for a drink, and, falling in, is struggling on the surface of the water. We ensmall ourselves and go down into the glass of water to listen to the discussions of the animalcula, as they look up in astonishment at the efforts of the ant to release itself from its predicament. One suggests that it is a thundercloud stranded. Another ventures to call attention to its actions, so like a living animal. One little fellow says he can't accept that, as we cannot conceive of a living being so much larger than we are! Here we have another skeptic, and the subject of skepticism is the magnitude of our former little skeptic, the ant.

3. The Solar System.—Even skeptical scientists admit that the sun—the center of the solar system—reaches out its powerful arm and holds the planets in their orbits; and that the last discovered planet, Neptune, that runs upon the outside track to "hum the wild, eternal bass in Nature's anthem," at a distance of twenty-eight hundred and fifty millions of miles, in a period of one hundred and sixty-five years, shapes its orbit by the influence of that same far-distant sun. How can the sun be everywhere?

4. The Sidereal Heavens.—We turn the great glassy eye of the telescope toward the starry heavens, and as we steadily apply increasing magnifying power, and probe the depths of the heavens, new stars respond to the call and present themselves in the field of vision, till we seem to have arrived at the frontier regions of the illimitable. Here astronomers admit that each fixed star is the center of a stellar system, as our sun is the center of the solar system.

Then they claim to have demonstrated that our sun, with its retinue of worlds in its train, is revolving around some great far-distant center, in an orbit, the cycles of which are yet among the undeveloped secrets of eternity. All this admitted, and yet skepticism in regard to God is strangely crowded into the same mind!

5. Hydrostatics.—To draw an illustration from hydrostatics, we will construct a box one foot square inside and one thousand feet long, fill it with water, and fasten down the lid. I make an aperture at each end of the box in the lid. As I press down upon the water at this end of the box, you, standing at the other end, may feel the same force of upward pressure in the aperture there. I fill a tube inserted in one aperture, to any given height, and the water will instantly rise to the same height in the tube inserted in the other aperture, though a thousand feet from me. I make any number of apertures between the two extremities of the box, and the pressure upon the water in one aperture will be instantly felt at all the apertures.

6. Pneumatics.—For illustration, suppose the cylinder of an air-pump will contain just one-tenth as much air as the receiver. Then at one motion of the piston one-tenth of the air will be exhausted from the receiver, but the remaining nine-tenths will expand and fill the entire space in the receiver; one more motion of the piston will remove one-tenth of what was left, but the remainder again expands and fills the whole space. Continue the process till an approximate vacuum is produced, and the last particle of air remaining will still fill the entire space of the receiver.

7. Attenuation of Matter.—We now return to our hydrostatic box and take off the lid and let all the water out. I will now fill the box five times with different kinds of material, without emptying it, and then send another substance

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through from end to end, without any impediment from the already five-fold occupancy.

(1.) From a pyramid of material, the elements of which are four inches in diameter—metallic cannon-balls—I first fill the box. As the balls are four inches in diameter, and the box one foot square inside, three balls will just reach across, and three rows fill to the top, nine balls, then three such layers, or twenty-seven balls, will just fill a cubic foot; and as the box is a thousand feet long, it will hold just twenty-seven thousand balls, and not one more.

(2.) Next, from a pile of material of smaller elements, bullets, I fill the box, and the bullets fall in and fill the spaces between the cannon-balls.

(3.) I now fill the box with small shot, which fill the interstices among the bullets.

(4.) I then pour in finely pulverized sand, which permeates the spaces amongst the shot.

(5.) Finally, I fill the box with water, fasten down the lid, and perform again the above-mentioned experiments in hydrostatics.

(6.) With the box thus five times filled, I insert the end of a wire into the central ball in each end of the box, and connect the other ends of the wires with the positive and negative poles of a galvanic battery, or, still better, with a heavily charged Leyden jar. On applying the discharger, a charge of electricity goes dashing through the entire length of the box, regardless of the five-fold occupancy of the space, and returns to the jar, equalizing the distribution and restoring the equilibrium of the electric fluid stored in the tin-foil.

I have introduced material substances successively more and more attenuated, till fluid and aeriform elements have been manipulated. Then, standing almost upon the verge of material substance, and looking across the chasm, if chasm there be, to the hither verge of immaterial substance, I invite a substantial entity from the immaterial host to come forth, and he leaps from his hidden ambush with a stately bound that sets at defiance and tramples under foot all grosser materialistic obstacles.

8. Electrical Experiments.—Passing the invisible line between attenuated matter and immaterial substance, we pause to pay our respects to electricity. Before a large audience in a public hall the lecturer has his battery and Leyden jar. He invites the ladies and gentlemen to form a line around the room, by taking hold of each other's hands, and connects the two ends of the circle with the battery or jar. You watch the result. You see not the invisible current, but you see its effects. If the battery, you see them trembling as if convulsed by some irresistible power. If the Leyden jar, you see an instantaneous and simultaneous convulsive jerking of the elbows all around the circle. Here is an invisible power, before which all the potencies of matter turn pale and sink into imbecility.

9. Electric Telegraph.—When Franklin had lassoed the lightning steed, it remained for Morse to harness it to the telegraph with wire and battery, and bid the lightning speak. And now if you desire intelligence from distant climes, you have but to tell it to the lightning and it answers back.

10. The Train-Dispatcher.—All along the line of the railroad are trains going, returning, or side-tracked, and yet the train-dispatcher knows, at every hour of the day or night, where each train is, though hundreds of miles away. The conductor of that train on the side-track, having lost the right of way, is not at liberty to start without orders from the train-dispatcher. Is a bridge broken down, or an obstruction on the track? the train-dispatcher receives and distributes the intelligence all along the line, and conductors of trains are all warned of the danger. The conductor who would disregard that warning, though placed on record at each station, would be deemed culpable. Thus the train-dispatcher holds the lives of thousands of human beings in his hands, and warns them of the danger that awaits the further pursuance of their course.

But he also has it in his power to plan their destruction, should he will to do so. He can order a train, at a certain station awaiting orders, to roll out and make the next station in a given time, knowing that it will collide with an approaching train, in rounding a dangerous point on a steep mountain-side, where the collision will inevitably hurl both trains down the precipice into the yawning depths, sending hundreds of passengers in a moment into eternity.

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The train-dispatcher who, through electricity, becomes so ubiquitous, is only a human being. And cannot God, the great train-dispatcher of the universe, through the divine spirit—an immaterial substantial entity—warn us of the danger in pursuing a certain course, and the salvation from that danger to be found in another course? Having seen the attenuation of matter, and the superior power of a still more sublimated substantial entity, electricity—to which may be added magnetism, attraction, cohesion, gravitation, heat, light, sound, etc.—can we not conceive of an all-pervading spirit superior to all these, rising above, guiding, and controlling them all? This brings us back to the starting point, or primary proposition that "God is a spirit."

The skeptical scientist believes all the wonders I have presented in the preceding illustrations from the sciences—and it requires as much credulity to believe these as to believe in a God. Indeed, it is more reasonable to believe in an all-pervading substantial entity, an intelligent vital superintending spirit, the creator and ruler of all, than to believe that all these wonderful phenomena are harmoniously manipulated by chance, or the blind potencies of inanimate matter. In the light of revelation and science, teleology beams forth in all the works of creation, proclaiming God everywhere.

LIFE AND THE BIOPLAST.

BY REV. JOS. S. VAN DYKE, D. D.

III.

A few concessions have been made by our opponents, as follows:

1. "The phenomena which living things present have no parallel in the material world."—Prof. T. H. Huxley, "Encyc. Brit. Biology."

2. "The increase of size which constitutes growth is the result of a process of molecular intussusception, and therefore differs altogether from the process of growth by accretion."—(Idem.)

3. Any and every mechanical theory of life finds a very serious obstacle in the genesis and continuance of self-consciousness. This is conceded by Huxley, Tyndall, Spencer, Haeckel, Bain—indeed, by nearly all the advocates of the molecular hypothesis, some even acknowledging that it is an obstacle that has not been surmounted, and is seemingly insurmountable. Undisputed.

4. The bioplasts which produce nerve cannot be constrained either by forces resident in the body or by external influences to produce muscle. Each set performs the work for which it was seemingly designed, and no other work. Though they are apparently precisely the same, in plant and in animal, in muscle and in brain, the results of their labors are entirely different. This is conceded by all.

5. Bioplasts, though very near each other, never interfere with each other's growth, and never coalesce. Conceded.

6. The several sets of bioplasts, each independent of the other, produce, as a joint result of their labors, a complicated network of muscles, tendons, nerves, etc. This result, not alone in its individual parts but in its totality, evinces design. Undisputed.

7. "All that is at present known tends to the conclusion that no cell has arisen otherwise than by becoming separated from the protoplasm of a pre-existing cell; whence the aphorism 'omnis cellula e cellula.'"—Prof. Huxley, "Encyc. Brit. Biology."

8. "Substances which are appropriated by one form of bioplasts will act as poison on another." This is asserted by Dr. Beale, and is unchallenged by his opponents.

9. "The chasm between the living and the not living the present state of knowledge cannot bridge."—Prof. Huxley, "Encyc. Brit. Biology."

May we not, from these concessions alone—others might be added—construct an argument sufficiently powerful to overthrow the mechanical theory? If "the phenomena which living things present have no parallel in the mineral world," is it legitimate to assert that life is molecular arrangement? The assertion, unsup-

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ported by proof, is a pure assumption, seemingly. To assert that because matter under different forms may have different properties, therefore, when its molecules are arranged in a particular way by "ordinary forces," life is one of its properties, seems considerably like a *petitio principii*. That inertia is one of the properties of matter science has proved. That mobility is a property of air can be established. That expansibility is a property of gas is susceptible of proof. Has it been proved that life is a property of matter, provided its atoms are arranged in certain ways? No. It has been assumed to be, merely because matter assumes new properties when new combinations are effected.

Moreover, if we are to accept the statements of certain scientists, we are under the necessity of regarding bioplasm, Dr. Lionel S. Beale assures us, as "hard and soft, solid and liquid, colored and colorless, opaque and transparent, granular and destitute of granules, structureless and having structure, moving and incapable of movement, active and passive, contractile and non-contractile, growing and incapable of growth, changing and incapable of change, animate and inanimate, alive and dead."

This theory, under whichever aspect we view it—the purely materialistic or the semi-teleological—fails utterly in explaining the sense of personal identity. If I am simply a mechanism, molecules of matter arranged in certain ways, which molecules are incessantly changing, new ones taking the place of those removed from the system, how does it happen that I retain the sense of personal identity down even to old age? I believe myself the same person who, at the age of five years, received the dying counsel of an endeared father. The body, however, has passed through several entire changes—modern science says I have had a new body every year. How could these evanishing atoms, whatever their molecular arrangement may have been, communicate to their successors the facts intrusted to memory? Can they convey, even down to old age, the loves, the hatreds, the moral principles and the settled judgments, the fears and hopes of an entire antecedent life? Strange. If, as some expect us to believe, these treasures are the possession of an underlying reality, which has two sets of properties, the material and the spiritual, then what is the agency by which this "single undivided reality" becomes possessed in man of properties so diverse from those it possesses as it underlies platinum? Has platinum sensation and consciousness and memory? Does the mentality of the crystal differ only in degree from mentality in man? Reason is disposed to answer: Upon the theory in question no explanation is possible of many of the phenomena of human existence.

If, as is confidently affirmed, bioplasts are precisely the same in every living organism, then—since some weave tendon; some, muscle; some, nerve; some, brain; some, mule; some, cabbage; some, oyster; some, rose, etc.—manifestly there must be some power back of them which causes them to produce such diverse results. If these materialistic philosophers are mistaken in affirming that all bioplasts are exactly alike, then what makes them to differ? Has each species of bioplast a molecular arrangement peculiar to itself? Science, it would seem, has not yet struck its hammer upon the foundation-stone of life. If bioplasts do not differ, why do the results of their working differ so widely? Causes precisely alike ought to produce effects precisely alike. If they differ, and the difference is due to different "molecular arrangements effected by ordinary forces," what is the agency which causes these "ordinary forces" to present such diverse results? Who taught these different kinds of bioplasts to work harmoniously in the production of the greatest miracle ever performed in the universe—the construction of a human body? Who gave them instructions in so correlating its parts that they might be all subject to the will? Who educated them in the art of transmuting nutrient matter into living matter? If the transformation is a mere change in the arrangement of the molecules, effected by physical forces, why may not physical forces effect, in the animal kingdom, the requisite molecular arrangements with inorganic matter, constructing animals directly from mineral substances, and not, as is invariably the case, from pre-existing bioplasm? After explaining why animal bioplasts are thus restricted in their operations, while vegetable bioplasts, which are declared to be precisely the same, are capable of working inorganic matter into living organisms, the materialist may proceed to inform us whence the animal bioplasts acquire the skill of weaving a nerve through and around a muscle,

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a tendon through an opening left in a bone for its reception. What agency directs the working of these infinitesimal units of life? Materialism answers: It is all mechanism—pure mechanism—without any superintending agency which directs the myriad movements of the complicated machine. Reason asserts: No.

We are safe, then, we think, in affirming that it is irrational to assume that several sets of bioplasts, acting independent of each other and without any supertendent, should produce a joint result which evinces marvelous design. How do they happen to construct a socket and a ball to constitute a joint? How are they induced to construct an eye fitted to receive light, and a nerve adapted to communicate the sensation of light to the brain? How came they to fashion an ear, so admirably adapted to the reception of sound? Are we to believe that the labors of ten thousand slaves, who worked upon the great Pyramid of Gizeh, were not directed by any superintendent? If there had been as many independent wills as there were workmen, or, rather, if there had been no wills whatever, would there have been unity of design in the result? The illustration, however, does injustice to the teleological theory of life, for the bioplasts that work in the human body are numbered by millions, not merely by thousands; nor are they capable of holding consultations and determining upon a plan which shall have its parts so nicely related as to manifest a settled purpose looking to remote results, as Egyptian pyramid-builders might have done; nor is the life of bioplasts extended to nearly or quite half a century, thereby enabling them to realize the completion of their plans, as is true in the case of the human beings whose bodies they build up. Where, then, is the power which moves, directs, and controls bioplasts? Materialists answer: Physical forces. Reason answers: LIFE. Beale, and Carpenter, and Frey, and a host of other specialists in science answer the same.

CONSERVATION, CORRELATION, DISPERSION, AND CONVERTIBILITY OF FORCE.

BY THE EDITOR.

As force, in its various manifestations, constitutes the life of nature, so the correct apprehension of force in its diverse operations constitutes the soul of science. In whatever else scholasticism might be right, it would all be vitiated and made worthless, so far as true scientific knowledge is concerned, if the real nature and character of the physical forces be not understood. For it is perfectly safe to assert that no man is capable of teaching any branch of elementary science correctly, or even intelligently, who does not possess correct ideas upon the subject of force as the natural agent in the production of physical phenomena.

We do not say that facts and natural phenemena may not be properly observed and correctly recorded, even in the midst of confused and radically erroneous conceptions of the nature of force. But such observation of facts and such record of phenomena do not by any means constitute science in its specific or intrinsic sense. The science of force or energy, in its various forms and manifestations, does not, for example, consist in the mere observation of the fact that the sun rises, shines, and sets every day; that the moon appears crescent, full, and gibbous monthly; that a stone dropped from the hand will fall to the earth, instead of rising; that wood will burn and consume to ashes, while no ordinary heat will consume asbestos; that light will pass freely through glass or crystal, while it refuses to pass through opaque bodies; that electricity will flash from the raincloud and shatter a forest tree; that compressed air will exhibit intensified heat, while the expansion or rarefaction of air will exhibit cold to the same degree; that the metals will conduct electricity with great facility, while glass will scarcely conduct it at all; that a spring will recoil after compression or expansion; that metals will become fluid by heat, and that some will melt at a mere fraction of the temperature required by others; that most bodies will expand by heat, while some will contract; that some alloys will melt at less than one-half the heat of either of their constituents; that a ray of white light passing through a prism will separate into various colors, while different bodies, even in this white light before its separation, may be of the same

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different colors; that one body vastly more porous than another of the same size is vastly heavier, thus actually containing less matter; that some bodies are solid, while others are liquid, vaporous, or gaseous; that one metal (platinum) will remain solid at the intensest white heat, while another (mercury) will remain liquid at 40° below zero; that different substances, on cooling, crystallize in different forms, while others do not crystallize at all; that a stretched string will vibrate audibly in response to a unison tone, while it will remain still and silent in response to any other sound, however loud; that some animals can live under water but will die in the air, while other animals can live in the air but will die under water; that animals in past ages as heavy as men (such as pterodactyls) have flown through the air like birds and bats, while man, with all his intelligence, can contrive no mechanical means with which to fly; that the explosion of a magazine will break windows miles away, while a peal of thunder, vastly louder, will not stir a feather near to where the bolt strikes; that the loadstone will lift an iron bar without touching it, etc., etc., etc.

The untutored savage may observe and correctly recognize all these things as facts, and scores of others equally mysterious, without the first correct conception of the scientific cause of the phenomena he witnesses, or the real nature or character of the various forms of force whose simple effects address his senses. To possess a definite *theory*, as to the nature of the forces as the true cause of observed phenomena, is the first and essential step in the acquirement of any degree of scientific knowledge; but to begin with a totally false theory of force or energy—one that is incongruous as well as erroneous, and which in the nature of things can afford no true explanation of observed phenomena—is worse than to have no theory at all, and does not equal in value the blank stare of the savage who only perceives the facts with a grunt of surprise mingled with indifference.

We declare our conviction, from all we can gather from the books in explanation of the true causes of natural phenomena as they result from the operations of force in its diverse manifestations, that such teaching of the schools, leading, as it necessarily does, to labyrinths of still accumulating errors, is worse by far than no teaching at all, for then the thoughtful student might, by careful reflection upon the phenomena observed, logically reach correct conclusions; whereas, after having been once thoroughly impregnated with the erroneous notions as now held and taught, no amount of after-reflection will serve to divest his thoughts of the warp they had received, or divert them into the true channel of investigation, and thus lead him to the true source of knowledge upon this subject.

If the text-books and the teachings of the schools upon the nature and character of force are carefully analyzed in the light of the Substantial Philosophy, it will be found that many principles enunciated in such books and teachings are broadly correct, and when properly carried out to their legitimate consequences as to scientific details, necessarily lead us to the true doctrine of the nature and character of all force; but if we try to evolve these details and reach intelligible ideas according to the present theories of force, these broadly correct principles of science as the premises of such reasoning melt away into a mist of mysterious ambiguity and absurdity in total contradiction of the sound and broad principles from which we had started out. This is especially true of the great underlying facts and principles, as at the heading of this paper, namely, the *conservation, correlation, dispersion,* and *convertibility* of the forces, the possibility of which the books admit and the schools include in the curriculum of their scientific courses. Yet when the professors of physics in the various colleges stand before their classes and attempt to explain how it is possible that the forces, as mere properties of matter or modes of motion among material molecules, can be *conserved* in quantity, *correlated* to each other, *dispersed* from or through each other, or *converted* into each other, and yet these forces in themselves be nothing substantial, or as entitative, objective existences, the whole idea of a possible conservation, correlation, dispersion, or conversion of force becomes a consummate scientific farce which, but for the almost sacred mystery environing the class-rooms where such scholasticism prevails, would provoke the smiles if not the outspoken ridicule of the intelligent students.

To talk of conserving or preserving the mere motions of a body, or of any indefinite number of bodies, such as those of the supposed ultimate molecules and atoms

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of any material substance, is the crudest of scientific trifling. Motion, *per se*, is and can be nothing entitative or substantial in any possible sense, and hence nothing that can be preserved. It is the name we give to the changing of a body from one place to another, and, as a mere phenomenon, necessarily ceases to exist as soon as the moving body comes to rest. As such motion could have had no existence before the body commenced moving, so, of necessity, it can have no existence after the body ceases to move, let that body be great or small. What contradiction in terms, then, to talk of the *conservation* of force, and in the same breath to teach that force is *motion*, or a mere phenomenon—that which cannot be conserved, in the nature of things, but which comes into existence and goes out of existence as often as any substantial body commences or ceases to move!

In like manner, did any physicist ever think of the impossibility, not to say absurdity, of the idea of the conservation, correlation, interconvertibility, or dispersion of the *properties* of material bodies? The property of a body is a certain quality or condition of its particles by which the application of force or energy in certain ways may act on this material substance through its cohesive force, so as to produce certain sensible phenomena; and therefore in no sense can a property of matter be an entity, and as a consequence it can never be conserved, converted, etc. Think of conserving the combustibility, malleability, fusibility, and hardness of a body as objective entities, or of their convertibility into each other! Yet there are grave scientists who are so dull of intellect as to jumble indiscriminately and incongruously together the forces of nature and the nonentitative properties of bodies, rather than accept Substantialism, and thereby have the whole matter intelligibly and consistently explained and harmonized.

That the idea of the conservation of force, as a fundamental principle of science, has not long before this opened the eyes of the great physicists to the fact that force, in all its manifestations, must be a real substance or objective thing, as the Substantial Philosophy teaches, is one of the scientific marvels of this age. The very first paragraph penned in the scientific discussions of the "Problem of Human Life" sets forth this idea of the substantial nature of the forces, in order to their possible "conservation," and does it so distinctly, as the very corner-stone of Substantialism, that we cannot do the reader a better service here than to quote it *verbatim*, especially if he has never seen that book:

"The recently established theory of the persistence of energy—otherwise termed the conservation of force—proves, as certainly as it proves anything, that all *force* is *substantial*. Nothing can be conserved or preserved unless it be something that exists, and it seems to be an axiomatic truth that nothing can exist unless it be a substance of some kind. If force in one form is convertible into force of another form, as claimed by the advocates of this theory, then all force, in whatever form it may be exerted, is substance, since it is impossible to conceive of the conversion of one thing into another thing and neither thing be anything substantial. Our inability to take cognizance of the constituents or corpuscles of a force, such as gravity or magnetism, for example, by the immediate action of our senses, as we are able to do of such substances as iron, water, air, or odor, is no valid reason to a thoughtful mind why such force should not be regarded as a real substance—as literally and truly an entity as is the atmosphere we breathe. The air when quiescent is admittedly unrecognizable by any of the senses as a *substance*. It can neither be seen, heard, felt, tasted, nor smelt; and even in motion we only recognize it by the effects it produces in displacing heavy objects or pressing against our bodies. To the minds of many who have not reasoned themselves into the philosophy of atmospheric pressure, it seems even now irrational and impossible that the air we breathe, so transparent and impalpable, can be a real substance having an actual weight of fifteen pounds to the square inch upon all bodies at the earth's surface. It would almost seem that this wonderful entity was intended by the all-wise Author of Nature, among its other uses, to show us the marvelous amplification of substantial existences in God's universe, and thus lead us step by step from the visible and corporeal constituents of gross matter up to the invisible and incorporeal elements of substantial entities outside of the present recognition of our senses. I never think of the air, or intelligently draw a breath, but a thought of adoration to the God of Nature pervades my mind for so ordaining this

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intermediate but invisible substance as to teach us that it is but the connecting link in the chain of entities from the gross earth up to the inconceivably attenuated existences outside of material forms, thus rationally and philosphically leading the mind from what we are, in relation to sense, to the possibilities of what we may be."—"Problem of Human Life," p. 27.

This single fact, that the universally admitted principle of the "conservation of force" must of necessity constitute force a substantial entity in order to its possible conservation, annihilates more than one-half of all the voluminous writings of physicists upon the subject of the physical forces, and equally tends to decimate the value of all that is taught in the schools upon the same subject. If such a principle is possible, or even conceivable, as the conservation of force, then *force* and *motion* are as separate as the poles, and must be as distinct as light and shadow. Motion, so far from being force, is the result of force in every possible case, just as shadow, though in no sense an entity, is always the result of the substantial force of light. No motion, therefore, of any body, large or small, can take place except by a previously existing force acting upon such body under a law of nature ordained and established by the sole, self-existent, intelligent law-giving Force of the universe. Hence, when we say that nothing can move itself, as in the case of all inert or material bodies, we utter a truism so self-evident that the whole scientific world agrees with it. But when we go a step further, as Substantialism compels us to do, and assert that no immaterial entity, such as light, heat, sound, gravitation, electricity, cohesion, or magnetism, can move itself any more than can a piece of granite rock, we will possibly meet with opposition in various ways and from various sources. But it is a philosophical truth, nevertheless, which all exact knowledge of science will justify and confirm. Why should electricity as a substantial force travel a single inch in any direction without having received power with which to do it, any more than can a stream of water travel toward the ocean without being coerced to do so by the power of gravity? And why should the invisible threads of gravity eternally wind in toward the earth's center, hitched inseparably to the minutest particles of the water, and thus pull them along, unless such gravital threads are given the power thus to wind themselves up and draw material bodies after them by some primordial and ultimate source of power involving the essence of intelligence itself?

As some ultimate and absolute fountain of force and power, physical, vital, and mental, must be assumed as the primordial source from which all manifested forms of force receive their energy to act or to produce phenomena, no scientist, however materialistic in his convictions, should object to the assumption of a self-existent, uncreated and infinite God as such primordial fountain of force, even though it involve an infinite mystery which, of course, no finite knowledge can ever begin to fathom or comprehend. One ultimate and incomprehensible mystery is vastly better and more satisfying for the human mind to rest upon, as a solution of all the innumerable and unsolvable mysteries with which it is environed, than to be compelled to face or try to fathom an ultimate mystery in every step we take, and in every natural phenomenon we encounter in our scientific investigations. The mind needs, seeks, and deserves rest in its conflict with the idea of infinity in everything it touches, and which it cannot obtain, even in a partial degree, except by allowing all natural, philosophical, and scientific mysteries to find their ultimate and final solution in an intelligent, uncreated First Cause—a fact which every intelligent atheist is forced to admit, unless through perversity of disposition he refuses to do so.

Then what short-sighted want of logical reflection to take the ground of the pantheist, that the visible system of nature, with its observed forces, constitutes all the God there is, and that the various phenomena observed are but his innumerable but unintelligent manifestations of himself and his power! As well make heat, light, electricity, gravitation, etc., lesser gods, each acting independently and, without intelligence or reason, managing its own department of affairs as best it can. Indeed, there is one philosopher right here in New York, within a single door of THE MICROCOSM office, who publishes a paper devoted to the idea that *electricity* is all the God there is, and that it is everything, and that everything is it, or comes from it. That light, heat, magnetism, sound, gravity, cohesion, life, mind, soul, and spirit are all but different forms or manifestations of this electric

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deity! He does not even overlook the fact that such a god seems necessarily to be without intelligence in the knocking of things about promiscuously, as when converting a tree into heterogeneous lumber. He declares that every act of lightning is the result of studied intelligence on the part of this god—*electricity*—however unintelligible its actions may seem to us!

This philosopher does not, however, condescend to explain to us why *heat*, for example, might not be the supreme little god, and why *electricity* might not be one form of its manifestations; or why light, or gravity, or magnetism, or cohesion, or even *sound*, might not chance to be this very god-elect of his diminutive system of pantheism, and that such tiny deity does often show its power in the form of electricity, as well as in the other forms of force which do not happen to be exalted to the first place in the realm of nature!

But what is most strange in the crude outgivings of our Park Row philosopher (since *mind* and *life* with him are also but forms of the manifested power of this deified electricity), is the fact that it never occurred to him to place *mind* itself and *life* itself upon the throne of nature as the very God of the universe, and then make electricity, as well as the other correlated forms of the physical forces, but the different manifestations of such a God of intelligence—such a living God—especially since his philosophy, muddled as it is about electricity, does really find the evidences of intellect, such as intelligent design and arrangement, irresistibly pervading every operation of nature. To ignore such a manifestly rational and systematic survey of things as Substantialism presents to us in the visible and invisible entities of God's harmonious system of nature, and to pick out one of the physical forms of force as the supreme and governing deity, and arbitrarily place it over the others, and even over intellect itself, is a puerility amounting to a monstrosity, and unworthy of this age of scientific investigation.

All such modifications of pantheism, however, are not only trifling but must be of ephemeral duration, even when intelligently presented and defended; much less can they hope for permanence when incoherently proclaimed amid the wildest vagaries of thought and crudities of expression. The man who would chain the chariot-wheels of his faith to any one of the physical forces here manifested, as the infinite God of the universe, falls far short of the dignity of a moderate atheist in the range of his intellectual conceptions. Compare such view with the magnificent grasp of the physical laws, forces, substances, and elements of the universe, in relation to their nature, origin, classification, and design, as set forth in the Substantial Philosophy, and the former will need no disparaging comment at our hands to point out the world-wide contrast between them.

With all the physical laws and forces as but the external agencies, or fingers, so to speak, of the infinite and intelligent Deity, as he reaches them out to the boundaries of creation to manipulate and operate the worlds he has made, we can see how God can be physically and personally omnipresent, as well as mentally, morally, and spiritually everywhere beholding the evil and the good. With these physical forces on a par with each other, as the messengers of the governing authority of the universe, and which are to do his behests in the material realm, we see how they can and must naturally be correlated the one to another, thereby being correlated also directly to the power which commissions and sends them forth, and how they may naturally, as substantial entities, be convertible one into another as they mingle and interblend in the universal fountain of energy, where, as the crude or unseparated force-element of nature, they return to quiescence as their different missions are ended, and from which, ever and anon, they are again sent forth in different forms and to produce different manifestations of God's power in the material universe.

Not a flash of electricity lights the sky, nor a thread of gravital force pulls a falling body, but as soon as its work is done and the energy required to do it is expended, it falls back as crude force or energy into the elemental fountain whence it emanated, and where, with all the other forms of expended force, such as light, heat, sound, magnetism, gravitation, and cohesion, it surrenders up its identity and settles into quiescence, there to await the mandate of the regnant force of the universe—the force of vitality and mentality personified—from whom primordially came the laws by which electricity, as well as every other form of force, emanates to accomplish its work.

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No other hypothesis but the one here set forth, involving a universal fountain of energy, where expended force, in whatever form, may relapse into quiescence, and thus constitute the force-element of nature, can show the least meaning or maintain the slightest consistency for these so-called laws of conservation, correlation, or convertibility of the forces. If *force* or *energy* is but molecular *motion*, which necessarily ceases to exist when the molecules come to rest, that ends it, and any such idea as conservation of force, when *motion* cannot be conserved, is a meaningless jargon of words unworthy of the name of science. If the *motion* of molecules is the *force* which moves them, as really claimed in the case of light, heat, sound, life, soul, mind, etc., then it ought to be true of larger bodies which we can see and handle. But if the *motion* of visible bodies is not the *force* which causes them to move—in other words, if the *motion* of visible bodies is always the *effect* of some external force instead of being the force itself, as we know to be the case, then the same common-sense law must hold good down to the smallest material body of which the mind may form a conception, even down to the so-called ultimate molecules and atoms of bodies.

If a cannon-ball's *motion*, for example, ceases to exist. as it actually does when the ball comes to rest, so also must the motion of a molecule of iron, which is but a miniature cannon-ball, and therefore this molecular *force*, which consists of such molecular *motions*, must of necessity cease to exist whenever the molecule ceases to move. If the cannon-ball, in stopping, transfers its force or energy to the body which stops it, and if such energy is thereby converted into heat or some other form of energy, that is altogether another matter—its *motion* as a cannon-ball ceases to exist all the same. The *motion* of any body is, as we have already shown, but the phenomenon of its changing from one position to another, and is entirely different from the force or energy which causes the motion, which force or energy is stored up in the ball, and can be transferred, as such energy, by conversion or otherwise. *Motion* is no more an entity than is a *shadow* of a tree an entity, though motion is caused by some form of force, just as a shadow is caused by the force of light. Remove the light, and the shadow ceases to exist. Remove the stored-up force, and motion ceases to exist.

But does this so-called vibrating molecule ever cease to move? We answer yes, as certainly as a swinging pendulum ceases to move before it can go the other way; and it matters not how many and how continuous are the vibrations of such supposed molecule, each motion is separate, and necessarily ceases to exist before the next movement can commence. Hence, molecular *force*, which consists, according to modern science, of molecular *motions*, is actually annihilated, and then comes into existence at each separate swing of a molecule! What, then, becomes of the idea of the conservation of *energy* or force as consisting only of *motion* which begins and ends its existence with the beginning and ending of each separate swing of the molecule involved? Echo answers—*What?* The idea that *motion* is *energy*, and that it is really both the cause and the effect of itself, for the reason alone that the moving body is too small to be seen, when the whole thing would be utterly false applied to visible bodies, is the most childish assumption known to modern science, and the fact that grave physicists should be satisfied with any such reasoning is one of the marvels of this age, especially when Substantialism, with its great luminous torch, stands ready to light their way out of the labyrinths of darkness into the flower-paths of true philosophy.

The great physicists of the present day talk eloquently of this essential law of the conservation of *energy*, of its persistence, of its dispersion, of its conversion into other forms of *energy*, etc., etc., but not one of them, with the single exception of Prof. Tait, of Edinburgh University, has ventured to define any form of energy as a substantial entity. Ask them what they mean by *energy*, and they will say, vaguely: The *power* of doing work. But ask them what this *power* consists of, and they will circle right into the universal vortex of *motion*, thus settling down upon the molecular basis that this *motion* in any body is the cause of itself and the very source of the energy which produces the motion. Prof. Tait, however, had the mental energy and originality, as well as courage, to see and admit that *energy*, as in the case of *heat, sound, electricity*, etc., which he specifically names (though objecting to the use of the term *force*), is a *substantial entity* or a *real objective thing*, and we were led by this outspoken truth to think that he had

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seen the "Problem of Human Life," or been reading THE MICROCOSM. But he writes to Dr. Mott, on reading our review of his positions in the October number of this volume, that he had never before heard of Substantialism. We trust, however, that the fact of his having been ten years behind in entering upon the substantial crusade against false science will not cause him to slacken in the work he has so well begun. We need his great genius and reputation to help us in this fight.

In formulating the principles of the Substantial Philosophy, it became at the start absolutely imperative to point out some consistent method of maintaining the great laws of conservation, correlation, and convertibility of force, which the physicists, who had laid down such laws, had failed to provide, and which, in their mistaken adherence to physical theories, they had absolutely prohibited by making the forces unpreservable in making them unsubstantial. Even if in some sense and in some form force was substantial, still scientists could see no way of conserving it only as in actual operation in some other form, as, for example, the disappearance of active electric or other mechanical force, to reappear in active heat-force, light-force, etc. But when heat-force disappears into light-force, no other conversion seems possible by which to conserve it, since, as the mere *motion* of jelly-like ether, it necessarily ceases to exist when the light ceases by the jelly's ceasing to tremble.

Hence the necessity, when unfolding the principles of a universal philosophy which makes every conceivable form of energy a substantial entity as really and truly as the material body through which it is manifested, that we should provide in the system a universal fountain of force, where all forms of expended energy might be conserved as real substance, and as the correlated and convertible force-element of nature. It was thus that we expressed it in a communication to Eld. Thomas Munnell, and which we authorized him to repeat and make his own in his defense of the Substantial Philosophy, as published in the *Christian Standard*, and which we copied into THE MICROCOSM, Vol. III., pages 307, 308. The following is the paragraph, with Eld. Munnell's introductory remarks, which every interested reader should study till he or she shall understand it:

"But the *Standard* critic seems really to have struck a happy thought, and supposes he has effectually caught the substantial philosopher napping at last. He seems to think he has him as safely secured in the meshes of his logical network as any octopus ever had a hapless porgie with his formidable antennæ wound about it. He has discovered that if sound is an *entity*, according to Substantialism, and if the locust *generates* these substantial pulses by its stridulation, then the insect actually *creates something out of nothing*, by scraping its legs across the nervures of its wings! This is plain, he thinks, because no sound was there till the scraping began. Or, if this substantial entity is not created out of nothing, then it must be manufactured out of the insect's organism, so that the poor little thing ought soon to use itself up in its own substantial noise! And still worse, what becomes of this sound-substance when it ceases to be audible? Is it annihilated? etc., etc. I have made the case even stronger than did the critic, to give the Substantial Philosophy a rare opportunity to show its powers of solution and explanation. And here its founder comes to the task, by the remark: 'How easy it is for even great men to be mistaken, especially when attempting to criticise something they do not understand or have not thoroughly investigated!' a very sensible remark, by the way. He then proceeds substantially thus: According to Substantialism, the incorporeal *force-element* in nature, from which sensuous sound is generated by whatever sound-producing instruments, *exists in all matter and space*, not as audible sound, of course, but as its elemental basis, and which only requires the vibratory process ordained in the economy of nature for transforming the force-element and thus calling it forth in that *definite form of force which we recognize as sound.* This same universal but indefinite force-principle, by the process of the battery or dynamo-machine, leaps forth in the definite form of electricity, with its own peculiar properties, and *which has no existence in that form in the air or battery until so transformed and evolved* from this force-reservoir of nature. Clouds also act as a battery and produce a similar transformation. The same universal element of force, by the peculiar but mysterious relations of the atoms of the steel magnet,

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pour out transformed into the shape of *magnetic rays* of real incorporeal substance that will lift a bar of iron at a distance, even through impervious glass. So also with the substantial light-rays, which are but another transformation from the same fountain or universal element of force, evolved to the sensible form of *light* by various processes ordained in nature to that end. But it by no means follows that electricity is created out of nothing or returns back to nothing when its substantial manifestations cease; nor is it created out of the substance of the electro-magnets in the dynamo-machine *which will last indefinitely without the slightest wear or deterioration of their material substance.* So a locust, while thus generating substantial sound-pulses, not out of nothing, but evolving them from this same universal, substantial fountain of *force-element,* uses not a particle of its physical organism as a constituent of such sonorous form of force. The *fire-fly,* as the editor shows in the March MICROCOSM, in reply to Prof. Goodenow, though but a hundredth part the size of the locust, can be seen half a mile of a dark night, and therefore must fill that much space in all directions with its substantial but incorporeal light-corpuscles which it generates at each flash from its thorax, not out of nothing, but out of that same force-element which pervades all nature and supplies each force, when definitely evolved, with properties peculiar to itself. The physical substance of this diminutive insect has nothing to do with constituting that form of substantial force called *light,* since, after thus filling hundreds of cubic miles night after night with actual substance, it has not exhausted its corporeal structure in the least! But what becomes of the *light,* the *sound,* the *electricity,* the *magnetism,* or any other peculiar form of force thus generated, after serving the purpose thus designed in nature, or after ceasing to manifest itself? It falls back from its definite form into the same indefinite force-element or reservoir from which it was evolved by the process appointed in nature; and *thus only can the law of the conservation of the forces be true.*"

As to the dispersion of force, or the dissipation of energy, as it is termed, the ideas of modern authorities are exceedingly vague. The effort to show anything like harmony between the *conservation* and *dissipation* of energy—a flat contradiction in terms—would be amusing if not so tiresome to thread in their incongruities. The general trend of the teaching, however, seems to be toward the idea that energy in whatever form cannot all be utilized or converted into work, and that the residue is converted into heat, which in turn is somehow dispersed in all directions throughout space, till finally in time, by this continued conversion and dispersion, the entire energy of nature will be equally distributed, making no more work possible, when all motion will cease, and universal stillness, silence, and coldness will reign. Such dispersed force, in the form of useless heat, is called the "waste heap" of inconvertible energy which is ultimately to stop the machinery of the universe. How weak and unphilosophical is such teaching in the light of the views presented by Substantialism, as just set forth in the extract from the argument of Thomas Munnell!

Force, or mechanical energy, after it has been used in the production of work through suitable appliances, is not conserved at all permanently and then dispersed as heat, or as any other definite form of force, but, as shown, returns in the form of crude force, so to speak, into the universal force-element of nature, there to lose its identity in the mighty ocean of substantial energy, till remanifestation is needed, either in its old form of heat or in other forms, such as those of gravity, electricity, magnetism, light, sound, cohesion, etc. Those who fear that heat will ultimately so disperse itself as to be equally distributed throughout nature, and thus put an end to all mechanical work (since all work results, as is claimed, from the unequal distribution of heat), must repudiate the idea of the convertibility of force altogether. If there were no such thing as the inter-convertibility of the various forms of force or energy, and if heat really persists as heat when dispersed, as this "waste-heap" notion must mean, we see no reason why the universe should not be constantly becoming hotter and hotter from the mighty expenditure of energy and radiation of heat going on continuously, not only from the conversion of mechanical force everywhere exerted, but from the millions of central suns like our own sending their waste heat throughout universal space.

If heat were not convertible into other forms of energy, or even into new working heat-force, within the great force-element into which it subsides after

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manifestation and exhaustion, it would not take long, comparatively speaking, entirely to exhaust every central sun in the sidereal heavens, dissipate its energy into heat, and thus, by dispersion, equalize the heat of the universe in one motionless, inoperative "waste heap," as the scientists claim. But the substantial view of heat, and of all other forms of force, in connection with the consistent doctrine of a universal fountain of crude force into which all expended energy subsides for reconversion and remanifestation, according to God's harmonious system of natural laws, solves all such problems, and relieves the mind from all apprehension of life's ever becoming extinct in the universe, either from too much or too little heat.

Great astronomers have puzzled their brains to know how the sun keeps up its supply of fuel by which to pour forth such interminable floods of heat by which to supply the wants of the various planets, and by which also to waste almost infinitely more in vacant space, without, apparently, benefiting anything. They have generally concluded that it is from a constant supply in the shape of meteorites pouring into the great solar furnace, with an occasiónal comet from surrounding space. But they forget that these meteorites, as they pass through empty space, are as cold as ice, and instead of acting as fuel, would tend to put out a fire into which they might fall. If any one doubts, let him try to burn a piece of one of these meteoric stones, such as those now on exhibition in the museum of Yale College.

No meteoric stone ever becomes hot till it comes into contact with another body, and thus generates heat by the conversion of the mechanical energy stored up in its flight into this peculiar form of force by friction. Without such conversion of force from one form to another, meteors falling into the sun, if there were enough of them, would soon extinguish both its heat and light. But let us assure the reader that our solar orb depends on no such precarious and ephemeral tenure of supply for its floods of heat and light so lavishly dispensed to its system of planets, and apparently wasted with such reckless prodigality throughout unoccupied space. Substantialism comes to our aid and solves this problem also. It sees, with its eye of philosophical reason, all this apparently wasted heat from the sun, as well as all that is poured into the planets themselves and from them radiated into space, gathered into the universal force-element, there to be remanufactured or coverted into electricity, gravity, light, magnetism, and even other forms of force perhaps unknown as yet to mortal man; and then by laws ordained for nature's harmonious government, carried back into the sun to be again converted into heat and light, thus enabling it to keep up its endless round of supply and waste and conservation and reconversion, without any necessity for a constant supply of material fuel, and without any danger of this well-governed planet of ours ever becoming either scorched or frozen, until such time, should it ever come, when a day of doom shall settle its fate, as ordained by the hand that made it.

Thus the mystery of ages, so puzzling to the scientific world, is solved and made as clear as the sun itself at a touch of the Substantial Philosophy, and by means of its indispensible "force-element of nature." The supposed *fuel* of a few meteorites, or even of an occasional comet, to feed the mighty furnace and keep up the endless supply of heat-energy wasted from the sun into useless space, is too trifling a view of nature's grand system of things to bear a moment's serious consideration. Indeed, if there were nothing but these puny meteoric makeshifts for fuel, which science has concocted by which to keep up this ceaseless flow and waste of light and heat for ages, it can be mathematically demonstrated from the amount of mechanical energy actually received from the sun and expended upon a single square foot of the earth's surface in a given time, that the solar orb, counting it fifty times hotter than melted platinum, would exhaust itself by radiation and become as cold as an iceberg in less than a month! Besides this, such a puerile grasp of the system of the universe, involving, as it does, an absolute waste of countless billions of times more of valuable energy than can possibly be utilized on sensible objects, and with no means of retrieving the same from the modern scientific "waste heap," places a most despicably low estimate upon the wisdom and power of the Infinite One. Fortunately, Substantialism steps in and rescues the character of God from the sneers of the infidel, as well as redeems science from the puerilities of modern materialism.

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By the *dispersion* of energy, properly complemented by its *conservation, correlation,* and *convertibility,* we need have no fear of a great "waste heap" left over, of which modern scientists treat so learnedly, as of too low a grade to be transformed into further work! Who ever heard of a great "waste heap" of *motion,* or of *shadow,* or of *silence,* or of *cold,* or of anything else that was not constituted of real *substance?* We might talk about the waste heap of metal turnings in a machine shop as real substance, but not of the *motions* of the turning-lathes, which motions absolutely ceased to exist whenever the force of steam and the energy of heat which caused them had done their work for the day. The substantial energy of heat and force of steam, as the result of the consumption of coal, may or may not all be converted into its equivalent of work. That depends on the perfection or imperfection of the processes and mechanical appliances by which this consumption of fuel is utilized. If discovery keeps pace with the present progress in the mechanic arts, the time will no doubt come when all, or nearly all, the heat-energy represented in a ton of coal will, by improved machinery, be converted into work, and whatever heat cannot be so converted may be transformed into electricity, or some other form of force, before seeking quiescence in the force-element of nature.

In a previous number of THE MICROCOSM we even ventured the prediction that the time might come when such discoveries in science and mechanics would be made that, by a trifling expenditure of heat-energy, the force-reservoir of electricity in nature would be tapped, somewhat as we now tap an inexhaustible reservoir of water, and by which an exhaustless supply of light, heat, and mechanical power would be secured to meet all the wants of man for manufacture, transportation and domestic purposes.

Judging from the discoveries that have already been made in the various departments of science and mechanics, in utilizing the natural forces in so many ways not dreamed of a few years previous, it is not by any means a Utopian stretch of the fancy to see in the near future means discovered by which electric-force, with the power of the lightning-bolt, and under the complete control of man, shall be drawn from the heavens and the earth in any quantities needed for the supply of his every want.

When this greatest of all mechanical desiderata is achieved, it requires no unreasonable sweep of the imagination to see the perfected air-ship sailing through the heavens, propelled by a force drawn in exhaustless abundance from the surrounding atmosphere itself; or to see the present steamships of the ocean using their coal-bunkers for the storage of freight, and with little or no outlay drawing an electric supply of mechanical force from air and water, to drive both wheels and propellers, and thus cross the ocean in half the time required at present.

No one, surely, should be chided, in this age of telegraphs, telephones, electric lights and motors, and of lightning printing-presses, for believing in the possibilities here foreshadowed, or that by the aid of such a free electric supply of force the very water of the ocean will be readily decomposed and, in its primordial material elements of oxygen and hydrogen, be made to burn like hydro-carbon oil. Why not? The achievements of man, judging from even the recent past, can have no bounds set to their chemical, mechanical, and philosophical triumphs in subjugating the elements of nature to his necessities, and forcing them to obey his behests.

The very facilities and encouragements which one scientific or mechanical triumph naturally furnishes to human effort in scoring still greater achievements with still less inventive effort or expense, give promise of an acceleration of mechanical and scientific discoveries in the immediate future as much surpassing those just alluded to as they outshine those of the times of feudal despotism. The very advances recently made in unraveling the mysteries of physical philosophy, and thereby unfolding more correct views of the visible and invisible entities in the universe, augur marvelous achievements for the future, and must act as so many direct helps in strengthening the minds of our great inventors and discoverers in grappling with the mechanical and chemical difficulties which have to be overcome in putting into practical shape the mighty forecasts just outlined. No great mechanical invention is wrought out by chance. It is first conceived and then worked out in the mind, and hence the necessity that the intellect of the com-

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ing inventor, who is to revolutionize the mechanic arts, shall be in that healthful condition of mental receptivity which the rational and consistent principles of true science and true philosophy can alone supply to their greatest perfection.

IS THE ACQUISITION OF KNOWLEDGE DESIRABLE?

BY JOHN C. DUVAL.

We are wont to boast of the vast progress we have made during the present century in the arts and sciences, but when the supreme test of *happiness* is applied to such progress, can we truly say that we have been to any great extent the gainers by it? That's the question. I remember very well when there was not a railroad nor a telegraph nor a telephone (and scarcely a steamboat) in the United States, and yet I am convinced that people were fully as happy and contented then as they are now. News that was days and weeks in reaching us by stage or horseback was just as much news to us then, and gave as much satisfaction to us, as the "broken doses" we get now hourly by telegraphs and railroads; and the man who achieved a journey of forty or fifty miles a day by post or on horseback was just as well satisfied as the man is now who quadruples that distance on a "lightning express."

For a long time people believed that the sun was about 95,000,000 of miles from the earth, and although scientists have since proven that the distance was several millions of miles greater or less (which is it?), still people are not happy. Science has enabled us to construct an instrument by which we have ascertained that the sun and planets are composed of pretty much the same materials as our own globe, and still people are not happy. Science has furnished us with railroads, steamboats, telegraphs, telephones, and labor-saving machines, and still people are not happy. Witches, spooks, hobgoblins, fairies, and ghouls have fled before the refulgent light of science, and still people are not happy. In spite of railroads, telegraphs, and labor-saving machines people are just as much subject now (and as a mass I think a little more so) to the primeval curse of gaining their living by the sweat of their brow as they were before such things were known. For all these things naturally fall into the hands of ambitious, aggrandizing capitalists, who wield them with irresistible power for the accumulation of millions upon millions of money, which seventy or eighty years ago would have gone into a hundred different channels, and benefited thousands, instead of heaping wealth upon a single individual or corporation. And, in this way, who can say that this very progress in material advancement may not possibly prove to be the main cause of the demoralization of our people, and the ultimate overthrow of our republican institutions?

But I do not "go the whole hog" with the poet when he says "if ignorance is bliss, 'tis folly to be wise," because I believe a wise man may be, and probably is, fully as happy as an ignoramus—but is he more so? that's the question. Nor can I agree altogether with a prominent atheist of the day, who says, "Give me the storm and tempest of thought and action, rather than the dead calm of ignorance and faith. Banish me from Eden when you will, but let me first eat of the tree of knowledge." There is something unquestionably of the "high heroic" and Jove-defying in such a sentiment as that, and also a good deal of that "vaulting ambition that o'erleaps itself." Knowledge is a good thing, I will admit, and greatly to be desired, and I would sacrifice much to obtain it—*but not my happiness*. If there were no alternative for me but to choose between knowledge coupled with woe and misery, and ignorance and bliss, I would unhesitatingly accept the latter. My experience proves to me that the wisest and most learned man, when suffering with the "jumping toothache," is just as miserable as an ignorant Hottentot would be if he were afflicted in the same way. If it were so ordained that the acquisition of knowledge should always augment *pari passu* our pains, mental or physical, I think but few of us would ever get beyond our A B

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C's. "Satan, upon whose brow," as Byron says, "deep and unfathomable thoughts are graved," has knowledge far beyond that of mortal man; but where would you find the man who would willingly change places with him? Knowledge, *next* to happiness, is more to be coveted than anything else; but I will venture to say this much: if I were in Eden, you wouldn't get me out of it with my consent, if I were compelled to leave happiness behind me—no, not even if the forests beyond its confines were filled with the "trees of knowledge." Happiness here and hereafter is the end and aim of all our struggles and efforts, and *nothing* could recompense us for its loss—not even knowledge.

I hope no one will suppose, from anything I have said in the foregoing, that I am one of those fossilized old fogies who are opposed to progress, and believe that the "good old times" were *better* than those of our day and generation. The desire of improvement, and the increase of knowledge, is an inherent principle of the human mind, and if debarred from gratifying it, man, no doubt, would be more unhappy than he is now. But I believe that happiness results mainly from the gratification of this desire, and not from the attainment of the object sought.

There is no doubt if the people of the present day could be carried back to the times of good Queen Bess, that they would grievously miss many things which custom has rendered essential to them (speaking for myself, I scarcely see how it would be possible for me to exist without coffee or tobacco), but yet I think it reasonable to suppose that the people who actually lived in those times were as happy as we are now.

I believe we are so constituted that even when knowledge shall have reached the utmost bounds possible for finite intelligence—when there shall be absolutely nothing left to be discovered or invented—that people will not be happy. For, even admitting they had *everything* essential to earthly felicity, the knowledge that such things would be taken from them in a few years by death, would be a sword of Damocles hanging by a hair above their heads to counterbalance the pleasure of possession.

THE CHEMISTRY OF WHAT WE DRINK.

BY HENRY A. MOTT, PH. D., F. C. S.

TEA.

(*Continued from page* 173.)

No very complete analysis of tea has been made as yet. The constituents which have thus far been detected are, according to Blythe:

Essential oil, theine, boheic acid, quercitine, tannin, quercitrinic acid, gallic, oxalic acid, gum, chlorophyll, resin, wax, albuminous, woody and coloring matters, and ash.

An analysis of green and black tea by Mulder has been quoted by most all books, and with the exception of the percentage of theine, which is too low, the other determinations are considered pretty accurate.

	Black Tea.	Green Tea.
Essential oil	0.60	0.79
Chlorophyll	1.84	2.22
Wax	0.00	0.28
Resin	3.64	2.23
Gum	7.28	8.56
Tannin	12.88	17.80
Theine (too low)	0.46	0.43
Extractive matter	21.36	22.80
Coloring substances	19.19	23.60
Albumen	2.80	3.00
Fiber	28.33	17.80
Ash (mineral substances)	5.24	5.56

By the most approved method of analysis Dragendorff has determined the percentage of theine in the teas in Russian commerce:

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Price per Russian pound	Yellow Tea.	Green Tea.	Black Tea.	Flower Tea.
Rubs. kop	8.	4.50	2.20	3.20
	Per cent.	Per cent.	Per cent.	Per cent.
Water	9.88	7.92	10.70	12.00
Const. sol. in water	36.50	37.50	27.20	26.70
Theine in non-dried tea	1.43	1.61	2.11	1.95
Nitrogen—per cent	6.60	6.01	——	——
Tannic and boheic acid	12.70	——	——	——
Const. insol. in water	53.70	54.60	62.10	61.80
Ash	5.33	5.78	6.18	6.20
Silica and sand	0.85	0.58	1.11	0.97
Ash, less silica and sand	4.48	5.20	5,70	5.23
Ash, from insol. const	2.79	2.04	——	2.47
Potash—per cent. on the tea	2.10	2.48	——	——
Potash—per cent. on the ash	39.55	42.99	——	——
Phosphoric acid—per cent. on the tea	1.33	0.77	1.14	1.04
Phosphoric acid—per cent. on the ash	25.02	13.32	18.54	16.88

Tea owes its peculiar aroma to a volatile essential oil of a citron-yellow color, which solidifies when cold and resinifies when exposed to the air. Its specific gravity is less than that of water; when extracted from the seeds it is 0.927. The amount present in tea varies from 0.6 to 1.0 per cent.

Tea contains, as stated, an alkaloid known as theine. This is a crystalline body, of an alkaline nature, and rich in nitrogen. It is represented by the formula $C_8 H_{10} N_4 O_2$.

Frerichs, C. J. Lehmann, Hausemann and others have experimented on themselves, and shown that theine in large doses is a poison. Lehmann, after taking .5 gram (7.71 grains), suffered from frequency of the pulse, irritation of the bladder, cerebral excitement, slight hallucinations, and, lastly, a desire to sleep. Hausemann took .25 gram (3.85 grains) with somewhat similar symptoms. Pratt found, with subcutaneous injections, that .3 gram lessened the pulse and caused sleeplessness; .4 to .5 gram quickened the pulse and caused a desire for frequent micturition, but no dilation of the pupil; .8 gram caused great uneasiness and anxiety, trembling of the hands and arms, so that he was unable to write, and later a restless sleep, with continual dreaming. Cooley[1] claims to have taken 1.29 grams (20 grains) of pure theine every day for a month without experiencing any other symptoms except elevation of spirits. Strauch gives the least fatal dose for cats as .25 gram, which killed a cat in thirty-five minutes.

Stenhouse has found from 0.70 to 2.13 per cent. of theine in various teas, and Peligot has found from 2.34 to 6.21 per cent.

Boheic acid $C_7 H_{10} O_6$ was separated by Rochleder[2] from the leaves of *thea sinensis*. It is a pale yellow amorphous powder.

Hlasewetz has found quercitrinic acid $C_{33} H_{30} O_{17}$ in tea leaves. It forms, on crystallizing, chrome-yellow crystals.

Filhol claims that quercetin, $C_{27} H_{18} O_{12}$, is present in tea leaves. It forms yellow needles on crystallizing, or a citron-yellow powder.

Wigner has determined the hygroscopic moisture in thirty-five samples of tea, consisting of hyson, capers, souchongs, gunpowders, and others:

						Per cent.
The maximum	amount	of moisture	found	in	hyson	5.68
"	"	"	"	"	gunpowder	6.55
"	"	"	"	"	congou	10.33
"	minimum	"	"	"	"	6.36
"	"	"	"	"	gunpowder	6.55
"	"	"	"	"	hyson	4.84

The total nitrogen found in sixty samples of black tea, by Wigner, was 3.26 per cent. Hodges found a sample of genuine tea from Cachar to contain 4.74 per cent.

S. Jauke found tea to contain from 6.922 to 8.1 per cent. of tannin. A tea giving only 6 per cent. must be looked upon with suspicion, as exhausted tea leaves contain from 2 to 4 per cent.

The extract of genuine tea varies considerably from 26 to 46 per cent.—the average being about 36 per cent.

Tea is consumed under the form of infusion, made by pouring *boiling* water upon it and allowing it to stand for a short time. Tea should not be boiled, as the essential oil which gives to it its peculiar aroma and flavor is volatilized.

[1] "Dic. of Prac. Receipts."—Art. Caffeine. [2] "Ann. Chem. Pharm," lxiii. 202.

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According to Dr. Letherby,[1] experiment has determined that infusions of tea are strong enough when they contain 0.3 per cent. of extracted matter, so that a moderate-sized cup (5 oz.) should contain 6.6 grains of extract of tea.

As to the best water to be used in drawing tea, the Chinese never use a very soft or hard water. As a rule, water from a running stream is preferred—"best from a hillside, and next from a river." "We must conclude," says Lehman, "that water of from four to seven degrees of hardness after being boiled is best suited for infusions of tea and coffee; for such water dissolves the aromatic and physiological constituents without extracting the disagreeable bitter principles."

Experiment and experience has shown that tea is a valuable article of diet. Still, tea cannot be regarded as a nutrient in the sense of maintaining structure or generate heat by its decomposition.

Much diversity of opinion exists amongst physicians as to the use of tea, some favoring its use in cases of indisposition or sickness, while others prohibit its use altogether. It is therefore necessary to study carefully the experiments which have been conducted respecting the effect of tea upon the system, so as to clear away such apparent diversity of opinion.

(To be continued in the May number.)

THEORY OF EARTHQUAKES.

BY PROF. T. W. LA FETRA.

I take the liberty to send you herewith a translation of a passage from an article just published in one of the papers here [Santiago, Chili] relating to the causes of earthquakes, and having special reference to the volcanic disturbances from May to September, 1883, in the island of Krakatoa, in the Sunda group. The theory advanced by the writer is so similar in some respects to one given by yourself in THE MICROCOSM of May, 1883, that I feel assured your readers will regard it with some interest.

After recounting succinctly the several theories advocated by some of the most eminent modern scientists, including Humboldt, Darwin, M. Perrey, etc., he refers to that of Mr. Rogers, a North American geologist, which considers earthquakes as produced by pulsations of the fluid matter beneath the earth's crust, transmitting their undulations from one point to another, like those of a great wave. This theory of the undulations of the central igneous mass, and the propagation of earthquakes by this cause, he regards as confirmed by subsequent observations in Venezuela, where tremors have been known to cross the western cordillera and, passing across the vast intermediate plain, to propagate themselves in the Parime ranges. He then continues:

Let us now examine the law which governs the location of volcanoes. All volcanoes, whether extinct or in activity, are found either isolated or in groups. Of the 200 and upward which have been in eruption within a century, more than 150 are situated on islands, and 171 on the western coasts of the continents. This fact, which appears purely accidental, rests upon a natural law: geological science considers mountain ranges as lines of upheaval, and the coasts which form rapidly inclined planes as lines of fracture, and, as a consequence of this general principle, considers islands as points of upheaval and their coasts as points of fracture. Hence it is that volcanoes, being the effects of the tides of the central igneous mass, have necessarily been formed precisely at the junction or angle of those two planes, that of upheavals and that of fractures, situated near the western coasts.

Let us now see why volcanoes are situated near the western coasts. The tide of the igneous mass of the interior of the globe, like the tide of the ocean, will traverse from east to west the interior crust of the planet, which is full of internal concavities and convexities, the former corresponding to the continents and islands, and the latter to the oceans and lakes. The wave of the interior tide of the earth would consequently pass readily from the convexities to the eastern part of the concavities, but with difficulty from the western part of the concavities to the eastern

[1] "On Food," p. 157.

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part of the convexities of the interior of the earth's crust. This difficulty which the line of interior concavity offers to the progress of the igneous tide makes it break the weaker parts of that line, which correspond precisely to the lines of fracture of the western coasts of the surface of the land, and so forms the law of the formation and location of volcanoes.

Now, these tides do not produce themselves, but obey, as does that of the ocean, the attractions of the heavenly bodies, principally the sun and the moon. This attraction made itself visibly perceived in the cataclysm of Krakatoa, since the complex phenomena which accompanied or preceded the first explosion of volcanic fire in Keeling Atoll, as, among others, the red crepuscular auroras, were the influence of the attraction and reflection of the sun upon the earth. Several weeks before the eruption of Java, sunsets or crepuscular auroras of singular redness were observed in the South Atlantic.

All of the phenomena observed in the earthquake of Krakatoa, as well as the explosions of the great interior wave as the undulations of the great marine and atmospheric waves which traversed in a few hours the surface of the globe, and the evening glows which preceded and accompanied that earthquake, being phenomena produced by one and the same cause, all are effects of the attraction and reflection of the sun, which operates as a force and as a light upon the earth. This is, in my opinion, the efficient cause of the volcanic eruption of Krakatoa.

In order to corroborate still more this theory, let us examine the phenomena of the crepuscular auroras, which have occasioned so many investigations. The volcanic cloud which for weeks after the 21st of May, 1883, rose in the form of a straight column, leaving some of its dust on the island of Timor, 112 miles distant from Krakatoa, cannot have been, as M. Flammarion and certain ship captains, witnesses of the eruption of Java, and whom he cites in his support, have said, the cause of the magnificent red twilights which shed their splendors on every horizon of the globe, and which are still seen some evenings in Chili. Optics teaches us that the white lights of the sun may be divided into seven lights of different colors, ranging from the most refrangible—that is, that which diverges most in being refracted—to the least refrangible, in the following order: violet, dark blue, light blue, green, yellow, orange, and red. The first three pass with difficulty through the atmosphere, as is proven by the absence of them in the colors of the crepuscula; in these are seen yellow, orange, and red, but never blue. The aerial envelope of atmosphere through which the sun's rays pass being denser at twilight, the rays, refracted by the aerial particles, as violet, dark blue, and light blue, are absorbed and invisible. The denser the atmosphere the more it will absorb the blue and refract the red. Consequently the presence of the red twilights which were observed before the earthquake of Java presupposes either that the atmosphere increased in density or that there burned in the sun a greater quantity of chemical substances which give a red light. With regard to the first, from the first eruptions at Krakatoa, which were not the most explosive, to the present time, no one has observed an increase of density in the atmosphere, while there was seen at the same time around the whole earth the evening glow. Moreover, the dust of the luminous cloud, which in part fell on the island of Timor, in order to have enveloped the atmosphere with a lamina of a single millimeter's thickness would require to have a volume of more than 600 cubic kilometers. On the other hand, with respect to the second point, astronomers have observed in the sun a reddish atmosphere which surrounds it, a probable result of volcanic disturbances in it caused by universal attraction, which produced also, by agitating the liquid masses of our planet, the terrible earthquakes of Java and Spain.

From the new data observed in the complex phenomena of Krakatoa, it results, then, that the cause of earthquakes and reddish crepuscular aurora is in the attraction which the heavenly bodies exercise upon the earth at the time of their conjunctions or oppositions, and that the secondary cause of those phenomena depends upon the pulsation of tides of the interior igneous mass of the earth.

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ERRORS OF THEISTIC EVOLUTIONISTS.

BY REV. JOSEPH SMITH.

Those holding the theistic phase of evolution labor to persuade themselves and others that they give no countenance or support to the infidel phase of the theory, and are quite indignant when told that such is the tendency of their course. But in this they are as much in the fog as they are in relation to the fact of evolution itself. For if it is conceded that there is so much of creative, or quasi-creative, power and skill stored up in the little moneron that it can successively change itself into such other higher species as are nearly related, it would be folly to attempt to convince a skeptical world that there is not enough power and skill in it to develop into *any* and *all other* animal forms, especially with the help of those mythical "missing links" that have been made to play so important a part in the theory of evolution. Hence, these defenders of theistic evolution are inevitably strengthening the hands of the infidel wing of its advocates, and doing a serious injury to evangelical religion.

But their grand error is in embracing evolution in *any* form. For evolution, whether theistic or atheistic—the transmutation of one species into another—is a baseless hypothesis, a mere theory, unsupported by a single fact.

This statement may seem pretty arrogant, in view of the numbers and standing of those who have embraced the theory. But what are the facts? For this is a question of facts, not of theory and fancy.

Has any one ever seen or known one species change into another? Never. What is the teaching of natural history during the myriad ages of the past, whose record is in the rocks as well as in human history? Does it report any such transmutation? Not at all.

In the British Museum are gathered specimens of every known form of animal life that has ever inhabited our earth. These specimens Prof. Etheridge, F. R. S., has carefully classified and arranged, and has thoroughly studied their relations and distinctive features for many years, till he has become a genuine expert in the science, and probably better fitted to give an opinion on the subject than any other man living. Has he, with all his unequaled opportunity for observation, discovered any evidence of the transmutation of species?

In an interview with a scientific gentleman, Prof. George E. Post, he said to him: "In all this great museum there is not a particle of evidence of the transmutation of species. Nine-tenths of the talk of evolutionists is sheer nonsense, not founded on observation, and wholly unsupported by fact. Men adopt a theory, and then strain their facts to support it. I read all their books, but they make no impression on my belief in the stability of species. Moreover, the talk of the great antiquity of man is of the same value. There is no such thing as a *fossil man*. Men are ready to regard you as a fool, if you do not go with them in all their vagaries. But this museum is full of proofs of the utter falsity of their views."

Now this is the deliberate verdict of an expert in this department of science—one not blinded by a pet theory, or captivated by the opinions or vaunted theories of others, and one who *knows* whereof he affirms.

Such is the teaching of the *past*. Nor is the evidence of the stability of species found *only* in the past. The present affords equal, and even stronger, evidence of the same fact.

There is ample proof that God has fixed *limits* to each species, both vegetable and animal, which it cannot pass. Marked varieties may, indeed, be produced. The single wild rose, for example, through artificial means may be developed into the full garden rose. But it does not thus become a new species. And even as a *variety* it is not in its nature *permanent*. Withdraw from it those influences by which it was developed and it will gradually return to its original wild type. The same is true of all other varieties in the vegetable kingdom.

Prof. Wood, author of some of our standard works on botany, says of these varieties: "They are *never* permanent, but exhibit a constant tendency to revert to their original type."

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Thus nature forbids the transmutation of one species into another. The same law holds in the animal kingdom.

Evolutionists have tried to establish a new species on the basis of hybridity. But this is impossible, for nature abhors hybridity as it abhors a vacuum. And in the animal, as in the vegetable kingdom, nature is equally opposed to any important or permanent departure of a *variety* from its normal type.

Change of climate, food, treatment, and forced connection may divert an animal from its native type till a marked change is produced. But this establishes no new species. This variety will generally continue so long as the animal is subjected to these new conditions. But return it to its natural home, and leave it to itself, and, like the vegetable variety, it will "exhibit a constant tendency to revert to its original type."

In blooded stock, where some desired quality is sought to be developed by breeding in and in, a marked variety is often produced, but no new *species*. Indeed, the tendency of such variety is to run out; for it not only grows less and less hardy the further it departs from the original type, but it is more subject to disease, and especially to sudden death.

And, however far the variety may be forced from its normal type, it is certain that it is not a new species, or approaching a new species, for it is as fertile as ever with the original type; when, if it were assuming the character of a distinct species, it would, like the mixture of the horse and ass, run into hybrid sterility when crossed with the original type. Hence the transmutation of species is an *impossibility*. Nature is sternly arrayed against it.

And this fact is absolutely fatal to every form of evolution, whether *theistic* or *atheistic*, for the whole theory rests on the assumed fact of the transmutation of speoies; and this being exploded, the whole thing collapses.

Thus utterly baseless is the theory of evolution that has drawn such numbers to its support, and that seemingly threatened the very foundations of Christianity.

Strongly desirous to be rid of God and the restraints of his government, men have "assumed this theory, and then *strained their facts* to support it"—facts, when rightly understood, as Dr. Hall has abundantly shown, yield it no support, and many of which are completely fatal to it.

Thus powerfully will a pet theory blind the eyes and pervert the judgment of men of science. No wonder, then, that in advocating such a baseless theory "nine-tenths of their talk" should be "*sheer nonsense.*"

And what is even more surprising is, that such large numbers of the Christian ministry are so dazzled and captivated by the reputation of certain infidel writers, and the specious presentation of their "strained facts," as readily to accept this groundless theory, and vainly labor to make the Bible conform to it.

Some of the more prominent of this class of evolutionists are evidently weakening and assuming a non-committal position, simply affirming that God *might* have produced the race of animals by transmuting one species into another, or he *might* have created each species independent of others. But the question is not what God *might* have done, but what he *has* done. The proof is abundant that species are permanent, and cannot be transmuted, and this settles the question.

The resemblance and gradation of species no more proves that one was evolved from another, than the gradation in architectural structures proves that all higher forms, up to the palace and cathedral, were evolved from the Indian wigwam.

But though evolution has been so extensively embraced, and its advocates hold it with such tenacity that, generally, they are very unwilling to listen to the proofs of its fallacy, and esteem as "fools," or at least as very *arrogant*, those who presume to oppose them, yet the truth is certain ultimately to prevail, even against great numbers and great names. And they may be assured that the stability of species will live when the theory of evolution, the mode of motion theory, and the wave-theory of sound will have passed to that "limbo, large and broad," where are stored the Ptolemaic theory of astronomy, and the myriad other like abortions of the human brain.

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EDITORS' TABLE.

THE PROBLEM OF A FUTURE LIFE.

THE DALLES, OREGON, Jan. 10, 1886.

EDITORS OF THE MICROCOSM,—The reading of your magazine for something more than two years has made me a pretty strong believer in the doctrines and principles of Substantialism. I like the seeming harmony there is between science and Christianity as taught in the "Problem of Human Life" and MICROCOSM. But I may either have misunderstood, or overlooked one point in science and theology to which I wish to call your attention should you consider it of sufficient importance, to wit: If electricity, magnetism, heat, gravitation, etc., when no longer in sensuous action, revert to their native force-elements and thus no longer retain their identity or distinctive existence, may not life, mind, and soul, when they have ceased their manifestations, again revert to the life, mind, and soul-element from whence they came, and thus leave no more trace of conscious or distinctive existence than do the physical forces? Could not the skeptic say, Oh, yes, we will agree that the forces of nature are substantial entities returning after manifestation to the force-element, but when the life-force and mind-force become disconnected from the body, what evidence have you that the mind of man maintains a personal conscious existence, or that it is not, like electric force, absorbed and lost in the great mind and life-element of nature? Respectfully,

H. RICE.

REMARKS BY THE EDITOR.

The problem here presented by Mr. Rice is without doubt the most difficult for satisfactory solution of any problem in religio-physical philosophy. The reason for its extremely difficult character is the fact that it takes in both sides of the hiatus which separates the here from the hereafter; and involving, as it does, the actual condition of the mind, life, or spirit after it has passed this chasm, it necessarily ceases to be the subject of scientific demonstration, though it is yet within the domain of scientific investigation by the principles of analogy, reason, and the intuitions of our being.

The difficulties suggested by Mr. Rice have by no means escaped our serious consideration, even during the earliest stages of the development of Substantialism; and while we fully realized that no possible solution of the problem could stand as a mathematical demonstration of the soul's identity and personality after it leaves the body at death, yet the analogies were regarded as so strong that it took only a slight preponderance of probability based upon the testimony of religion to make human immortality a settled fact, even from a scientific and philosophical standpoint.

Although this seems like a confession of weakness, yet it is a demonstrable fact that all the strength science has with which to favor religion, results from the rational truth of Substantialism as relates to the physical laws and forces and their unavoidable correlations to the vital and mental forces of the universe; while it is equally demonstrable that without the aid of this new philosophy, as we have repeatedly shown, religionists stand utterly helpless in the presence of the weakest materialist. No doubt can exist of this, with the universally admitted analogies of the vital, mental, and physical forces as mere modes of motion or properties of matter, which scientists everywhere teach, dead against any such idea as human immortality. Which is better, therefore, to have the strong and almost conclusive analogies of physical science with us in making the forces of nature substantial entities, or directly opposed to us in our hopes of a future life, as they would be on the supposition that Substantialism is not true, and that all force, or energy, is but the property or motion of matter? With Substantialism philosophically true, that every physical force or form of energy is a real objective existence or entity, life-force, mind-force, and spirit-force are instantly transformed into substantial entities on a basis of scientific analogy so nearly amounting to demonstration that it defies the opposition of science to jostle it.

Thus stands the argument upon the general problem under consideration, and upon the very borderland of the spirit-realm, when the difficulty of the materialist, as presented by Mr. Rice, demands an answer. What reason, he asks, is there why the human intellect or spirit, as the force which the Creator has raised to the highest perfection in the realm of Nature, should retain its identity and personality after separation from the body, when the inferior vital and mental forces of lower animals, and still more inferior forces of the physical domain, subside back into their respective force-fountains, lose their identity, and merely continue to exist as the crude but substantial force-element from which each of these indentical forms of energy had its rise? Does not the very putting of the question, as here fairly done, somewhat tend to give the true reason why such a distinction and difference in favor of *spirit*, as the crowning triumph of Nature's God in the human soul, should really exist?

If an intelligent God pervades this universe, not as gross matter, but as infinitely refined intellectual and vital personality (for which innumerable rational considerations can be produced), would it not be in keeping with such intelligent and personal spiritual essence and *ego*, that other corresponding intellectual and personal beings on the finite plane should exist as the crowning work and glory of such an infinite personality? And whence could come such glorified beings except as transformed personalities from the human vital, mental, and spiritual organisms, which for a time are permitted to tabernacle in this material body, thus allowing them from their exalted environment to earn and inherit individuality and identity forever, rather than a subsidence into the crude vital and mental force-element to which inferior vital and mental forms of force are appropriately consigned?

Unless there is no intelligent First Cause, or primordial fountain of vitality and mentality in the universe, a supposition at which every higher faculty of reason and human consciousness revolts, then rational analogy and the eternal fitness of things irresistibly proclaim that *man*, nature's superlative diadem of glory and the Creator's noblest work of divine art, must personally survive the catastrophe of bodily dissolution, and prove the sole exception to the otherwise universal law of nature's force-element as the receptacle of all other forms of energy after they have served the purposes of their manifestations here. If this be not so, then the creation of man with his mighty intellectual powers, so analogous to what the Deity himself must be, was a consummate trifling with infinite possibilities by infinite power and wisdom, making the failure so lamentable and stupendously pitiable that even angels, were there such beings, would cover their faces in shame.

We infer, therefore, from the very nature and essence of the intellect of man, which is capable even while in the body of virtually living in the spirit realm by anticipatory yearnings, that it was originally and chiefly designed by the Creative Will to fit man for that form of existence as being the state of God himself, and therefore that such must be the sphere best suited to the perpetual development, exercise, and enjoyment of faculties and powers so far transcending anything else the earth affords.

In corroboration of the hints here hastily thrown out it might not be uninteresting to the reader to glance at the embryo thoughts upon this theme, as we presented them originally in the "Problem of Human Life," which we copy as follows:

"Thus the way is logically made clear for the assumption that the vital and mental organism of each living creature consists of a mere drop from out the fountain of God's own infinite vital and mental substance. To the primal and miraculously created parents of each species the Creative Will must then have transferred an infinitesimal drop of His own being, constituting not only the real entities of these primal parents, but the perpetual

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specific germs for transmitting the same entity to offspring, and the only part of an organic being not liable to displacement and substitution, as so clearly shown in the preceding chapter; while the primordial stock of knowledge given to the first parents of each species, necessary to their primitive conditions of life, was also but a drop out of His own infinite intelligence.

"And here, accidentally, we again come back to the starting point—the real, intrinsic, and essential difference between the vital and mental organisms of the human and lower forms of being. From the hints already given, the thoughtful reader must have caught a glimpse of an infinite chasm yawning between the man and even his faithful dog; though its expansion, embracing an eternity of existence and development, may not have been fully comprehended by him thus far. He has only to note the essential constituent element of difference in the vital and mental entities on either side of this hiatus, and it will flash upon him at once as the grandest of biological conceptions. Here it is in a condensed form. While the lower animals receive at birth their specific stores of knowledge suited to their environment (without the capacity of teaching or being taught, except to a very limited specific extent), thus adapting them exclusively to this single state of existence, the human being receives no knowledge at birth—not a single idea of inherited intelligence—but, as before observed, an unlimited blank capacity for being taught, having an interior organism capable of being cultivated and expanded to eternity! This alone constitutes a wall as broad as the earth and **as high as the heavens between the man and the brute.**

"But, as a necessary psychological corollary and scientific outgrowth of this sublime demarkation, lower animals cannot have the slightest conception of a future life, since their vital and mental organisms, as well as their specific stores of inherited knowledge, are only suited to and limited within a temporary existence. Hence, a future life of conscious activity, being unanticipated, undesired, and wholly unconceived of, by lower species, would be of not the least advantage even to the most cultivated orang-outang, and would be unappreciated by such creatures even if they had it, since it would be but an eternal sameness without the eternal advances in culture necessary to make it otherwise, of which their very organic natures are wholly insusceptible.

"The greatest and most important difference between man and the lower animals, even including the higher apes—that difference which may be properly called the distinguishing characteristic—consists in the fact that no animal below man has or can have a conception of life after death, from the very nature of their instinctive knowledge and the manner of its reception. Whatever other differences may exist, and they are numberless and startling, this is incomparably the most intrinsic and universal.

"All this limitation to earthly objects, however, is exactly the reverse with man. With his unlimited blank capacity at birth for receiving instruction, he immediately acquires with his ordinary and rudimental intelligence, even if not specially taught it, a conception of living on forever; and not only such a conception of a future existence, but a desire for and appreciation of such an endless opportunity of acquiring knowledge. There is no reasonable or scientific ground for supposing that a longing anticipation of and a universal aspiration for a life beyond death could have been thus made an indestructible part of man's mental organism were there no such a possibility as a future life in the divine economy of the universe. This blank capacity for unlimited cultivation and eternal advancement in knowledge becomes the guarantee of man's immortality—while the lower animal, having no such capacity as a title-deed to a future life, gives back at death the mental and vital drop of its essential entity, which, instead of being annihilated or in any sense lost or blotted out, exists forever—not as an identity of being, but falls back and is reabsorbed into the great and infinite fountain of life and intelligence from which it originally came as a spark of being—the same as a drop of water which rises from the sea in the form of vapory mist, and after being carried by clouds to distant lands and caused to descend in rain to water the soil, serving thereby its temporary use, percolates to the river, through whose channel it at last finds its way back to the original fountain whence it came, where, by illiquation, it forever loses its identity in the bosom of the mother ocean, without an atom of its substance being annihilated.

"Even the infant, at birth, or before it has a conscious thought, is thus the heir by title-deed to immortal life, though its actual knowledge is not the millionth part that of the pig or puppy of the same age. It starts, thus, a blank as to intelligence; but, having the infinite indorsement of its father and mother, which involves the undeveloped capability of analyzing the stars and weighing the planets, it holds wrapped up in its vital and mental organism the *ego* of an indestructible personal identity; and should it thus die untaught, and even unconscious of its own being, its *magna charta* of selfhood will be its passport to the primary college of the angels, and thence to the university over whose entrance is written in letters of life—The Garden of Eternal Progress."

Man a Glorified Duck or a Bankrupt Monkey.

Rev. Dr. Talmage delivered a lecture quite recently on the Absurdities of Evolution, at the Madison Avenue Church, before a large assemblage.

The following are some of the remarks made by the Doctor:

Dr. Talmage stated that evolution made guesses where we came from. Theology treats of where we are going.

But still we are here. There is no war between genuine science and religion. Science is the bass, and religion the soprano. All of the great discoveries have been made by Christians. Morse, who gave us the telegraph, was a Christian; and Simpson, who gave us chloroform, was a Christian. If Haeckel, Mills, Huxley, or Spencer were asked: Do you believe in the Bible, in Adam, in miracles, in the death of Jesus, in the Holy Ghost?—their answer would be, No; and so would they all say. All scientists who believe in evolution are, therefore, infidels. Evolution tells us that at one time man was a web-footed animal. He must, therefore, have been a glorified duck. Any one who says there is no difference between the biblical account of creation and the evolution account, utters a gross misrepresentation. As Spencer was not present at the commencement and God was, I prefer the divine knowledge.

Evolutionists may push God sixty millions of miles away if they wish, but he will still be too near for evolution.

Bitten by the tongue of the second death be the man that utters that natural selection and the survival of the fittest is true.

What kind of evolution do you call it that has reduced the average height of a man of a few thousand years ago from ten feet down to the present average height of five feet six inches, and the age of man from eight hundred years down to thirty?

Natural evolution is downward and not upward. Give natural evolution a chance and all the inhabitants of this world would be in a penitentiary. According to evolution, man is a bankrupt monkey. Evolution reduces everything down to germs and protoplasm, and accounts for their appearance by spontaneous generation. What a narrow escape from not needing a God. Evolution is crowded with mysteries and missing links. Why not admit the one great mystery of God and have that settle all mysteries?

Farm Recipes:

When the ground is frozen hard is a good time to break down the stalks. Rake up the trash and burn it. Have the fields as clean as possible. You will

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save time both in preparing the land and in cultivating the crops.

It will not do to run a plow through an orchard, as the roots of the trees may be cut and hacked to pieces so greatly as to do injury. A light cultivator may be of service, however, as by its use weeds and rank grass may be kept down.

A hill of raspberry plants, after being trimmed in the spring, should only have three or four canes about three and a half feet high, and nearly one inch in diameter at the base, each cane having a few side spurs about ten inches long.

If you have a good farm horse, keep him. The difficulties in the way of securing a good horse cannot be realized until the animal is really required, and attempts are made at purchasing. But few horses are exempt from defect of some kind.

Avoid getting the boar fat. Feed him no corn at all, and allow him plenty of room for exercise. If too fat he will be of but little service, and as it will be less expensive to keep him in moderate condition, it is a matter of economy not to feed him heavily.

Muddy barnyards will cause the milk to fall off. When cows are compelled to stand knee-deep in mud, with their bodies plastered over with it, dirt will find its way into the pail, while additional food will be necessary to supply that lost from cold and and exposure.

Strawberry plants should be set out in early spring or in August, in both cases the object being to derive the advantages of the early and late rains. The plants should be set one foot apart in rows three feet apart, and should not be allowed to fruit or run the first year.

Sickly-looking plants may be taken out of their old pots, the roots washed, the weaker branches trimmed and placed into as small pots as the roots can be placed into. Let such a plant remain there until by good growth it shows its healthy roots; then it may have more earth in a little larger pot.

The man who drugs his horse to make his hair sleek and shiny shows very little sense. The best means to keep the coat glossy is careful and daily grooming. This, with plenty of oats and water and an occasional bran mash, is all the horse needs when in health. The arsenic groom should be discharged.

A New England man has patented a process for improving the fertility of fields by trenching and cross-trenching them three and a half feet deep and four rods apart, partly filling the trenches with loose stones and throwing enough earth over them to allow the plow to pass over without coming in contact with the stones.

During cold weather cows that receive water which has been warmed to a temperature of 110 degrees will give more milk than those that are compelled to drink the ice-cold fluid. This has been demonstrated by actual experiment, as there is quite a loss of animal heat on the part of the cows when compelled to drink ice water in cold weather.

If ammonia is allowed to escape and permeate through the stable it will render the animals liable to disease, and also rot the harness. Plenty of dry dirt or muck will absorb it, and the use of these substances will, therefore, not only assist in avoiding waste of valuable fertilizing material, but prevent annoyance to stock from gaseous substances.

The rule in pruning grape vines is to shorten the shoots in proportion to their strength. Summer pinching, properly performed, of the strong shoots should equalize the strength of the vine. As a general rule, excellent grapes can be had by almost any judicious system of pruning, for the only object of pruning in any case is to get strong shoots to push where they may be desired, or to add to the increased vigor of the shoot, which pruning supposes will follow the act, increasing size in the fruit it bears.

There is no part of the whole economy of the farm that affords a greater field for investigation, that requires a greater variety of information and more thorough preparation, than that health-promoting department, the growth of fruits. Crops of other kinds, as grains, cotton, etc., bring the bulk of the farmer's income, but fruits are indispensable if a good, healthy enjoyment of life is any consideration. Grains and vegetables all, as a rule, need cooking before they can be used, but fruits come from the tree when ripe just as God made them, ready for man's immediate use.

Fruit growers are beginning to understand that hardiness as a character for fruit has a very uncertain meaning, if taken in the absolute sense. A variety that is hardy enough when it first appears, gets its constitution run down, and thus it is not hardy. It does not follow because a stock of any given variety in one man's hand is not hardy, that the same variety will not be entirely hardy in the hands of another who has other plants. In most cases the trouble comes from a weakened stock; methods of propagation, culture, or the secret attacks of invisible fungi will often weaken a whole race, and the first evidence is found in the plants being not hardy, or in some other way they are found to be running out.

Whatever grass land is to receive a dressing or manure this season, should receive it before the frost is out of the land, for after the frost is out there is but very little grass land that is hard enough to cart over without injury, unless the work of carting the manure on is delayed so late in the spring that the manure will not have time to settle down to the roots of the grass, where it will keep moist enough to decompose in time to be of any use to the growing crop of the present season; but if applied now, the spring rains will settle it down to a position where it will soon be converted into plant food after the warm weather commences, and it will also settle down where it will not be disturbed by either the mower, tedder or the rake.

This is the time for building hotbeds.

North America produces annually over 100,000,000 pounds of honey, worth $15,000,000.

Chloride of lime in the runaway of rats will both drive them away and serve as an excellent disinfectant.

Sorghum makes an excellent fodder, either when fed green or cut and cured like common corn and then fed out as wanted.

Watch the potatoes. If they are sprouting rub off the sprouts and reduce the temperature of the cellar as much as you safely can.

Haul out manure for your orchard this cold weather. But don't put it close up to the trunks of trees. Put it two to three feet away.

We should not desire to develop the fat of the fowl at the same time we are endeavoring to secure eggs. Wheat, oats, milk, meat and green food are better materials for laying hens than is corn.

It requires twenty-one days from the egg to bring forth the perfect bee, and from fourteen to sixteen to make such bee a forager. But, however, such bees are valuable, for the reason that they can do the housework as well as their older sisters, and thus allow them to become foragers at once.

Soiling crops demand the very richest ground. It will not pay to cut and gather a poor crop to be carried to the barn and fed while green. If the land is not rich enough to produce a maximum crop let stock gather herbage for themselves until enough land can be got in suitable condition.

A successful grower of carnations has found lime to be a good fertilizer for them. They will be much finer grown in soil containing lime than in any other. It also prevents the attack of worms. The red spider and green fly may be overcome by the application of tobacco water, although many florists prefer fumigation with tobacco smoke.

In planting a new bed of asparagus the first

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and most requisite thing is the selection of suitable soil, which should be a light, sandy loam or clear sand, without stones or gravel. Seed should be carefully selected from the largest and most productive roots, and planted as early in the spring as possible, in heavily manured, clean land, in drills about one foot apart and eight or ten seeds to the foot.

For culture in the window, the rose requires an abundance of heat, light, sun, water and nourishment in the shape of liquid manure or commercial plant food. If the plants are kept in a healthy condition the attacks of insects need not be feared. The principal depredators are red spiders and plant lice, both of which can be destroyed by dipping the plant in a solution of tobacco water. An occasional sprinkling of the leaves with a wash made by steeping quassia chips is very beneficial.

When hotbeds are desired only for a few flowers or vegetables for home use, the frame may be made movable. Dig a bed six feet wide, two feet or more deep, and of any length desired. Level off the bottom of this bed and drive down a strong stake in each corner, to which nail cheap boards. Make the frames twelve feet in length by five feet ten inches in width, so that a sash three feet by six may be used. The manure used for the hotbeds should be fresh and well worked, removing all coarse litter.

Manure should be put around rhubarb roots and the small fruits, and upon the asparagus beds, as soon as the ground thaws, if it was not done last fall. All of them will bear liberal manuring, and will pay well for it. Prepare the hotbeds as early as possible. Every farmer should have one, in which to grow his supply of lettuce, cabbage and tomato plants. If a few potatoes are sprouted in the hotbed they can be transplanted when others are planting potatoes, and about two weeks can be gained in the time of growing. Some farmers also go so far as to start their sweet corn, cucumbers, and a few other vegetables which they wish to obtain early in this way.

Electricity in Engraving.

In a new engraving machine Lieut. B. Carter, of London, has made an interesting application of electricity. The machine is chiefly intended for decorative work upon metals, and rapidly produces high-finished results. The words or designs to be engraved are first furnished by a setting of ornamental types or stereotype plate. A fine platinum point traverses this, its motion being responded to by a table carrying the metal to be engraved under the point of the graver. As the platinum point is raised or let down by the design an electric current, acting upon an electro-magnet, produces a corresponding movement of the graver, which is thus made to accurately cut in the metal an enlarged or reduced copy of the types.

The Treatment of Fever.

Methods of Modern Physicians Compared With Those of the Past.

The old injunction to starve a fever and stuff a cold, followed for many centuries as containing the quintessence of human wisdom, contained an error of great magnitude. Countless thousands of fever-stricken victims were offered as a sacrifice to this idea of starvation. "A cold" is a moderate fever; if "stuffing" it was good practice, then starvation in any fever was wrong. Experiment has shown the truth of this inference, and Graves, the great Dublin physician, was right when he desired no nobler epitaph than "He fed fevers." Systematic support by food given as medicine and by alcohol in some form—also as a food—forms now the most important element in the management of all the self-limited diseases like typhus, typhoid, relapsing and yellow fever, pneumonia, consumption, dysentery and diphtheria, the eruptive fevers and acute inflammations generally.

The reduction of excessive bodily heat being one of the most important ends to be reached by medical treatment, and quinine and its congeners not being always available, other means have been sought for and obtained for attaining the same object. The old style of keeping the sick-room hot and without fresh air, and covering the sick man with heavy non-conductors of heat, and not allowing him cold drinks, has been abandoned by every practitioner, whether he calls himself "regular," homeopathic or eclectic. Cold baths, cooling drinks, ice and good ventilation are recognized as among the most efficient aids by the physician. The people are themselves learning some facts regarding the hygiene of the sick-room that will render the old practices impossible in the near future.

A Pump That Cost $1,000,000.

The largest pumping engine in the world is that at Friedensville, Penn., used to pump water out of a zinc mine. It was built at Merrick's foundry, Philadelphia, in 1870, at a cost of nearly $1,000,000. Its parts were so heavy that all the bridges along the line of the North Pennsylvania Railroad, from Philadelphia to Center Valley, were strengthened to insure against accident. Its cylinder has a diameter of 110 inches; the piston rod is 14 inches in diameter. It has a stroke of 12 feet, and in one minute forces over 20,000 gallons of water, or 30,000,000 daily, out of the mine to a height of 130 feet.

Reviews of New Books.

Notice to Publishers.

Special arrangements have been made to have all new books sent us carefully reviewed by specialists.

Webster's Unabridged Dictionary, G. & C. Merriam, publishers. *Buy it.*

This work is truly a library in itself. It is difficult for us to see how any one can do without this valuable work. Every scientist should possess it, and it should be found in every private and public library as well as schoolroom.

The addition to the old dictionary of a "Pronouncing Gazetteer of the World," containing over 25,000 titles, briefly describing the countries, cities, towns and natural features of the globe, greatly advances its intrinsic merit.

History of the United States

from 1492 to the year 1885—12mo., pp. 254, by Emery E. Childs. Publishers: Baker & Taylor, 9 Bond St., New York. This work is a condensed encyclopedia of the historical facts relating to the United States, arranged in chronological order, and includes notices of manufactures as they were introduced; the various industries, railroads, canals, telegraphs and other improvements and discoveries. At a glance the reader can find any important event happening in any given year from 1492 to 1885. There is hardly a fact mentioned in this valuable work that a well-informed person should not be posted on.

We heartily recommend the book to all who desire to improve themselves, and who wish to know more about the United States than can be acquired from larger works in the same amount of time.

It will pay every reader of this paper to send sixteen cents in stamps to the Joseph Dixon Crucible Co., Jersey City, N. J., for samples of lead pencils. By mentioning this paper, they will receive pencils worth double the money.

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The Microcosm.

April, 1886.

THE SUBSTANTIAL THEORY OF SOUND.[1]

BY HENRY A. MOTT, PH. D., F. C. S.

It is a well-known fact that our senses have only a certain narrow gauge within which they are able to bring us into sensible contact with the world about us. All outside of this range we are unable to reach, except in so far as artificial means have assisted us.

For example, we do not see all forms and colors; we do not hear all sounds; we do not smell all odors; we cannot consciously touch all substances; we cannot taste all flavors.

The owl and the bat can see when we cannot, the hare can hear sounds which would pass by us unheard, and the hound can scent an odor which we can only know the existence of by our higher faculty of reason.

We must not imagine, therefore, that because we cannot hear sounds in what we call perfect stillness, that there is no sound. The fact is, had we ears more sensitive we would be continually surrounded by noises or sounds on all sides; in fact, by sounds of deafening intensity on the one side, and sounds of far less intensity than are produced by a fly when walking on the other side.

It is evident that the limitations put to our sense of hearing are quite essential for our comfort and happiness. It is a fact that when our organs of hearing receive on the one side less than sixteen pulsations in one second, and on the other more than about 40,000 pulsations, we will fail to hear sound; between these limits, however, we can hear all sounds of sufficient intensity.

In presenting the *new theory of sound*, or, more properly, the SUBSTANTIAL THEORY, it will be necessary to set forth, as briefly as possible, an outline of the PHILOSOPHY OF SUBSTANTIALISM founded by A. Wilford Hall, Ph. D., LL. D., and such other facts deduced from experiment, observation, and reason as bear more or less directly on the subject, when the substantial theory of sound will appear to our reason as not only consistent with observed facts, explanatory of sound phenomena, but rational in every sense.

In the first place, the Substantial Philosophy regards the forces of nature as objective entities, real substantial things, and different forms or manifestations of the all-pervading force-element of nature, which is an immaterial substance, and which is constantly put forth and sustained by the Infinite.

2. The word substance is a generic term, and embraces material as well as immaterial substances—all matter being substance, but all substance not necessarily material. All material substance is supposed to have been synthetized or condensed in different degrees of concentration out of the all-pervading immaterial substance by the infinite power and held together by the substantial force of cohesion.

Just, then, as we see a graduated ascending scale in material substances, from osmium, the heaviest of all metals; through lithium, the lightest of all metals; through acetylene, the lightest of all liquids; through hydrogen, the lightest of all gases; through odor, the most highly attenuated condition of all material substance, so, on the other side, commencing where the material left off, and ascending from odor, we have the substantial force of cohesion, chemism, adhesion, heat, sound, electricity, magnetism, gravitation, light, soul, mind, and spirit.

An *immaterial substance* must necessarily be such an entity as does not possess

[1] From *Sci. Am Suppl.*, Apr. 3, 1886.

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the recognized properties of weight, inertia, physical tangibility, etc., and which can operate and exist in defiance of purely material conditions. We are compelled to judge of the substantial or entitative nature of anything of which the mind can form a concept, not by its recognizable or unrecognizable qualities through the direct evidences of our finite senses, but by its demonstrable effects upon other and known substances under the exercise of our rational faculties in judging, analyzing, comparing what they accomplish.

To assume *force* to be unsubstantial, or a nonentity, is to attempt to conceive of the most manifest and gigantic physical effects as without a cause, such, for example, as the shivering of a forest tree to splinters by a touch of electricity, or even the pulling of a satellite or planet from its tangential course by an invisible and intangible mode of motion. Motion, surely, is not force; it is a phenomenon, the result of the application of force to a body—withdraw the force, and motion is at an end. Because a force cannot be seen, heard, felt, tasted, or smelt is no proof that it is not an objective thing, an immaterial substance as really and truly as water is a material substance. On the contrary, by its action and what it accomplishes, we are compelled to give to it an entitative existence, especially as science has shown that, like matter, force can change its form of manifestation, but cannot be annihilated—its quantity cannot be altered. It must, therefore, be an entity; and if an entity, must be an immaterial substance, as it defies material conditions.

Magnetism, that can lift 100 or more pounds of iron against the attraction of gravitation, can only be known to exist by its observed effects—not upon our sensations, but upon inanimate objects. The same is true of gravity. The same also would be true of light, were there no eyes, and of odor, but for the single sense of smell, no possible experiment within human reach enabling us to prove its existence except by that sense alone. How many other real, substantial entities, with wonderful properties and powers, may exist in surrounding nature, but wholly intangible to any of our senses, it is impossible for us even to imagine.

With this brief insight into the nature of matter and force, we can readily imagine the vast and far-reaching scope of the Substantial Philosophy. Sound, therefore, according to the Substantial Philosophy, is a substantial force, one form of manifestation of the force-element of nature. As all the forces of nature are mutually convertible into one another, and back into the force-element itself, so substantial sound-force can be converted into substantial heat, electricity, etc., as substantial heat and electricity can be converted into sound.

3. Force acts upon force in changing from one form of manifestation to another, and no force disappears to reappear into any other form until it has accomplished its work. In other words, a force never loses its identity until it has expended all its energy as such.

The truth of this statement is shown in the acoustical telephone, over which sound can be heard for a distance of only a few miles. The substantial sound-force finds much difficulty in passing through the wire, as it has to contend with the substantial force of cohesion, which in turn is controlled to a certain extent by the substantial force of heat and electricity present in the wire under ordinary conditions. The result is that by degrees the substantial sound-force is converted into heat during its passage until it disappears as sound altogether. It succeeds, however, much better in traveling through the wire than it would through the air; only, however, because the wire is a better conductor—*i. e.*, offers less resistance to its passage. The substantial forces at work in the air so control its passage through it as to permit it to travel at a velocity of only 1093 feet a second, while iron wire permits it to travel through it at a velocity of over 17,000 feet a second. As a force will always travel in the direction of the least resistance, it would be expected that a wire would pick up from the air the various sounds traveling through it, and thus produce a rumbling noise in the phones, which actually does take place, especially in the phones used in a large city.

4. All material bodies, as we know and handle them, contain, as stated, substantial cohesive force, substantial heat force, and substantial electrical force. The *truly normal* condition of all material bodies, as pointed out by Dr. Hall, is the solid deprived of substantial heat. They would then be at *absolute* zero potential as regards this force. We cannot, however, deal with any bodies at absolute

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zero potential as regards either heat or electricity. And it is for this reason that a force has work to do in passing through a material body. If a piece of silver, from which sufficient heat has been taken to reduce its temperature to 32° F., be tested, it will be found that substantial electrical force will pass through it with far less resistance (*i. e.*, having less work to do) than if the silver be allowed to take up sufficient substantial heat force to raise its temperature to 212° F. If we represent its conductivity at 32° F. at 100, at 212° F. its conductibility will be reduced to 71.316.

5. To detect the presence of the substantial force of electricity in a body at zero potential (not *absolute* zero), it is necessary that some body in its vicinity be placed in an abnormal condition; then, as electricity repels electricity, there is a difference of potential which exists until an equilibrium is established.

To illustrate this, we may assume that a given metallic and insulated cylinder in a room is at zero potential—that is, there is no observable difference of potential between the electrical condition of the cylinder and the electrical condition of other objects in the room or the room itself. Now bring into the room in the vicinity of this cylinder a cylinder charged with + potential, or electricity (which is naturally in an abnormal condition to the things in the room). Then, since electricity repels electricity, there will be found a difference of potential in the first cylinder —the opposite end to the charged cylinder being at + potential and the near end being at – potential; and this state of affairs will exist until the charged body parts with its excess of electricity to the first cylinder and surrounding bodies in the room and the room itself is at zero potential again.

This change in the electrical or potential condition of bodies has been attributed to induced electricity, when it is plainly due to a disturbance in the electricity present in all bodies, by the presence of a body at a higher potential. With this explanation, it is not difficult to explain why sound travels further over the secondary circuit of an electrical telephone than over the circuit of an acoustical telephone. It results from the fact that the primary circuit is at a + potential, as regards the potential of the secondary circuit; hence, the potential or electrical condition of the secondary circuit is disturbed, which disturbance favors the passage of the substantial sound-force (*i. e.*, the other substantial forces—cohesion, heat, etc.—not offering the same resistance as when the electrical condition of the wire is unchanged), it therefore travels with greater velocity and to a much further distance, but in time, as it always has to work its way, it is converted into heat, or some other form of force manifestation, which takes place after it has traveled some few hundred miles.

Just as sound-force which emanates when we whisper to one another in a room can only affect us at a certain defined distance, depending somewhat on the sensitiveness of our organs of hearing to be impressed, but more on the fact that the sound-force, having work to do, is partially converted into heat before it reaches us, so is there a well-defined limit to the distance that sound-force which emanates from loud speech can affect us, either traveling through the air or through an acoustical or electrical telephone.

I have stated above that experiment has shown that for the human ear to be impressed by a sound, it must receive at least sixteen pulse effects in one second. Something more than this is necessary, as the number of pulse effects in one second simply determines the pitch of a sound, not the intensity, which is alone dependent upon the blow or pulse effect that any particular sound is capable of giving after traveling through a medium. A rabbit or hare can hear sounds that we cannot hear (*i. e.*, their organs of hearing can be impressed by a weaker pulse than the human organs of hearing, and probably by sounds whose pitch is much lower than sixteen pulse effects per second).

Right here I will state that just as electricity is generated by lifting a weight, by separating two pieces of paper, by the conversion of the substantial attractive force of adhesion or cohesion, as the case may be, so also is sound produced of greater or less intensity; but having in the case of the weight generally too low a pitch (*i. e.*, too few pulses in one second), or too weak an intensity to affect our organs of hearing; whilst, amongst some animals, if the intensity was sufficient, the pitch would possibly be quite high enough (*i. e.*, sufficient number of pulses in one second) to affect their organs of hearing.

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The fallacy of the wave-theory of sound has been clearly set forth in the pages of THE MICROCOSM and in my book on the subject,[1] so it will not be necessary to go into an explanation of the arguments and experiments used to annihilate it. Suffice it to say that numerous institutions of learning in this country have abandoned the same as perfectly unworthy of further countenance. One expression of opinion in relation to the wave-theory of sound is all I will give, and is from the pen of Prof. C. H. Kiracofe, president of Hartsville University of Indiana, who says: "We no longer teach the wave-theory of sound as science, but as a theory worthy of consideration only as an example of what may be palmed off on the world as true science."

We will therefore proceed with the consideration of the substantial theory of sound.

When a tuning-fork is struck, or made to vibrate by other means, at each vibration a pulse of sound-force is sent off which travels at the rate of 1093 feet in one second, if allowed to pass through the air. Just as substantial electrical force requires a conductor for its transference, so does substantial sound-force—the rate of transference depending upon the resistance offered to its passage, hence we have good and poor conductors of sound. There being no air or other conductor in a vacuum, naturally we do not hear sound, and in this case the energy which would have been converted into sound is converted into some other form of substantial force manifestation—probably heat.

The energy—that is to say, the power of doing work a tuning-fork possesses after being bowed or struck—is the stored-up substantial force, which is partly converted into substantial heat in the tuning-fork while vibrating and part sent off in pulses of sound at each swing of the fork. So naturally as this stored-up force or energy is continually being diminished, the pitch of the sound produced, while never varying, still varies in intensity, and can be heard loud at the start at a given distance from the fork, and then less loud, and so on until the substantial sound-force is converted into heat and disappears. As less sound-force is produced as the amplitude of swing of the prongs of the fork diminishes, hence it can only travel a less distance, as it has work to do in traveling through the air or other medium as conductors. The frequency of the prong (*i. e.*, its number of vibrations) in one second never varies in number, but does vary in the width or amplitude of swing—the number of vibrations determining the pitch, while the amplitude of swing the intensity, which depends upon the amount of stored-up substantial force or energy that has been imparted to the fork.

It is clear, therefore, from what has been said, that sound is not transmitted by condensations and rarefactions of the air, in wave or undulatory motion, but that sound is a substantial force, which is sent off as the energy of a vibrating body is converted into the same; and if the frequeney of the pulses of sound-force are at least sixteen in one second, and of sufficient energy, our organs of hearing will be impressed, and we will become conscious of hearing the sound thus produced, whilst, on the other hand, if the frequency of the pulses are more than 40,000 in one second, or even if less frequent but not possessing sufficient energy to affect our organs of hearing, we will not become conscious of the sound; whilst some animals, who have ears differently and more sensitively constructed, may be able to hear sounds which have a very low pitch and low intensities, or high pitch with low or even high intensity, as before intimated. Conversation, therefore, for aught we know, may be carried on between animals by sounds whose pitch and intensity pass by us unnoticed.

As some confusion may arise from the adoption of the word pulse, it may be well to draw a distinction between the use of the word by the wave-theory of sound and the use which is adopted by the substantial-theory of sound.

If a series of ivory balls be placed in a row, and the first one hit, a pulse is said to travel through the balls and cause the last ball to fly off. This is the use given to the term by the wave-theory, while, according to the substantial-theory, a pulse is an emission of sound-force, caused by one stroke or vibration of a body, and just as often as the vibration takes place, just so often will a pulse of sound-force be sent off. So that a tuning-fork making 256 vibrations in a second will send off 256 pulses of sound in one second, and the distance to which the pulse will

[1] "Fallacy of the Present Theory of Sound." Mott.—John Wiley & Son.

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travel will depend upon its energy (*i. e.*, its power of overcoming the resistance offered by the substantial forces present in the medium through which it travels). The amount of energy that is converted in its production will determine, therefore, the amount of energy the sound-pulse will have. It is easy, from this explanation, to understand why it is that a stretched membrane is made to vibrate when sounds are directed against it. The pulse of sound-force strikes the membrane in its endeavor to pass through it, and owing to the resistance offered by the substantial force of cohesion in the membrane and other substantial forces present, the membrane is made to tremor or vibrate, which vibration is assisted by the succeeding pulses of sound-force until the sound ceases, and the membrane finally comes to a state of rest. The tremor or vibration of the membrane is a forced condition, and while capable of producing sound-pulses itself of low intensity, still the vibration is entirely incidental to the passage of the original sound, as any motion imparted to the air by its own vibration, or the vibration of the original body producing the sound, is incidental to the production of sound, and is not sound itself.

It may also be well to state that, according to the philosophy of Substantialism, matter is considered homogeneous, and not heterogeneous, and consequently is devoid of molecules or atoms; and in three elaborate papers on the question "Is Matter Heterogeneous or Homogeneous?" which have appeared in THE MICROCOSM, I have replied to each argument advanced by the physicist and chemist by the light of the new philosophy, and such arguments have been found wanting in validity. If, therefore, matter be homogeneous, although more or less porous, the wave-theory of sound, which depends upon the harmonic motion of the molecules, and their crowding nearer together in the condensation and their separation more widely apart in the rarefaction, has no foundation in fact, as matter is not composed of molecules at all. Experiment and reason dictate that matter is theoretically infinitely divisible; of course it must be conceded that a finite ability could not disintegrate matter to infinity. This alone can be accomplished by the Infinite. The state in which matter would be when divided to infinity is what confuses the mind, as it will always confuse the finite to understand the Infinite. The one and only great and incomprehensible problem in this world which can never be fathomed or elucidated by the finite mind, is that of the Infinite. Here Science must veil her face and bow in reverence before its all-pervading majesty.

The siren, which is familiar to all scientists, is an instrument which is capable of producing different pitches of sound, of great or less intensity, by forcing air through orifices in a revolving disk. The double siren is simply a duplicate of the single siren. Given, twelve orifices in each disk, then by operating the two sirens together, so that the twelve puffs of the upper siren alternate with the twelve puffs of the lower siren, twenty-four puffs will be obtained, the same as if the revolving disk contained twenty-four orifices instead of one—the result of which will be the production of the octave as we double the number of puffs which causes the fundamental tone or the pitch produced by one disk acting alone. If, on the other hand, we produce a tone consisting of twelve double unison puffs, they naturally reinforce one another, and the intensity is increased four-fold, but the pitch is not raised.

By rapidly revolving the disks any number of puffs can be made per second, which number will determine the pitch of the tone. The energy of each puff is in part converted into a substantial sound-pulse; and as the energy thus converted may be great, the intensity of the sound will likewise be great, and consequently can be heard from a steam siren for over ten miles—the pitch depending alone on the number of pulses per second, or, in other words, the number of puffs which produce a like number of sound-pulses. To determine the exact pitch of a note the siren is unquestionably of value.

It is not difficult to understand, according to the substantial theory of sound, why it is that by using a funnel or an ear trumpet the intensity of sound is augmented. Sound-force at the moment of generation travels in all directions; consequently, if a funnel is used, more sound-force will be directed against the organ of hearing than if it were not collected and thus focused. The number of pulses will not be changed, but their energy will be intensified, and consequently the sound will be heard more distinctly.

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From actual experiment conducted by Capt. Carter, he found that, instead of sound diminishing as the square of the distance, instead of four equaling one at double distance, four equals one at thirty times the distance.

In the vicinity of a sound-producing body—take a piano, for example—the pulses of sound-force are sent off with great intensity, possessing considerable energy; but as the organs of hearing are small, only a given quantity of substantial sound-force can enter the ear from each pulse, and consequently the sound is not of deafening intensity. As we recede from the instrument the same number of pulses per second strike our organs of hearing, but the energy of the sound-pulse is more or less spent in overcoming the resistance offered by the substantial forces present in the air, and if we recede far enough away we no longer are conscious of the sound. In a room the walls reflect or throw back the sound-pulses, and consequently there is no observable difference in the intensity if the room be not too large. In a large hall, however, the difference in the intensity is quite observable.

The effect of a substantial sound-pulse is witnessed in the sympathetic vibration of unison tuning-forks. If a tuning-fork is caused to vibrate, at each vibration a pulse of sound-force is sent off, which travels in all directions, and if a unison fork be in the vicinity the prongs of the unison fork will be struck by each sound pulse, and in a short time, if the two forks are in perfect unison (*i. e.*, vibrate exactly the same number of times in a second), the unison fork will start to vibrating by the stored-up energy derived from the substantial sound-pulse which strikes it on its advancing journey. Is it possible to explain the vibration of any body whatever except by the application of the energy of a substantial force—surely the explanation here given to the sympathetic vibration of tuning-forks in perfect unison is what would have been deduced from reasoning, if the experiment had never been conducted and the fact of sympathetic vibration verified. It being understood that a tuning-fork of a given number of vibrations per second never changes the number until it comes to rest, the only change which actually takes place is the width of swing or amplitude of stroke as the stored-up energy disappears. Hence, a tuning-fork can only be set in vibration by the substantial sound-force sent off by another fork which has identically the same number of vibrations per second.

The organs by which human speech is produced are[1] the lungs, the larynx, and the parts of the mouth above the larnyx. The lungs are, as it were, the bellows of the organ; they simply produce a current of air, passing out through the throat, and varying in rapidity or force according to the requirements of the speaker. The larnyx is a kind of box at the upper end of the windpipe, and contains what is equivalent to the reed of the organ-pipe, with the muscular apparatus for its adjustment. From the sides of the box, namely, spring forth a pair of half-valves, of which the membranous edges, the "vocal chords," are capable of being brought close together in the middle of the passage, and made tense, so that the passing current of air sets them in vibration; and this vibration sends off pulses of substantial sound-force which, on reaching our organs of hearing, make us conscious of the words spoken. In ordinary breathing the valves are relaxed and retracted, leaving a wide and rudely triangular opening for the passage of air. Thus the larnyx gives the element of tone, accompanied with variety of pitch. From this explanation it is evident that speech ought to be transmitted telephonically in a suitably constructed electrical instrument, by taking advantage of the ability the individual pulses necessary for each word spoken ought to have when directed against a diaphragm, to vary the resistance, as well as to open and close the primary circuit associated with the secondary circuit.

Just this thing has been accomplished by Prof. James W. Bonta, of Philadelphia, and for which he has received a patent, and which result is contrary to the wave-theory of sound, and therefore inexplicable by such theory, as many prominent scientists, who have examined the same, have had to admit.

The Bell telephone, operating in a closed circuit, and the sounds supposed to be transmitted by an undulatory motion of induced electricity in the secondary circuit, and finally converted into sound by the final vibrations of a diaphragm.

This new telephone, which is only explainable by the substantial theory of sound, will be the subject of another paper. I will only state here that sound is

[1] See "Life and Growth of Language," p. 59.—Whitney.

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not converted into electrical undulations and then back again into sound. But the substantial sound-force advances as sound-force until it is converted into some other form of force manifestation, and never loses its identity until so converted, when as sound it ceases to exist. This may be before the sound reaches the ear, provided the ear is several hundred miles away, or if the ear is sufficiently near and the energy of the sound-pulses is still great enough, the sound-pulse, on striking the ear, will make us conscious of the communication.

VITALITY AND MATTER.

BY JOHN C. DUVAL, ESQ.

I can see no reason for supposing that vitality, with its accompanying instinct, as in plants and animals, and intelligence, as in man, is merely an abnormal creation of matter. The body of man (for instance) consists of a few simple substances (oxygen, nitrogen, carbon, hydrogen, iron, lime, etc.), combined in certain proportions, which are molded by the action or power of vitality into the form of a man. Is it reasonable, then, to suppose that the conjunction and arrangement of these material substances have originated or *created* vitality, when we can plainly perceive that it is solely due to the action of vitality that such a conjunction and arrangement of these material substances had been possible? Do we ever find in *any matter*, except that controlled by vitality, such an arrangement and conjunction of material atoms? That we do not is corroborated by the fact that we are compelled to make use of two terms to express the two entirely different conditions of matter—organic and inorganic. Is it reasonable to suppose that dead inert atoms of matter, however connected or arranged, could have *created* a power or principle dominating and controlling its *creator*, say for a hundred years, or even a thousand, as is the case with some species of trees? For the manifestation of vitality in its connection with matter, it is necessary that the material atoms should be arranged and joined together in a certain and specific way, so as to form brain, lungs, heart, bones, nerves, and all the other organs of the body, for we see when this arrangement and conjunction is materially interferred with (or fatally injured, as it is termed), that death ensues; or, in other words, that vitality can no longer manifest itself through the disordered or injured medium. But we see also that if this injury is not fatal, that vitality sets itself to work at once to repair it, and it usually succeeds in doing so, if its action is not impeded by that of quacks and their nostrums. When a limb has been cut off, or amputated, of course vitality is unable to supply a new one, because there remains no medium—bones, flesh, nerves, etc.—through which it can transmit the matter requisite for the formation of another member, but it does all that is possible by sending to the extremity of the amputated limb the material to heal it over.

No one will contend, I think, that there was any power or principle inherent in matter, by which it was thus enabled to act *intelligently* of itself, and, as it were, to say to itself or to similar matter, place *here* the materials requisite for the formation of bones, *there* such as are necessary for the formation of flesh, and *there* and *there* and *there* such as are requisite for building up all other parts and organs of the body; and that matter, obedient to *its own mandate,* could act thus intelligently, and to specific ends and purposes.

When I look around and over the vast domain of inorganic matter, I see no arrangement and combination of material atoms, such as those of organic substances, of plants and animals. Then is it not more reasonable to suppose that these wide differences in form and arrangement are owing to the action of vitality, than it is to suppose that vitality is the result of such arrangement and combination; and the more especially when we take into consideration the fact that this particular portion of matter in which this vital energy is said to have been thus created, is capable of setting at defiance for a thousand years or more the laws to which its *creator* was passively obedient prior to the creation of this vital principle?

Let us take the oak—"the brave old oak, that has stood for a thousand years"—as an example, to show the action of this vital power. Within the tiny mass of

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the acorn it was implanted as an embryo miniature oak, and forced the matter with which it was surrounded into the form of a sprout, and, by its continuous energy for hundreds of years, into the form of a majestic oak. But if this acorn had been immersed, previously to planting it, in boiling water sufficiently long to destroy its vitality, it never would germinate under the most favorable conditions of climate and soil, although the matter within it remained *undisturbed*.

By the impulse and control of this vital principle, the oak, in opposition to the laws of gravity, lifts its ponderous limbs a hundred feet or more in the air, and will resist for ages, or so long as vitality is connected with it, the persistent and never-ceasing efforts of material laws to convert it into its original and separate constituents. The vitality of this oak is therefore evidently *something*, though not matter, for we see that it controls matter, compels it to furnish the substances, and arrange them in the shape and manner to form an oak, and not a pine or maple; forces it to send the fluids through its pores to the extremity of its topmost branches, and for a thousand years or more will resist the vain efforts of material laws to resolve it into its original elements.

But the materialist will tell you that vitality and the oak itself are both simply the result of material laws acting on matter. I think in making such an assertion that they place the cart before the horse. I would say that the oak was the result of vital power acting on matter; because, as I have said, it is unreasonable to suppose that matter could originate or create a force or power superior to itself, and capable of controlling its creator, and of arresting, for a time at least, the action of material laws to which *all* matter unconnected with this vital force is subject.

A PERIL PECULIAR TO THE VOTARIES OF SCIENCE AND PHILOSOPHY.

BY REV. T. WILLISTON, M. A.

Having, in the March number of this monthly, presented some thoughts on Paul's *caveat* to Timothy respecting "oppositions of science falsely so called," I would in this number be allowed to put THE MICROCOSM's contributors and readers on their guard against an evil to which the devotees of science and philosophy are peculiarly exposed. That evil is briefly indicated in these three words of Scripture: "*Knowledge puffeth up.*" The Scriptures use the word *knowledge*—and what is *science* but certain or demonstrable knowledge?—in two unlike senses, and they make a broad distinction between the knowledge that "puffeth up" and that knowledge which, in them, is synonymous with "wisdom," "discretion," and "understanding" (see Prov. ii., etc.), and the very "beginning" or principal part of which consists in "the fear of the Lord." When Solomon says, "If thou criest after knowledge . . . . then shalt thou understand the fear of the Lord, and find the knowledge of God"; and when he elsewhere says, "The excellency of knowledge is, that wisdom giveth life to them that have it," we see at once that he uses the word knowledge in a different and far higher sense than that in which Paul uses it when he says "knowledge puffeth up." Paul's meaning was that unsanctified knowledge generates pride, or that the speculations and attainments of men in earthly science are apt to beget self-exaltation and its natural concomitant —practical atheism and an utter neglect of the "great salvation." It is a humiliating fact that acuteness of intellect and high attainments in knowledge have a powerful tendency, when not counteracted by grace, to inflate men with self-admiration, and to render them contemners of God. Indeed, it may safely be affirmed that intellectual pride and unbaptized science have been the foundation, the animating principle, of nearly all the anti-Christian views and practices that have ever prevailed. And this is just what Paul had in view when he wrote to the Colossians, "Beware, lest any man spoil you through *philosophy* and vain deceit," and when he warned Timothy to avoid "*oppositions* of the knowledge [R. V.] falsely so called." It was as though Paul had said, "Under the guise of a *love of wisdom* a kind of philosophy will prevail that is anti-Christian; and there will

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come 'oppositions' to the Gospel from what professes to be science, or accurate knowledge, when in reality it is nothing but scientific guesswork."

Such oppositions were doubtless prevailing in Paul's day, and such are prevailing in our day. In fact, the world has abounded in sophists and sophisms, in scientific smatterers, whose conclusions, though announced with great confidence, were "science falsely so called." Pope wrote wisely when he said, "A *little* learning is a dangerous thing." Would not his *caveat* have been equally wise if, neglecting rhyme, he had said, "Much learning and large attainments in science are a dangerous thing, when not connected with a profound adoration of Him who teacheth man knowledge, and with a consequent sense of personal littleness?" If dangerous in no other respect, they are so in this, that they tend to puff up their possessor, and to keep him estranged from Him who "hath respect unto the lowly, but who *knoweth the proud afar off*."

Numerous things which once passed for science are now mentioned only to be derided, and exploded theories are found all along the track of bygone centuries. That Egyptian astronomer who, seventeen and a half centuries ago, taught that all the heavenly bodies did obeisance to the earth by going round it every twenty-four hours, was doubtless for that period a very eminent scientist; yet now the civilized world—bating, of course, that worthy descendant of Ham, our brother Jasper, whose indignant protest against the received Copernican theory may yet, perhaps, revolutionize astronomy, and restore our earth to the dignity once claimed of being the grand center of the whole stellar and planetary system—thinks there must have been at least one very soft spot in the brain of Claudius Ptolemy. Seems it not quite probable that Time, the great crumbler, will by and by number some of the popular hypotheses of the present day among the bygones? May it not be that Gabriel and his associates hold some nineteenth century theories and speculations in about as much derision as we do the Ptolemaic system? (Not *you*, dear brother Jasper, but only the *system* you adhere to, and which you so eloquently advocate.) To say nothing of the nonsensical evolution or *gradual growth* theory, I am not ashamed to confess that I question whether *all* the conclusions and affirmations of geologists are reliable science, instead of being unproved hypotheses.

When they affirm, for instance, as some of them do, that God's creating work probably began some fifty or more millions of years ago, and that each of the Six Days was a period of many thousands or tens of thousands of years, I confess I listen with skeptical ears, and find myself saying, "When backed by demonstration assertions are in place, but out of place when not thus backed." I suppose, however, this only shows what an ignoramus I am!

Let none of THE MICROCOSM's readers get the impression from what I have written, that I would dissuade any one from being a devoted lover of science, or a painstaking acquirer of knowledge in any or all of its numerous branches. The sole object of this brief article has been to point out a peril to which scientists are peculiarly exposed, a snare in which many a learned man has been caught and rendered a wise fool. When science becomes, as it often has, man's idol and the Creator's rival; when the pursuit of it, instead of attracting one to the omniscient Source of all knowledge, has the effect to render him proud, self-sufficient, and a despiser of piety and the Bible, whatever benefit the world may derive from it, to its possessor it becomes a positive curse. See to it, then, you that are delightedly prosecuting scientific and philosophical inquiries, see to it that yours is not the knowledge which "puffeth up" and alienateth from God, but rather that knowledge which finds its highest satisfaction in studying his works, and rendering him adoration and praise. He alone is the true scientist, or the true philosopher, who, like Robert Boyle, finds nature and history to be one vast looking-glass, in which the Creator's form and face are all the while discerned. It matters not how devotedly one studies the great volume of nature, if he is but careful to "look through nature up to nature's God." Would that the investigations and acquisitions of all learned men might lead them to feelingly exclaim, "Great and marvelous are thy works, Lord God Almighty!" "We will praise thee, for we are fearfully and wonderfully made!"

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IS LIFE ONE SIDE OF A DOUBLE-FACED UNITY?

BY REV. JOS. S. VAN DYKE, D. D.

It may perhaps be said that a complete refutation of the mechanical theory necessitates a consideration of the views of those who do not regard life as an attribute of matter, but as an attribute of an underlying reality which has two sets of properties—the material and the spiritual. Has the existence of any such underlying single reality been proved? If so, what is it? If not, why push the question into the field of pure speculation? Besides, if there is any such undivided reality underlying all things, whether it be material or immaterial—and we presume it must be one or the other—it must be a very singular reality which is capable of possessing two directly opposite sets of qualities: extension and non-extension, activity and inactivity, form and formlessness, the distinctive properties of mind and the distinctive properties of matter also.

This theory, in the hands of Prof. Alexander Bain and Prof. Tyndall, assumes the form of an elaborate attempt to combine two theories of life—the mechanical and the teleological. "The arguments," says Prof. Bain, "for two substances have, we believe, now entirely lost their validity; they are no longer compatible with ascertained science and clear thinking. The one substance, with two sets of properties, two sides, the physical and the mental—a double-faced unity—would appear to comply with all the exigencies of the case."[1]

The advocates of this view claim for it the honor of doing full justice to both phases of life—the material and the mental. They pronounce it competent to explain all the phenomena of organic existences, regarding them as an intimately connected, and uninterrupted series of purposive effects resulting from the varied combinations of the two sets of qualities which inhere in the one substance. Life, then, is not to be regarded as a necessary, nor even as an ordinary quality of matter—indeed, not as a quality of matter at all, but as the quality of a substratum in which inhere both the matter and the life of an organism. Life is an affection which matter seems to assume when its molecules are arranged according to a certain extended class of forms, that is, in the vegetable and animal kingdom; in reality, the spiritual side of this "double-faced unity" is more fully turned toward the observer—simply this. Matter, whatever its primary qualities may be, takes upon itself new qualities with new arrangements of its molecules. Life, whatever its essential attributes may be, manifests different phenomena according to the combinations of spiritual qualities displayed by this underlying reality in each living organism. Life, so far as science is able to determine, is never separate from matter. Matter, under every form, has some measure of life. The one substance has two sets of properties: here the physical properties are more conspicuous, there the mental are. Mental qualities, transmissible in a material germ, are so far independent of external influences, and so far permanent in each organism, as to need no internal directing agent to control them, only a certain environment being necessary to their full development. Physical forces, during the life of each organic being, maintain that arrangement of the material molecules which enables the underlying substance to manifest its non-material qualities. The bioplast is the morphological unit, every living organism being merely an aggregate of bioplasts. These infinitesimal units of life, being capable of reproduction, build up animal structures by converting nutritive matter into living matter.

It is safe to say that this is also a mechanical view of life. Huxley admits that "it may be combined with a strictly mechanical view of evolution." It is difficult to see how we can regard it as anything else, unless, under its guidance, we pass into some pantheistic theory of the universe. We certainly do not account for the evidences of design everywhere apparent in nature, especially in the kingdom of life, by assuming that there is an underlying substance which, when matter assumes the molecular arrangement peculiar to bioplasm, is capable of manifesting spiritual attributes, the spiritual gleaming, as it were, through the interstices of the material. Most of those who are familiar with the teachings of modern physics are prepared to admit, with Prof. Clerk Maxwell, that matter may assume new

[1] "Mind and Body," p. 196.

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affections when new combinations are effected; that the magnitude and motions of the molecules which combine, and the physical forces which are operative in effecting the combination, determine in a measure the properties which they shall manifest under their new forms; but, though the present tendency is manifestly toward the acceptance of the theory that matter is merely phenomenal, it certainly has not been proved that matter and spirit are but two phases of one undivided substance, in which inhere inertia and sensation, changefulness and the sense of personal identity, powerlessness and will-force, insensibility and self-consciousness.

If, as every form of the mechanical theory assumes, molecules of matter braided together in certain forms have inherent power adequate to the construction of every living organism—that is, if the structureless infinitesimal bioplast is the artificer of all living forms—then, seemingly, everything is explained in the kingdom of life, save this marvelous "morphological unit." How came this possessed of such wonderful powers? If, as we are assured, it is structureless, then life is antecedent to organization, and may be, quite probably is, its cause. A living atom without organs produces marvelous results. These results cannot be attributed to the atom of matter, for that would be to assign effects to an inadequate cause. Nor are the effects produced by the organs of the bioplast, for organs it has none, we are assured. Why, then, may we not conclude that they may possibly be produced by the life of the bioplast?

If the bioplast is structureless, though possessing power adequate to construct all organisms, and if it has no individual life, though capable of imparting life to nutrient matter, then why regard it as the true morphological unit? The unit ought, it would seem, to possess a structure of its own, and a life of its own. Not possessing these, the arduous task is imposed upon it of producing effects seemingly not contained in itself as cause. If, on the other hand, the bioplast has an individual life of its own, as we presume it must have, whence did this life originate? To say that molecules of matter chanced to come together in such forms as to originate life does not satisfy reason. God is not eliminated. If he is needed nowhere else, he is needed apparently as the creator of bioplasm.

If it is said, on the other hand, that the bioplast has an organization, though it cannot be discovered under the most powerful microscope—which we presume is the case—then how came it to possess this organization? How did it happen to be an organization endowed with skill adequate to the marvels attributed to it? A cause must be equal to the effects produced by it. Consequently, small as it is, it must be equal to the production of every species of plants and animals, if, as we are told, they are all constructed by it. Accordingly it must be the most powerful agent in the universe. But it is unquestionably an effect. Can that which is capable of constructing organisms originate without an organizer? As the effects which it produces evince design, can it possibly have come into being without a designer? God is not eliminated. The more wonderful the results the bioplast is capable of producing, and the more completely its working is independent of superintendence, the greater the need of assuming that it must be the production of an intelligent designer.

THE ORIGIN OF CONSCIENCE.

BY REV. L. W. BATES, D. D.

"Is conscience innate?" was formerly a popular question for discussion in the numerous lyceums and literary societies.

That conscience is innate, so far as being born with us as a natural faculty, cannot be doubted, but that it is innate to the degree of infallibility cannot be true. Infallibility can be obtained only from God's word and spirit; and from them only in such a modified degree as scarcely to justify the use of such a term. There can be no such thing as infallibility naturally incorporated with man's faculties, for all are confused and weakened by sin; and he who denies the depravity of human nature is not worth arguing with.

The physical senses of seeing, hearing, feeling, etc., are not infallible, or they

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would be uniform in all cases. Not being uniform, they are not infallible; and not being infallible, they are not reliable. They must be educated to wisely distinguish and recognize the variety of flavors, odors, sounds, and lights, and to measure distances; but when educated to their highest possible perfection they are not reliable, because they are still liable to mistakes.

The mental faculties are not infallible, or the reasoning, perception, and memory would be equal in all cases. Not being equal, they are not infallible; and not being infallible, they are not reliable. The untrained mental faculties may perceive some truths, reason out some conclusions, and recall some facts, but the process and results are confused. There must be careful and persistent education to develop these faculties to their full capacity; but when they have attained their utmost perfection they are not reliable, because they fail to recall some essential facts, to perceive some important truths, and to reach some just conclusions. So with the moral sense—or spiritual faculty, as I prefer to call it—of conscience. It is not infallible, or its action would be uniform in all cases; and not being infallible, it is not reliable. In its primary condition it may distinguish some vices from some virtues, but it is capable of approving the wrong and reprobating the right. Saul's conscience may consent to Stephen's death, and prompt him to an active approval by standing guard over the clothes of the murderous fiends who take the life of that holy man, and urge his religious zeal to the length of persecuting men and women to prison and to death, and to do many things contrary to the name of Jesus. But Paul's conscience consented not only that he should be bound, but also that he should die in Jerusalem; and prompted him to reason of righteousness, temperance, and judgment to come, till Felix trembled; to boldly preach Jesus and the resurrection before Festus and Agrippa; and to lift up his voice in behalf of the Son of God in Rome, to the sacrifice of his own life.

Saul and Paul were the same man, but not actuated by the same conscience. John Brown's conscience approved of murdering the white men of Virginia to free the blacks, and Giteau's conscience claimed a divine commission to assassinate Garfield, but the consciences of twenty-four men hanged them as murderers. The human faculties are not causative, but receptive. It is by education that the eye and ear distinguish the face and voice of a friend from those of an enemy. The trained eye and ear of the artist acquire a high tone in sculpture, painting, and music. The educated taste of the florist excels in color and fragrance. The understanding of the philosopher excels in perception and reasoning, and the orator in thought and expression. So the trained conscience excels in its perception of purity and safety. Educated, it recognizes the voice and image of God; and, familiar with Divine communications, it distinguishes them from all others, and the Holy Ghost, God's infallible spirit, not only bears infallible testimony, but so quickens and enlightens the spiritual sense (conscience) that it at once recognizes the communication, and rests secure and contented under the Divine guidance and approval.

The conscience needs education as much as any other faculty. Right and wrong exist independently of the conscience and its decisions, just as truth and falsehood exist independently of the rational faculty and its conclusions; as light and darkness, sound and silence exist independently of the eye and ear and their operations.

What if the education be wrong, so as to pervert and corrupt the conscience? Why, you must take the consequences. There lies the trouble: men do educate their consciences wrong, and, in most cases, designedly do so. Some men have a legal conscience, and when they defraud their neighbor outside of law, or by the authority of law, they wipe their lips and say they have done no wrong. Some men's consciences are governed by results. They are thoughtless and daring in driving their horses, handling their guns, and administering medicine, and conscience remains dormant; but when they run over a child, shoot a friend, or poison a patient, conscience speaks in thunder tones, and wrings the heart with deepest anguish. Conscience may be so educated as to be active as a moral sense between man and man, and be dead as a spiritual sense between man and God. Hence the conscience of a moralist chides him whenever he sins against his fellow-man, but remains as quiet as a sleeping infant when he sins against his Maker.

Many a religious bigot has engaged in bloody persecution for opinion's sake

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with a clear conscience, essaying to step into the place of God to execute vengeance upon error and heresy. The Jews doubtless crucified Jesus as a blasphemous impostor with a clear conscience.

Is a man to be governed by his conscience? Most certainly. What else can he do? However uncertain the operations of his other faculties may be, he must follow their directions. If your eye or ear should tell you that there was danger or safety in a certain direction, it would be madness to reject the admonition. If your reason should declare that certain conclusions were inevitable, or your perceptions that certain principles were true, you would be obliged to adopt them; otherwise you would be rejecting the dictates of your mental faculties. Where would you then be? Adopting acknowledged error. The man who violates his conscience stands self-condemned just as in the other case. The man who violates even a bad conscience is self-condemned and not honest, and the man who obeys a bad conscience is deluded, and must be condemned by the very principles of right and wrong. So, to obey or disobey a bad conscience is wrong. Deny it if you can. A wrong conscience does not protect you any more than defective sight, hearing, or reason. It may be inquired: If that be so, of what use is a conscience? Of as much use as eyes, ears, and reason are. You could not see without eyes, hear without ears, nor understand without reason; nor could you perceive right from wrong without conscience.

As we control the endowments of our nature, so we must be controlled by them. The conscience is sufficiently under our control to make every man responsible for his conscience. As reason is to be observant of evidence, and open to the truth, to embrace its teachings, so must conscience be observant of the right, to obey its behests. When I say that a man must obey his conscience, I mean in regard to active duty; but when conscience simply points out a privilege, he may forego it without blame.

I admit that there is a difference in regard to the education of conscience and the other faculties, in two respects. The other faculties may be so defective that they cannot be educated, as in color-blindness; but the honest seeker need not fail in securing a correct conscience. The mistakes of the other faculties may be fatal in their consequences, even when there was no possibility of a better education, either by lack of means or lack of capacity; but in regard to the conscience, responsibility is always in proportion to the opportunity and means of its education. Paul says of some who have made mistakes in faith and conscience, that though their works shall be burned up and they suffer loss, yet they themselves may be saved; and that the heathen, who have no revelation of the law of God, are accepted when their consciences bear them witness that they live in accordance with the law written on their hearts.

The mental faculties are to search out, grasp, and apply the evidences of God's truth, mysterious though it be, until faith can take hold of that truth and appropriate it with a trusting confidence that nothing can shake or even jostle; and the conscience is to drink it in as its own life-force, guided by the infallible Spirit into a oneness with the truth and the God of truth.

Conscience is appointed, in a modified degree, as the vicegerent of God to try the hearts of the children of men, and therefore the standard is fixed by God himself; and when the conscience is bribed to indorse evil and approve sin, it becomes a corrupt judge, and God will set aside its decisions and carry the case to a higher court. It is God's vicegerent only when it speaks according to his Word and Spirit, and not when it speaks in accordance with man's prejudices, inclinations, and ignorance.

A pure conscience is a quickened sense of God's opposition to evil and his identity with the right, and both the Word and Spirit of God are necessary to produce such a conscience.

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THE SUBSTANTIAL PHILOSOPHY.[1]

BY THE EDITOR.

SECOND PAPER.

1. If the assumption of a certain fact or state of things in science will plausibly explain or account for any class of observed phenomena, such supposed fact or state of things may be regarded as a tentative or *working hypothesis*, and as such can properly be used as a basis for further research and investigation in the same direction.

2. If reasonable evidence shall accumulate, by such continued research and investigation, that the assumed fact or state of things is really true, and, by comparison with other hypotheses, that it better accounts for the phenomena in question, or more completely explains their relations to other facts involved, than can any other hypothesis, then such premises and conclusions may fairly rank as a *theory of science*, and may be so entertained till a more reasonable theory shall supplant it.

3. If the assumed fact or state of things shall not only be demonstrated to be true, but shall so conclusively explain or account for the observed phenomena in question as to preclude the possible correctness of any opposing hypothesis or theory, then such fact, with its explanation or solution of the phenomena involved, becomes a *fixed law of science*.

4. But if instead of one fact or state of things, we shall assume and bring together various classes of facts pertaining to different departments of science, and if, after proving such facts to be true, we can successfully apply them to the solution of all the observed phenomena in those various departments of scientific investigation, and in such a way as harmoniously to account for the phenomena involved, then such combined facts or states of things, with their solutions, laws, theories, and hypotheses, may fairly be claimed as a *system of scientific philosophy*.

5. But, finally, if such multiplicity of facts or states of things shall not only solve and harmonize all related scientific phenomena, as here supposed (doing it so completely as to exclude every other supposable explanation), but shall logically connect themselves with the known facts of other domains outside of science, and in all other departments of human knowledge and research, and shall still account for their phenomenal manifestations as fully and satisfactorily as they had done in the different departments of science, then such broad generalization of doctrines, solutions, inferences, and conclusions may properly be regarded as a *universal system of philosophy*, and as such it can and must maintain itself, if no rebutting arguments can be brought to show that its facts are mistaken or the conclusions therefrom have been illogically deduced.

In this latter light do we confidently regard the Substantial Philosophy, considering it with reference to its origin, progressive development, general scope, and basic principles; and as such have we undertaken to present, explain, illustrate, and defend it in this series of papers. And we say at the start, that with this view of what properly constitutes and is involved in a universal system of philosophy, we have no apology to make in springing upon this late decade of the nineteenth century the apparently presumptuous claim that, after all that Grecian, Roman, and modern times had achieved in this direction, there still remained unexplored regions, in the scientific, metaphysical, and religious domain of thought, for another philosophy whose elementary principles had been overlooked—even a philosophy of universal application. And this claim, presumptuous as it really seems to be, will, we repeat, need no apology at our hands when the numerous considerations involved therein, and which necessarily led to its development, shall have been duly unfolded to the readers of this magazine. And if the considerations to be presented shall be shown to be as true in reason as many of them have been proved to be new in science, no unbiased investigator will hesitate to admit that the claim of a universal philosophy, pretentious as it seems to be, is not without a foundation in probable truth.

[1] Written for the *Cosmopolitan Magazine*.

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In discussing the merits of this claim of Substantialism to a place among the philosophies of the world, one of the most eloquent writers and accomplished scholars of this age declares:[1]

"Neither is there room in its vocabulary for the term 'hypothesis' in the sense of its common acceptation. Not for one moment can the name 'philosophy,' in its broadest signification, be rightfully withheld from the harmonious collection of facts, phenomena, and logical deductions, which was obliged to annihilate a universally accepted theory of science in order to lay its foundation-stone on solid rock. Ordinarily such a collection of facts, phenomena, and deductions, depending entirely upon their harmonious consistency for acceptance, might, at best, be held as only a tentative theory; but when such systemetized collection or arrangement was not only entirely congruous in accounting for all the phenomena involved, but, in order to crown its work, was also obliged to destroy one of the best-established theories in physical science, nothing but educated ignorance and narrow bigotry can refuse its admission to the family of philosophies. And whether now admitted or rejected, it will make but little difference in the near future's unfolding years. Conscious of the revolutionary work already accomplished, it will not condescend to 'bow the suppliant knee that thrift may follow fawning'; but standing erect in the majesty of its intrinsic worth. the vigor of its symmetrical constitution, and the beauty of its admirable proportions, it will thunder with authority at the feeble gates of stubborn scholasticism, until the learned world will be glad to own and honor and utilize the only system of philosophy that can strike the fetters of fallacy from its limbs and bring it to the light and liberty of a more enduring substance."

Before Substantialism had taken the first formative step toward its present definite shape, we encountered the momentous problem of the nature of *force*, as it presents itself to the observation of man in physical phenomena, such as those of heat, light, sound, electricity, gravitation, magnetism, cohesive attraction, etc., and we naturally asked ourself, and asked others to explain, if possible, of what these so-called forces consisted, and how it was possible for the observed phenomena to result from such apparently insubstantial causes? We found every book on the subject within our reach, as well as every scientific man with whom we conversed, entirely at sea as to any definite or well-settled ideas on the subject. No two writers or teachers agreed in all respects even in expounding the theories of the various forces which had been accepted and placed permanently in the text-books for the use of schools. This state of facts convinced us that something was radically wrong in the very foundation principles of science upon this most elementary subject, and that it had always been wrong since the dawn of scientific investigation, and hence that the general theories of science which had grown out of such confused, erroneous, and contradictory views of the very basis of all science, namely, the nature of *force*, must all be more or less wrong in the nature of things; and that if an absolutely correct understanding could be had of the nature and character of force, it would be but an easy matter to correct and finally formulate the various scientific theories in accordance with such fundamentally true conceptions of force.

After much examination and comparison of the various authorities upon this question of the nature of force, it became manifest that the general drift of scientific thought was to the effect that force, in whatever form of manifestation, consisted wholly in the motions of the material molecules of the various substances in or through which the manifestation took place. Thus, that *sound*, outside of us, was but the vibratory motion of the air-particles sent off from the sounding body, and within us was but the corresponding vibration of the tympanic membrane and of the auditory nerve. That *light*, outside of us, was but the vibratory motion of an all-pervading *ether*—a highly attenuated material substance filling all space and surrounding the molecules and ultimate atoms of all solid, liquid, or gaseous bodies—and that within us light sensations also consisted of correspondingly minute vibrations of the optic nerve and the retinal membrane. That heat, of itself, was a similar vibratory motion of this supposed ether in the air, or in whatever surround-

[1] From a paper on "The Future of the Substantial Philosophy," by Rev. J. I. Swander, D. D., of Fremont, Ohio, in THE MICROCOSM, Vol. V., page 49.

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ing objects outside of us, while within us it was a corresponding vibratory motion of the sense-nerves which, when conducted to the brain, became translated into the sensation of warmth. Hence that sound, light, and heat were but "modes of motion" of various kinds in different material bodies or substances, and therefore that force was simply motion, though in another sense, as held by some, it was but the property or quality of the material body manifesting itself by such motions. This was the general view, especially regarding those forms of force which resulted in sensuous effects.

But there were various other forms of physical force, such as magnetism, electricity, gravitation, etc., recognized by reason outside of our sensations. If heat must be explained as a "mode of motion" of the molecules of some material body, it seems consistent that all force ought to be accounted for in the same way, in order to maintain harmony in nature. Hence, magnetism was actually decided by the highest authorities, such as Sir William Thomson, to consist of the motion of the molecules of the steel magnet. This strange conclusion, without stopping to ask what force back of this magnet caused the molecules of steel to move, is a fair specimen of the bewildering confusion in which all this "mode-of-motion" reasoning is involved. If it were assumed that the ultimate molecules of the steel magnet vibrated in consequence of the action of the ether substance surrounding them, then the same difficulty presents itself as to what force acts upon the ether particles to move them against the steel molecules, and thus cause them to vibrate!

In view of the universally admitted truisms, or laws of physical science, that *inertia* is a property of all material bodies, and hence that no inert body, however small or however attenuated, can move itself or vibrate, unless actually forced to do so by the energy of some mechanical cause, it is no wonder that philosophical minds in all ages have been dissatisfied when they tried to trace the vibratory motion called force to inert molecules, with the elementary fact staring them in the face that no molecule, either of steel or of *ether*, can move, unless an efficient cause in the shape of some real force back of it should produce such motion. And no wonder that scientific errors innumerable should creep into the theories of physical philosophy which were based upon such childish assumptions as that the motions of molecules, which had never been witnessed, constituted the force manifested, while the molecules themselves, being inert matter, could not stir unless by the coercing action of some force by which to overcome their inertia, and thus put them into motion.

At this point in our early reasoning and investigations, the Substantial Philosophy, as a new revelation from the secret archives of nature, flashed out upon our mind with electric brightness. We saw it mentally as a mighty panorama sweeping before our vision in its far-reaching importance and revolutionary consequences. We then and there wrote down this sentence, as the scene was moving: "Every physical force or phenomenon-producing cause in nature, whether it addresses our sensuous consciousness or only appeals to our reasoning powers, is a *real, substantial entity* or *objective thing*, as much so as is the material body through which or upon which such manifestation of force takes place, and consequently that all the prevailing notions taught as science throughout the world, that any force, as a phenomenon-producing cause, consists of the mere motions of the body thus caused to move, is false in fact, preposterous in theory, and self-stultifying in logic."

From this central article of what was to become the creed of the adherents of a new philosophy, we began to map the outlines of the substantial doctrines which were ultimately and necessarily to constitute the superstructure to be reared upon that foundation principle. The first generalization from so radical a scientific departure was, that everything in the universe, without exception, of which the mind can form a positive concept, was a substantial entity or objective existence, and that these innumerable entities were naturally divisible into two main classes, namely, *material* and *immaterial* substances. That as the material class of substantial entities consisted of various grades of density, grossness, rarity, refinement, etc., such as platinum, diamond, gold, copper, iron, rock, wood, water, flesh, air, gas, odor, etc., so the immaterial substances of the universe were similarly graded through numerous degrees of density, rarity, coarseness, sublimation, refinement, etc., such as heat, electricity, magnetism, sound, gravitation, cohesion, light, vitality, instinct, mind, intellect, spirit, etc., the most refined and exalted substan-

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tial entity in the universe being the spirit-essence of the infinite intelligence from which all things, directly or indirectly, have proceeded and must still proceed.

From the natural difficulty of conceiving of a substance that is not material, owing to our incorrect habits in the use of terms, it became necessary to illustrate the fact that though all material bodies, of whatever name or character, are *substance* or *substantial,* it by no means follows that all substantial bodies are *material.* This is the very first fine or difficult distinction that a beginner in Substantialism has to learn, and ever thereafter to keep in mind. Remember, therefore, that *substance* is the generic term, including all entities in nature, while *matter* is the specific term, designating only one of the two general departments of substance. Thus, while metal, or wood, or stone, or water, or air, or hydrogen, for example, are all *matter,* yet each term expresses only a single minor division of material substance. In like manner, while heat, light, magnetism, electricity, life, mind, or spirit each expresses a single minor division of immateriality, they all, as on the material side, are substantial entities.

We have often tried to make this truth plain, in teaching the principles of Substantialism, by the familiar illustration that, while all *maple* is *wood,* it by no means follows that all *wood* is *maple.* While all *iron* is *metal,* it by no means follows that all *metal* is *iron,* etc. Extending the illustration still farther, we say that while all *metal* is *matter,* or material, it by no means follows that all *matter* is *metal* or metallic; and to carry this distinction to its culmination, we say that while all *matter* is *substance* or substantial, it by no means follows that all *substance* is *matter* or material. In this way we have tried to illustrate and enforce the correctness of our general classification of all substances in the universe into material and immaterial entities. If these illustrations shall be carefully compared and studied, the difficulty which strikes so many scientists as formidable, in distinguishing between material and immaterial substances, will at once be dissipated.

By material bodies, in their various degrees of density, refinement, or attenuation, we mean those specific forms of substance which are ponderable and thus possess the property of inertia, or some other physical or tangible property by which, in the chemical laboratory or by mechanical tests, their material existence can be determined. By *property* of matter we do not mean *force* in any of its forms or manifestations, though no property of any material body can exist except as the result of the action of force in some of its forms. For example, the property of *inertia* cannot exist in a body except as the result of the action of the immaterial force of *gravity,* both in bulk, downward, and as acting among the smaller particles of the inert mass, one toward another. So the property of *elasticity* in a material body can only exist as the result of the action of the immaterial but substantial force of cohesion, by which the material particles of a body are so arranged in relation to each other, and so held together as to constitute this elastic property, quality, or condition of the body. The peculiarity of this particular arrangement of the infinitesimal particles of a material body by which it is constituted *elastic,* is entirely unknown to man, and no doubt, like the different cohesive arrangements constituting all other observed properties of matter, extends back into the infinite, where the human intellect can never penetrate, at least in the present life.

The *elastic property* of a body thus depends upon the relation of its material particles toward each other, as disposed by the substantial force of cohesive attraction, but the *elastic action* which takes place in a body after distortion—that action which restores a distorted body to its original form—is the direct result of the distorting force itself which is stored up in the material structure, and which reacts through this elastic property by permission of that same cohesive force. The mechanical force which a clock-spring exerts, for example, in causing a clock to run for a whole week, is simply the energy exerted in winding it, and thus stored up among the particles of the spring by permission of the cohesive force, and which constantly reacts through the property of elasticity to restore the spring to its normal form. Thus it is not the spring, in the prime sense, which runs the clock for a week, but it is the mechanical energy of the person's arm who winds up the spring, and which stores up this energy through the elastic property of the spring,

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and which, by suitable restricting devices, distributes this original force throughout so many days of work.

Thus also is it with the properties of transparency, opacity, malleability, brittleness, fusibility, hardness, ductility, combustibility, compressibility, or the conductibility, either for sound, heat, or electricity, and which are entirely due to the controlling action of this fundamental, constructing, and governing force of the material universe, namely, *cohesion.* No ray of light could ever penetrate any body or pass through it but by the permission of cohesive force in putting the particles of the body together so as to create this property which we call transparency. No heat, or sound, or electric current could ever pass through any material body, only as cohesion has so arranged the particles of the material substance as to permit the passage of such forms of force with various degrees of facility. But all this argument, or rather statement of these scientific truisms of the Substantial Philosophy, is somewhat in advance of our subject, and may thus prematurely anticipate what more properly belongs to a future paper.

By *immaterial* substance, therefore, we mean entities that do not possess the properties of matter, such as ponderability or inertia—such substances as will pass through material bodies in defiance of material conditions, and which are subject only to the control of cohesion or some correlated form of force. This is well illustrated by that form of force called *magnetism.* While some of the forms of force, as just hinted, pass readily through some solid bodies, yet they will scarcely pass perceptibly through others, as witness electricity passing freely through silver, the best known conductor, in contrast with the difficulty with which it passes through glass, owing, as we have stated, to the permission or non-permission of the force of cohesion which controls the particles of all bodies, and determines by its own arbitrary laws what forces shall enter and what shall be excluded.[1]

Not so, however, with magnetism. This form of force, *par excellence* (thanks to cohesion), furnishes us with an irresistible proof of the substantial immateriality of force, *per se,* since magnetism defies all material conditions—and apparently defies cohesive force also—in its passage through bodies of every form or character without any loss of its attractive energy, acting the same exactly through non-conductors as if nothing intervened between the magnet and the iron armature attracted. Place sheets of impervious glass, for example, between the poles of the magnet and the suspended piece of iron, or place between them flat vases of distilled water, the freest from porosity of anything known, and let the magnet attract, and still, when these vases are removed, the power exerted upon the iron armature is in no wise greater than before. Suspend the iron in a vacuum as perfect as a Torricellian tube of glass, and the magnet placed outside will attract it with the same force precisely as if the piece of iron were suspended at the same distance from it in the open air. No molecular motion of the particles of the magnet, or of the medium connecting it with the armature, can begin to account for this startling result. Nothing but the fundamental principles of the Substantial Philosophy can approach the subject of a rational solution of such a mystery. Nothing but a real, immaterial substance passing from the poles of the magnet, thence through the glass, water, or vacuum, and finally seizing the piece of iron and displacing it bodily, affords the least ground of explanation of the problem.

But this paper must close here, having already reached its limit. Let no reader jump at conclusions upon the subjects thus partially discussed, but wait and read patiently to the end, when a rational and just conclusion, based upon the entire premises and argument, will the more likely be the result.

[1] We once supposed, with everybody else, and until very recently, that glass was a complete insulator of electricity. But by more refined experiments, as now conducted by Prof. Culp, of this city, it is determined that there is no substance which will not admit the passage of electricity to some degree, which proves that different bodies conduct it with different facility, proportioned to the favorable or unfavorable relation of cohesion as operating among the particles of the conducting medium.

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THE RECESS IN THE SCHOOL OF PROPHECY.[1]

BY REV. J. I. SWANDER, A. M., D. D.

I have been requested to sketch an "Outline of Events from the Closing of the Old Testament Canon to the Opening of the New." The subject assigned us has its peculiar difficulty. It is not an easy task to make an excellent quality of brick without straw, or an equivalent thereof. And yet we are not left without the material necessary to at least approximate a partially correct narrative of the leading events that occurred during the period of time under consideration.

According to one view there was no such intercalary age. The Old Testament looked forward in the way of inspired prediction, and the New reached back in the form of a fulfillment of the foregoing prophecies, as well as an infallible record thereof. The Bible is, therefore, our first book of reference.

Aside from such canonical source of information, we have access to records of a secondary class and character. Some of the Apochryphal writings, including especially the two books of the Maccabees, though not fully inspired, were probably written by pious men, and are generally received as measurably authentic history, and as furnishing valuable information upon the subject now in hand. Josephus, the Jewish scribe, with his peculiar advantage of access to the sacred archives, may well be reckoned the standard Jewish historian, and an author of great value in any such work as that assigned us in the programme. The portion of his writings bearing more directly upon the events of the age under consideration begins with his "XI. Book of Jewish Antiquities." Besides these, we have some of the records made by cotemporaneous historians, both Greek and Latin. From these we learn not only the events on the outside of the Theocracy, but also inform ourselves of what was actually transpiring, during that period, in Palestine and the typical Kingdom of God.

The section of time of which I am to speak began about 430 B. C., and ended, say 70 A. D., measuring in round numbers 500 years. It reached from Malachi to Matthew, from Nehemiah to Nero, from Pericles to Paul, from the highest point of glory ever attained by the Greeks to the subjugation of ancient Britain under the Claudian conquests of Rome, from Plato to St. Peter, from the beginning of Roman ascendancy under that virtuous dictator, Cincinnatus, to the commencement of her decline in the destructive elements of her moral degeneracy.

In making up the vast volume of the world's historic onflow, there is a constant commingling of elements, sacred and profane. We cannot separate, but we must distinguish between the events on the outside of the Theocracy, which may be regarded as milestones along the road of profane history, and those on the inside which are links in history's more sacred chain, or ripples on the current of history's more sacred stream. This more central channel of the world's unfolding life was once known as Judaism: it is now the history of the Christian Church. In Judaism it was the stream rising in the mountain of Prophecy. In Christianity it is the mighty river moving majestically forward to make glad the City of God.

On the outside of this channel, during the period under consideration, Greece, having become triumphant over the old monarchies of the East, had already begun to decline. The Spartan and Macedonian powers had arisen, flourished, and fallen. Carthage had struggled hard through all her Runic wars in disputing with Rome for the empire of the world. The Hannibals and the Hamilcars displayed a valor and maintained a struggle worthy of a more unenviable immortality. But Providence had ordained that for a few centuries longer the world's mistress should sit upon the seven hills by the murky and turbulent waters of the Tiber. Rome was in the brilliancy of the Augustan age, and was ruling the world by force of arms, when the Prince of Peace made his appearance to plant an empire in which he will ever sway the scepter of love. Yet even at that time Rome had seeds of national decay in the process of destructive germination. The smoldering fires of national conflagration were already kindled in her most combustible parts. At

[1] Prepared and delivered by request of the committee, before the Sandusky County S. S. Institute, at its recent convention in the M. E. Church, Fremont, Ohio, and now published by request in THE MICROCOSM.

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the same time there was an undeveloped opposition from without. An imperial Hercules was just awakening from his infantile sleep across the Alps. Germany had already begun to cultivate that spirit of stalwart independence which in fifteen centuries made her the cradle of the Reformation, and which in the nineteenth century makes her the strongest empire upon the planet. About the time that Christ was going into Egypt before the jealousy and persecution of Herod, Arminius was rallying his patriot countrymen to drive back the haughty legions of Varus, which they did in A. D. 9, securing at once and forever the independence of the Teutonic race.

Taking our stand for a moment within the compass of the Theocracy and the Promiseland, we see that when the voice of prophecy became silent the chosen nation was in a state of comparative national independence. But they did not long so remain. After the death of Alexander the Great, B. C. 323, and the consequent division of his ephemeral empire among his generals, Palestine became tributary to Egypt. It so remained until 200 years B. C., when it passed under the yoke of Syria. About 48 years B. C., at the time of the First Triumvirate, which consisted of Pompey, Crassus, and Julius Cæsar, it became one of the provinces of Rome. Hence Milton:

> "Judea now, and all the Promised Land
> Reduced a province under Roman yoke,
> Obeys Tiberius."

The breaking up of the First Triumvirate, by the death of Crassus in battle with the Parthians, the overthrow of Pompey in the battle of Pharsalia, and the assassination of Cæsar on the 15th of March, B. C. 44, made room for the Second Triumvirate, in which was Octavius, the veritable Cæsar Augustus, who sent out his decree that all the world should be taxed. Joseph and Mary, both being of the lineage of David, started upon a journey of seventy miles, and reported at Bethlehem, the birthplace of David, to be taxed. Here, while his parents were rendering unto Cæsar the things that Cæsar demanded, the Redeemer of the world was born. The birth of Christ was the culminating event of that inter-prophetic age. It was the new end of the past, the new center of the present, and the new beginning of the future. Chronologists do not agree as to what time the Star of Bethlehem appeared, and precisely when the wise men came from the East to pay the unconscious homage of heathenism to the new-born King. For many centuries the Church has observed the 6th of January as the Epiphany, or time of Christ's first and prophetic manifestation to the Gentiles. This would seem to indicate that in the opinion of the early Christian historians the infant Messiah was about twelve days old when that embassy of devout pagans paid their homage before his manger-cradle. They were most probably Persian astronomers. Glancing over the constellations of heaven, they saw the new star twinkling over Judea's hills, and started to Jerusalem to inquire: "Where is he that is born King of the Jews?"

The events within the nation during those declining years of the Theocracy may be strung on any one of several historic threads running down the age:

1. *The ancestral line of the Messiah.*—Of this we have about ten generations in the section of time now under consideration. It reaches from Eliakim to Joseph, the Redeemer's foster-father. The notable fact connected with that last age of our Saviour's ancestry was its tendency from its former meridian luster in royalty enthroned at Jerusalem down to the respectable family of a plebeian carpenter at Nazareth.

2. *The history of the Old Testament Scriptures.*—Touching them, the event of that period was their translation from Hebrew into the Greek language. This great work was accomplished at Alexandria, 285 B. C. The new translation has since been called the Septuagint version. It was so called because it was rendered by *seventy* translators, probably from Jerusalem. It was a great event, and became the nucleus of a great movement. That was the missionary age and work of Judaism. Restless under the heavy heel of growing foreign oppression, and having already cultivated a desire for the mercantile pursuit, for which they are noted even unto this day, they began to travel abroad with the Scriptures in one hand and merchandise in the other. They began thus to disperse voluntarily among the nations. There was therefore a consequent mingling of the Hebrew

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and the Greek languages and the rise of the Helenistic dialect, which was in general use at the first coming of Christ, as well as a mutual exchange of religious hopes and views, which doubtless planted in the hearts of many Gentiles a longing for the promised appearance of Him who was to be the desire of all nations. Thus the translation of the Old Testament helped, in God's providence, to prepare the way for the Lord's first coming, even as the more recent and modified translations and printed copies of the Christian Scriptures are now fast preparing the world for His second advent.

3. *The Temple at Jerusalem.*—The temple built by Solomon was rebuilt by Zerubbabel after the Captivity, and 520 B. C. It was despoiled by Antiochus Epiphanes, the Syrian, 170 B. C. This intolerable desecration and sacrilegious vandalism provoked the Jews to rebellion. Under the friendly eye of ambitious Rome they threw off the Syrian yoke and rallied into a state of nominal independence before the world. This gave rise to the Asmonean, or Maccabean family, 166 B. C. The family was a Jewish dynasty of four generations, and without which there would have been no Hamlet in the Apocryphal play of the Old Testament. This line of Judean princes, beginning with Mattathias and ending with John Hyrcanus, reached over a period of sixty years, or to 106 B. C. These Maccabean princes were a family of warriors, kings, and priests. They fought for Jewish independence, swayed the scepter of the Theocracy over the chosen nation, and perpetuated the formal worship of Israel's God in the temple at Jerusalem. They were devout, brave, and progressive—men of whom the world was not worthy. They dared to be the custodians of their own consciences, both in religion and politics.

With the extinction of all that was good and noble in this Maccabean family, by the death of Hyrcanus 106 B. C., the Jewish people began a new career of dissipation, and continued to make but little pretention to national independence before the world. The chariot wheels of God's providence moved forward with seemingly increased velocity to usher in the fullness of time. That fullness of time was reached in the *birth of Christ—the* event which brought new force into the world's history, and therefore governs all other events, from the departure of the human family out of Eden to the final entrance of the redeemed into the heavenly Jerusalem. It takes from history the character of a riddle and makes its chapters appear beautiful in the light of a divine and beneficent purpose. All other events are judged correctly only in their relation to this. Whether antecedent or subsequent in time, they are always dependent upon this as to their cause and tributary to it in their service. Christ's life of thirty-three years on earth is an eventful history. His death was more than a sacred tragedy—more than the mere payment of a penalty. It was that transition from humility to glory which his disciples on the way to Emmaus could not understand, because they were fools and slow of heart to believe all that the prophets had spoken concerning Immanuel. This transition, of course, included the event of his resurrection on the third day, about the first of April, as we reckon time. His ascension, forty days later, occurred in May. During that forty days the apostolic commission was given and holy baptism was instituted. After ten days ascension was succeeded by the advent of the Holy Ghost. Pentecost takes rank in importance with the birth of Christ as a cardinal and *creative* point in history. Then began the miraculous increase, or rather the formative period of the Christian Church. This was followed by persecution and the consequent dispersion of believers.

St. Stephen stood at his post and became the first martyr, in will and fact, A. D. 39. In the year 40 Saul was converted into Paul. After spending some part of three years in Arabia, he appeared and preached at Jerusalem, A. D. 43. In 44 Cornelius was converted, and James put to death. In 45 a Church was organized at Antioch, and the disciples first called Christians. About that time Paul made his first missionary journey, visiting and bearing the heavenly message to Cyprus, Iconium, and Lystria, returning to Antioch. He afterward journeyed to Jerusalem, and was there present at the first Christian synod, or conference, in A. D. 50. In 51 Paul heard the Macedonian cry, and went to Europe. This was his second missionary tour. In Europe he visited Philippi, where the earthquake shook the jail at midnight, and Corinth, where Gallio cared for none of these things. He also visited Thessalonica, Berea, and Athens, where he encountered

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the Epicureans and Stoics, and confronted the whole imposing and opposing array of Grecian mythology and materialistic philosophy. Paul's third missionary journey was begun from Antioch in 54 or 55, when he visited Europe the second time. In about 59 Paul journeyed again to Jerusalem, where he was arrested and thrown into prison. He was then sent to Cæsarea, on the sea-coast, where he made his defense before Felix and his appeal to Cæsar. In A. D. 60 he set sail upon his stormy voyage as an appellate prisoner to Rome, where he arrived in the spring of 61. If Paul ever visited Western Europe, it was between two terms of imprisonment at Rome. In our mind it is exceedingly questionable whether the great apostle ever went to Spain (according to his intention, as expressed in Rom. xvi. 24) or to Britain, as has been claimed by some in the interest of a feeble theory of apostolic succession. In A. D. 64 Paul laid his head under Nero's ax and stepped into the skies.

Shortly after Paul's death Peter arrived at Rome, where, instead of living as the first great bishop or primate, he died as the second great martyr under the bitter reign of Neronean persecution. Then the eagles of Rome began to gather about the festering carcass of Judaism. Jerusalem was destroyed in A. D. 70. St. John outlived the other apostles, and survived the destruction of the sacred city. He was banished to the "isle that is called Patmos," under the Emperor Domitian, whose reign ended in A. D. 90. John wrote the Book of Revelations after his return from exile, either before or during the long term of his pastorate at Ephesus.

The grouping and comparison of a few events or prominent points in history might prove profitable in the way of assisting our memories—possibly, also, our faith:

1. About thirty years B. C. our Lord's mother was born. At that time Cleopatra was dying. What a contrast between those cotemporary heroines of the world! The one went down to dishonor with the fangs of the deadly asp in her vitals, the other entered upon her high career of superlative blessedness among women with the infant King of Glory enthroned upon her virgin bosom.

2. Anna, the prophetess, B. C. 48, was already a young widow, abiding in the temple, serving God with prayers and fastings night and day, while Cornelia was following the unfortunate star of Pompey, to become a widow the second time by the assassination of her husband in Egypt.

3. Fifty years B. C., while Simeon was yet a young man, "waiting for the consolation of Israel," Julius Cæsar, Pompey, Brutus, and Cassius were plotting in their unhallowed ambition for the perishable empire of the world.

4. The voice of prophecy became mute about the time that the ears of its disciples had become dull of hearing. This was 430 years B. C.—the exact number of years that the Children of Israel sojourned in Egypt. The next year after the closing of the Old Testament Canon Plato was born, and the founder or formulator of the world's most stalwart philosophy was ushered upon its stormy stage.

What wonderful coincidents and coevents! A thousand years had passed away since God began to make known his ways unto Moses and his acts unto the Children of Israel. During that time the world, and even his peculiar people, were not disposed to receive and appreciate the light that scintillated from the lamp of Revelation. Therefore God gave them over to search after the truth in the uncertain twilight and with the unassisted powers of nature. It seems that Jehovah intended to give the human family an alopathic dose of its own homeopathic medicine; and if we are to judge from the symptoms of the patient at the first coming of the Great Physician, we are justified in the conclusion that the disease was of that type of chronic perverseness which, for once at least, made questionable the truth since crystallized in the medical axiom: *Similia similibus curantur.*

The Platonic philosophy ruled for 500 years, or until Paul appeared at Athens, where Plato had been born, and preached the truth as it is, and as it is revealed in Jesus Christ. Paul was superior to Plato by virtue of his greater mission. Plato did nothing more than project a restless inquiry after the truth; Paul did nothing less than proclaim a glorious revelation of the truth. Although Plato believed in the immortality of the soul, and entertained some dreamy notions of a spirit land, Platonism was really the typical nest-egg from which, after many centuries of incubation, has been hatched that monstrous materialism of modern times, as repre-

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sented in the teachings and theories of such men as Tyndall, Herbert Spencer, Mill, and Haeckel, and which in these last days is evidently serving the grand purpose of Providence in creating a demand for something more immaterially substantial in philosophy, and at the same time more objectively real and entitative in the popular vaporings of our holy religion.

THE TRANSFUSION OF SPIRITUAL LIFE.

BY PROF. J. R. SUTHERLAND.

That doctrine of the divinely inspired apostles, which symbolically sets forth Jesus of Nazareth as the Saviour of sinners, through the cleansing efficacy of his blood, and in harmony with which we sing

> "There is a fountain filled with blood
> Drawn from Immanuel's veins,
> And sinners plunged beneath that flood
> Lose all their guilty stains,"

certainly presents us a most beautiful and substantial idea of the philosophy of spiritual purging and regeneration.

In this wonderful doctrine we may see the life-idea floating, as it were, in the blood-idea.

Millenniums ago God declared to Noah, and afterward to Moses, that "the blood is the life." Every well-informed physician, every faculty of physicians of the world to-day, reiterates this truth with emphasis.

Physiological science explains this emphatic assertion by showing us that "the blood *is* the *vehicle* of life to every atom of our organization."

What, then, must be the substantial solution of this blood-idea taught us by inspiration?

Contact with the blood of Jesus is simply contact with the life of Jesus. In him was life, light, the truth, and *no* sin.

When, therefore, we put on the meek, the adorable life of the Divine Master, we put off sin. We are then no more the servants of sin unto death, but of righteousness unto life, and his blood, his life cleanseth us from all sin; not only in the sense of procuring pardon, but also by the complete transformation of our lives by the moral force of his own.

Here, then, *is* cleansing—here is new life. But in order to have it we must "become as little children."

The Christ said to Nicodemus: "Marvel not . . . . I say to you, you must be born again."

What is the meaning of this *seeming* enigma? It means that *new life* must be given you. The royal blood of Abraham's seed, according to the flesh, or of any and all other carnal ancestry, becomes impoverished of its riches by disease and filled with effete, poisonous substances which the enfeebled system is unable to remove. Soon death lurks in every organ, fiber, and tissue of the human organization, and from it there is no escape except by new life, new blood. "You must be born again," "become as a little child," through whose system the pure blood of life courses, giving health, vigorous strength, and growth. And all this is analogically true of the "inner man," who, of whatever seed or descent, has lost his pristine purity and become morally diseased. He "must be born again"—receive new life, *new* moral *blood*, as it were, and this is supplied in the blood of Jesus.

Modern skill and science greatly assist us to a better comprehension of this blood-doctrine, which was formerly construed into an appeasing libation to Deity.

Persons have been rescued from the very clutches of death by the transfusion of new blood into their depleted blood-vessels and starved, diseased systems. And this, too, when all other remedies have failed.

So it is just as impossible that we should be liberated from sin and live to God without the transfusion of the life of Jesus into our impoverished, sin-poisoned lives, full of moral, death-gendering impurities which our inefficient energies can-

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not cast off, as it is that the emaciated, bloodless victims of physical disease should recover without the transfusion of pure, new blood into their veins.

And what is this but a new birth? Or, what is it to "be born again" but to receive *new life*, spiritually, "drawn from Immanuel's veins"?

These things enable us to grasp substantial conceptions of the wonderful reality of the Christ-life as a spiritual power, and of his ability to free us from sin.

To see that wasted, lifeless form which once awaited the certain and near approach of death, restored again to health and vigor is, to us, positive evidence that by some means new, rich, life-giving blood has been poured into the veins, and that it has swept away all vestiges of disease.

To see an individual who once was full of sin, and drifting on without inclination or ability to free himself from it, restored again to righteousness and purity of heart by the Gospel, is the best of evidence of the reality and transforming power of the Christ-life, the cleansing efficacy of his blood.

But individual effects are not the only evidence of the cause. "The stream [which] His flowing wounds supply," coursing through the arteries of the ages, has cleansed millions, and given a forward impetus to the moral life of humanity that all the powers of sin cannot turn backward.

And what, I ask, is this but the substantial evidence that the life of Jesus is a divine stream of moral, life-giving, sin-destroying energy, driven by the heart-throbs of Him who is the fountain of all life and purity?

FOREKNOWLEDGE AND FREE AGENCY.

BY REV. JOSEPH SMITH.

The symposium in THE MICROCOSM, on "Providence, foreknowledge, will, and fate," has disclosed some errors in fact and logic which need correction.

Some writers seem to think that God could have given men such a kind of free agency that they must always and inevitably have done right. But this is absurd, for a free agent has the same power to do wrong that he has to do right; and if his will is always controlled by another, he is not a free agent. Each act, to be free, must be determined by himself; and if one chooses to pursue the road to death, there is no power in heaven or earth that can prevent it.

It is urged that man's evil surroundings and depraved nature place him at a ruinous disadvantage. But there are ample compensations. God is ready to give all needed help to those who truly desire and try to do right. He will grant sufficient grace to enable them to overcome all foes within and foes without.

Again, it is urged that millions live and die in darkness. But there is no moral agent but has some light, and salvation does not depend on the *amount* of one's light, but on the *use* he makes of what he *has*, whether much or little. If one will faithfully walk in such light as he has, he will not fail, under the Spirit's guidance, to find his way to heaven.

Again, it is said that if any are to be forever lost, God should not have created moral agents who would be liable thus to ruin themselves. But not having thoroughly mastered all the unfathomable mysteries of God and his government, it would hardly be modest in me to attempt to decide this question on abstract principles, as one writer has ventured to do. There are, however, a few points bearing on the subject which it may be well to consider.

A world of irrational animals, unable to know and serve God, and capable of nothing but mere sensual enjoyment, falls vastly below the possibilities of being, and failed to satisfy the divine ideal. For God saw it best to create a class of beings *in his own image*, capable of some higher pleasure than that of eating and drinking, capable of enjoying the unspeakable blessedness of knowing, loving, and serving him.

These godlike powers do indeed carry with them great privileges, and great responsibilities and perils. From their very nature they confer both great possibilities of good and great possibilities of evil, according as their possessor chooses to use them.

As God has infinite knowledge, he must have had in his view all possible

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plans of being; and from that infinite number and variety he chose the present, as, on the whole, embracing the greatest amount of good, notwithstanding the evils incident to moral agency. And this he deemed wisest and best on the whole, though permanence of character and his revealed Word plainly teach that those who willingly and willfully choose to live in rebellion and die in their sins "*shall never see life.*"

Again, one writer takes the ground that if God foreknew that Judas would be lost, Judas "had no power, capacity, or ability to be saved," that "every effort on his part to be saved would be abortive."

Thus the damnation of Judas, and, of course, of every other incorrigible sinner, is regarded as an independent and arbitrary act, whereas it is but the inevitable result of a previous life of sin. God foreknows the ruin of any one only as he foreknows the acts of sin that lead to it, for he condemns no one without sufficient reasons for it. He must, therefore, foreknow one's life of sin in order to foreknow his condemnation. Hence, one's salvation does not depend on God's foreknowledge of his final destiny, but on the *choice* he makes of the life he will live and the character he will form.

Then what we need to do is not to speculate as to what God foreknows about our destiny, in order to know whether there is any use in our trying to be saved—whether "every effort on our part to be saved would be abortive"—but we should faithfully labor to serve God, and this will decide both our salvation and God's foreknowledge of it. But if we choose to live and die in sin, this will settle the question that God foreknows our final ruin, because he foreknows that we choose a course that must end in ruin. For God cannot foreknow anything in human conduct except what men choose to transact, or anything in human destiny only as it is connected with the course men choose to pursue. Then, all along the line of one's probation, he has full opportunity to seek salvation. And if these opportunities are improved, he will make it impossible for God to foreknow his damnation, for he will make it necessary for him to foreknow that the path he travels will end in life eternal.

How God foreknows just how we shall act, we cannot tell. It cannot be from his having *determined* that we *shall* act in a given way, and then so laying his plans and exerting his power that we *cannot* act in any other way, thus linking us into an inexorable chain of cause and effect. This would not only destroy our free agency, and make us mere machines, but it would also make God responsible for all our evil conduct.

It is very possible that God fills eternity as really as he fills immensity, thus making all events as truly *present* to him as are all portions of space. In that case, there would be, strictly speaking, no such thing as foreknowledge with God. It would simply be knowledge of all events as transpiring before him. This is a theory which many have maintained, and which no one can prove to be untrue.

But however this may be, it is certain that in some way—and we need not trouble ourselves how—the Infinite Mind is able to grasp all knowledge, and hence knows the course that each will pursue, and the award that each will receive. For can we suppose that Infinite Wisdom would choose and pursue a plan, of the workings and outcome of which he were wholly ignorant? He would be liable to find himself sadly disappointed in such an experiment.

But we need not trouble ourselves about God's foreknowing our course, for it does not exert the least influence on our choice of it. I may see a traveler approaching a point where his road forks. He will take one or the other of the two roads, but which I cannot tell till he reaches the point and makes his choice. My observing him does not exert the least influence on his choice. And had I the power to look into the future a few minutes and see how he would choose when he reached the forks, he would act just the same as if I knew nothing about it. And it would be the same throughout his whole course of life, could I foreknow it all.

And God's foreknowledge has just as little influence on our conduct. We act just as we should if he knew nothing whatever of our future life. We have, therefore, no occasion to deprecate God's foreknowledge, but only our own folly and perverseness if we fail to choose the way of life and accept Christ as the captain of our salvation, who would surely give us the victory over every foe, and conduct us safely to the home of the blest.

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ENERGY, FORCE, INERTIA, MOMENTUM, PROPERTY, ETC.

BY THE EDITOR.

It is of the utmost importance, in the investigation and discussion of scientific subjects, that we lay down, as nearly as possible, fixed definitions of the principal words employed to convey our ideas. There is a looseness in the general discussion of scientific subjects, among even the best of writers, that is deplorable in the highest degree. Words of chief importance in such investigations, should, as far as possible, have but one literal meaning, and should be employed outside of that meaning as seldom as possible. Besides this, no two words should be employed with precisely the same shade of meaning, if it can be avoided, for in all such cases a confusion of ideas or want of definiteness must result in all labored scientific discussions.

Still, notwithstanding the necessities for such rules of action, we find great difficulty in conforming to them. Words, such as those at the head of this article, have been so long used by different authors with varied significations, as when they are employed in treating on different philosophical subjects, that it seems impossible to settle down upon any uniform definitions that will be apt to be acceptable to all or that will be permanently adopted.

The term *force*, for example, is just now the subject of much discussion, and the definitions given of it are as widely different as daylight and darkness, almost. Prof. Tait, of Edinburgh University, by a recent very forced and inexplicable departure from all accepted usage, makes it neither an entity nor a phenomenon of an entity, but the mere *rate* at which an entity moves or does work, a shadow of an entity's motion, or even less, since a "*rate*" is neither a thing, nor the motion of a thing, nor the property of a thing, nor the effect of a motion or of a property, but the *rate* at which an effect of a property or of a motion of a thing is accomplished, as, for instance, the bank-rate of interest, the birth-rate of a city, etc. Such definition is confusing in the highest degree, and makes physical science less understandable than it would be if the word *force* were entirely expunged from the vocabulary of our language.

The Substantial Philosophy has the commendable merit, at least, of steering clear of all such unnecessary confusion by making everything of which the mind can form a positive concept an objective entity, particularly anything that can cause a phenomenon or produce a motion in any other entity.

The two words, *force* and *energy*, come nearer having the same real meaning, as variously used in times past by different writers, than almost any other two words in the English language. The conservation of *force* has been often expressed as the persistence of *energy*, thus making them synonyms. We speak indifferently of the correlation of the *forces* and of the conversion of *energy* from one form to another, thus again using the two words as synonymous. With such constant license among approved writers and scholars, we should, as far as possible, restrain a disposition to jangle over the meaning of any particular word, especially so long as its recognized employment is well understood. Let us try for a moment to see how far we may limit the meaning of these or other words to some restricted use, and thus, if possible, simplify our investigations of science.

All motions or phenomena of substances or entities, are the result of force, but are in no sense entitative themselves. Not a thing moves or can move in the universe, except as induced to do so by force of some kind. If gravity pulls a stone to the earth, then gravity is the force which causes such motion, while the motion is simply *position* constantly changing. This definition of *motion* as *simple space*, or *the position of a body in space constantly changing*, is the best proof of the non-entitative nature of motion that can be desired, since space, or mere position in space, whether changing or unchanging, is absolutely *nothing*. But the force of gravity which causes a change of position in space of a falling body, is a real entity or objective thing, according to Substantialism; and hence if this gravital substance moves or stirs, it, too, must be impelled into such motion by a force behind it, and external to it, up to the infinite source or fountain of all force, just

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as our law requires, namely, that no finite entity can move itself or stir only as compelled to do so by some force above itself.

To illustrate: If the engine moves, we know it must be by the force of the steam behind the piston, but what moves the steam? It, too, must have a force behind it by which it acts, as steam is as much an inert entity as the water from which it has been expanded into vapor. That force which makes steam effective is *heat*. But heat, again, is an entity—a substantial, objective, finite, or limited, thing—and as such can only *act*, and thereby move the water, changing it into vapor, thereby acting on the piston, thereby moving the engine, thereby propelling the train, and, finally, transporting the passengers. What force is it that moves this substantial heat into effective action?

Men and beasts are but living engines, moved by the force of vital steam, generated by the force of vital heat, developed by the vital energy potential in the consumption of material elements, and the whole governed by mental force as the controlling engineer, so that the engine shall not dash itself to pieces by the action of this vital force without a governing power. As the life of every creature is also an entity, according to the Substantial Philosophy, and as no finite entity can move only as it is compelled or allowed to do so by a force behind it, if our law be true, what force, then, is it behind life which causes it to act and thus drive the machinery of our bodies? A finite mind, the governing (not the propelling) force of these vital engines, is also an entity; it, too, cannot move nor act only as caused to do so by a force behind it. What is this force which also moves the substantial mental powers of man and beast, converting them into intelligence?

What a startling class of facts here confronts us as we survey the ground now hurriedly gone over! Electricity, being a substantial entity, cannot move along a wire or flash from a cloud only as it is driven to do so by a force behind it. Magnetism, also being an entity, cannot reach out its invisible fingers to lift the iron armature at a distance, except it be compelled and moved to this work by some force behind it. Substantial light could not travel a rod from sun or planet only as a force behind it drives or urges it forward; and substantial sound, even could it be generated, would fall dead where produced, and instead of going through the air 1120 feet a second, and through iron 19,000 feet a second, would not go at all only as it is coerced to move by a real force behind it.

The mind thus harassed and buffeted at every turn, seeks, like the wearied dove, some solid place on which to rest the soles of its feet. An infinite, substantial, and all-sufficient cause must of necessity exist behind or back of every finite effect observed in nature, whether that effect be among material or immaterial substances. So far as our powers of observation or reason extend, no finite substantial thing can change its position or stir without a force or form of energy to move it; and such force being logically necessary, and inevitably a substance, it also must be induced or coerced to act by a force still back of it. So with all the forces of nature, as we have seen, within the entire range of human observation.

Does not wisdom, then, utter her voice and cry aloud even in the streets, assuring us that there must of necessity be an ultimate, intelligent, self-existent, and unoriginated fountain of force as the moving power of all the forces, and other entities in nature, and as the primordial First Cause of all the minor causes in this universe which come within the observation of sentient beings? To bring up abruptly against the source and cause of every separate force or observed phenomenon as an infinite and incomprehensible mystery, as the atheist is forced to do, and thus fritter away the mind in endless perplexities when the concession of a single almighty mystery would settle the matter with everything in nature and put the mind at rest, is certainly unwise. It is just as easy, as a simple mental effort or rational conclusion, to accept reverently an infinite, intelligent, and uncreated fountain and source of all finite things—animate or inanimate, material or immaterial—and thus solve all the myriad minor mysteries in nature, as to be compelled to accept the equally mysterious fact that a magnet will lift a piece of iron at a distance by means of something which no scientific test on earth can ever show to have an existence, and that, too, without any source above it from which to derive such power to act unless an infinite fountain of force shall really be postulated.

The substantialist is involved in no such provoking difficulty as the atheist or

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materialist is compelled to face at every turn of his investigations. Substantialism is a calcium light which shows magnetism to be as really a substantial entity as is the magnet itself from which it emanates, and by the same light the intelligent substantialist sees these immaterial magnetic threads going out from the steel magnet to the piece of iron, as we may express it in common parlance, but really sent out, or carried out, by the fingers of an infinite, immaterial, and intelligent manipulator back of the magnet and directly correlated with this invisible force, through which alone it derives all its power to act.

Hence, all the forces of nature, vital, mental, or physical, as real substantial entities, can only act under the correlation of the forces as the power is given to them to move, and communicated to them from the primordial and intelligent force-fountain of the universe—God himself. Hence, the term *energy* might easily have a shade of meaning slightly varying from that of *force* in classifying and arranging such terms for the best possible use in our scientific discussions, by making it signify the *power* or *ability* of any substance or body to accept of, or move under the action of, applied *force*. Thus, for example, the *energy* of an engine is its ability or power to move by the application of the *force* of steam; and the *energy* of steam is its ability to move, and thus act on the piston by the *force* of heat; and the *energy* of heat is its ability to act on water under the primordial *force* communicated to it from the force-element of nature, where all force or energy is correlated to the intelligent fountain, as embodied in the infinite *ego*.

Under these definitions it is not at all difficult to grasp the meaning of *momentum*, in its true sense, notwithstanding all the confusion which has resulted from the present unsatisfactory application and use of that term. To illustrate: the cannon-ball moves under the force of the expanding gases of the powder, and it moves with an *energy* proportioned to its ability or power to accept the action of this force from the powder. Such *force* is stored up in this energy under the common name of the *inertia of motion*, or under the more definite name of the *momentum* of the cannon-ball. *Momentum*, therefore, is simply *energy in action*, utilizing stored-up mechanical *force*. How plain and beautiful! Energy at rest, or static inertia, is the potential ability of a body to receive motion and momentum by the due application of mechanical force.

Having thus defined force, energy, inertia, and momentum, we have now to ask what is meant by the "property" of any given body, and how does it originate? And here we approach one of the most profound and difficult fields of research and investigation in the entire domain of physical science. To this field, and the mighty problems it opens up, we propose now to give our serious attention; and we ask the reader to accompany us with all the powers of discrimination he can summon, as the task even of grasping the problems involved, after they are met and explained, is an immense one.

We say first that, while a property of a body is not a force or any form of energy in the true sense of these terms, yet its existence as a condition, quality, or characteristic of a body is always an *effect* of one or more forms of substantial force. Thus *elasticity*, for example, is the name of a certain property of bodies, as the result chiefly of the form of force commonly known as *cohesive attraction*, and by which the particles or smallest conceivable portions of a body are not only held together when united, but by which also they were originally placed together under certain laws and arrangements at present unknown to man.

Indeed, we are not at all satisfied with the term *cohesive* force, as applied to the various natural operations not readily attributable to some other recognized form of force. The term is not broad enough to include the original construction of bodies, the arranging of their particles, the rearranging of them into a more contracted or expanded form, etc., etc. *Constructive* force would be a more generally appropriate term, making it to include cohesion, adhesion, rearrangement of bodies, chemism, etc. Then when destruction or disintegration of a body takes place by any form of force, the *cohesive* form of this *constructive* force would be destroyed, or, what is better, converted into heat, or some other form of force, as when a piece of metal is pulverized into impalpable dust. The bulk of cohesion in such a case disappears, to be re-generated from the force-element of nature by the action of heat, as when this dust is melted into a liquid, and then cooled into a solid mass. When a chemical compound is produced, this general *constructive* force acts as

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chemism, and when the chemical union is destroyed by heat or electricity, such constructive force is relegated to the force-element, to be re-generated as chemism when the separated substances are again united, either with each other or with some other substance in practical chemical proportions. But we use *cohesive* force at present, as we have done in the past, with many grains of mental reservation, entering this mild protest as a part of the record of Substantialism.

Returning, then, to the cause of the elastic property of bodies, we say that without the original constructive energy of this force of cohesion in arranging the particles of the elastic body, and the continued static persistence of its energy in maintaining them, no such property as that of elasticity could exist in matter, nor could the opposite property of *inelasticity* exist either.

The property of elasticity has been superficially mistaken by all writers on physical science, ancient and modern, for one of the forces of nature, instead of being, as it is, the effect of force merely. This error runs through every text-book we take up, and the most critical investigators, we are sorry to say, even after their attention has been called to it, still persist, on account of their prejudice or habits of thinking, in trying to make a plausible showing of argument in defense of this most unscientific blunder of their predecessors.

We are humbly proud of the honor, and we say it without boasting, of having been the first to announce the true explanation of elasticity as in no sense a force, but as a characteristic or property of a material body, superinduced by the action and persistence of the force of cohesion in so arranging and sustaining the particles of the body in relation to each other as to permit the mechanical force, after distorting the body, to store itself up in it, and thus react, when outside resistance is removed, by which to restore the distorted body to its original form. (See MICROCOSM, Vol. IV., pages 346, 347.)

We have repeatedly invited scientists to name the book, in the thousands published on physics, where any intimation of this fundamental and most essential principle of science can be found. Under this universal law can every property of matter be explained to the intelligent satisfaction of any unbiased student of science; and we unhesitatingly declare our belief that it is entirely impossible for us to solve one in a hundred of the more startling problems of physics, except by calling to our aid this essential view of cohesive force in its relation to the other forces of nature. We will, therefore, devote the remainder of this paper to the consideration of specimen illustrations of such physical properties and to other problems of matter, by which to aid young substantialists in their investigations of these intricate questions.

Take the property of transparency in glass or crystal as one out of many mysterious examples. Why is such a body transparent while another body of the very same material composition is entirely opaque? Simply because the substantial but incorporeal force of cohesion has so placed together the particles of the glass, and so sustains them, as to permit the substantial light-force to pass through freely; while in opaque bodies of the same substance this governing force of all material nature has arbitrarily so arranged the particles in relation to each other as to refuse passage to this immaterial force of light!

The diamond, for example, is the same in material substance, chemically and otherwise, as a piece of soft carbon coal. Why is the one the most transparent as well as the hardest of all known bodies, while the other is both soft and opaque? This same principle of physics, as here set forth and first revealed by the Substantial Philosophy, will answer this question also, namely, that the all-governing force of cohesion so rearranges the particles of soft carbon in their transformation to diamond as to produce this property of the greatest hardness known to science, as well as the property of the most perfect transparency existing in any solid substance. And it is therefore evident that when we shall learn, as we undoubtedly will in time, the simple method of utilizing cohesive force in its constructive power upon soft carbon, we can change cartloads of anthracite or bituminous coal into cartloads of diamonds, as easily as we can now convert cargoes of pig-iron into cargoes of the finest Bessemer steel.

Take another illustration, namely, the property of *weight* or ponderability in all material bodies, which, though not a force in any sense, is the effect of the action of two forces, namely, gravity and cohesion, and may be affected by others, as we

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shall show. Look at the singular fact that this property of weight is not at all "in proportion to the *amount of matter* contained in a given body," an erroneous law which all scientists have taught from Newton down to the present. The fallacy of this supposed law we also had the honor first to demonstrate, by referring to the almost self-evident but overlooked fact that a given ball of *glass* contains more matter than a ball of *gold* of the same bulk, simply because the glass is known to be *less porous*, that is to say, to have less vacant or unoccupied spaces, and hence of necessity must contain *more matter;* while the gold ball, demonstrably more porous, and consequently having less matter, weighs many times as much. (See MICROCOSM, Vol. I., pp. 134, 135.)

What causes this difference in the property of *weight* in these two bodies, if science has always been wrong, and if the difference in the quantity of matter may be in the contrary proportion to the weight? Plainly, with the force of gravity an admitted nonentity, as always taught, there was some excuse for the baseless law of Newton that the weight of a body must be in proportion to the quantity of matter it contained, even with the rebutting fact of *porosity* staring it in the face.

It was impossible, in the nature of things, for the true cause of the property of *weight* in bodies to have been discovered until Substantialism had come to the rescue and pointed out the true character of all force as substantial, and that the interaction of the immaterial forces alone was the cause of weight, as well as of every other property of matter. With the force of gravity acting on the material particles of all bodies by permission of the regnant force of cohesion, and according to its arrangement of said particles, it is plain to see how this latter force could construct, arrange, and maintain the particles of two bodies of precisely the same quantity of matter in such relationship that gravity or any other form of force would act more effectively on one arrangement of particles than on the other. Why should this not be so, since it is clearly so in the action of other forms of force?

Why is it that electricity, for example, will not travel through platinum, having vastly greater density, more readily than through silver? Plainly because the controlling force of cohesion has arranged the particles of the silver more in harmony with the force of electricity than in the case of platinum.

Why is it that one form of force will neutralize—weaken or strengthen, as the case may be—the action of another form of force under certain different arrangements of the particles of a body? For example, cohesive force, as exercised among the particles of platinum, as we have shown in a former article, will resist any amount of ordinary heat before yielding sufficiently to permit the metal to fuse. But let us allow heat to co-operate with cohesive force, as it acts among the particles of melted *lead*, by dipping the platinum into such liquid metal, and instantly the cohesive force in the platinum yields up its energy to the heat insomuch as to break its own hold and allow this most refractory metal to become as fusible as lead itself.

So, also, as we took occasion to show in our review of Sir William Thomson (MICROCOSM, Vol. IV., No. 1), the force of gravitation is almost entirely neutralized on a piece of silver or copper when placed in an intense field of *magnetic force*, as between the poles of a powerful electro-magnet, while a piece of any other metal of the same size would show no loss of weight whatever! What explanation, save that here given by Substantialism, is equal to such a mighty mystery as this? The cohesive and gravital forces in the silver and copper are manifestly so correlated to magnetism and the gravity of the earth as to prevent the latter from getting a hold upon the particles of these peculiar metals under these circumstances, while in other metals the correlation of these substantial forces does not effect the neutralization or even weakening of the gravity of the earth by the presence of or intermingling with magnetic force, however intense the field. We have challenged the scientific world to produce even the semblance of an explanation of this problem, save on the principles of Substantialism, as here set forth, namely, that the forces of nature are correlated with and affect each other as real substantial entities, and not as modes of motion. Such a view of force, in whatever form or manifestation, is consistent and harmonious with all we know of nature, and Substantialism thus applied is capable of intelligently solving every problem in the realm of physical science, however complex and mysterious such problem may be.

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Take another illustration, which a beginner in physical science will comprehend, but which no physicist has ever attempted to explain, simply because it is inexplicable according to any present scientific theory. We refer to the well-known fact that a certain proportionate alloy of *lead, tin,* and *bismuth* will fuse at 201° F., while *lead's* fusing point is 619°, *tin's* fusing point is 442°, and that of *bismuth* is 510°. Why is it that these metals when mixed will melt at less than half the heat required by the lowest, and less than one-third the heat required by the highest, of the three metals constituting the alloy? Surely here is a problem worth attacking by science. But difficult as it seems, all mystery disappears when we give proper consideration to the nature and correlation of the forces as substantial entities.

The melting of any substance by heat consists simply in the yielding of the cohesive force which holds the body in a solid condition, sufficiently to liquify it. The intensity of heat required to melt any given body, and thus overcome its cohesion as a solid, depends entirely upon the correlation existing between these two substantial forces, as regards the cohesive arrangement of the particles of the particular substance to be fused. Plainly the same metallic substances must exist in the alloy which existed in the three separate metals before mixing, the only difference, so far as the action of heat-force is concerned, being a new and different cohesive arrangement of the particles in the alloy, by which heat can the more easily master and thus neutralize cohesion. If there is nothing in these forces by which substantial co-operation or conflict can occur, then the melting point of the alloy should be the *mean* of the three separately; that is to say, about 523° F., just as the *weight* of the alloy would be the mean aggregate of the three weights before melting. This is as it should be, and according to observation, for the reason that no change takes place in cohesive force in its relation to gravity in this act of forming an alloy, while there does a change take place in cohesion in its susceptibility to be overpowered by heat; for, instead of the fusing point in the alloy occurring at the average or mean temperature of 523°, it is actually reduced to 201°.

The truth is, this mingling of the three separate arrangements by cohesive force, in the three separate metals when alloyed, simply weakens its hold on their combined particles and, on account of the peculiar contest it experiences with heat in the alloying process, now makes it an easier prey to its chief enemy in nature—heat. If these forces were not as really substantial as the metals upon whose particles they act, we see no possible ground for an intelligible solution of the mystery they present. As real substantial friends or enemies in the economy of nature, these forces may oppose or assist each other, as circumstances require, and thus exhibit all the wonderful phenomena observed, but not otherwise.

The contraction or expansion of bodies under the action of certain forms of force is another mystery only explicable by this hypothesis of the rearrangement of the material particles under the controlling force of cohesion. As is well known, some metals will contract by heat, while most all known bodies will expand under precisely the same circumstances, as we have formerly taken occasion to show. Water will continue on contracting in bulk as its heat radiates till it comes to the freezing point, when, in the formation of a solid, cohesion steps in with renewed energy, asserts its power over what heat remains, rearranges the particles of the water, by which they are made to occupy much more room than before, in defiance of the expanding tendency of the heat, and it exerts this power in the new effort at rearrangement with such force as often to burst granite rocks asunder which even giant powder could not break. Nothing could give stronger proof of the active energy of cohesive force than this rearrangement of the particles of water into ice and its mechanical effect.

To prove that cohesive force is the chief agent in nature by which such rearrangements of particles take place even in the solidest of bodies, we have only to refer to the remarkable fact that a solid piece of the metal *palladium,* without any change in temperature at all (except as the effect instead of the cause of such re-arrangement), will actually *expand to nearly one-twentieth its additional bulk, or sixteen times more than if heated from the freezing point up to that of boiling water, alone by the absorption of hydrogen gas and its strange process of solidifying among the particles of this metal!*

It is a demonstrated fact that a solid piece of palladium will receive among its

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particles, transformed into a solid condition, ***more than nine hundred times its own volume of hydrogen gas***, and will expand to receive it, by the wonderful rearrangement of its material particles under cohesive force, and by which combination, as just stated, the solid metal has to be increased in bulk about one-twentieth. That a solid metallic body, under the mere action of a slight current of electricity, could admit among its particles another material body of nine hundred times its volume, and thus be compelled to crowd its solid substance apart one-twentieth in order to make room for such outside substance, and that, too, without the application of any mechanical force whatever, is one of the most marvelous and suggestive exhibitions of the working of cohesive force ever witnessed, and should teach modern scientists, who deny the substantial nature of force, a lesson in physics they could hardly forget.

And another thing equally surprising in this transformation is the fact that cohesion, in its peculiar relation to the particles of palladium, aided by electricity from the *negative* pole of the battery, has the mysterious power of rearranging the material particles of hydrogen gas so as to contract this substance to about *one eighteen-thousandth* of its normal volume, thus reducing the lightest and most attenuated known gas to a solid of the compactness of a metal itself. All this, too, is done by cohesion, without the aid of mechanical pressure, and even in opposition to the expanding presence of heat, simply abetted by this mild negative current of electricity.

Then, again, by co-operating with the *positive* current from the same battery, this governing force of the material universe has the power not only of rearranging the solid mass of metal to its original bulk (reducing it one-twentieth), but of releasing the solid hydrogen gas and letting it escape into the open air, restored to its normal volume and density, and which, by suitable protection, will combine with oxygen, and under this new transformation will change to water and fall upon the experimenters in a shower of rain!

And here, incidentally, by way of "hedging" on our hitherto decided conviction that the "Keely Motor" must be a vagary and mechanical deception, we remark, why may it not be possible for a new discovery to have been made by Mr. Keely, in the wonderful correlations of the natural forces, by which his so-called "etheric force" can actually accomplish the mechanical marvels he claims? This force, according to all accounts, seems, it is true, out of all the proportions of cause and effect, judging by everything we know in mechanics; but is not the same, or even greater, disproportion manifest in the facts just examined into, by which hydrogen gas is absolutely condensed to a solid without one pound of mechanical force, and for the accomplishment of which hundreds of tons of pressure would not suffice if applied to the gas in any way at present known to mechanics?

We sincerely desire Mr. Keely's claimed discovery to turn out true, as set forth by those who have seen his experiments. At all events, with such wonders of the natural forces in correlation and co-operation, as exhibited in the action of electricity and cohesion in the combination of palladium and hydrogen gas, doing the work of a steam engine by a current of electricity that would not hurt a chicken, we should be very careful how we repudiate in advance any claimed discovery in science, however marvelous it may seem. When the rationale of Mr. Keely's achievement shall have become public, if ever, we will take the privilege of analyzing it in the light of the Substantial Philosophy.

In this connection, and in conclusion, we will name one other mystery in science which we have never seen referred to in any text-book, though it involves one of the profoundest physical problems ever observed. It consists of the fact that a mass of cold iron, condensed to the most contracted and imporous condition by hammering, when thrown into a crucible of melted iron will float upon its surface like a cork on the surface of water! Why is this, since the liquid iron is of necessity greatly expanded by heat, and necessarily much lighter, bulk for bulk, than the cold and condensed mass of the same material? No answer is possible to this startling enigma, save that based upon the interaction of the substantial forces of nature, and their modifying effects upon each other under differing conditions and circumstances.

But the reader asks, How is this latter problem to be solved, even according to the laws of Substantialism, since the solid and cold iron bar manifestly appears to

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become lighter when it rests on the molten mass? This is not only an appearance, but an actual fact, and to explain it we have only to revert to our solution of the piece of silver or copper which, as we have already shown, becomes actually lighter by the neutralized condition of gravity in consequence of the presence of other forces in certain relations. The silver, as the reader will remember, could not fall suddenly, because the relation of its own gravity and cohesive force was such, in the presence of dense magnetism, as partly to make its metallic substance impervious to the downward pull of the substantial gravity of the earth. In like manner we assume that the presence of heat, constituted of so much suspended cohesive force in this molten mass, acts on the cold iron somewhat as the dense atmosphere of magnetism acts on the bit of silver to shield it partly from the downward pull of gravity. Hence, let such a block of cold iron be accurately weighed in its relation to the molten mass, and we guarantee it will be found to have lost part of its gravity by the neutralizing effect of the other forces present, just as certainly as the piece of silver must have weighed less while immersed in the magnetic field, as described by Sir William Thomson. How clear and rational are all these solutions, viewing the forces of nature as correlated substances instead of nonentitative modes of motion!

Let us bear in mind constantly that without the substantial but immaterial force of cohesion no material body could have existed as matter. Take away this force entirely, or even convert it into heat, and the famous molecules and atoms of the physicists, and upon which the whole present doctrine of physical science depends, would fall to pieces, and those pieces of molecules would be as much smaller than the supposed indivisible atoms of the present theory as those atoms are smaller than planets. It is, therefore, upon this elementary force of cohesion that the character, properties, and even material existence of all bodies depend. How reasonable, then, that a correct apprehension of this governing force should, as we have maintained, tend largely to solve all the mysteries of the material universe!

APOSTROPHE TO MATERIALISM.

BY R. HAWKINS.

Wonderful art thou, O Materialism! Astounding indeed are thy revelations; but unfortunately (or fortunately) for man, thou hast limited thy inspirations to a few individuals, who, though eminent in scientific lore, have not the capacity to inspire the balance of mankind with any faith in thy wonders.

It has been revealed through thy apostles that there is nothing in the universe but matter and space—that is, matter and infinite room for matter to operate in; that matter is dead, inert, incapable of either producing or arresting motion; and that inasmuch as matter is the only *real thing* in the universe, there can be no such thing as force—this term conveying to them the abstract idea of the effect of the motion of matter.

It is further revealed that all the matter in the universe is normally, or naturally, in motion; and that to its passiveness, or inability to arrest this motion (or motions, for there are various kinds of motion, according to the theory), that is, to assert its motion and inertia, is due all creative power that exists, or ever did exist. To them creation means organization of matter, and organization is the necessary result of the inherent motion of matter which it cannot arrest, being inert.

It is further revealed that these motions are governed by a great number of inexorable and wonderfully complex laws, but few of which are understood, even by thy greatest apostles, as they admit. Now, as matter is the only *real thing* in the universe, according to the theory, it follows that matter must create the laws for its own government, and then execute them itself; in other words, govern itself without law—for law, according to ordinary comprehension, is the fiat of a lawgiver, prescribing the mode of the application of force by an executive, and has no self-enforcing characteristics at all.

How matter can do all these wonderful things, and yet be *inert*, may be clear to the materialistic scientist, but it staggers the faith of ordinary mortals. Per-

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haps it may be said that the term *inertia* has reference to matter as related to only one phenomenon of nature—change from the state of rest to that of motion of mass, and *vice versa,* as the result of the application of external force—but why should it be thus restricted?

It cannot be disputed that the term inertia, used with reference to matter in its relation to external force used in the production of motion or change of state in a *mass,* conveys the idea of the *adaptation* of matter to the action of external force in the production of this phenomenon. Then, by analogy, why should we not conclude that in every phenomenon of nature there is an adaptation of the matter involved to the force or forces brought to bear on it—this adaptation being analogous to, if not identical with, *inertia?*

If matter cannot change its state of rest or motion, how can it govern its motion so as to produce the wonderful phenomena of nature?

But all these wonderful things must be true, if there is nothing in the universe but matter—and there certainly can be nothing but matter, because thy disciples, after the most thorough investigation, aided by the best instruments and appliances invented by man, have utterly failed to *see, hear, taste, smell, or feel* anything but matter. Perhaps thy apostles will say that the laws of nature were not created nor enacted at all, but are self-existent and self-executing, eternal and never changing. I do not see how they are to prove this, or how an ordinary mind can comprehend it. But suppose it be true, wilt thou, then, please reveal to a benighted world how long it will be before this gigantic, blind, unthinking, and unchanging perpetual motion shall run through all the permutations comprised in a full and complete cycle of the universe? Thy sages have computed the number of vibrations of light to the second, the number of molecules of matter to the inch, the velocity of molecular motion in the gases, and many other wonderful computations have they made (or guessed at); now wilt thou reveal, through them, how long it will be before a universal cycle shall be completed, beginning at this epoch; how long before the writer hereof, after having returned to dust, shall again materialize (or reorganize), and shall again, seated at the same table, by the light of the same coal-oil lamp, at the same place and with the same surroundings, write this nonsensical article on the same paper?

Shed, then, O Materialism, a little more of thy effulgence on a benighted world! If thy fundamental principles are true, there must be a resurrection of the body—yea, many resurrections of the same body; but alas! they are so far between times that man never knows himself on his periodical return from the dust. What sayest thy apostles, O Materialism—is this not a logical necessity?

Thou hast defined matter as something having dimension as a necessary characteristic; that which has dimension cannot be infinite in quantity, and that which is not infinite in quantity cannot require infinity of time in which to complete all possible permutations.

The operations of nature, as every one knows, appear to abound in smaller cycles; then, if the laws of nature are unchanging (having no engineer or architect to regulate the machine and adapt it to new work), and the quantity of matter in the universe is limited, how can we avoid the conclusion that the innumerable smaller cycles are confined in one universal cycle, at the end of which all things will return to their present condition? Whilst thou hast shed no light on this point, thou hast made many other wonderful and incomprehensible revelations.

Thou sayest that matter, though inert and dead itself, through organization brought about by inherent motion, governed by law (whatever that is), can produce in the organized form the characteristics of life—intelligence, will, reason, etc.—characteristics which neither matter, nor the laws which govern the motions of matter, possess themselves!

Wonderful, indeed, if true, but very hard to believe. Thou requirest of man a faith, O Materialism, compared to which the Christian's faith in an all-wise, intelligent, omnipotent Creator and Governor of the universe is easy!

Great art thou only in the magnitude of thy humbugging!

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THE REIGN OF SCIENCE.

BY THE EDITOR.

A close observer of journalistic progress in this country can hardly have failed to notice that within the last decade or two newspaper reading of a scientific and solid character has made rapid advances, even in supplanting the so-called higher grades of literature, as abundantly evidenced in the changing tone and spirit of most of our weekly and monthly publications. No one can doubt, who has made the matter a subject of thoughtful observation, that just in proportion as general education advances, and the young men and women of the wealthier portions of a county return home from the cultivating and elevating influences of our universities, colleges, and higher seminaries of learning, to mingle with their former associates, does scientific and substantial literature, in its various forms, take the place in that community of story papers and novels of the trashier sort. And just in proportion as we make our way beyond the reach of these higher educational influences, and penetrate among the illiterate masses, and thus descend into the lower strata of mental development and cultivation, does the prevalence of these story papers become apparent, and a predominant taste for a superficial and sensational literature demonstrate the standard of that community, and thus form its true gauge of intellectual progress.

So conspicuously has this popular change shown itself of late, that one can scarcely pick up a paper of any kind, whatever its ostensible character, but he will find scientific and philosophical articles copied into its columns in profusion, from various journals, on subjects involving the profoundest thought and the results of the most intricate research—problems such as those of astronomy, geology, botany, physiology, natural history, electrical phenomena, as well as those of light, heat, and sound—where a score of years ago such columns would have teemed instead with trivial incidents and narratives, and overflowed with story chapters, no more calculated to elevate the intellectual plane of the race than would be the "Mother Goose" tales of the nursery told us when we were children.

All this transitional progress in American journalism, as the initial reign of science, evinces a healthy educational condition of our people as a nation, and must be confessed to have a developmental and salutary effect on the community at large, especially upon the poor youth of both sexes who have been limited to the advantages of a common school education. This continual advancement of the popular press toward a higher standard in the character of its news and the literature of its graver columns, is owing in a great measure to the reflective influences of our noble institutions of learning, which are every year sending forth their thousands of missionaries in the persons of graduates into all parts of the world to tell of the wonderful achievements and beneficent deeds of the *alma mater* which has opened their eyes, and turned them from darkness to light.

These great schools are the inviting oases in the intellectual waste which but yesterday, as it were, covered the earth, while every year a score or more of such green and gushing spots are adding their foliage and causing their fountains to play above the moral sand-plains of the nations, to purify the social atmosphere, make the desert around them to blossom as a rose, and thus form life-saving stations in the Sahara of human existence, where intellectual wayfarers can pause for rest, and refresh their hungry souls.

So marked is this tendency to progress in all classes of periodical publications and among all civilized nations, toward a higher grade of intellectual food, that a recent writer on the educational aspects of France was struck with the signal deterioration now taking place in the influence of journals in that country devoted to light literature and superficial amusements. He became convinced by investigation that such papers were rapidly dying out, and being supplanted by others of a sturdier intellectual stamp, devoted in whole or in part to scientific and philosophical information. He referred to a dozen or more periodicals which only a few years ago were in popular demand, being among the most extensively read journals in France, but whose trashy pages had become so unattractive to the growing French taste and culture, owing to the steady intellectual development

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superinduced by the influence of the great educational institutions of that country, that some of them were forced entirely to succumb and disappear, while the survivors were only enabled to live by tacking their course to meet the popular breeze, and filling their pages with a more substantial course of mental diet. Some of these publications, he assured us, are now practically scientific journals, though still under their old misnomers, and are sought for and read by the scientific student whose advancing cultivation forbids his wasting time, even in the free libraries and reading-rooms, with the insipidity which was but recently his chief delight and the staple commodity of French journalism.

The same intellectual progress is evidenced in English, and particularly in German, publications. The tendency, in fact, of intellectual activity throughout the civilized world is toward the reign of science—the evolution of higher and grander thoughts, and toward those researches and investigations which unfold the verities of life and of nature. Science, in its broad and comprehensive sense, is beginning to become the watchword of civilized progress, and will be the signal flash by which we shall herald our approach to the coming generation. But science, falsely so called, of whatever grade or pretension, is destined to melt away before the intensifying rays of the sun of educational development, while the numerous false theories wearing the garb of philosophy or labeled as science, shall one by one be relegated, by the consent of universal enlightenment, to the limbo of exploded hypotheses, never more to be referred to, save as a part of the record of the weakness and folly of a less progressive age.

MATTER A CREATED ENTITY.

BY S. D. HELMS.

Though the later geological products and deposits of the earth were clearly prophetic of the coming of a reasoning mind, still mind did not appear to witness the forms and changes of matter till long subsequent to its principal formative epochs and evolutions. All the knowledge that man can now have of the primordial condition of matter he must gain by reasoning from its present laws and condition. It is not, however, improbable that matter originally existed in a gaseous state, and that the material universe has, through the process of evolution, developed into its present condition by the spontaneous action of the properties with which the gaseous matter was originally endued. We hold that these properties are self-acting, at least where the nature of the property admits of activity. Extension and form do not admit of activity, as do the various kinds of attraction. The evolution of the material universe had far progressed before vitality appeared among the forces of nature, and with the writer it is presumable that in vitality we have the direct exertion of Divine power, controlling and holding in abeyance those properties with which matter was originally endued.

Among the reasons for this belief let it be noted that the properties of matter, properly so called, are constant; vitality is not constant. In certain vegetables, or woods, vitality holds sway for a long time, as in the cedar and pine—longer, perhaps, in some varieties of seeds, but it at length yields, and the constant forces reassert their control. While vitality continues, it overcomes gravity, that mighty force that holds suns in their places, and rolls the planets with an unvarying order in their orbits. Cohesion and chemical affinity are both overcome by vitality; these, with gravity, yielding to its sway as it lifts the tree hundreds of feet into the air. But no sooner does vitality depart than these original properties resume control, and the tree and the animal fall to the earth, and the organic forms given them by vitality disappear—the elements of both returning to the common mass.

Further, accepting the testimony of geology as valid, the constant and more common properties of matter, and also the forces of nature, as light, heat, electricity, galvanism, natural magnetism, etc., existed through long epochs before vitality made its appearance as a force in nature; and when it did appear, it was altogether unique. As a new force in nature it possessed great significance, not only in subordinating primal forces to its special ends, but also in adding beyond

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computation to the evidences of design in creation. Indeed, life is the condition of value in anything, as also of its appreciation. If we attribute the original appearance of vitality among the forces of nature to a direct intervention of divine power—an assumption which we see no reason to question—then may we also attribute its withdrawal from each living thing to direct divine intervention, or power.

While we consider the above theory of God's relation to the material universe the more plausible one, we regard it also as the one most salutary as an influence on a world of rational, moral beings. Let death denote everywhere, and in all things, the withdrawal of God's vivifying presence, and how impressive must be that event to all who witness it. All the more impressive is it for being a change unique in itself. The irrational creature could, of course, give it no such significance. The theory that assumes that all changes in matter are produced by direct exertion of divine power, much lessens the significance of both life and death, and especially the impressiveness of the latter.

In the theory here advanced God is seen as the complete master of the material universe, holding and using it all in subserviency to life, animal, mental, and spiritual. Moreover, to maintain that all the secondary forms and changes of matter are produced by direct divine energy, is virtually to deny that matter is itself an entity. Abstract, *seriatim,* the several properties, and what conceivable is left? The answer clearly is, nothing—nothing that is conceivable; thus it has been so often said that reason, or the laws of thought, affirms substance, or a *substratum,* as a colligating bond of the several properties that constitute the subject, atom.

As a suggestion, we ask: May not this colligating something be a species of affinity, combining the essential properties, or forces, of matter, as its elements, into the atom—an affinity to which chemical affinity stands related as a secondary form? But here we have an abyss, unfathomable to the human mind. Still, we hold to the popular faith that matter is real—an entity, something more than perpetual divine energy; something that includes in its entity self-acting properties, which are essentially inseparable from its entity. To deny that the properties of matter are self-acting, a denial that is implied in making the secondary forms and changes in matter a product of direct divine energy, is equivalent to denying the entity of matter; and this opens a wide door to Pantheism, which is about the same, in its practical and moral results, as atheism.

MATTER NOT INERT.

What has been denominated the *inertia* of matter is but the supremacy, for the time, of some one of its forces or properties. When the weakest of the attractions of matter, as gravity, is unrestrained by a stronger form of attraction, or a stronger force, or property, the manifestations of matter's essential activity accord with the laws of gravity. When cohesion, a stronger form of attraction, dominates—and to the extent it does so the manifestations will be in accordance—the walls over our heads will not fall upon us, nor we fall through into the cellar. The same is true of chemical attraction, with its affinities of varying strength. But gently place an acid on the wall that has remained *in statu quo* for a hundred years, that has for some one of the elements in the wall a stronger affinity than the attraction of cohesion that has held each particle in its relative position so long, and the experimenter will have evidence that matter is *not* essentially inert, but active. The activity of matter is implied in its properties in so far as its properties are forces, as certainly are gravity, cohesion, and chemical affinity.

When cohesion is dominant and in equilibrium between the several particles of a mass of matter, it gives to matter the appearance of being inert. But that appearance is but the manifested dominancy of the cohesive force, or attraction of matter. Chemical affinity, or attraction, is also manifested in the steady grip with which the particles hold each other, till other particles, of a stronger attraction, come so near that their power dominates over the previously prevailing affinity. As stronger than the above forces in nature, we have vegetable and animal life—or, if preferred, direct divine power—which, within its range, subordinates all the above forces to its own ends. Other forces there are in nature, as heat, electricity, etc. These vary in strength and dominancy over other forces according to accumulated intensity.

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As a creation of divine power, there is no more absurdity in assuming that matter is endowed with spontaneous activity, than there is in assuming that mind is so endowed. Consciousness is witness to the spontaneity of mental activity—we will take the testimony of "common sense" for the spontaneity of matter's activity. Deny the essential activity of matter, and where find we physical, necessary causation? or what is there in physical causation besides uniform *nisus* of will? If physical causation is not a misnomer, matter is not inert, but everywhere spontaneously active. Is there any such a thing as physical causation?

Without further remark in the above line, we shall assume that God, in creating matter, endued it originally with self-acting properties, which have given, in the process of long geological periods, the present general form to the material universe, and that the astronomical development and arrangement of the planetary systems, and also other secondary forms and changes of matter, were anticipated in its original endowment with these self-acting properties, as were the particular parts of Solomon's temple in the shaping of the timbers and stones in advance of their being brought together to be placed in it, each particle being constituted and fitted to the purposes to be subserved by it. Such anticipation in the self-acting properties of matter, of ends to be subserved by it, instead of weakening the evidence of design in creation, enhances rather its force, just as when we find in our watches not only a curious and ingenious mechanism, but one which, without the presence of the maker's hand to move it, has in itself the motive power needed for that purpose; and, more, another power, the regulator, causing its movements to synchronize with the revolutions of the earth and give us the time, when the indices of God's great chronometer are, by clouds and darkness, hid from our view. But in Solomon's temple there were no such flux and change of materials as we see upon the face of the material world. This the Creator provided for in the properties he gave to matter, abating, as required by our theory, those changes attributable to vitality.

The number of the digits is small, compared with the different numbers that can be expressed by them. In the issue of a weekly paper, each successive number has a like general appearance with previous numbers, yet each issue differs widely from those that preceded it. These marvelous possibilities of the type illustrate the still more marvelous possibilities that are going on in nature through the changes effected by the constantly shifting arrangement in the relations of the relatively few properties of matter as the seasons revolve. We have no reason to suppose that the original properties of matter are numerous. They probably are not. Yet how grandly do they exhibit the wisdom of the Great Designer. To attribute all the changes in nature to a direct divine energy is, in effect, to make God the user of the pen rather than the type, and so less capable than the beings he has made in devising instrumental power. This we do not admit, but rather recognize in each particle of matter that makes up this vast material universe, the hiding of a most marvelous divine power. In what has man ever exhibited such marvelous power as in the device of the type?

And not only have we in nature a wonderful variety of products, there is also, through the law of definite proportions, in all chemical combinations, giving to such products an otherwise impossible definiteness of quality throughout all time—a circumstance of inconceivable importance as condition of man's possessing a knowledge of the quality of those substances which he may need to use. In this a great need of man has been anticipated, for without this law there would be no fixed properties, or rather qualities, in material substances.

All men will readily admit that the manner of building Solomon's temple implied more thought, and care, and skill than the "cut-and-try" method. Very exact must have been the calculation and measurements, to anticipate all the requirements of so large and complicated a structure. As including this particular feature, it may be questioned whether the history of architecture records a more wonderful achievement. But to what infinite heights above human genius has divine wisdom risen, where all physical cause is to be put in movement not only, but will, as free cause, is a large factor, and their combined action is to be anticipated and directed, without obstruction to the moral freedom of the latter, to the certain attainment of ends contemplated from the beginning of the work of creation. "O, the depths of the riches, both of the wisdom and knowledge of God!"

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If the secondary forms and changes of matter are the products of the self-acting properties in matter, *then the evidence that those forms and changes furnish for the existence of a God establishes equally the fact that matter was created—that it has not existed eternally.* For this we chiefly value the theory of matter we have here set forth. So far as we have seen, the above theory involves the only method of proving, *from nature itself,* that matter may not be eternal. But this theory throws all the evidence which the secondary forms and changes furnish for the existence of a God, in the support of the fact that matter itself is a created entity. When we see a watch that gives time accurately without the immediate attention of its maker, the evidence of design in its structure is much strengthened. Nor could any one be persuaded that the several parts of the watch were without a designer and shaper behind them. So had every atom in the material universe a designer, a shaper, behind it; and since, hidden in its atoms, are the impelling and regulating power that gives us unvarying time from age to age, we call the mechanism of the heavens God's great chronometer.

Nor need the theory that we have here advanced, as certain physicists have assumed that it does, put God further from us in our conceptions, than it does to assume that all changes in nature are produced by a direct exertion of divine power. In making the grain to grow a year in advance for our present need, God is no less a father than he would be did he furnish each day's supply on the morning of the same. The metals and minerals, as coal, salt, gypsum, marble, etc., which he stored away for man many thousands of years ago, show him equally the Father as would their production from day to day. In all these, and scores of other things, man's coming was anticipated in the atom, since, with the exception of salt, no other creature uses them. Man is not a mere appendage of the world—the world was made for him.

Though matter has been described as consisting of antagonistic forces, ensphered upon a point, such a view seems hardly to meet the requirements of the problem, and it is quite evident that it does not answer to the common conception of the nature of matter. The popular conception makes it an entity—gives it a real being in itself—a being given it by the fiat of omnipotence; nor can we know that the fiat of a less power could annihilate it. If matter consists of force only, what else is it than energizing will, appearing as phenomenon only so long as the *nisus* of that will is continued? and what more than a mere phantom have we of the material universe? And, applying the same reasoning to the world of mind, what more than a succession of evanescent impressions and thoughts have we here? In what consists identity and personal responsibility? We say consciousness testifies to identity. True, but on broader grounds than a flowing current of impressions. Both matter and mind we hold to be entities, yet distinct and widely different.

The fashion with the atheist has been to assume the eternity of matter, and then, proceeding upon a very common conception that the properties of matter are self-acting, dispense entirely with the idea of a designing Creator in accounting for its secondary forms and changes. To complete their theory, much effort has been made during these later years to ascertain for themselves, and then show to the world, that life, if not a common property of matter, is, nevertheless, one of the forms in which portions of it exist. Could they but succeed in making it apparent that bioplasts exist without transmission from antecedent life, the great *desideratum* would be gained—their world could be built without the intervention of a designing architect. Still it would be true that the process of bringing to its present form the universe of matter had far advanced before life appeared, or could have survived, had it existed. That it existed at all on this planet till late in its geologic history, is the sheerest assumption. In the erection of a grist-mill the design of the builder is as obvious in the selection of a site, where the fall of the water and the height and firmness of the banks are suited to create a head, as at any after stage of the work, as the arrangement of the water-wheel, the stones, elevators, bolts, etc.

To refute all the assumptions of the atheist, not excepting the eternity of matter, God placed in the atom itself those original forces, such as gravity, cohesion, chemical affinity, and crystallization, that carry in themselves and their products all the evidence of design needed to satisfy the requirements of a rational faith.

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Through these the world took on its general form, with all its stores and capacities of production that would be needed by the living creatures that were to inherit it. God cannot be ruled out of his own world, even if he is, by their assumptions, shut out of the *hearts of skeptics*. Every atom rises up as his witness, to repeat what is so often reiterated in the Bible: "That they may know, that the Lord, He is God."

[Remarks on the foregoing by the editor will appear in next number of The Microcosm.]

THE CHEMISTRY OF WHAT WE EAT.

BY HENRY A. MOTT, PH. D., F. C. S.

Haddock.

The haddock is a soft-rayed fish of the cod family and genus *Morrhua* (*Melanogrammus æglefinus*). This fish is found all along the American coast from New York to the Arctic regions, as also on the other side of the Atlantic. The species vary in length from one to two feet, and weigh from two to six pounds. They occur in immense shoals, changing their ground as their food becomes exhausted. It is a voracious eater and is easily caught, and is pursued in the same manner as for cod. It is sometimes eaten fresh, when it is excellent; sometimes, however, it is smoked, or salted and dried.

It resembles the cod, but can be readily distinguished by its having a black lateral stripe instead of white, as in the cod. The fishery is valuable to New England and the British provinces.

The haddock is inferior to the whiting in flavor and digestibility, and has a firmer texture.

The composition of the haddock is as follows:

Water	78.0
Solid matter	22.0
	100.0
Nitrogenous matter	18 1
Fat	2.9
Salts	1.0
	22.0

Hake.

Hake is a name applied to the *Merluccius albidus*, a fish of the cod family, caught along the North American Atlantic coast, and the *M. vulgaris*, a similar fish of Europe, found in the ocean and Mediterranean Sea and on the coast of Ireland and Cornwall. It grows to the length of one to two feet, and is caught and cured like the cod in northern countries. The white or common hake is caught along the coast of New Jersey northward, and reaches a length of from one to three feet. This fish is largely exported from the British provinces. The hake is both coarse and poor, but is salted and sold as cod to those unable to detect the difference.

The hake has only two dorsal fins, and can thus be readily distinguished from the cod.

Halibut.

The halibut (*Hippoglossus vulgaris*) is a large fish of the family *Pleuronectidæ*, sometimes weighing more than 600 pounds. It is caught on both sides of the Atlantic—from New York to Greenland on the one side, and along the northern shore of Europe on the other. It reaches a length of from three to six feet. The fish has a flat, oblong body, compressed vertically, the right side dark brown

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and the left a pure white; the eyes are on the upper or dark side. Large quantities of these fish are caught on George's Bank and Nantucket Shoals; it is also abundant in the Bay of Fundy and in the waters of Nova Scotia. The flesh of the halibut is highly prized in this country, but not to the same extent in England. It is somewhat coarse and dry, but when properly cooked is very palatable.

The flesh is dried, salted or smoked in large quantities, and is largely consumed in northern countries. The fresh-water sturgeon is said to be smoked and sold for halibut.

Sword-fish.

Sword-fish is a common name given to fishes of the family *Xiphiidæ,* characterized by the prolongation of the upper jaw in the shape of a bony sword. The common sword-fish (*Xiphias gladius*) ranges from the Atlantic coast eastward to the Mediterranean.

The sword-fish has no ventral fins, a long, broken dorsal fin, a large and deeply-forked caudal, and very fine scales, and is often from ten to fifteen feet in length. It is a very rapid swimmer, and attacks ships and whales with its sword. Very frequently on striking a ship it leaves the sword imbedded in the planks of the vessel.

Its flesh is valued as food, although quite dry. The sword-fish is captured by the harpoon, thus affording exciting sport.

Sturgeon.

Sturgeon is the common name applied to the species of the family *Acipenseridæ.* They are peculiar-looking fish, having large bony plates arranged in longitudinal rows, the mouth under the snout, without teeth and very protractile, and the lobes of the tail unequal; the nostrils are double and in front of the eyes. The skeleton is cartilaginous and has numerous vertebræ. Species are found in all the temperate portions of the northern hemisphere. All breed in fresh water. The sturgeon of the great lakes are from three to six feet long and of a ruddy hue. The sturgeon of Europe is often sixteen feet in length and frequently weighs 1500 to 2000 pounds. The sturgeon ascend the Hudson River, and are called "Albany beef." The flesh of the sturgeon has a reddish color, is firmer than that of other fish, and resembles veal. It is eaten by many, and in fact is highly esteemed by some.

As stated under "Halibut," large quantities are cured and smoked and sold for genuine halibut. Their eggs (roe) are often made into caviare, which is greatly prized. From their air-bladders a kind of isinglass is made, and an oil is also expressed from these fish.

White-fish.

White-fish is the name given to fishes of the family *Salmonidæ* and genus *Coregonus.* These fish are usually from sixteen to twenty inches in length, and found in the colder waters of the northern hemisphere, especially in the great lakes. Their weight varies from one to five pounds; occasionally, however, some weigh as much as twenty pounds.

The most familiar species is the *Coregonus albus* of the lakes. It is bluish-gray in color above and white below. This fish is caught in nets and seines, as also with the hook. It is one of the most important of the economical fishes, the annual catch being estimated at 15,000,000 pounds. Extensive warehouses exist for its storage along the lake borders, large quantities being consumed by the Western States when fresh, while large quantities are salted and packed in kits and barrels for the market.

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HUMAN DEPRAVITY.

BY ELD. W. H. WINTERS.

A great deal has been said of late in THE MICROCOSM on the subject of the depravity of human nature, and this depravity is almost invariably traced back to Adam, he being held accountable for it.

In view of this, I have been led to inquire:

First—Is human nature depraved?

Second—If so, is Adam responsible for it?

Let us investigate the second question first.

Who is responsible for Adam's nature? In Genesis, first chapter, we are told that God "created man in his own likeness and image," "male and female created he them." After the creation, together with his other works, man is said to be "very good."

While man was in favor with God, and dwelt in the Garden of Eden, he certainly possessed a nature. It was not an angelic nor an animal nature, but a human nature—a God-given human nature, for at that time man was what God made him.

He was in possession of a nature capable of sinning, but he had not as yet sinned. That he was capable of sinning or not, as he chose, is shown by the restriction which God placed him under—the blessings offered in case of obedience and the penalty threatened in case of disobedience. At this time his nature was not depraved, or, if so, God surely gave him a depraved nature to begin with.

After man sinned we still find him possessed of a nature, not angelic, not animal, but a human nature. Was there any change in man's nature? If so, what?

He is still in possession of a nature capable of sinning or not, as he chooses, as is abundantly taught in the Scriptures and in our experiences, but he possesses a different character.

Again, let us look at the regenerated man, who is "born again" of "incorruptible seed." Is his nature different from what it was before his new birth? Are there any new faculties added? Is he not subject to the same temptations, annoyances, and conflicting passions as before? If not, why not?

I can conceive a change of character, of life, but not a change of nature. "Can the Ethiopian change his skin, or the leopard his spots?" No more can a man change his nature. Hence I conclude that God gave man his nature, whatever it may be.

Then, first, is man's nature depraved, or, as some add, totally depraved? In the light of Scripture teaching and our experiences, I must answer, No. Christ says of children, who are perhaps the purest representatives of human nature, "Of such is the kingdom of heaven." Surely the kingdom of heaven is not composed of depravity.

Again, Paul says of Christ, Heb. ii. 16: "For verily he took not on him the nature of angels, but he took on him the seed of Abraham." Christ is represented as man, as the son of man, as tempted and tried as we are, as taking on our nature —human nature. Did Christ become depraved, or take on himself a depraved nature? If so, then we have the singular spectacle of depravity redeeming depravity.

But, say some, "The bias to evil is as inborn as the susceptibility to disease." Perhaps in some instances this may be. In cases where the thoughts and actions of the parents, especially of the mother, are impure and unholy during the period of conception and gestation, this bias may possibly be transmitted to the offspring. Usually we need go no further back in our search for the cause of this bias and early manifestation of violent outbursts of passion than to the nursery. How often we hear the mother or nurse say to the infant, when accidently hurt or injured in any way, "Naughty old chair to hurt baby," "Mean old cradle," etc., and how often it is taught to strike the article named, or mamma, or little brother or sister, and thus taught to resent all such mishaps as personal injuries and insults, thus throwing the blame on some one else.

The child-nature is absorptive. It, like the sponge, absorbs from whatever it

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comes in contact with, whether good or bad. Of whatever material it absorbs it makes a part of itself. Honestly, now, dear parent, of which does your child have the greatest opportunities to absorb, the good or the evil? We are not only responsible for the teaching our children receive, but for their associations. About what per cent., suppose you, of the teachings and associations of our children are religious, or even moral?

I think that if we should take more of the responsibility of our children's bad actions upon ourselves, and lay less of it to Adam, we would very likely have better children. Solomon seemed to think so when he said: "Train up a child in the way he should go, and when he is old he will not depart from it."

GROWING OLD.

BY J. R HOFFER, ESQ.

Life in this world has its coming in and going out, therefore its rise or growth, and fall and departure or decay. From childhood to full manhood is growth and development, and thence to the end is shrinkage or decay. Such is the case with all life in nature—human, animal, and vegetable. All things after reaching their maturity decay. No kind of life finds this world a permanent abiding place; and since no life comes here to stay, it cannot be said that life really belongs to the material world. All matter is dead.

Life enters into the world by clothing itself with this dead matter. It cannot even take up the matter it needs and hold it while it stays; it can only remain here by continually rejecting old and receiving new matter, which shows that matter is not adapted to its permanent wants. It must use matter as people use things that are too hot or too cold for them. When life can no longer take up new matter—when it does no longer burrow into new earth—it soon works itself out of the material elements of this world. The matter through which it burrowed, as it were, from beginning to end, all remains here, but not a vestige of that life continues with it. So complete is its exit out of the material world, that it seems to those still here as if it had been nothing. But can that which made such a stir among dead matter be rationally considered as nothing?

Growth in this world is an entering into it; and at maturity the plant, animal, or man has entered into matter as fully as is possible. And all except the man are evidently then developed to their fullest capacity. He has desires and faculties which he continually feels cannot enter matter; inexpressible longings and emotions that groan for want of proper means of communication to others. His physical body develops and decays like that of any other living creature, but in spirit he does not decay. He continually grows, adding new substance to his store. The mind, indeed, often grows partly, and even almost entirely, out of the material substances through which it operates in nature, so as to be no longer able to act rationally through the body. But there are many instances in which the spiritual organs of the mind are almost the last against which the doors into nature are closed.

Growing old spiritually is to grow brighter, stronger, wiser, and constantly more perfect and more beautiful. The very nature of mind and affection shows that this must be a perpetual growth, so that when a person departs from the scenes and apparent realities in nature, he undoubtedly improves and progresses to all eternity.

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EDITOR'S TABLE.

THE EARTH AND MOON PROBLEM—MUTUAL COMMON CENTER OF GRAVITY AND MOTION.

BY REUBEN HAWKINS.

The interaction of gravitation exerted between the earth and moon, tending to bring them together, is recriprocal and of equal intensity in both directions; action and reaction being equal. The earth having a mass eighty times larger than the moon, and hence eighty times greater inertia, is affected, so far as regards velocity of motion produced by an equal force, eighty times less than the moon.

The same ratio must hold good when the force is so applied as to continually deflect the two bodies respectively from rectilinear to curvilinear motion;—hence the difference in the size of the moon's orbit and the small inter-lunar orbit of the earth. It is admitted by all that the moon is held in its orbit by the interaction of gravitation between it and the earth;—and in performing this office gravity is called the centripetal force, because it acts in the direction of the center of the circle described by the revolving body.

The earth must likewise be held in its inter-lunar orbit by some force ever acting on it in the direction of the center of the orbit it so describes.

In other words, there must be a centripetal force acting on the earth to counteract its tendency to go off on a tangent, otherwise it would not continue in its orbit. Hence it is self-evident that if the interaction of gravitation between the earth and moon furnishes this force, its action as affecting the earth must *be in the direction of the moon, and the center of the orbit described by the earth must of necessity lie between the earth and moon.*

It is impossible for me to conceive of any other combination of conditions upon which the earth and moon could be kept apart and their distance from each other maintained.

In supposing the earth and moon to both revolve around a point in space situated on the opposite side of the earth from the moon, it is quite easy to understand that the moon would be held in its orbit (or some orbit), by gravitation toward the earth; but it is not easy—to me it is impossible—to understand why under these conditions the earth should revolve around this point on the opposite side from the moon with no centripetal force to hold *it* in this orbit, and with gravitation pulling it in the opposite direction.

It is self-evident to me, however it may appear to others, that the center of motion of both earth and moon must be at their common center of gravity; and that this common center of both gravity and motion must, in their orbit around the sun, describe a plain or regular curve—not bobbing up and down across what would have been the earth's orbit had there been no moon. In other words, the projection of this common center forms the mean or common orbit of the two bodies around the sun, the earth and moon passing alternately across this line, but the line itself continuing on a simple curve without waves.

What would have occurred in the establishment of mutual relations between the earth and moon, on the supposition that the earth was established first in its annual orbit and afterward the moon was launched into its orbit with the earth relatively at rest, is a question not necessarily pertinent to the moon question, and I will omit its full consideration at this time. I would remark, however, that under the conditions of this supposition it would have been impossible for them to have established such mutual relations as now exist, for the reason that while revolving in the same general direction in their respective orbits, they are situated at opposite sides of these orbits, and hence traveling in opposite directions.

I would further remark that the hand of omnipotence is plainly discernible in the adjustment of these masses and forces, and in the original and proper impulse given each body respectively to start the wonderful machine.

REPLY BY THE EDITOR.

We are very sorry that we cannot succeed in making so able a scientist and so fine a critic as Mr. Hawkins see the real point and bearing of our moon discovery (for we do claim it to be a *discovery* of real importance to science), after all we have written on the subject. We are not generally accused of obscurity or literary muddiness in our scientific expositions; but we must confess that this short paper of our esteemed contributor rather tends to take us down a peg or two in our own conceit. Not entirely discouraged, however, we will try once more, and if we cannot succeed in convincing even Mr. Hawkins that our position is plainly correct and invincible, we will give up the moon-problem as a bad job. Let every reader, therefore, whether he be scientific or not, try to do a little solid, sober, common-sense thinking while we try just this once to make this problem clear.

In the first place, let us state the case of the relation of the moon and earth to their common center of gravity and motion the way it is believed and taught by astronomers (as approved by Mr. Hawkins), and then give, in as few words as possible, our own view, which we claim to be a genuine discovery. To simplify the whole matter, let us leave out of the account entirely the travel of the earth and moon together annually around the sun, as this has nothing to do with our present problem. Suppose the earth standing quiescent in space, uninfluenced by the attraction of any other body. Then suppose the moon in some way thrown into its present orbit with its present projectile force. Now, it is admitted by every one that the only possible influence the moon and earth can exert upon each other is to attract—never to repel. Astronomers now tell us correctly that as the moon makes its appearance in its orbit 240,000 miles from the earth, their common center of gravity must be between the earth and moon, and at such a distance from each as to balance them scale-fashion, the earth being eighty times as heavy as the moon.

This of course would place their common center of gravity 3000 miles from the earth's center, between it and the moon. There is no dispute or muddiness about this. The important question is, what motions must the earth and moon now have, actuated alone by the two factors, namely, their mutual attraction of each other and the moon's projectile force? for, remember, the earth as yet has no projectile force or motion whatever, and cannot possibly get any except what it is to acquire from the moon's pull of the earth and the earth's reciprocal pull of the moon.

Surely this statement of the premises is clear, so that a beginner in science can not misunderstand it. Here it is that astronomy steps in and tells us that this *common center of gravity*, 3000 miles from the earth's center and on a line toward the moon, must also become the *common center of motion* of both bodies, as the moon, under its projectile force, goes forward but is pulled from its straight line into its circular orbit by the earth's attraction.

Astronomy further tells us, that as the moon starts in its big circle, the earth starts in its small circle of 6000 miles in diameter around this common center of gravity; but what is singular, and what no astronomer attempts to explain, is, the earth starts in its little orbit in the opposite direction to the motion of the moon, the same precisely as if the two bodies were connected by a bar with this common center of gravity as the pivot, and as if the earth were pried around in its little orbit by the projection of the moon. In other words, that when the moon started in its orbit, it did not start around the quiescent earth's center at all, but around this common center of gravity, which stood still while the moon's forward motion, as just described, pried the earth in the opposite direction.

We challenge any astronomer to deny this statement as fairly representing the present teaching as

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to the actual motions of earth and moon, though, as before remarked, how it was brought about or inaugurated. they do not pretend to explain, notwithstanding they have been urged repeatedly to do so both by Dr. Mott and ourself.

Now we deny that there is the least reason or science in this claimed motion of the earth around the common center of gravity and on the opposite side of it from the moon, and we further assert that such a motion is totally impossible in the nature of things under the simple reciprocal attraction of the two bodies and the moon's projectile velocity. If we cannot show this to the comprehension of an average intellect, then we will stop trying to teach anything in science.

Here is the true solution of the only motions possible in the premises. The moon, attracting and being attracted by the earth, as the former starts in its orbit, must commence circling around the earth's center, since it is the whole earth which pulls it from its tangent or its rectilinear course. Surely it is not the common center of gravity which pulls the moon from its tangent or which the moon attracts, but the *whole earth*. Remember this. Therefore the moon, at the very start, begins its circle around the earth's quiescent center. Is not this plain and indisputable?

But what now takes place? Under the mutual pull of the earth and moon, the earth's eighty-fold mass begins to yield, slightly at first, in the direction of the moon, and of course in the direction of the common center of gravity between the two orbs, and as it moves out it necessarily begins to swing spirally around, keeping the line of the moon's pull, thus steadily increasing its little orbit, till finally the earth's center is pulled out entirely to this point which was the common center of gravity, and which represents the difference in mass of the two bodies and their mutual displacing power upon the larger of the two, while the moon is being drawn from its tangent. Was ever anything clearer than this?

We now come to Mr. Hawkins' real error which is the cause of all his trouble; and here let us make no mistake. He supposes and assumes that the earth, as well as the moon, at the beginning of this operation, must have had some sort of a *projectile impetus* or movement in a straight line, and in an opposite direction to that of the moon, and at exactly one-eightieth of the moon's velocity; and thus while the earth would pull the moon eighty from its great tangent, the moon would pull the earth one from its little tangent!

In this way it is assumed that the earth has its centripetal force directed toward the common center of gravity, while the moon has its centripetal force directed toward the same point, that the earth's small projectile velocity (1-80) is overcome by the moon, and that the earth is thus diverted into its little orbit, just as the moon's projectile velocity (eighty times as great) is diverted into an orbit eighty times the diameter of that of the earth. All this has to be assumed in favor of the present theory, notwithstanding its infinite nicety, before any such motion of the earth around the common center of gravity can for one moment be imagined.

But all this unavoidable assumption is of necessity false and in the nature of things impossible. Infinite wisdom, by special miraculous interference only, could have so arranged the two orbs and so started them in opposite directions by a projectile impetus of exactly the right velocity to correspond with their difference in weight. But God does not so act in the physical realm. He does everything by the physical laws when they can be as well accomplished without the interference of miracles. And what necessity was there for these two nicely adjusted and miraculous projectile motions in these two bodies, when the projectile force of the moon alone accomplishes the same result, as we have explained it, without getting the astronomical cart before the horse.

Mr. Hawkins says in substance that it is impossible for him to conceive of the earth moving around a point in space (its former quiescent center, for instance), and in a line between such point and the moon, without something in the direction of that point to attract it and thus divert it from its tangential tendency. He can't *conceive* of such a thing! Well, we have only to say that we can beat him out of sight in our powers of conception. Is it not possible to conceive, as we have explained it, of the small moon swinging around in its orbit, pulled into this circle from its tangential projection by the larger earth? and then is it not just as easy to conceive of the large earth being pulled out a proportionate distance toward the moon by their mutual attraction, and that the earth will thus be carried around the point from which it started (its original quiescent center) as the moon continues to advance along its circle? Thus both the earth and moon would continue to circle by mutual attraction around an absolute vacant point in space (the earth's original quiescent center), if we only suppose, what was reasonably the case, that projectile force was given to the moon only, thus bringing it within the earth's attraction while at absolute rest.

If Mr. Hawkins wishes to aid his powers of conception, he can do so at once and produce the very same effect that we have described in the case of moon and earth by a simple experiment. Let him station a large float in a still lake and connect it by a rope to a small steam-tug 1000 feet away. Now let him start the tug at an exact tangent to the float. Of course, if properly hitched to the float, the little tug will instantly commence turning itself into an orbit around the float, and as it circles it will, as a matter of mechanical necessity, begin displacing the float from its quiescent position. What other motion, in the name of reason, can the large float now have except to be drawn out a short distance by the tug and made to circle around a small orbit whose focus must be its former quiescent center? We defy Mr. Hawkins to conceive of any possible relation between the float and the tug except that which our astronomical discovery ascribes to the earth and moon, namely, that the float will all the time keep in a line between the tug and the float's former quiescent center, and that it will thus circle around that center in a line between it and the tug, and in a small orbit whose diameter will be proportioned to the velocity of the tug and the comparative weight of the two bodies. No mechanic on earth could be so insane as to suppose that this float, thus pulled from its quiescent center by the tug, *could travel around this circle on the opposite side of such old center, and in a direction opposite to that of the tug, as if pried around that central pivot by a lever instead of being pulled by a rope, the equivalent of gravity.* Yet that anomalous performance, in the simple mechanics of nature, is exactly what all the astronomy of the world now teaches, and what Mr. Hawkins indorses, but, as we believe, without due reflection. We wait anxiously for him to revise his science and to come over on the right side.

Rattlesnakes.

Where the Small and Large Reptiles Are Found.

The largest rattlesnakes are in Texas, on the Lower Rio Grande, where they sometimes attain the length of twelve feet, and are heavy in proportion. The smallest are the "horned" rattlesnakes of Arizona, New Mexico, and Southern California, which reach a length of two feet. They have two little excrescences over the eyes, and are full of devilment. They have rattles, but seldom use them, preferring to lie half hidden in the sand until stepped on, when they remonstrate. The sand or "desert" rattlesnake is also small, and pretends to be on neighborly terms with the prairie dog, whose burrows he occupies. I have reason to believe that when the rattlesnake inserts himself in the bosom of a prairie dog's family, he does so on fraudulent grounds, and is unwillingly entertained. The prairie dog carries no life insurance, and cannot

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afford a quarrel, and the snake is mean enough to take the advantage of him. There is a little brown and very comical owl, who likewise takes up residence with the dog, but he makes at least a show of earning his rent by remaining at the entrance and acting as janitor, politely bowing to everybody who passes. Neither snake, dog nor owl seems to mind the other's presence, but are exceedingly sociable.—*Nashville American.*

Enemies of Plants.

DESTRUCTIVE LITTLE INSECTS THAT THE GARDENER HAS TO FIGHT.

It is well to remind those who are fighting insect enemies that in the use of sulphur it is dangerous to use the word "fumes," as many persons will understand this as meaning that sulphur must be ignited as we produce the fumes of tobacco. This would destroy all plant life as well as the insects, but the sulphur placed under hot sun or on pipes or flues, and so warmed to a degree less than ignition, gives off a vapor that insects do not like, without being dangerous to vegetation.

There are two classes of insects with which the gardener has to deal: those which eat and those which simply suck the juices of plants. Poisons like hellebore or Paris green are of no use to the sucking class, like the greenfly, as they bore through the tissue, suck the juices, and thus escape. Potato beetles, caterpillars and the like, that feed on foliage, of course eat the poison also.

The sucking insects are usually reached through their breathing apparatus, and it is here that the vapor of sulphur or the fumes of tobacco prove useful aids to us. But in case of thrip, for instance, which falls to the ground as soon as it smells tobacco, these remedies are of little account. Cleaning off the rough bark and washing is excellent, as destroying a large number of eggs.

Tired Eyes.

INDICATIONS OF THE STRAIN ON THE INNER AND OUTER MUSCLES.

Persons speak of their eyes being fatigued, meaning thereby that the seeing portion of the brain is fatigued, but in that, says Dr W. W. Seely, they are mistaken. So men say their brains are tired. Brains seldom become tired. The retina of the eye, which is a part of the brain and an offshoot from it, hardly ever is tired. The fatigue is in the inner and outer muscles attached to the eye and in the muscle of accommodation. It may be set down that there is something wrong when the eye becomes fatigued. The defective eye, as it gives out sooner, is really safer from severe strains. The usual indications of strain is a redness of the rim of the eyelid, betokening a congested state of the inner surface, accompanied with some pain. When it is shown that the eye is not equal to the work required of it, the proper remedy is not rest, for that is fatal to its strength, but the use of glasses of sufficient power to render unnecessary so much effort in accommodating the eye to vision. It is not good sense to waste time in resting the eye, and practice does not strengthen it.

Eyes begin to age at about the tenth or twelfth year of life, when they have reached their full development. At the age of forty-five or fifty years the lenses cease to thicken, when the pressure is removed and their old sight begins. When a child is compelled to use or requires the use of glasses, there is little reason to hope that it will outgrow the need; but the person will use these glasses as a basis, adding other glasses as he reaches the age when old sight begins, or using thicker glasses. Dr. Seely, however, mentioned one case he had observed where a child had outgrown the need of glasses, but in the meantime he had grown from a small and puny child to a large and well-developed man.

Young, but Great.

SOME OF THE WONDERFUL ACCOMPLISHMENTS OF YOUNG MEN.

Many great deeds, whether of mind or action, have been performed by young men, as the following examples will show:

David, son of Jesse, was only twenty-two years old when, hearing the challenge of Goliath, the gigantic and armored champion of the Philistines, and seeing the dismay of his countrymen, and hearing the reward proposed by King Saul, he accepted the issue of a combat, and rejecting, as unwieldy, the king's armor placed at his disposal, took with him only his shepherd's sling and fine, smooth stones, selected with care from the water course flowing through the valley that separated the opposing hosts, and slew the giant, whom he beheaded with his own great sword.

Alexander the Great is another instance of early success. His accession to the throne took place when he was only twenty years old. Having crossed the Hellespont he won the battle of Granicus when he was twenty-two, and having conquered the world —until, it is said, he wept because there were no other countries to subdue—died at the early age of thirty-three.

Julius Cæsar, who was born exactly 100 years before the birth of Christ, so highly distinguished himself as a volunteer soldier at the siege of Mitylene that a civic crown was awarded to him.

In other than warlike courses many young men have won undying fame.

Raffaele Sanzio, one of the most illustrious of painters, produced one of his finest works—a "Holy Family"—at the age of seventeen, and before he was twenty-one, he had produced "The Coronation of the Virgin," now in the Vatican, and "The Marriage of the Virgin," now in Milan. He died at the age of thirty.

Michael Angelo, sculptor, painter, scholar and poet, was so highly distinguished that in 1490, at the age of sixteen, he was invited by Lorenzo the Magnificent to live in his palace at Florence, and there pursue his art.

The great Venetian painter, Georgio Brabarilli, one of whose portraits in the Manfrini Palace was characterized by Byron as "the poetry of painting," died at the age of thirty-four.

The best painters of modern times, American as well as European, have for the most part generally exhibited marked ability in their early manhood.

Nicolo Paganini was the most wonderful player on the violin, not only of his own day, but of all time. When he was twenty-one years old he made a professional tour through Italy, beginning at Lucca, in which city, at the age of fourteen years, he had first played in public with great success, and was considered a musical wonder.

Byron's first volume, called "Hours of Idleness," early and rather indifferent poems, appeared when he was nineteen years of age. He was twenty-one years old when, roused to anger by a very sarcastic notice in the *Edinburgh Review*, he produced that vehement and able responsive satire, "English Bards and Scotch Reviewers." Then he spent some time in foreign travel, and on his return in 1812 his "Childe Harold" was published. He did not exaggerate when he said of that poem: "I awoke one morning and found myself famous." He died at the age of thirty-six years, at which early age, Robert Burns, the great peasant bard of Scotland, had also "shuffled off this mortal coil."

Brain Cells.

IS THEIR CAPACITY FOR RECORDING PRACTICALLY UNLIMITED?

When we come to look the question in the face the mere number of cells and fibers in the human brain, immense as it undoubtedly is, would surely never suffice for the almost infinite variety of perceptions and facts with which memory alone, not to

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mention any other mental faculty, is so abundantly stored. Suppose, for example, we take merely the human beings, living or extinct, with whose names or personalities we are more or less fully acquainted, and try to give a cell or a fiber or a ganglion to each. How many cells or fibers or ganglia would be left unappropriated at the end of the enumeration for all the rest of animate or inanimate nature, and all the other facts or sensations with which we are perfectly familiar, to say nothing of emotions, volitions, pleasures, pains and all the other minor elements of all our complex being? Let us begin, by way of experiment, with Greek history alone, and try to distribute one separate nerve element apiece to Solon and Periander, to Themistocles and Aristides, to Herodotus and Thucydides, to Zeuxis and Phidias, to Socrates and Plato, to Æschylus and Sophocles, to Aristotle and Alexander, and so on straight through down to the very days of the Byzantine Empire. Then let us begin afresh over again, and give a cell all around to the noble Romans of our happy school days, Romulus and Remus (myth or reality matters little for our present purpose), the seven kings and the ten decemvirs, the Curtius who leaped into the gulf and the Sævola who burned his hand off in the Etruscan fire, those terrible Scipios and those grim Gracchi, our enemy Horace with his friend Mæcenas, and so down through all the Cæsars to the second Romulus again, pretty much where we originally started. How many cells, fibers and ganglia would be left?

Vegetarians.

We find in one of the numerous tracts issued of late years by the Anglo-American vegetarians some food diagrams which exhibit peas as containing twice and a half as much heat, force, and tissue-producing power as "butcher's meat." Now this is what the rhetoric of common life calls proving too much. And how is it done? In the first place, dried peas are compared by weight with raw beef. That is, a soft substance, two-thirds of which are alleged to consist of water, is compared with a hard, dry one which holds only one-seventh of moisture. But we are not pigeons that we should eat dry peas, nor do we consume our meat raw. The comparison should fairly be made between cooked meat and pea-soup, or pease-pudding, or a dish of green peas, or rather between a vegetarian's meal and that of an omnivorous man, which practically includes the vegetarians: and we should like to see how the case would stand then. The same reckless style of misstatement runs through these diagrams which, says the author of the tract, "on card-board, with the flesh-making elements colored dark red, the carbon appropriately black, and the water beautifully blue, I have found very effective in illustrating my vegetarian lectures."

These diagrams are followed by a table of the analyses on which they are ostensibly founded, and one is not surprised to find that, out of the sixteen articles of diet enumerated, the percentages of five only will "add up;" the other eleven being hopelessly wrong, and all of them at variance with the tables of the Bethnal Green food collection. This precious tract also carefully prints Genesis i. 29, which allows the eating of vegetable food: but is cautious to ignore Genesis ix. 3, which permits flesh. Perhaps it is on such evidence as these said diagrams and tables that Mr. F. W. Newman in his essays advances "the positive testimony of the first chemists as to the real superiority of grain and pulse, and dried cabbage or cauliflower, and nuts, and dried apples and potatoes, to equal weights of dried meat." But the whole truth does not lie in any of these statements. To quote the late Mr. Dallas in his almost classic "Book of the Table": "There never was a greater farce than these tables of nutritive values. It appears that white of egg is more than twice as nourishing as the yolk, and that a red herring is more than nine times as nourishing as mother's milk. What can be the worth of a science that works out such incredible results? Not only would these results—even if they were trustworthy—be valueless, since they take no account of the digestive labor required to utilize the different substances, but they cast doubt on the received chemical doctrine that the nitrogenous elements of food are the most nutritious.—*The Saturday Review.*

Age of Vegetables.

THOSE CULTIVATED AT PRESENT KNOWN OF CENTURIES AGO.

Many of the species of vegetables we now cultivate have been grown and eaten for centuries. Even before the Christian era many of them were in use. Lettuce has been used at the table for thousands of years. Herodotus tells us that it was served at the royal tables centuries before the Christian era, and one of the noble families of Rome derived its name from this plant.

Spinach, asparagus, and celery have been cultivated and eaten among the Eastern nations for thousands of years. Radishes were known and grown by the Greeks and were offered at Apollo's shrine, wrought in precious metals. Parsnips were grown and brought from the Rhine to add to the luxuries of Tiberius' table.

Beets were most esteemed centuries ago, and carrots were in such repute in Queen Elizabeth's reign that the ladies of her court adorned their huge structures of false hair with their feathering plumes. Peas at Elizabeth's court were very rare, and were imported from Holland as a great delicacy.

Fruits were also in great repute among the ancients. The currant was cultivated centuries ago in European gardens, and was called the Corinthian grape. One old writer speaks of the berries as Corinths, hence the name of currants. The damson plum was extensively cultivated at Damascus, whence its name.

The cherry came from Crosus, a city of Pontus, and the delicious peach, king of fruits, was first known in Persia. The quince was a holy fruit, dedicated to the goddess of love, and was called Cyndonian apple. Pears are as ancient as apples, and are mentioned among the Paradisal fruits.

To Beautify the Skin.

WHAT TO USE IN TAKING SUMMER BATHS—TO AVOID DISAGREEABLE COLORATION.

To make the skin elastic, and aid in removing the unpleasant spots that appear on the back of the neck, an emollient bath is recommended; and this may be obtained by using a preparation of bran and barley instead of soap. Boil in soft water a dozen pounds of barley-meal and four pounds of bran, until the mixture becomes about as thick as a heavy oil. Apply this over all the surface of the body with a flannel cloth, and wash it off with warm water; then rub in some almond oil, take a quick bath, and dry the skin carefully—not as if you were rubbing a piece of satin, but firmly and softly, yet effectually. The flesh brush is not advised for women with ordinarily sensitive skins, unless, indeed, they have become accustomed to its use. If one has not been in the habit of using it, it is very apt to hurt the skin, shock the system and do more harm than good.

The ardent advocate and devotee of outdoor sports notices that her hands grow red and unsightly, and she does not like it. Who would? However, she can easily whiten them, for all that is necessary is that they should be washed in hot milk and water just before going to bed, then rubbed well with either almond, palm or clear olive oil and a pair of chamois gloves drawn over them. Use hot water and good soap for washing, and in the daytime wear gloves that will promote perspiration. Lime water—that is, the juice of limes—is

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said to be good for sunburned hands. The other kind of lime water, more or less diluted and taken internally, will be good for the woman who suffers from continual malaria, and fears that her breath is feverish. Nothing is so mortifying to a woman as to know this, and yet, unless she does, she cannot help herself. When the unpleasant odor is not due to the teeth or temporary indigestion, a good gargle is made by mixing equal parts of tincture of krameria and eau de cologne, diluting the whole with a little water. This is astringent in its effect, but not enough to cause a sensitive pair of lips to suffer.—*Exchange.*

The Science of Perfumes.

By a process known as enfleurage, which is the exposure of beef fat to fresh flowers in close boxes until it is thoroughly permeated and charged with their odors, the perfumes of six flowers are obtained, which could in no other manner known to science be preserved apart from the fresh petals. Those flowers are violet, jasmine, tuberose, rose, orange-flower and cassie (cinnamon flower). From those six there are fifty or more combinations made for the simulation of the odors of other flowers. Sweet pea is made with orange-flower and jasmine; hyacinth is counterfeited by jasmine and tuberose, and the lily of the valley by violet and tuberose. But the resources of the perfumer are by no means confined to the pomades, as the scented fats are termed. He uses many essential oils, the principal of which are sandalwood, bergamot, lemon, rosemary, neroli (made from bitter orange-flowers), patchouli and attar of roses. It is very difficult to get the last named in a pure state, because its great cost tempts to dishonest adulteration. Very often rose geranium oil is substituted for it. Musk is another important ingredient, entering, as it does, into almost all perfumes, except those which are actually imitations of flower odors, or, as styled by perfumers, "natural"—as, for instance, heliotrope, tuberose, white rose and violet.

A Printer's Error.

A society paper, published in Chicago or some such town, gave an account of a society event, and in speaking of one beautiful lady of gigantic proportions it meant to say that "Mrs. Smith possessed a form that Juno might envy." The editor went home and left a subordinate to get out the paper, and the next morning he read in his paper that "Mrs. Smith possessed a form that Jumbo might envy."

Reviews of New Books.

Notice to Publishers.

Special arrangements have been made to have all new books sent us carefully reviewed by specialists.

"THE HOMILETIC REVIEW" for May is a number of marked excellence. The leading article is on "The Present Status of the Darwinian Theory of Evolution," by Sir William Dawson, LL. D., of McGill College, Montreal. This is a very discriminating and interesting paper. Dr. Henry J. Van Dyke, Jr., of New York, gives an able paper, the third in the Symposium on the Christian Ministry. Dr. William A. Snively, of Brooklyn, discusses "The New Theology" with admirable spirit, and yet with keen, discriminating analysis, that makes his polished thrusts the more effective. Dr. T. W. Chambers' exposition of "Modern Criticism," in its relations to doctrinal Christianity, is sure to command attentive reading. Dr. Howard Crosby gives a third paper on "The Advantages of Greek to the Average Clergyman." Dr. Arthur T. Pierson continues his valuable contributions on "Seed Thoughts for Sermons" and "The Missionary Field." Dr. Stuckenberg, of Berlin, Germany, discusses "Socialism and the Church" in "thoughts that breathe, and words that burn." It deserves careful and prayerful reading. There are seven sermons in the Sermonic Section, besides fifteen outlines as "Prayer-Meeting Service," and under "Hints at the Meaning of Texts," twenty-two in all; besides seven review articles on themes of utmost interest, and by as many eminent writers. The leading sermons are by Dr. Christlieb, of Germany, Rev. Henry Ward Beecher and Dr. J. B. Thomas. All the other departments, as usual, are full of choice and varied thoughts, discussions, facts, statistics, suggestions, adapted to the many needs and conditions of the study, the pulpit and pastoral work, making a Clergyman's Review that fairly distances every other of its class in the world. Published by FUNK & WAGNALLS, 10 and 12 Dey Street, New York. $3.00 per year; 30 cents per single number.

The May number of "MIND IN NATURE" has a second paper from Dr. Valin on "Heredity of Memory." R. W. Shufeldt reviews Bishop Coxe's contributions to first volume of "MIND IN NATURE." I. Lancaster has a few more thoughts on "The Doctrine of Evolution." Sarah E. Titcomb replies to a review of her book, "Mind Cure on a Material Basis," in the March number.

To many readers the most important article is the report by Dr. A. M. Hutchinson, of Minnesota, on a "Faith Cure," which came under his own observation; the nature of the disease and condition of the patient is given in full, and the doctor honestly says that he assumes no credit for the marvelous recovery. There is also a very interesting paper on "Occultism in Chicago," a short, but pungent article on "Personal Purity Among Men," which with other papers on kindred topics, make up a very valuable number worth far more than the ten cents asked for it.

COSMIC PUBLISHING COMPANY,
171 West Washington Street, Chicago.

Magazines and Newspapers Received.

"Golden Days," Philadelphia, Pa.
"Health," Wernersville, N. Reading, Pa.
"Homiletic," 10 and 12 Dey Street, New York, N. Y.
"Mt. Joy Herald," Mt. Joy, Pa.
"Southern Medical Record," Atlanta, Ga.
"Montgomery Advocate," Rockville, Md.
"Christian Advocate," Nashville, Tenn.
"Irish World," 17 Barclay Street, New York, N. Y.
"Glen Cove Gazette," Glen Cove, L. I.
"National Tribune," Washington, D. C.
"Brooklyn Magazine," 106 Livingstone Street, Brooklyn, L. I.
"Legal Adviser," 78 Fifth Avenue, Chicago, Ill.
"Texas Christian," Thorps Springs, Texas.
"Mental Science Magazine," 161 La Salle Street, Chicago, Ill.
"American Inventor," Cincinnati, Ohio.
"Earnest Christian," North Chili, N. Y.
"Herald of Health," 13 and 15 Laight Street, New York, N. Y.
"Mind in Nature," 171 West Washington Street, Chicago, Ill.
"Memphis Weekly Record," Memphis, Tenn.
"The Christian Companion," Kansas City, Mo.
"Beck's Journal of Decorative Art," 142 West Forty-third Street, New York, N. Y.
"Bible School," Kent, Ohio.
"Inter-Ocean," Chicago, Ill.
"Brooklyn Sunday Eagle," Brooklyn, L. I.
"Home Circle," Boston, Mass.
"Journal," Lewiston, Maine.
"Christian Leader," Boston, Mass.
"Gospel Banner," Augusta, Maine.
"The Theological Quarterly," 216 Woodland Avenue, Chicago, Ill.

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