EVOLUTIONISM.

A SERIES OF

ILLUSTRATED CHART LECTURES

UPON THE

EVOLUTION OF ALL THINGS IN THE UNIVERSE.

From Atoms to Worlds,
From Atoms to Souls.

Knowledge guides us like the magnetic pole,
Ignorance forges fetters for the soul.
One leads us safely 'cross the pathless deep,
The other binds us in a slothful sleep.

BY

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INTRODUCTION.

The publication of this series of Temple Lectures in book form was undertaken for a purpose. My experience during the past few years has demonstrated the fact to me that Evolution is the one great TRUTH which stands at the very threshold of all intellectual advancement. The want of a knowledge of it stultifies all attemps to understand the Infinite truth.

I have found that nine-tenths of the persons who think they understand it, do not. Also, that the books on the subject present grave and well-nigh insurmoutable difficulties to the ordinary investigator. By the time the average person has waded through 600 pages of geology and 900 pages of evolution and "origin of species," and 350 more of embryology, all in fine print, he has forgotten nine-tenths of what he has read. I have put in months of hard work making drawings for this book, in order to give the average reader an opportunity to see the fossiliferous deposits illustrated side by side with the strata in which they are found.

I shall never receive pay for one-tenth of the time expended in this work, but it has been a labor of love with me, and I do not look for pecuniary reward.

OLNEY H. RICHMOND.

LECTURE I.

Evolution of a System.

OUR SOLAR SYSTEM FROM AN ATTENUATED ATOMIC MASS TO SUN AND WORLDS.

THE "CREATION" IDEA UNTRUE.—THE REIGN OF LAW.—INFINITE DIVERSITY, YET UNITY.—MOLECULAR VIBRATIONS.—THE WONDERFUL ETHER.—THE ETHERIC BALANCE.—CHEMICAL AFFINITY.—THE "WALTZ OF ATOMS.—A UNITED FAMILY OF WORLDS.

NO scientific person can conscientiously put off the question: "How did that come to be?" with the old stereotyped answer: "God made it," or "God created it."

That time has gone by, with the childish conceptions which originated it; and the man of science of to-day answers the question as a man of knowledge, and does not attempt the evasion of it in any "Santa Clause" style.

During the ignorant and barbaric ages of the past, that make-shift, "God created it," was very convenient, especially for those who pretended to be direct purveyors to the people of the Almighty's wishes and orders.

That the universe, both physical and energetic, is a constant and infinite series of cause and effect, with no possible beginning and no ending, no limitation in bounds and none in ultimate evolution, is a grand fact which every new discovery only tends to strengthen.

No scientific writer of to-day says a word about "creation" of forms and matter, except it be to truck to the church, and thereby get religious patronage. No work which tells the plain, unvarnished Truth can be gotten into our public schools, and hardly into most public libraries. Such institutions are usually controlled by old fogy boards, and men of science know this to be a fact.

Thank the stars! The undersigned is not obliged to cater to ignorance, and can afford to state facts as he finds them, without fear or favor.

In starting this series of lectures on general Evolution, I shall not look for a "beginning." We can in no place put down our stake and say, "here is the starting point." I firmly believe that millions of sextillions of ages ago worlds and their satellites, suns and clusters of suns, systems and universes of Nebulæ were going through their great periods of evolution—not the same as to-day, for Nature possesses infinite powers of transformation, but under the same general laws as to-day and subject to the same gigantic ever acting forces.

If we should examine a million maple trees we would not find two alike in the entire million; but all of them would be found to possess certain characteristics appertaining to maples.

Just so, if we should examine a million clusters of suns, we should find no two exactly alike; but this would not prove that they formed under different laws, any more than in the case of the maple trees.

It is now generally admitted by science

that the primary constituents of all that is in the universe is ultimate atoms and their motions. And I cannot see, after years of study of the subject, that we need anything more. The non-creatable, ever existent atom furnishes all that we need to account for matter, and the vibration of the atom furnishes all we require to account for all the manifestations.

Attraction and repulsion, light and heat, chemical energy and affinity, electricity and magnetism, mind, spirit, soul force, sound, odor, and every conceivable manifestation can be fully accounted for under the law of motion, or atomic and molecular vibration. The entire universe is full of vibrating atoms. The fact that light, heat, and other numerous modes of transmitting energy, come to us across tremendous regions of space, proves that there is no such thing as a vacuum anywhere. Science has accepted the existence of inter-planetary or inter-molecular ether as a fact, attested in a thousand ways. It has even been computed how

much its pressure is; and from proportional ratios, as compared with sound vibrations, it is believed that the ether exerts a pressure of *six thousand million tons* to the square inch. Why does not this inconceivable pressure crush everything? Simply because it is exerted on all sides, in, out and between. The only thing it cannot penetrate is the atom, and that cannot be crushed or destroyed by outside pressure, for it is indestructable. But if we displace the etheric balance ever so little we find what a giant we have awakened. The silent force which occupies yonder trolley wire, which is capable of sending a vibration down through the car which shall actuate its wheels and drive it along the track, loaded with passengers, is nothing but a slight displacement of the ether which is made to vibrate through a space of less than one-twentieth thousanth part of an inch. Even this small displacement of the etheric atoms shakes every atom of copper in the wire from one end to the other. Shake the atoms composing a man's body in this vio-

lent manner and he falls dead instantly. His body can stand higher vibrations even than that, but they must be vastly shorter in range.

The ether does not possess its enormous power and exert its pressure from the closeness of its atoms so much as it does from their enormous normal vibration. The normal vibration is perfectly frightful to contemplate and beyond the possibilities of belief. This is the reason that the ether is the most elastic medium in all the universe. It is so elastic that some scientists have supposed it to be a "perfect gas," or one possessing the highest possible elasticity. The vibrations transmitted to the cosmic ether by combustion, magnetism or electricity are wholly distinct from the normal vibrations belonging to the ether.

In the same way the vibrations of the voice in a telephone superimpose electric pulsations in the line wire entirely distinct from the normal vibrations of the electricity in the wire.

But it is not my intention here to go into the law of vibration, as fascinating a subject as it is, as I desire to call your attention more particularly to the evolution of peopled worlds.

EVOLUTION OF A SOLAR SYSTEM.

Let us suppose that in some particular part of the universe, covering a space roughly averaging some fifty-four thousand millions of miles in diameter, there exists a quantity of atoms, mixed with and suspended in the ether. There are enough of them to make a respectable sun, like ours, and to furnish material enough for a complete outfit of planets and other attendants. These little invisible atoms would be so far apart that the density of the entire mass would be less than one eighteen hundred thousand millionth that of hydrogen gas. If the whole lot should be brought down to a ball with a diameter equal to the orbit of Mercury, it would then have a density thirty times less than hydrogen gas.

Now, as this gas is the most imponderable

of anything in the shape of matter handled by us, we can form a small idea of the extreme tenuity of this matter. It is no "fire mist." It cannot be seen, or in any manner detected by the finest instruments.

We have here latent conditions for the making of a solar system, but it consists of multitudes of separate atoms, held far apart by "atomic repulsion." What is that? says one. Just this: An atom possesses the property of movement. It wants to vibrate in a little orbit of its own, and it will do this whenever it can find enough room. If it can get large elbow room it will occupy a large space. If it is crowded by other atoms it will vibrate in a smaller and smaller orbit, until it gets so crowded that it will have to join forces with other atoms in order to have any room at all. In this manner chemical action is started. But our little entities have wills of their own, for when they *are* obliged to choose a partner in this great "waltz of atoms" they pick out those which are most agreeable. This is "Chemical

Affinity."—the lowest form of "mind" or "soul force" known to us in all the universe. The condition which we have assumed in this mass of attenuated vapor would go on eternally without any particular change were it not that each atom has still another quality which is inherent and always active. That is the quality of gravity. That mysterious, but well known force is all the time exerted on every separate atom or molecule of matter. It constantly tends to overcome all other forces, for others are more or less subject to change from environment and position; but gravity is always on the watch; it never lets up an instant. Under this gentle, but persuasive force, our little friends —the ultimate atoms of Hydrogen, Carbon, Oxygen, Nitrogen, and so on—begin to draw in toward the point where there is the most company. At first they hold aloof from the dance and hang upon the outskirts of the crowd; but the vibrating throng soon produces too great an attraction for them to resist, and they join in. This is going on all

over the vast mass, and soon little centers of more condensed matter are formed here and there. These little circles possess more power and draw still more atoms to them. It is not yet necessary, nor for millions of years to come, for these atoms to unite in the close embrace of chemical union. They are not near enough. The closest of them are still hundreds of thousands of times their own diameters apart. They belong to the same society, but they are not acquainted yet.

After a time these little clusters begin to revolve about other clusters, and those, in turn, about others, and the condensation goes on thus, we will suppose, for a billion of years, and our matter has been so drawn in together that it now occupies a space about six thousand millions of miles in diameter.

Now, what would we naturally expect to find, as the net result of all this motion? Turn a pail of water into a funnel, and see how the water naturally begins to turn about

on itself as it "condenses" toward the point of escape. This is because all masses of matter coming toward a center *must produce currents*, and these currents cannot be uniform in direction. They cannot proceed in radial lines direct toward the center of gravity, but must slide off and spread over the outmost layers of matter in order to obtain room. The well known circular character of storms and cyclones is a manifestation of this same property in an element millions of times more dense, atmospheric vapor or air.

So far, our little atoms, in their whirling clusters, have been falling gradually in, all the time moving in a great spiral toward the center of gravity. But they have, by this time, generated such a motion of gyration that they begin to feel the counteracting effect of another force. Everything tends to move in straight lines, and the more rapidly a given thing moves, the harder it tries to go straight ahead.

Fasten a lead ball to a string and begin whirling it about your head, and you will

soon realize that the faster you whirl it the harder the ball pulls to get away from you, until it breaks the string. Now take a rubber cord, say ten feet long, and try the same. You will see that at a given velocity the leaden ball will stretch the string out to, say, fifteen feet, and there stop stretching it, and will remain at that distance until the rate of motion is changed. In other words, the tendency to go straight ahead just balances the elastic force of the rubber cord in holding it to a circular orbit. This has been called centripital and centrifugal "forces," but they are not "forces" at all, as far as I can see. But if this property of inertia did not exist there would be no worlds or suns, such as we now have.

Now, a large ring of the uttermost parts of this mass of matter has gotten to that point where it has no more tendency to fall in or out, so it rushes on in a non-contracting circle for a long period of time. But the first tendency was for the ball of matter to flatten itself out into a disk, because all

the matter at the poles of rotation would, as its velocity increased, have a tendency to get away from the center of rotation as far as possible, while yet prevented from flying off by the attraction of the rest of the mass.

Finally the time came when our outside atoms, pursuing their orbit, drew from the nearest ones within the circle all who would yield allegiance to the new dynasty, and the central disk, still shrinking, drew with it all who would go, and a split occurred, which left our outside circle independent, with nothing to do but whirl on and on at a velocity of about 209 miles per minute. This is rapid for earthly motion, as we move on its surface, but slow for cosmical motion.

Our circle once formed, would go on forever, were it not that disruption always will come, in time, to all circles. Contentions will break up all circles and organizations of men, and the same thing holds good with atoms. In this case the "contention" is the pulling and hauling of other masses of matter at a distance, and waves of motion and

aggregations of matter set up in the body of the ring. A ring will resist these outside influences a good while before breaking up, as witness the rings of Saturn, yet intact. But the rings of Saturn have progressed, from their great density, caused by proximity to the immense body of their primary, to a point where the matter has condensed into masses of meteoric character, so it has become visible. Just as soon as the large ring of matter, which we have been considering, broke in one place, the ends would rapidly fall toward the central part of the ring. The rear end would be drawn forward and the front end would be gradually retarded until the matter, in time, would fall into a lump, ready to go through the same process by itself, resulting in the formation of another smaller ring. As the inside of the large ring would be all the time retarded by the proximity of the inside ball of matter, that side would be retarded so that the outer part would have a greater velocity.

The effect would be that the resulting

planet and ring, or rings, which were destined to become satellites to it, would have a revolution in the same direction as the original mass.

This is just what we find in our solar system, for the planets revolve in the same direction as the sun, and so do their satellites. As the sun is what there is left, after all the planets had, in turn, been made from rings left behind, it, of course, shows the direction of the motion. As the disk of matter concentrated, it naturally gained a greater velocity, as all falling bodies do, and we see this most beautifully illustrated by the time of revolution of all the bodies. The sun revolves in 24 days; Mercury moves around it in 88 days; Venus, in 225 days; the Earth, in 365 days. Each of these planets illustrate exactly the rotation of the parent mass at the time the ring was cast off which formed it, and the sun shows the motion left at a diameter of 850,000 miles. All these bodies in our solar system are connected by an exact mathematical law

or laws; all connected as if they were one family, as they really are—a family of heavly bodies. We first saw Neptune born. We could go on and watch the birth of each planet in succession, but it is useless. When we see one we see all, for that is the general process. If you are really scientific, and desire to go deeply into the study set forth briefly in this lecture, with the facts and figures in minute detail, I advise you to procure "The Origin of the Stars," by Prof. J. Ennes, and study it well. It explains fully the making of suns and systems.

What have we learned from the facts set forth thus far? That with the ultimate atoms in any conceivable state of diffusion in space, Nature has the power of going on and making worlds, and the residuum left in the center when concentrated to the point where intense chemical action can unite the atoms, as it is bound to do, will be a hot and shining sun, to heat and light the worlds.

If some great comet should come crashing in from outer space, made up of "left-over"

matter from some odd corner of the universe, and should plunge into our sun and again turn him to gas, and cause that gas to expand until it took in Mercury, Venus, Earth and Mars, and they all became melted in "fervent heat" until they were all again diffused as gas, that disk would go right on revolving, and go to forming new planets again, as serenely as if nothing had happened. *Nature was not made for us.* We were formed to fit Nature as she is. Remember that.

Many tremendous ages, as we understand time, passed between the birth of Neptune and the parting of the Earth ring. We shall not fill in this great space, but shall, in our next lecture, start with our Earth in a gaseous form and watch her in her onward progress along the great path of evolution.

LECTURE II.

Evolution of our Earth.

PROGRESS OF THE PLANET TERRA FROM A RINGED SUN TO A GLOBE COVERED WITH VEGETATION.

SIXTY-SIX MILLION YEARS AGO.—THE EARTH AS A GLOBE OF GAS.—THE EARTH AS A SHINING SUN.—SURROUNDED BY OTHER SUNS.—IT BECOMES A RED HOT PLANET.—A RAIN STORM LASTING HALF A MILLION YEARS.—NEPTUNE'S BATTLE WITH VULCAN.—VULCAN OVERCOME AND IMPRISONED.—BEFORE LIFE BEGAN.—LIFE APPEARS ON OUR GLOBE.—LEFT IN CLOUDS OF CARBON.

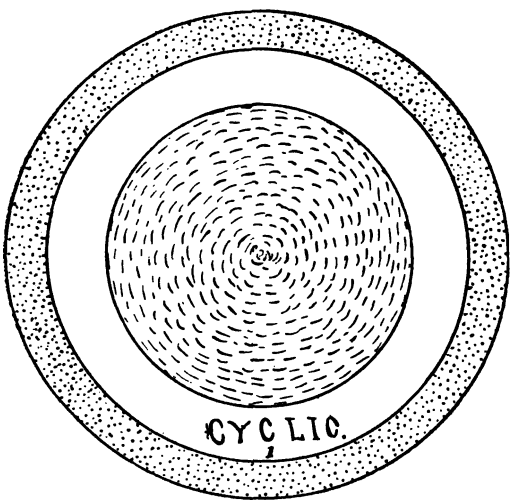
OUR lesson this evening is to be upon a subject that is of great interest to all. The evolution of the Earth from the point where it ceased to be a part of its mother Sun, up to the time when it is a full-fledged world, cannot but be an interesting theme to persons of intelligence.

We will take this infant, however, after a few millions of years had elapsed. The ring of matter which parted from the sun about sixty-six million years ago had slowly gathered itself into a disk, thick in the middle and thin, comparatively, at the outer edges, ready to form itself, under the unerring law of nature, into a small system. Of but little importance to the universe was the forthcoming insignificant globe and satellite, but of the greatest importance to the countless millions of beings who were destined to evolute upon the surface of one or the other of these tiny specks.

We need no engraving to present to our sight the thinly distributed mass of matter composing this system, for the place was as near being a dark void as we can conceive.

This disk, when a million miles wide in its diameter, must have contained matter attenuated to at least one eight-hundredth the density of air. In other words, the space occupied by it was a greater "void" than the vacuum producible by our old-fash-

ioned air pumps. Yet, strange as it may seem, this state represented a condensation of matter that had been going on for thousands of millions of years, extending back to a period long anterior to the birth of Neptune.



THE EARTH IN A GASEOUS FORM, WITH THE RING OF LUNA.

Our first view of Terra exhibits her as a ringed planet, somewhat like Saturn, except that the ring is not compound, as with Saturn, and the planetary matter had not condensed to near the same extent.

The ring contained the matter which was destined to become the Earth's satellite, Luna. We see Saturn to-day with his three rings, slowly preparing for the birth of new satellites to add to the number he already possesses; but the work goes on so slowly that we can see but the most minute displacements occurring during the long periods of time it has been under observation. These great cosmical changes are slow, but sure.

Our Earth, at the stage shown in engraving No. 1, was about 445 times greater in bulk than at present; so its density must have been still far less than that of water. The moon having parted from this infant Earth, we will leave her to fulfill her own destiny; to become an inhabited globe, with seas and continents, mountains, lakes and islands; to afterwards die out to a cold and airless rock, as we now behold her, a fit type of what our Earth is to become in the fullness of time.

While our gentle attendant was passing

through her cycle of life, she possessed several brightly shining luminaries to warm and vivify her.

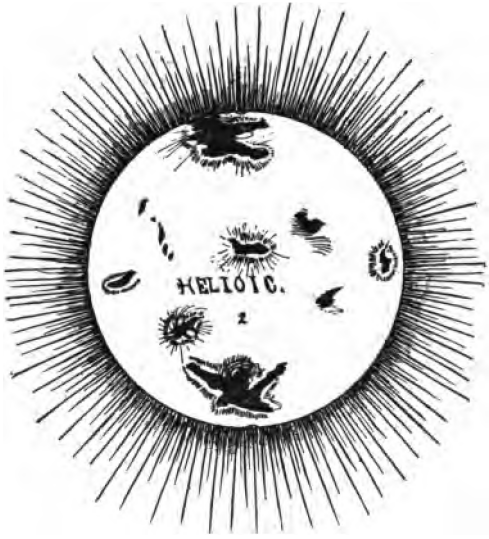
Jupiter must have been a very respectable Sun at that period, although on the wane.

Saturn was probably only red hot, as Jupiter is now. Venus was, no doubt, very bright and spotless in her "garb of light," while "Old Sol" himself was many hundreds of thousands of miles larger in diameter than at present.

But all these grand globes of fire and light would sink into insignificance, in the eyes of Lunarians, beside a larger and grander Sun, which they had ever with them. It was brighter and larger than any of the others, from its close proximity, giving it an apparent magnitude more than sixteen times that of Sol. This Sun was the one upon which we now reside.

"A Sun?" say you. Yes, a Sun. For we are living and moving upon the ashes of a dead Sun—upon the storm-beaten and earth-quake-shaken mass of cinders left from

the dying out of a small Sun. Engraving No. 2 shows this sun after she was well advanced in years. Her once white-hot surface had become yellow, while many spots obscured her fair face. These spots were



THE EARTH, AS A SPOTTED BLAZING SUN.

vast masses of scoria which had become slightly cooler and had in many cases anchored themselves to the more condensed material of the core of the body.

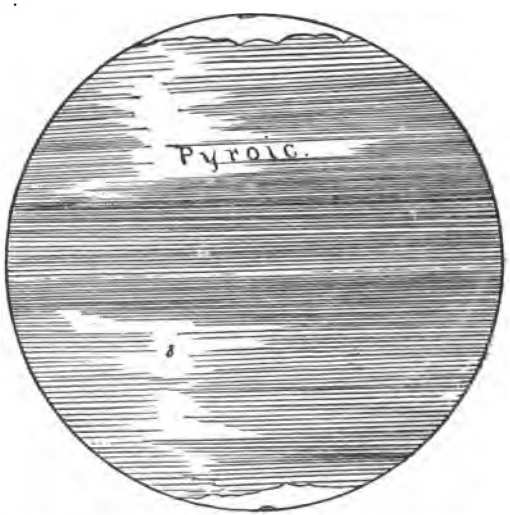
Around these "islands of red-hot lava"

gigantic cyclones of fire swept and swirled, while the war of elements was so great that a mass of basaltic rock the size of Rhode Island might have been tossed about as a pea in a boiling pot. It has been thirteen million years since she parted from the parent Sun; still she is an infant.

We could pause here and devote much time to a study of the gigantic forces brought in play at this stage of our globe. We could describe the outbursting torrents of flaming hydrogen, as they tear their way upward through the dense atmosphere of carbon, iron, and other elements; but all of this belongs properly to the history of Suns in general, so we will omit it and hasten onward.

Five million years must pass, and we view her once more in No. 3. Ah! what a change! The blemishes we saw so long ago have increased until they have enclosed her melted interior with a shell of lava; red hot about her equator; gray and dark about her slowly turning poles. Why is this? you ask. Let me explain:

Under the well known principles of gravity, centripetal and centrifugal forces, a floating body on a circularly moving surface will seek the parts that move with the least velocity; even as chips floating in a tub of water will seek the center of motion when



OUR EARTH AS A RED-HOT GLOBE.—THE FIRE STAGE.

the water is whirled about the tub with a stick. Therefore the poles became loaded with masses of cooling rock, ages before the equator became cool enough to become dark red. Up to this time the central Sun, al-

though blazing away with twice its present power, had but little effect upon the Earth, because her own heat was so great. But now, the cooling process was to go on more rapidly at the poles, by reason of the slant rays of the Sun upon them. So the crust gradually thickened and hardened at those points, while it was constantly cracked and fissured by enormous upheavals and the bursting forth of the pent-up matter within.

The engraving shows the Earth in this stage of fire as a belted planet, like Jupiter; the belts being composed of dark masses of aqueous vapor, mingled with carbon and other gases. These formed a belt about the equator a thousand miles in thickness, and extended nearly to the poles. That belt contained the future seas and oceans, the coal beds and rich earth that were millions and millions of years later to render the Earth a fit abode for man.

These carbonic and hydrogen vapors were constantly condensing, as they came in contact with the extreme cold of outer space,

thereby becoming precipitated to the hot Earth below, to again be sent flying upward in the form of steam and gas. This produced a constant rain, night and day, *for more than five hundred thousand years*, and a period followed this when rain storms were violent and almost constant for millions of years more.

I am aware that these figures sound large to those who are unaccustomed to cosmical time. To some people, five or six thousand years seem an eternity. But Mystics understand that such small sections of time as are dealt with in human history are simply as nothing, when dealing with the stupendous works of Nature.

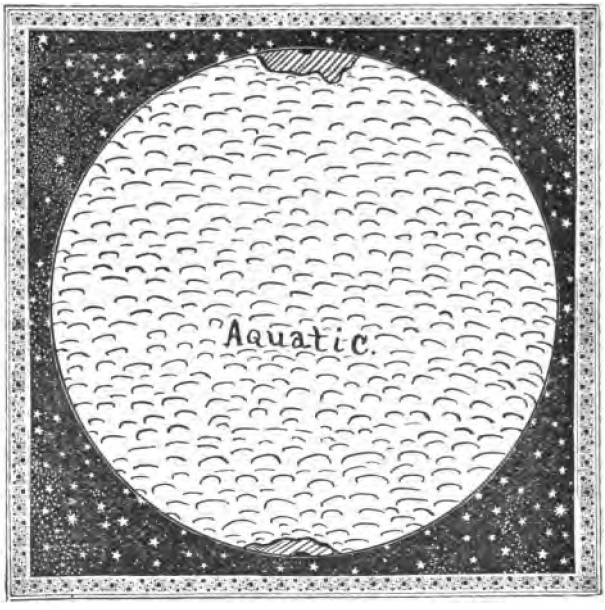
Friends, the making of a world is no light task. Nature has a mighty workshop, and she does her work well. Time is no object.

> "Ten million years to heat the iron,
> Ten million more to pound,"

is as nothing in her shop.

Our world being now formed in the shape of a ball, slightly flattened at the poles, we

will watch it during its further development, for a grand and mighty work must yet be done upon her by the forces of Vulcan before she can become the abode of life. We



THE EARTH, COVERED WITH WATER.

have left her astronomical history now, and must begin upon her geological career.

We first view her as an Aquatic globe, something like fourteen millions of years later. During all this vast period the ter-

rific fight has been going on constantly between Vulcan and Neptune. At first, old Vulcan had the best of it, hurling the forces of Neptune backward at every assault; but the latter had good staying qualities, and the time came when Vulcan was sent downward and incarcerated in a dark and gloomy prison. But he was, and is yet, a very unwilling prisoner, for he attempts to escape often, with a portion of his forces, and many a conflict ensues in consequence.

Many wonderful chemical changes took place within the great ocean of hot water, which covered the Earth during the Aquatic Period. These gigantic combinations of elements were necessary to give to the world, which was to be the variety of compounds which are needed in an inhabited globe.

It is a well known fact that chemists today avail themselves of the solvent powers of hot water in the formation of hundreds of compounds. So the Earth presented the very conditions for a gigantic chemical manufacturing laboratory during many ages.

We will take our next view some six millions of years later, when she has become the AZOIC EARTH, during which period mighty changes have taken place. The crust has cooled slowly, until the white-hot core is covered with many miles of stone. But the pent-up fires within are constantly heaving and gushing upward through vast rents in the warm rock. Were it not for this, the level earth would be covered with water, impregnated to saturation with carbonic acid gas, to the depths of hundreds of feet. But the contraction of the crust under the cooling process has folded up great ridges of rock, and has thereby lifted it above the terrible abyss of waters, so that dry land appears.

But what an inhospitable shore it is! A great, dry, hot granite rock, a thousand miles long, marks the birth of a new continent, the first one south of the Arctic Circle.

America, called the "New World," is, geologically, the old.

"We may walk," says Agassiz, "along

its summit, and feel that we are treading upon the granite ridge that first divided the waters into a northern and a southern ocean; and if our imaginations carry us so far, we can look down to its base and fancy the sea

OUR GLOBE IN ITS EARLY STAGE OF LAND FORMATION.

washed against this earliest shore of a lifeless world."

A little land at the poles, a V-shaped strip extending from the north polar land downward to where Lake Superior now is, and from thence northwesterly to the Arctic Sea,

together with a few islands, widely scattered, and all the rest a wilderness of black waters. That is the Azoic Earth twenty-eight million years ago.

Although the parts of the Earth's frame, explorable at present by man, yield no traces of organic life in the Azoic rocks, we cannot say but that early forms of vegetable life might have been in existence at one of the poles—probably the north—even at that early period. We cannot examine the rocks that now lie hidden beneath five hundred feet of ice, but we can examine the lands bordering upon the vast polar region, upon all sides, and such examination has exhibited a world of evidence of an exuberant life at the North Pole. This is in the shape of shiploads of ivory tusks from Siberia and Alaska, while borings in the north of our own continent have revealed hundreds of feet in depth of coral formations, which could only have been laid down in warm seas.

Life is natural to all conditions that favor it; therefore we must reason that between

the point where the temperature became low enough to allow life to exist and the point where it was too low to allow it, there must stretch a tremendous period of time, even at our poles.

The Azoic rocks are conglomerates of still older rocks, which are, evidently, the fragments of entire continents, which were, no doubt, located very differently from the continental areas of to-day.

The great "Laurentian Period" covered some five million years of time, and the rocky formation is about thirty thousand feet in thickness. The "Huronian Period," lasting about four million years, with from twelve to twenty thousand feet of rock, comprises the balance of the Azoic, or, as called by some geologists, the "Eozoic Period."

THE PALÆOZOIC EARTH.

Our next view shows the earth after this tremendous period of nine millions of years had elapsed.

The first Palæozoic period was characterized by terrific convulsions, during which

thousands of mountain tops were thrust upward through the waters, forming islands. Thus the Earth might be said to have been in its "Island Period."

EARLY LIFE STAGE OF EARTH.—ISLAND PERIOD.

This period is divided, for convenience of study, into the Silurian, Devonian and Carboniferous ages. To whatever conclusion geologists may arrive regarding earlier forms of life, there is no doubt whatever that the Silurian age developed billions upon billions of mollusks, while the Devonian age follow-

ing it found the warm seas literally swarming with fishes. These animals existed in such immense quantities, during the two periods named, that their fossilized remains build up thousands of feet of rocky formations.

The third part of the Palæozoic period, called the Carboniferous Age, abounded in such a growth of arborescent forms of life, that we cannot even grasp an idea of what it was. Plants that are now simple, tiny spores, scarcely to be seen by the passer-by, were, in that age, gigantic trees. The massive coal beds laid down upon our continent show plainly that an enormous amount of carbon must have been precipitated from the air, as well as laid down in the form of vegetation, in order to form the great beds of coal, in some places more than twenty-five feet thick and covering, in one State, Missouri, a hundred thousand square miles.

Prof. Winchell says, in his Geological Sketches: "The amount of vegetable mat- in a single coal-seam six inches thick is

greater than the most luxuriant vegetation of the present day would furnish in 1,200 years."

So long were each of these "ages," into which geologists divide the Palæozoic time, that they subdivide the Silurian age into the upper and lower, which are again subdivided into three and four divisions respectively. The Devonian age is subdivided into four great periods, and the Carboniferous into three—the one called the Permian being the third, or uppermost.

We could write an entire book upon only one of those divisions, and then not exhaust the subject, as Hugh Miller wrote a large work upon the Devonian alone.

As an inkling of the wonderful formations during this period, we will say that the Hamilton series of the Devonian subdivision of the Palæozoic formation, in the State of New York, comprises more than five thousand feet of rocky strata—nearly one mile in thickness!

The estimate of time for the Palæozoic period is as follows:

Three great periods of lower Silurian, comprising the Potsdam, Trenton and Hudson, about three million years.

Four great periods of the upper Silurian, Niagara, Salina, Lower Helderberg and Oriskany, about two and one-half millions.

Four great periods of the Devonian, some four million years.

The three great periods of the Carboniferous, three million and a half more, making some thirteen million years of Palæozoic time.

Many geologists give a longer period than this to the Palæozoic, holding that the vast changes which took place would have required more time. Some assign seven million years to the Devonian alone; but we must take into consideration that geological work went on much more rapidly when all was nearly hot, and chemical action correspondingly active within the crust of the earth. In the same manner we reduce the

estimates for the Carboniferous period, for reasons which will be obvious to all who consider the rank-growing vegetation of that age.

There will always exist a wide difference of opinion regarding the lapse of time in the consideration of geological formations. There must be a wide latitude allowed, as there is no exact line of demarkation between the various ages and the formations appertaining thereunto.

We can, therefore, only deal in approximate figures, in order to attempt to give you some idea of time, as well as thickness of strata.

But we will now leave our Earth, covered with the wonderful growth of the Carboniferous period, which was engaged, for ages upon ages, in the work of burying beneath thousands of feet of coal, slate and shale the fossil remains of untold billions of fish of the Devonian period, and other untold billions of Trilobites, who ruled and possessed the Earth, "and the fullness thereof," during the great Silurian Period.

We will leave her, with her rank and reaking swamps of gigantic asparagus-like trees, her tropical jungles, her hot beds of ferns, where what are now only a growth of a few inches, were then great and towering forms. We leave her in her tangled dress of vegetation, with cold-blooded, croaking amphibians crawling over her bosom, knowing that we shall soon see her again in all her glory, as a purified Earth, being slowly prepared for the habitation of the higher forms of life, which should eventually result under the great forces of evolution in the production of man.

LECTURE III.

Earth's Evolution.

PROGRESS OF THE PLANET TERRA FROM THE CARBONIFEROUS PERIOD TO THE ERA OF MAN.

SECOND LIFE STAGE.—GREAT CHANGES TAKE PLACE.—THE AGE OF SHELLS.—GIGANTIC REPTILES.—WONDERS OF CHALK.—THE THIRD STAGE OF LIFE.—THE GREAT INLAND SEA PERIOD.—MODERN LIFE-FORMS DAWN.—THE WORK OF THE ICE FLOW.—AMERICA A VAST CEMETERY.—THE FUTURE OF OUR GLOBE.

THE lesson this evening starts with a view of Old Terra, as she appeared after emerging from the vast period of preparation for the higher life, when we left her covered with the wonderful vegetation of the Carboniferous Age.

We are surprised to note how few are the changes produced in the great time that has

elapsed; but, upon reflection, we conclude the mightiest part of the work is below the surface, only the smaller portion appearing as additions to the embryo continents.

SECOND LIFE STAGE OF EARTH.—INCREASE OF CONTINENTS.

The framework of the Americas has been filled out more completely from the vertebrate of rocky islands shown in the previous view. The Carboniferous area has been added. The great Appalachian chain has been uplifted above the sea.

New England was a peninsula. The

Gulf of Mexico washes the sides of the Sierra Nevada. The great United States was a vast basin of salt water, dotted with islands, while the Northern Atlantic was filled with a mass of land which was afterward to be hurled by gigantic currents and upheavals upon the surface of the North American Continent. Mesozoic time is divided into the Triassic period, the Jurassic period and the Cretaceous period, each of which lasted long enough to develop the most remarkable class of animals of which imagination could possibly conceive. Reptiles of all patterns and sizes ruled the earth. Gigantic lizards, "with eyes two feet in diameter;" turtles nearly large enough to lay out into city lots, and numerous other reptiles, some of them with wings, and all of them having Greek names long enough to paralyze any modern animal to carry. Nature had a partly-made earth, warm and dank, with the air filled with carbonic gas; so she developed a lot of monsters to fill in the time and keep things moving.

We estimate the time during this period at four million years, although there are grave reasons for assigning part of this time to the preceding period. But the New Red Sand Stone, which is assigned to the Devonian by some geologists, belongs to this formation. When we consider the vast chalk deposits laid down by microscopic animals, together with numerous other strata, such as the rock salt beds of the Triassic period and the sand stones of the Jurassic, interstratified with gold-bearing quartz, we must concede a very long period to the Mesozoic. This period constitutes the great middle-life stage of development, in geological history.

The work of purifying the air from carbon was still going on, and one of the most potent factors in this work was the laying down, in the form of rock, of large layers of carbonate of lime.

It is usually considered that the Mesozoic really starts a new cycle of life on this globe, so great is the distinction between the fos-

siliferous deposits found here and those in lower strata.

But we must hasten onward, leaving the more minute examination to a future lecture, when we examine the strata closer, in a journey toward the center of the earth.

During the Cretaceous period, of the Mesozoic, Nature seems to have literally reveled in the manufacture of shells.

While she gave due attention to enormous reptiles, animals encased in shells were, apparently, a special feature of the work of that period.

In England there are immense beds of chalk; also in France we find the same formation. Now, the microscope reveals to us that every inch of this stratum is composed of tiny, indestructible shells—indestructible, that is, by ordinary convulsions of nature, *because they are so exceedingly small.* One cubic inch of chalk contains over fifty-eight thousand microscopic shells. The chalk beds, thousands of feet thick, were laid down under water at the rate of the *thickness of a sheet of tissue paper annually.*

During the Mesozoic time, vast mountain chains were forced upward and then slowly degraded or worn down, leaving the upturned edges of the strata of preceding edges exposed. Upon these edges the newer formations were laid down. As one geologist exclaims: "The surface of the earth seems to have teetered up and down, as if the land rested upon a water-soaked bog." That exactly expresses the facts as revealed by an examination of the rocky leaves from the Silurian upward. It was a "water-soaked bog," but the bog rested upon a thin crust of rock, which in turn pressed upon a mass of white-hot semi-liquid earth material.

The thinness is only so by comparison with the size of the earth; for it is estimated that at this period the crust averaged about thirty-eight miles in thickness. Many miles of this crust would be red hot, though consistent.

We must not linger longer with this fascinating Earth, but hasten onward to the age of Mammals, those forerunners of man.

THE CENOZOIC EARTH.

We next view our Earth in the Cenozoic period, in the great "third Life Stage," or, as some geologists call it, the "Inland Sea Period."

The great continental areas are better defined. The United States is still nearly

THIRD STAGE OF LIFE.—THE GREAT INLAND SEA PERIOD.

bi-sected by an enormous arm of the Northern Sea, while in South America the valleys of the Amazon and the Rio de la Plata are united in a vast sea, which divides the continent into two parts.

It was during this long period that some of the most stupendous changes took place in the configuration of the globe, as far as the surface was concerned. Previous changes were mostly beneath the waters, but a grand fashioning of the land must now take place.

The Cenozoic time is divided into two great periods—the Tertiary and the Post Tertiary. The Tertiary is sub-divided into three grand periods called the Eocene, Miocene and the Pliocene.

The Post Tertiary extends upward through the Glacial epoch and the Terrace epoch.

We cannot stop to examine the wonderful animals which developed upon the land during the Miocene and Pliocene periods, but we will examine the geographical changes. During the ages which supervened, we find that the great sea arm of North America was cut off by the rising of great walls of rock in the north. Then the sea grew smaller and smaller by slow degrees, while its salt was deposited slowly in layers upon its bottom, until, after an enormous time

had elapsed, the great sea became a comparatively small lake, still somewhat impregnated with salt and other soluble minerals. But, though small in comparison, it occupied an area five times the size of Lake Superior, at the close of the Miocene period. It covered the spot where Golden City and Denver now stand, and the "Bad Lands" and sage brush plains of the West, over an area of over 150,000 square miles. (Steel, Hayden, Denton.)

The Mississippi and Ohio rivers then emptied into the Gulf of Mexico near where Cairo, Illinois, now stands. In addition, we notice that the islands of the North Atlantic had risen into a broad continent, which was a continuation of the older North-polar continent, and was, with its outlying islands at the south of it, destined to become a great highway, over which the early races of men could flee from the gathering cold of the North-land. (See "Religion of the Stars," pp. 18 to 21.)

In addition to the immense quadrupeds,

such as the terrific monster exhibited in the Anthropological building at the World's Fair, Prof. Dana says that 25,000 specimens of fossil fruits have been found, as well as over 3,000 species of shells in the Tertiary rock alone.

The Eocene epoch of the Tertiary period covered about four hundred and fifty thousand years, and during this time we find the first dawn of modern life forms. This means that previous to about two million years ago Nature had not yet developed her patterns of life at all, as we now behold them.

The Miocene epoch of the Tertiary period covered about the same length of time as the Eocene. During this epoch great changes took place in the surface of the earth, and the fossils show a large proportion allied to existing forms.

The Pleocene formation, which was laid down during an age estimated at three hundred and fifty thousand years, completes the great Tertiary period.

This brings us down to the Glacial epoch,

the lowest formation of the Post Tertiary, called the "Drift."

We show the Earth at the beginning, or near the beginning, of that time. Our poor, tortured Earth has been tried by fire, by

THE EARTH IN THE GREAT DRIFT PERIOD, OR THE LAKE AND ICE EPOCH.

water, and by earthquake shocks, for ages upon ages. But now she must pass the ordeal of the air. For the air now conspired, with all the others together, to bring upon her the most extraordinary series of experiences that could be conceived.

First, we ask you to dismiss from your minds the idea that the Glacial period was brought about through extreme cold. Cold could never have done it alone, nor could heat; but a combination of the two could. What is needed to make enormous quantities of snow? Plenty of steam, or water vapor. What is needed to generate this vapor? Plenty of heat.

So we have, as so ably shown by Prof. Donnelly, the conditions for a Glacial epoch:

First. A place where much aqueous vapor could be generated.

Second. Winds to carry it to a colder place on the globe.

Third. Cold air to turn the vapor to snow.

All these conditions came when the air above the poles became cold, through the shutting off of the internal heat of the earth by the thickening of the polar crust and the lessening of the sun's effectiveness by reason of its diminished size, and the polar angle of the earth to the sun's rays.

Many different opinions have been ad-

vanced regarding the probable period to be assigned to the Glacial epoch. It is a thing which is open to all sorts of speculations, because the beginning of glacialization is hard to define, while the ending has not even come yet in many parts of the earth. But I am inclined to think that the epoch was one of waves; that is, the ice had its terms of advancing and retreating, with a period of about twenty-one thousand years each, corresponding to the "geological season." We can safely estimate the Glacial epoch at half a million years.

When the geologists examine the terrific evidences of the plowing down of vast mountain chains, the gouging out of large lakes, like Lake Michigan, the filling up of great valleys, and then running the immense ice plows through them again and again, they cannot curtail the Glacial epoch much, if any, beyond the period named. And what is the use of it, anyway? It has been demonstrated, by careful experiments in the cooling of granite and basaltic rock, that the

crust of the earth would require, at the least, fifty million years to cool down to its present average thickness of between forty-eight and fifty-one miles.

Therefore, the geologist need not cut down his needed time to bring about the evolution of the earth. The astronomer deals in cosmical changes requiring such enormous reaches of time, that the paltry fifty millions asked for by geology can be accorded without a murmur.

The great glaciers of piled-up snow and ice crushed toward the equator, from both poles, in stupendous ridges of ice, many miles in depth; but the hot earth-belt of the torrid zone melted the ice and sent it upward in steam, to be again caught by the "powers of the air," and hurried to the snow-clad poles, to once more pass, at the rate of a few feet per year, toward the equator.

During this awful period, life, both vegetable and animal, had a hard struggle for existence. It was driven first to the north, then to the south, in waves or vibrations

corresponding to the "great astronomical year" of the earth. But the work of evolution went on slowly, step by step, to more perfected forms, as the environments would permit.

While this tremendous work was going on, Pluto had not ceased his labors, by any means, for we find that our continent was lifted bodily and again dropped down beneath its load of ice, several times.

The next epoch, called by some geologists the "Post Glacial," and by others the "Champlain epoch," finds our Earth in the "spring-time of life" once more. The ice breaks up, the ocean covers part of the State of Main, and broad, majestic rivers dig deep channels through the wide valleys furrowed by the gigantic ice flows of the preceding epoch. The land arose and fell like the billows of ocean during the period, which lasted some three hundred thousand years.

After the "Champlain Epoch" came the great period called the "Terrace Epoch," which lasted some two hundred thousand

years, and is yet, for we are in the alluvial portion of that epoch at the present time. During this period the land all over the earth oscillated up and down, like a ship at sea. It was during this time that the gi-

THE POST-GLACIAL.

gantic terraces, or stair-like ridges, were formed, such as those we see at Mackinac and elsewhere. This feature is especially noticeable in the West or Rocky Mountain region, where the great lakes are shown in the engraving.

The Atlantic continent is seen almost submerged, to again uprise, while its mate sinks, on this "continental teeter."

The mouths of the Mississippi, Amazon and Rio de la Plata are still several hundred miles inland from their positions at a later period. The State of Michigan and part of Wisconsin are under water, forming one large lake.

We might say that the terrace and glacial epochs are going on, even at this day, as they are, in a mild and restricted way; but for convenience those designations are confined to ancient energetic conditions long past.

In the illustrations of the Post Glacial epoch, you will notice that the Americas have assumed an appearance nearly the same as the present, yet there is a great difference in details, too small to be shown. The river systems have changed a great deal, also the lake systems.

Atlantis, the "gem of the ocean," has become well defined during this period, while

the Atlantic continent has been broken up and partly washed away, leaving numerous islands.

Greenland has retreated farther northward, leaving the place where the Atlantic continent stood, with its millions of beings, to become the great submarine "ocean telegraphic plateau" of our day.

There has been much controversy over the question as to the particular point in geologic time, when man first became a development which could be distinguished from the quadrumana. Scientific authorities differ very widely upon estimates; and every new discovery has a tendency to place the accepted estimate farther back. Taking all the evidence at hand from various sources, we are of the opinion that the first distinct type of men appeared upon the earth about 450,000 years ago.

There was a great and distinct change in animal life during the Post-Glacial epoch, when the mammoth and cave-bear seem to have co-existed with early man.

Long ages of time elapsed, during which tremendous vicissitudes occurred to our earth and its inhabitants. Man was obliged to fight his way upward, even as his progenitors had done before him, step by step, sometimes retrograding for a time, then advancing.

We give another view of our Earth, in the alluvial or present stage of time, when the rocks over a large part of the continental divisions are deeply covered with the rich debris from former lands, now pulverized and scattered.

Monstrous beasts roamed over the earth in the early part of this epoch; vast quadrupeds multiplied on the face of our planet, and disputed possession with man. But "mind" conquered brute force, as it always does, and puny man put to route the wild beasts, who threatened his existence.

WAS THE WORLD FINISHED ON MAN'S ADVENT?

It unquestionably was not. We are in the midst of changes as vast as ever, only

the earth being cooler the changes are slower. Continents are being raised and lowered. Mountains and hills are being degraded, and river valleys filled up by the ever-active forces of Nature.

THE EARTH IN THE ALLUVIAL OR RIVER PERIOD.

"America is one vast cemetery of buried and forgotten forms of life, man being included among them."

Other nations have arisen upon this continent, fought the battle of life, and have fallen into oblivion.

Fourteen thousand years ago a flourishing nation occupied the soil where we now strut about as upon the stage of life.

Other nations will follow, and still others. Lands will sink and lands will rise, as, step by step, the cold of the arctic regions will drive men towards the Equator.

Lake Michigan will dwindle gradually to a river. Chicago, after attaining the grand position of a leading city of the world, with six million inhabitants, will sink beneath the quicksands, inch by inch, and will disappear from the sight of man. New York City will be under four hundred feet of salt sea water, and Boston will be a memory.

The lakes and rivers become slowly congealed as the great ice walls of the arctic sea press downward over our devoted and doomed country, step by step, until the whole is covered with the crystal pall.

But, while this change is going on, kind Nature provides a home for her children. She raises vast bodies of land from the broad bosom of the Pacific, whose thousands of

islands become continents. Although our sun is diminished in splendor at this far-off date, the loss of heat is compensated for by its perpendicular rays upon the land surface of our globe.

I have one more chart to show you. It is a view of Terra some millions of years hence, when the broad bosom of the Pacific is dotted with new islands and new lands,

IDEAL VIEW OF THE EARTH THREE MILLION YEARS IN ADVANCE.—EQUATORIAL LAND PERIOD.

peopled with races who have not the slightest history that such a country as the United States of America ever had a being.

Billions of tiny animals are busily engaged in the work of building up new lands, upon a scale so vast that the achievements of men in changing the face of our globe are as an ant-hill compared with the great pyramid.

The people of that period will have no more knowledge of there having been such a country as the United States of America than we have now of countries which existed ten thousand or twenty thousand years ago. Our very records will have disappeared, and our language will have been forgotten.

We can imagine them sending air-propelled vessels to the sites of Chicago, Boston, New York, London or Paris, there, amid the dangers of an arctic rigor of climate, to excavate for long-forgotten evidences of a past civilization.

LECTURE IV.

The Age of Mammals.

—o—

A DESCENT INTO THE ROCKY STRATA OF THE PLANET TERRA.

—o—

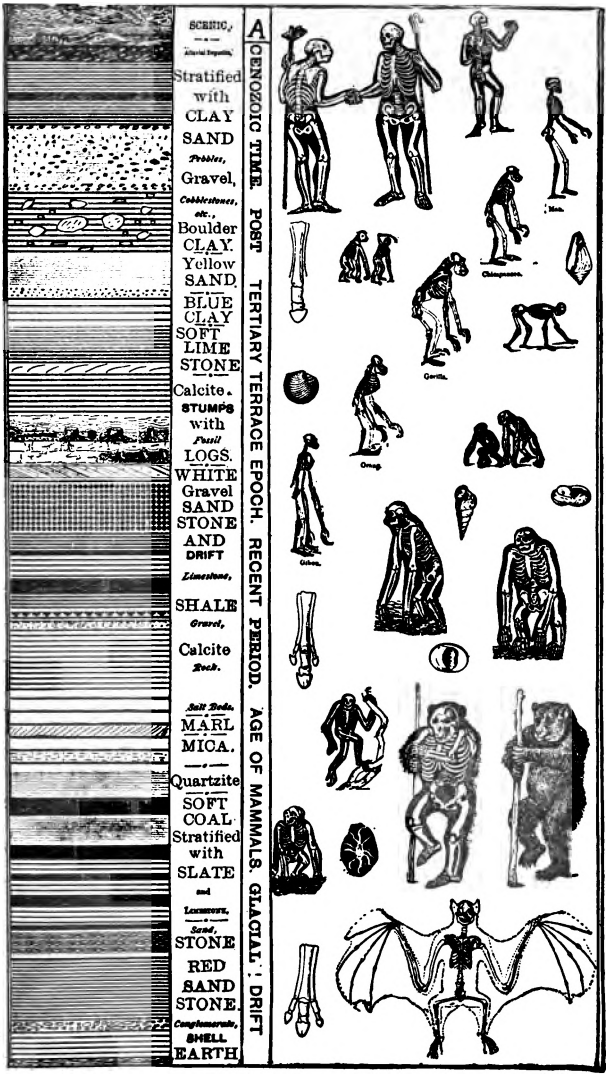
THE AGE OF MAN.—DEVELOPMENT AND COMPARATIVE ANATOMY FROM THE BAT TO MAN.—THE AGE OF GREAT BEASTS AND BIRDS.—CHARTS SHOWING THE FOSSILS CORRESPONDING TO STRATA.—WONDERS OF THE CHALK.—UNTOLD BILLIONS OF ANIMAL REMAINS TO EACH SQUARE FOOT.—EARLY FORMS OF ANIMALS NOW ON EARTH.—TWENTY-SEVEN HUNDRED FEET DOWNWARD.—A GENTLEMAN OF THE TERRACE EPOCH.—ANECDOTE OF A MONKEY.

E have traced the formation of our globe from a formless void of gas to an inhabited world. We have watched her career, by a series of gigantic strides, as she passed through the vicissitudes attending her birth and growth.

Now, dear friends, I propose to take you upon a shorter journey, but a strange one—down into the crust of this old earth of ours, where we can examine more minutely the structural formation and the corresponding fossiliferous deposits which make up her history on pages of rock.

Now, do not be scared, thinking that I am going to talk to you of animals, in names eight syllables long, and in small italic at that, for I know better than to do so. I know very well that such a name as "*Ramphorhyncus*" conveys no specific meaning to the average mind, and does more to confuse and cause a dislike for science than anything else. We shall view the fossilized remains of these animals as we find them, but their Greek names will be left severely alone. I hope to make geology, which so many consider a "dry" study, an interesting and juicy one.

I will call your attention first to Chart A, where man, the "crowning glory of creation," stands at the top. The representative


SCENIC,
Stratified with CLAY
SAND
Pebbles,
Gravel,
Cobblestones, etc.,
Boulder CLAY.
Yellow SAND.
BLUE CLAY
SOFT LIME STONE
Calcite.
STUMPS with Fossil LOGS.
WHITE Gravel SAND STONE AND DRIFT
Limestone,
SHALE
Gravel,
Calcite
Rock.
Salt Beds.
MARL
MICA.
Quartzite
SOFT COAL
Stratified with SLATE
and
Limestone,
Sand,
STONE
RED SAND STONE.
Conglomerate,
SHELL.
EARTH
A
CENOZOIC TIME. POST TERTIARY TERRACE EPOCH. RECENT PERIOD. AGE OF MAMMALS. GLACIAL DRIFT

of the Caucasian race is shaking hands with the representative of a lower race, who is much nearer, physically and mentally, to the gentlemen who are seen below, "climbing upward." All the figures upon this chart are given with the anatomical structure showing, in order that you may compare the anatomy.

The giant bat of the drift, whose "fingers" were wing-frames, is an intermediate form, yet his skeleton is not so very different from man's, aside from the fingers. You will note the gradual change in length of arm, which took place, under the law of development, as the quadrumana evoluted. As they raised their bodies more and more to an upright position, the arms, which at first were simply fore legs, became longer and longer, until the time came, as we see in the gorilla, when the arms were dispensed with, as supporters, and used for other purposes.

They then shortened rapidly, up to man, where the hands come only to the leg. On the left you will notice the leg and foot of

the horse. Further down, in the early part of the Terrace epoch, the horse had three hoofs. In the drift he had two long toes and a hoof.

The rocky strata, on this chart, speaks for itself. You will see logs and stumps under many feet of rock. This is very common, and we shall, doubtless, find more of them as we dig deeper.

We do not see the lower order of monkeys in Chart A; they extend far down into the Tertiary period, and the upward evolution was a much longer process than would be supposed, from the examination of this chart.

STUDY OF CHART B.

The lower part of the Post-Tertiary Period was characterized by the development of some most extraordinary animals. Size seems to have been the great feature of the period. Gigantic birds, enormous quadrupeds, some of them weighing, when alive, more than fifty tons each. That turtle-like animal, standing up high, with a thick, protecting shell, must have weighed over a


BLUE CLAY
SOFT LIME STONE
Yellow CLAY
Gravel
WHITE Quartzite
GNEISS
SHALE
SAND STONE
HARD LIME ROCK
SHALE
HARD LIME STONE
Marble
BLACK Stratified Marble
Boulder RED ROCK
SLATE
SLATE
Yellow CLAY AND SHALE
Stratified with LIME STONE AND
B
CENOZOIC TIME. POST TERTIARY PERIOD. AGE OF MAMMALS.
A

thousand pounds. Such was the abundance of animal life at this epoch that the tusks of certain animals are an article of commerce in immense quantities now. Single tusks have been found, weighing two hundred pounds. This trade has been going on for more than five hundred years, yet the supply seems undiminished.

At figure A we see an earlier form of the foot of a horse, having four toes.

EXAMINATION OF CHART C.

Passing downward a few hundred feet from the surface, we now arrive at the strata of the great Tertiary period and come to the Pleocene epoch. We have passed the interesting period of the Glacial drift, as it offers but little in the way of fossils. There was too much ice grinding its way over our continent to allow much life to exist.

We still find the remains of animals resembling existing species. Many enormous quadrupeds roamed over the clayey soil. Wonderful shell fish abounded. In some parts of the world, such as the "Bad Lands"

C
CENOZOIC TIME.
TERTIARY
PERIOD.
AGE OF MAMMALS
TERTIARY
PERIOD.
PLEIOCENE
EPOCH.
BLACK EARTH
GNEISS
Quartz
SHALE
MARL
SLATE
Gravel
HARD SAND STONE
SLATE AND SHALE
Stratified with LIME STONE.
Yellow Boulder CLAY
WHITE CHALK
SOFT SAND STONE
Marble.
DIAGONAL UPTURNED STRATA OF MANY KINDS OF ROCK.
HARD BLUE CLAY.
GREEN STONE

of Dakota, and the soil below Paris, France, the clay is actually built up with skeletons. Below the great clay beds are found chalk deposits, hundreds of feet in thickness, which are entirely made up of microscopic shells. A piece of this chalk the size of a pin head is shown, greatly magnified. This piece is from the Cretaceous stratum, lower down, but it possesses the same characteristics as the chalk of the Pleocene.

CHART D CONSIDERED.

Another drop of many hundreds of feet takes us through the wonderful Miocene Epoch, where we find but very few fossils of species allied to existing forms. Abundance of vegetable remains, as well as animal, attest to the exuberance of those two forms of life. It is claimed that more than 3,000 species of Tertiary shells have been discovered, together with numerous vegetable species. In Virginia, near Richmond, extensive deposits of earth are found, made up of fossil diatoms, so small that a single cubic inch contains forty-one million perfect

D
CENOZOIC TIME. UPPER MIOCENE
AGE OF MAMMALS.
TERTIARY PERIOD. LOWER MIOCENE
UPPER EOCENE
SLATE
SHALE
CLAY
MARL
SHELL
LIME
STONE
AND
MICA,
with
FOSSIL
STUMPS.
LIME
STONE
GREEN
SAND
CORAL,
BLUE
CLAY
Gravel
AND
STRATA
OF MANY
KINDS
OF ROCK.
SAND
STONE
Boulder
CLAY
MARL
WHITE
CHALK
BLACK
Stratified
Marble
BLUE
STONE
Gravel
AND
CLAY.

fossil organisms. This is more than seventy thousand millions to the cubic foot. One thousand feet perpendicularly, one foot square, would contain a thousand times as many. This means that, as a man stands over a square foot of ground, in some parts of the earth, he is standing over the remains of more than seventy millions of organisms entomed in chalk, to say nothing of other millions encased in the other numerous formations.

Oh! the wonders on wonders of life and of death which have "made our planet a cemetery of buried and forgotten forms!"

But we must leave this stratum just as we reach a few feet of the Eocene, and pass downward to the

CONSIDERATION OF CHART E.

The Eocene Epoch is the lowest of the great Cenozoic Age and the Age of Mammals. Fossils of gigantic quadrupeds and fishes are found here in abundance. Enormous teeth are found, so large that a man can scarcely lift one. Lime-stone strata are


SOFT COAL.
CLAY.
CORAL.
Marble.
LIME STONE.
SHELL AND CORAL LIME STONE.
Calcite.
MARL.
Syenite
HARD LIME STONE.
CHALK.
SHALE
SAND.
COAL, with STRATA OF MANY KINDS OF ROCK.
Calcite with Marble.
SLATE.
E
CENOZOIC TIME. TERTIARY PERIOD. MIDDLE EOCENE EPOCH. AGE OF MAMMALS. LOWER EOCENE EPOCH.

found here, hundreds of feet in thickness and covering many thousands of square miles of territory, which is largely composed of small coin-shaped shells called Rhizopods. These are scattered all through the Eocene strata all over the world. The great Pyramids of Egypt are built largely of this stone.

This stratum is rich in fossils wherever it is found, and, being of an average thickness of a thousand feet, we can form but a small conception of the tremendous number of animal and vegetable forms which lived and had their being and left their records on the rocky leaves. Early forms of some of our most common animals of to-day are found in the Eocene. Among these are the tapir, camel, mouse, bat, squirrel, rhinosceros, possum, mole, hedgehog, and a numerous collection of fishes. But it is a notable fact that among all the fossils found, not a single species resembling the monkey of to-day or of the Pleocene has been found. Insects abound in great multitude, shell fish swarmed in the great Eocene seas and lakes;

but among all the vast and teeming throng not one species had developed to the dignity of our humble and despised little progenitor, the monkey. While we rest here, "down in the depths," about *twenty-seven hundred feet*, let us reflect upon the lessons taught by the strata we have passed through. We have only, as it were, "scratched the surface" of our Earth, yet we have arrived at a point where we find only early forms of any existing species.

We have watched the development, step by step, and we can see so plainly the gradual work of Evolution, as life slowly changed under environment.

In the Miocene, deer first became deer, and at the same epoch a small animal, which had inhabited the forests of the Eocene epoch, became so expert at climbing trees and taking hold of limbs with his "fore feet," and with all so cunning in escaping from the ravenous wild beasts who threatened his existence, that he "resembled" the monkey of our present tropical forests.

Not a monkey of all the tribes living now is exactly like that far-back forefather, who first lifted himself up a peg above the brutes about him by using his reasoning powers to save his life. The great orang, who developed in the Terrace epoch, was a highly intelligent and learned gentleman, compared to his humble Miocene prototype.

A few years ago I stopped in front of a store to watch the antics of a beautiful ring-tailed monkey which the owner of the store had just procured from abroad. While I was watching the little fellow the proprietor came out, and I asked him if he would hang a small mirror up in the cage. He consented, and we soon had the monkey puzzling over that wonder. He sided up to it and primped himself before it for a few minutes; then he seemed to reflect, and he made up his mind that the other monkey, which he could plainly see, was, in some mysterious way, out of the common. He was a Mystic, of low development, that monkey was, for he was not contented with mere appearances.

They might do for a dog or cat or a bird or some such low order, but not for our scientific friend in the cage.

"I must understand this thing if it takes all summer," he seemed to say, as he carefully sided up and suddenly reached around behind the mirror, in the hope of catching the ghost which he saw. Then he climbed all about it, and closely examined the glass, and came to the conclusion that it was a fraud, on the face of it. Then he swung himself off to the other side of the cage, and got another good look at his reflection, and, shaking his head, seemed to say: "There it is again; there is no use of talking, here is a wonderful phenomenon, which I have got to investigate. I never saw such a wonder as that before." Then he would start for the mirror again, with the most puzzled look on his quaint little face, which told plainly that he had lost all interest in the common affairs of life in the presence of this new problem.

By this time the crowd had become so

large that I had to back out of it; but I have many times thought of that little fellow, and I have reflected that the men who burned heretics at the stake a few hundred years ago and those who burned witches in Salem, need not blush when they look back to their progenitors of a former epoch.

The monkey of Africa, who climbs upon a limb and chatters at his tribe seated on the ground beneath, is an orator, in his way, talking upon affairs of interest to them, no doubt; and, although he never gave his vote and "influence" for a block of gas stock, or helped to rush a street car franchise, he is none the less entitled to our consideration and respect.

We will now ascend to the surface, and at our next meeting start here and dig downward into the Great Mesozoic Stratum, to see what secrets of life we can read there.

LECTURE V.

The Age of Reptiles.

TWENTY-FIVE HUNDRED FEET DEEPER INTO THE BOSOM OF MOTHER EARTH.

GRAND MARCH OF PROGRESS.—TERRIBLE MONSTERS INHABIT THE EARTH.—GREAT WINGED DRAGONS FLY THROUGH THE AIR.—WE FIND THE REMAINS OF SWARMS OF MONSTROUS REPTILES.—A FROG AS LARGE AS AN OX.—A LIZARD WITH EYES THE SIZE OF A WASHTUB.—A NEW CYCLE OF LIFE.

OUR journey this evening has its point of departure about half a mile below the surface, and the strata already passed in our descent represents millions of years of the wear and tear of the elements, and ages of uplifting and degrading of the land surfaces of the globe, while life went forward in its grand march of progress.

THE GREAT MESOZOIC TIME—CHART F.

We now delve into the rock of the "Age of Reptiles." This age ended with such terrific convulsions and disturbances that but a few types remained of all the vast number of beings who inhabited our planet.

The Mesozoic time, like the Paleozoic, was closed by mighty upheavals. As Winchell beautifully says: "The ever-shrinking earth-nucleus necessitated the ever-enlarging wrinkles of the enveloping crust; the furrows must deepen and the folds must rise."

Steel says of this period: "Another cycle of geologic history is finished, another phase of life has swept across the slowly-forming world, culminated and broken on the shore of the past. The reign of reptiles is closed." "The increasing pressure of the Atlantic and Pacific oceans produced another upheaval of the land, and another addition to the growing continent. This was probably not a sudden convulsion, but a long-continued upward movement. By it, however, the conditions of life were changed."

F
MESOZOIC TIME. AGE OF REPTILES. CRETACEOUS PERIOD. WHITE CHALK EPOCH. LOWER CRETACEOUS.
MARL.
GREEN SAND.
LIME VEINS.
WHITE CHALK
GREEN STONE
SOFT WHITE CHALK
RED SAND STONE
WHITE SAND STONE
MARL.
CHALK
Calcite.
CHALK
MARL.
HARD WHITE CHALK
GREEN SAND STONE
Stratified with MARL.

Nature had ended a long series of developing efforts, during which she had produced some of the most remarkable monsters possible to conceive under natural law. Yet, upon the other hand, we shall find that all the monsters conform to general principles of structural devlopment, forming a connecting link in the chain of evolution.

Gigantic animals, capable of crashing their way through the rank forests of the period, existed, as types of those later animals which we find in the Tertiary epoch. Other terrible monsters were able to fly through the air and to dart upon their prey from thecarbon-ladened atmosphere.

But these animals were cold, slimy reptiles. We find, however, a very few fossils, indicating that here and there a small mammal, or a bird, or a flowering shrub had made its appearance in some extra-favorable spot upon the globe.

But reptiles were the rulers of the earth. The water is alive with them; the land is black with them; they swarm upon every

hand. Great lizards, seventy feet long and many feet in height, crash their way through the tangled forests. Awful winged dragons, with great mouths like crocodiles, armed with a formidable array of teeth, sail slowly along on broad, leather-like wings.

But a great part of the present land surfaces were under water then, so the stratum we are now in is called the Cretaceous, from "*Creta*"—chalk.

As the large animals were all protected by coats of mail, the smaller ones, on both land and in the sea, seem to have been provided by kind Nature with houses of their own to live in. On the land, snails and worms swarmed; in the sea and in the great lakes, innumerable shell fish lived. We have already found some of these in the chalk of the Tertiary. Here we find hundreds of feet, like the other, made up of the remains of animals. The green sands and marl of this period are rich with fossils.

Passing downward about one thousand feet through this stratum, we come to the

stratified rocks of the Jurassic period and the epoch of the lower chalk,

ILLUSTRATED IN CHART G.

Lizards and other enormous reptiles, with teeth like great stumps, and, in some cases, like pruning knives, were as plenty as swallows are now. We find in the strata of the Jurassic more than twenty species of flying dragons. Our modern friend, the frog, who has a form somewhat allied to man's, had his prototype in this age in an animal as large as an ox. Think of such an animal, hopping forty feet at a jump, coming after you to snap you up, as a frog or toad snaps up a fly!

The illustrations on chart G will show you the remarkable forms of shells, which were inhabited at that period, better than I can describe them to you.

Great upheavals of strata took place, when entire States would be turned up on edge, so that our reptilian progenitors had a pretty hard life of it in some parts of the earth.

Prof. Nicholson says: "The total thick-

SAND
STONE.
MARL.
STRATA OF MANY KINDS OF ROCK.
GREEN
SAND.
Quartzite
VEINS.
WHITE
CHALK
Yellow
SAND
STONE
STRATA OF MANY KINDS OF ROCK.
BLUE
MARL.
BLACK
TRAP
ROCK.
Boulder
BLUE
CLAY.
DIAGONAL UPTURED STRATA OF MANY KINDS OF ROCK.
FAULTS.
DIAGONAL UPTURED STRATA OF MANY KINDS OF ROCK.
ROCK
salt.
G
MESOZOIC TIME. UPPER JURASSIC PERIOD. LOWER CHALK EPOCH. AGE OF REPTILES. LOWER JURASSIC

ness of this stratum may be over 1,000 feet, and it teems with fossils."

CONSIDERATION OF CHART H.

Here we find still earlier forms of the monsters described above. One lizard had eyes *two feet in diameter, or about the size of a washtub.* One great animal had a head like a lizard, teeth like a crocodile, neck like a snake, and paddles like a whale. He seemed designed as a sort of experiment of what was to be tried later in various animals.

The great eight-armed cuttle-fish first makes his appearance here, in a form quite different, however, from the modern octopus. The bellemnite, or "dart-fish" of the Triassic period, was a progenitor of our cuttle-fish, even possessing the "ink bag," as it is called.

Prof. Nicholson gives the Triassic as averaging fifteen hundred feet in thickness. In the United States the Triassic and Jurassic strata are, in many places, six thousand feet thick; but this is in great valleys, which were filled from the washings of adjacent hills. Where we are now—about six thou-

COAL.
SLATE.
COAL.
LIME
STONE
COAL.
LIME
ROCK.
RED
MARL.
Marble
RED
SAND
STONE
Stratified
with
RED
MARL
LIME
STONE
AND
DIAGONAL UPTURED STRATA OF MANY KINDS OF ROCK
with
FAULTS
MARL.
LIME
STONE.
COAL
with
SLATE.
H
MESOZOIC TIME.
UPPER TRIASSIC PERIOD.
AGE OF REPTILES
LOWER TRIASSIC PERIOD.

sand feet beneath the surface—the very first representatives of anything approaching birds or mammals in structure or habits have been found.

In all the tremendous eons of the past, Nature had only been making ready to develop these higher forms.

A new cycle of life seems to begin with the Mesozoic. Five grand old types of life remain, but they are changed to meet the newer and better conditions. The Permian period had greatly purified the air, so that animals could live on land, and the vegetable world had developed to a point where birds and mammals could feed thereon, and multiply their numbers. But there were no such animals at first; they all must be evoluted, and they were. Lizards came forth upon the land and multiplied for ages upon ages, until the legs grew longer, the heads and tails shorter, until the structure, in time, came to resemble somewhat that of the early beasts of the Paleozoic.

It is strange that certain parts seem to de-

velop in pairs. Thus we notice that the corals of this age have six arms; that is, they are arranged in sixes; while in the next we are to enter they have but four.

The fishes, too, have changed materially in structure.

Here, at the depth of about a mile, we will call a halt, while we rest a bit and contemplate the wonders of Evolution. How plainly we can see that instead of the earth being "created" to fit the animals, the animals are evoluted to fit the earth's conditions.

The surface was just fitted for the occupancy of the gigantic reptiles we have seen, and they were there to live and enjoy it. A man would have been as much out of place on the earth, in the Triassic period, as a "giant lizard" would be in a modern drawing-room. The earth was not ready for the higher life. In the same manner, we know that man, only a hundred years ago, was not ready for the light. He could not comprehend it and he could not receive it. When evolution had advanced him to where he

was ready for it, then science and the light of truth could come. Everything comes when the time is ripe for it.

All our experience and all our history shows that Truth cannot be comprehended by human beings until they have developed up to it. We are making the most terrible mistakes now, in government, in finances, and in our laws. Most awful injustice is being done now, and has been done in the past, and all because we are not progressed to the understanding of Truth.

When we are all fit to enjoy a heaven of bliss and happiness, we will have such a heaven, and not before.

LECTURE VI.

Through Coal and Fish.

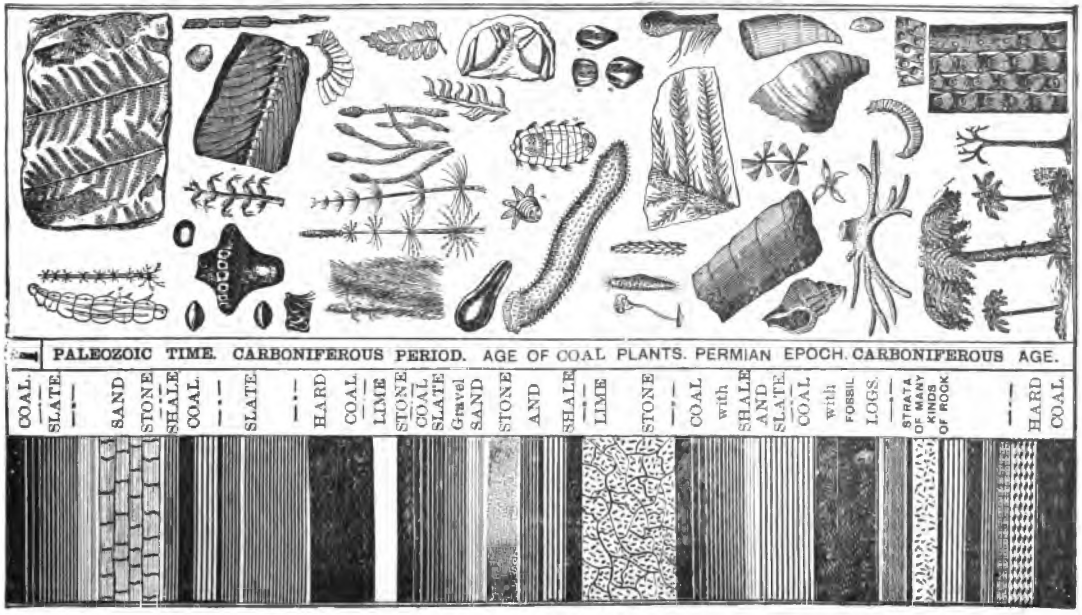
A JOURNEY TO THE BOTTOM OF THE OLD RED SAND STONE.

THE HIGH WATER MARK OF ANCIENT EVOLUTION.—THE EARTH A REEKING SWAMP.—BEAUTIFUL FESTOONS OF FOSSIL FOLIAGE.—WONDERS OF THE COAL LEVELS.—A PLUNGE INTO THE DEVONIAN.—A WORLD OF FISHES.—FOUR SOLID MILES OF ROCK ABOVE US.

WE are now about to penetrate into a new field, for we must start our next descent into the strata of the great Paleozoic time, starting in with the Permian Epoch of the Carboniferous Age.

CONSIDERATION OF CHART I.

We are now in a stratum which was the high water mark of evolution for a long series of transformations. Prof. Denton beautifully says of this period:

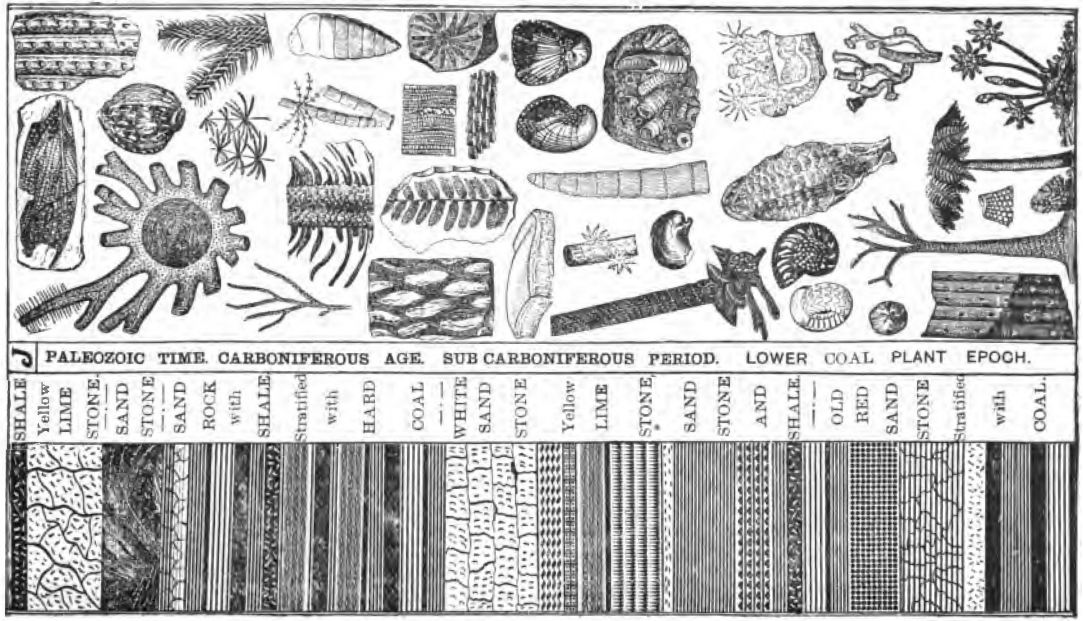

PALEOZOIC TIME. CARBONIFEROUS PERIOD. AGE OF COAL PLANTS. PERMIAN EPOCH. CARBONIFEROUS AGE.
COAL.
SLATE.
SAND
STONE
SHALE
COAL.
SLATE
HARD
COAL.
LIME
STONE
COAL.
SLATE
Gravel
SAND
STONE
AND
SHALE
LIME
STONE
COAL
with
SHALE
AND
SLATE.
COAL
with
FOSSIL
LOGS.
STRATA
OF MANY
KINDS
OF ROCK
HARD
COAL.

"As the stars sink, one by one, in the west, and new stars rise in the east, to be succeeded by the dawn and then the day, so through the night of the past sank the old life-forms, to be succeeded by the new, approaching nearer to the dawn of the day in whose morning we live."

The close of the Carboniferous period finds the surface of the earth a vast greenhouse. Rank vegetation is everywhere. No songs of birds are heard above the reeking morass of ferns and giant mosses. The fossils in this stratum are, therefore, nearly all of vegetable origin. Seams of coal, many feet in thickness, are made up from trunks of trees and masses of ferns piled in together "pell-mell." The warm, carbonatious soil of that age caused plants to grow to trees, which now attain a height of only a few inches. The sub-Carboniferous period is

ILLUSTATED IN CHART J,

where other vegetable forms are seen. So plentiful are the fossils in this stratum that we might almost say, "it is all fossils."


J
PALEOZOIC TIME. CARBONIFEROUS AGE. SUB CARBONIFEROUS PERIOD. LOWER COAL PLANT EPOCH.
SHALE
Yellow LIME
STONE
SAND
STONE
SAND
ROCK with
SHALE
Stratified with HARD
COAL
WHITE SAND
STONE
Yellow LIME
STONE
SAND
STONE
AND
SHALE
OLD RED SAND
STONE
Stratified with COAL.

Dr. Buckland says: "The most elaborate imitations of living foliage upon the painted ceilings of Italian palaces bear no comparison with the beauteous profusion with which the galleries of these instructive coal mines are overhung. The roof is covered with a canopy of gorgeous tapestry, enriched with festoons of graceful foliage."

Speaking of the rising and sinking of the land during this period, Prof. Steel says: "At one time it was lifted up to be covered with vegetation, and at another sunk with the ruins of the forests below the incoming ocean to receive a deposit of sedimentary rocks. The theater of these repeated changes was the whole of the present coal area, and much besides from which the coal has been swept by subsequent denudation. During a season of verdure a vast amount of vegetable debris, such as leaves, limbs, fallen trunks, etc., accumulated, only to be overwhelmed by the flood of sand, pebbles and mud, washed in by the rushing waters. The peat deposit gradually changed to coal, and the sediment

hardened to shales, sandstone or clay. Sometimes the water became deep and clear enough for coral or mollusks to exist, and Nature, suiting the life to the new condition, populated the shallow sea with swarming millions, and there a limestone was interpolated. Perhaps a hundred times in the course of the age this process was repeated, and as many alternate layers chronicled the changes in regular succession. In a Nova Scotia coal bed, Lyell found, in a portion 1,400 feet thick, no less than sixty-eight levels, showing as many different old soils of forests, one above the other, where the trunks of trees were still furnished with roots.

These characteristics culminated in the Carboniferous Period of the age, being preceded by the sub-Carboniferous and followed by the Permian, in both of which the land of these formations was submerged by the sea, receiving mainly rock deposits."

While we pause here, at a depth of two miles, after having passed through some

five thousand feet of coal beds, lime-stones and other rocks of the Carboniferous Period, let us endeavor to comprehend the wonder of it all. We stand fairly dazed as we contemplate the magnitude of all this, and realize that to-day we are warming our homes, running our locomotives and factories, and, in fact, doing almost everything, with the "black diamonds" which were formed from vegetation many millions of years ago.

To think, that to-day the vibrations which are being made visible to us in the form of heat in yonder stove, were locked up and imprisoned in coal ages upon ages gone by. Coming from the sun, those vibrations were consumed, as energy, by the rank vegetation of the Carboniferous period, and then dragged downward to the tomb to sleep until the "day of resurrection" should come, and our dark friend, Carbon, could again come forth and restore to the atmosphere the same energy, as he glows with joy, at his union once more with his beloved and long-lost bride, Oxygen.

By calculations made by Brongniart, the atmosphere contained from 7 to 8 per cent of carbonic acid during the sub-Carboniferous Period. At present it contains only one part of acid to 2,500. This shows us what an important work, in the scheme of evolution, was performed by the vegetation of that period.

CHART K OF THE GREAT DEVONIAN AGE.

We now plunge into the remarkable strata of the "Age of Fishes," as it is called. The "Old Red Sandstone" system is something like ten thousand feet in thickness, and the entire formation is made up of the remains of those animals, together with crustacea, marine plants and corals. The plants are all of low type, the animals are all water-breathers. But the marked feature of the period was fish. Fish in shoals, fish in schools, fish everywhere, swarms upon swarms. Prof. Anderson says: "The remains of Ganoid fishes are so abundant in the yellow sandstone deposit of Dura Den, Scotland, that a space of little more than

K
PALEOZOIC TIME. UPPER DEVONIAN PERIOD. AGE OF FISHES. MIDDLE DEVONIAN EPOCH. FISH AGE.
CORAL
ROCK
CORAL
LIME
STONE
GREEN
SAND
STONE
OLD
RED
SAND
STONE
GREEN
SHALE
AND
SLATE
Stratified
with
Yellow
SAND
STONE
GREEN
STONE
RED
SAND
STONE
AND
SHALE

three square yards yielded above one thousand fishes, most of them quite perfect, with scales and fins entire."

Chart K exhibits several types of the fossils of the period.

A CONSIDERATION OF CHART L

leads us down through nearly a mile of Devonian strata, where we find large numbers of queer shells and a very few survivors, in a modified form, of the wonderful and numerous inhabitants of the preceding age. The Devonian is worthy of weeks or months of study. Entire books have been written upon it; but we must not spend too much time here, as we have still greater depths to visit. But what a weight of rock piles above our heads—*more than twenty-one thousand feet*, or about four miles of formation.

We may stop here and contemplate it as a vast book of history—the history of life upon a planet. Each rocky stratum is a leaf, and on the page is illustrated the life of the period, with the very bodies of the animals

L
PALEOZOIC TIME. DEVONIAN AGE. LOWER DEVONIAN PERIOD. OLD RED SANDSTONE EPOCH AGE OF FISHES.
SHALE
OLD RED SAND STONE
BLACK SHALE
WHITE LIME STONE
Yellow SAND STONE.
Quartzite LIME STONE.
OLD RED SAND STONE,
Stratified with LIME STONE AND BLACK SHALE.

who lived when that leaf was made. Again we wonder and stand in awe of Nature's works.

How little did the writers of the so-called "Holy and Inspired" books of other days imagine that beneath their feet rested a grander book, whose rocky leaves would refute their vain imaginings; that the Truth read therein would far transcend in wonder all the fables of men and the marvelous inventions of an ignorant age.

How can we poor mortals comprehend "our place among Infinities?" How can we expand our souls to the realization of the marvelous grandeur of even this small portion of the Majestic Universe?

LECTURE VII.

The Age of Molluscs.

DOWN THROUGH THE GREAT SILURIAN FORMATION.

A GREAT CHANGE IN LIFE FORMS.—THE TRILOBITE AS A KING OF EARTH—"ALL THIS WAS MADE FOR ME."—SWARMS OF LIFE IN SILURIAN SEAS.—EARLY LIFE FORMS.—GREAT CHANGES OF SURFACE.—FIRST THE SEA, THEN THE LAND.—THE NIAGARA GORGE ONLY AN INCIDENT OF GEOLOGICAL TIME.

ITH what feelings of emotion do we prepare to invade the ten thousand feet of ancient rock which was the home of the Trilobite and his contemporaries.

How well I remember the time, years ago, when a geological friend of mine showed me a petrified Trilobite, and, with awe-struck air, said: "Just think of it! that fellow lived away back, down in the

Silurian!" I had a vague idea, at the time, that his "away back down" meant one or two thousand feet downward, and perhaps a million years back in time.

Now, I know why he spoke as he did, for there is nothing like digging down, foot by foot, examining the fossiliferous deposits of the ages as we go, to realize the tremendous facts of geological science.

CONSIDERATION OF CHART M.

The class will notice at once that a marked change appears here in the character of the fossils. We are in the world of Trilobites; those odd-shaped animals which seem to have contained the forms, so to speak, of all the later developments which were to follow. The "Trinity" appears for the first time in this animal, as he was divided into three lobes. He foreshadowed the coats of mail of the Age of Reptiles, the fins of the Devonian Period, the claws of the crab family, the eyes of the beetle family, the rudiments of the vertebrates of the Cenozoic. Some of the four hundred varieties of the

M
CORAL
LIME
STONE.
Stratified
with
BLACK
Marble
HARD
RED
SAND
STONE.
SLATE.
Yellow
SAND
STONE.
CRYS
TAL
LIME
ROCK
BLACK
SHALE.
SOFT
LIME
STONE
AND
SHELL
ROCK.
PALEOZOIC TIME. SILURIAN AGE. SALINA PERIOD. NIAGARA EPOCH. AGE OF TRILOBITES. UPPER SILURIAN.

family could roll themselves up so as to present an armor on every side.

Although we find many varieties of life in the upper Silurian, and even a few stray fishes, the principal evolution was in the line of the Crustacea. Of these, the Trilobite was the king. He "owned the earth," and, could he have published books and lectured and reasoned, he would, without doubt, have proved, to his own satisfaction at least, that the entire object of creation was to furnish a large and beautiful world for the use of Trilobites. But, not being conceited, like the animals now standing at the head of the evolutionary series, our modest Silurian friend doubtless wasted but little time in vain speculations.

One branch of the Trilobite family developed into an immense animal during the Niagara and Salina Epochs. Each age seems to have produced some animal remarkable for size. The animal in this case was a tremendous Crustacean, with the body of a Trilobite, the tail of a reptile, and the

great claws and swimming limbs of a cross between a sea lobster and an octopus. He was only eight feet in length, but that is large for that period.

Many strange shell-fish also are found. One of them, not shown on the chart, was over thirty feet in length, but this was only his shell, as the animal only occupied a limited portion of his house at one time.

DOWN TO THE POTSDAM EPOCH—CHART N.

The lower part of the Silurian is simply a continuation of what we have already passed through.

The early part of the Silurian had developed, during four or five million years, a swarm of life. The land, where there was a little of it, was rocky and barren. The sun of that period, with its hot and scorching waves of light and heat, struggled in vain to penetrate the mists which hung over the heated waters. But life always appears as soon as conditions permit, so we see the evidence of this in the fossils of the period.

At first the life forms were very simple.

N
PALEOZOIC TIME. LOWER SILURIAN AGE OF MOLLUSKS. HUDSON PERIOD. TRENTON EPOCH. POTSDAM EPOCH.
CORAL
LIME
STONE.
SOFT
SHALE.
DIAGONAL
UPTURED
HARD
STRATA
OF MANY
KINDS
OF ROCK
with
FAULTS.
BLACK
SLATE.
BLUE
SHALE.
BLACK
Marble.
Quartz
ite
Stratified
with
OLD
RED
SAND
STONE

Some of the vegetable productions could scarcely be distinguished from the rocks upon one hand, or from animals on the other. Some of the early forms of animal life resembled crystals, while others looked like plants. The "Eozoon" of the Laurentian Period, or what is called the "dawn animal," had developed into higher forms, although they were still very elementary structures.

Of course, as hundreds of thousands of years grew into millions, there was abundant time for the slow work of evolution to bring about all the changes which we observe. The millions of years of the Silurian age would, indeed, have been time enough to bring about much greater changes of structure in animal and vegetable life, had it not have been that violent cataclysms occurring on the earth's surface, upset the work of ages, or greatly retarded it.

Here, at a depth of twenty-seven thousand feet, let us try to picture to ourselves the scenery of the Silurian age. The air is

damp with fogs, and thick, noxious gases hanging over land and sea. The continents are, as yet, new and unfinished; as we can dimly discern by the dim and lurid light of the faintly visible sun. We hear no song of bird, no hum of insect. Everywhere we see broad, low, barren plains, rocky deserts, with gulfs and ridges rent and upheaved with earthquake shocks and swept by floods of burning lava, which, from time to time, break through the thin crust of earth. The sea contains all there is of life. The low, rocky beach contains no grassy patches, no garment of verdure, being garnished only with gray and brown sea-weeds. Every wave strews the sand and low rocks with shells and broken Silurian corals. Here, where we behold this stratum of fossils, once existed a Silurian bay, where these lily-shaped crinoids, blossoming with life, covered the sea bottom with a foreshadowing of the flowers which should, in time, deck the earth.

Then the sea retired, and sand, inter-

spersed with numerous chambered shells, held sway for a thousand years. Again the land sank below the waters, and the sea contained whole shoals of Trilobites. Another thousand years, and their remains were buried beneath a mass of melted rock, overflowing from a volcanic vent. Other thousands of years went on, and gigantic upheavals lifted the entire country, round about, into an almost vertical inclination. The rock, raised above the surrounding surface, became a great ridge, which acted as a rock break-water for ten thousand years more, perhaps. But constant wearing and pounding of the violent waves wore it down, and we next see a coat of shale spread evenly over the upturned strata. Another sinking, and this becomes the bottom of a deep sea, where myriads of forms of life enjoy themselves, multiply, and, anon, leave their shells or bones to record their existence.

So the eternal fight of life and the war of the elements goes on; first the sea, then the earth, fire, water, earth and air; the great

drama of life and death, begun in the early Silurian Sea, is played on and on while Old Earth endures.

And we, dear friends, are playing the same old drama—the same fight for existence—the same style of evolution; only on a vastly higher plane.

We look upon our New England shore—the "rock-ribbed, iron-bound coast" of Maine—and to us it looks like a picture of the eternal ages; but that coast is just as surely sinking, year by year, as ever shore line did in any geological age of the past.

As we look upon Lake Michigan, it appears to us as if it rolled its waves eternally against the same sandy banks; but the visitor to Little Traverse Bay finds one beach behind another, step after step, extending into the woods back of Bay View and Petoskey, and he realizes that ten thousand years ago the waves were beating on a beach-line three hundred or more feet above the present level. But what is ten thousand years? A mere nothing! My friends, the carving

out of the Niagara gorge, which required about thirty thousand years, was only an "incident" of the Cenozoic Period—just a little side issue—a little "scratch upon the surface," as Prof. Agassiz remarked.

Speaking of the lower Silurian, Steel says: "The organic remains found in this period represent the Radiates, Mollusks and Articulates among animals, and the sea-weeds among plants. The Trilobite was the highest type. Three of the four general ideas of expressing animal life were thus simultaneously developed at the beginning; the fourth does not appear until long after. There is, says Dana, no proof that the dry, primordial hills bore a moss or lichen, or that the ocean contained a single fish. No sounds were heard in the air, save those of inanimate Nature—the moving waters, the tempest and the earthquake."

We are now at the bottom of the great Paleozoic Formation—about thirty-one thousand feet below the surface, or nearly six miles. Think of it! think of those miles

of strata! and we have not exaggerated them in the least; we have under-estimated them in our ideal journey, if anything. Dr. John Pye Smith gives the thickness of the Silurian *alone* at seventy thousand feet, in some places, or about thirteen miles. The same writer gives the entire fossiliferous strata at fifty miles; but, of course, not all in one place on the globe. He makes this astonishing total by taking the maximum of each stratum, as found in different localities, and adding them together.

Our next lecture will take us into the age of Protozoans, and down through the age of Crystals.

LECTURE VIII.

The Dawn of Life.

—o—

A JOURNEY THROUGH FIFTY THOUSAND FEET OF EOZOIC AND AZOIC ROCK.

—o—

THE AGE OF PROTOZOANS.—SIMPLE LIFE FORMS.—ORGANIZED BEINGS BUT LITTLE HIGHER THAN INORGANIC MATTER.—CHRYSTALS AND THE AGE OF CHRYSTALS.—THE LAW OF NATURE IS TO PRODUCE ORGANIC FORMS.—FINAL OBSERVATIONS ON THE END OF THE JOURNEY DOWNWARD.—EVOLUTION AND CONSTANT TRANSFORMATION IN LIEU OF "CREATION."

E now start our descent into the tremendous mass of rocky strata called the Eozoic and Azoic. The highest portion of the Eozoic formation is called the Huronian, but that name does not appear upon the chart we are now considering.

REFERRING TO CHART O.

The Eozoic strata contains some traces of animal life and many traces of vegetable productions; but the extreme age of the deposit is such, that the upheavals of later periods have destroyed and utterly obliterated nearly all traces of life of that age. Dr. Steel says:

"THE PROBABILITY OF LIFE.—The presence of limestone, graphite and anthacite coal would indicate the existence of life. It would seem reasonable to suppose that vegetable life had the precedence, since the animal kingdom is wholly dependent on the vegetable for its subsistence; and that the vegetation consisted of land plants, since the earth would be cooled sufficiently to admit of life sooner than the water. Geology is, however, as yet silent on this subject, and no plants of that period are known."

Speaking of the Azoic period, M. Esquiros says of it:

"In the Azoic rocks are conglomerates bearing no resemblance to the beds in which

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EOZOIC TIME. AGE OF PROTOZOANS. LORENTIAN PERIOD. AZOIC TIME. AGE OF CRYSTALS. UPPER AZOIC EPOCH.
GNEISS
Granite.
SLATE.
Porphyry.
Marble.
Quartzite.
SLATE.
Granite with
GNEISS
Quartz ROCK.
FLINT STONE
Syenite.
Quartz.
TRAP.
ROCK with LAVA VEINS.
Basalt.

they are found. They are fragments of other rocks, other continents, perhaps, broken up and destroyed. There is, then, little hope of our discovering the origin of life on the globe, since this page of the genesis of the facts has been torn. For some years geologists loved to rest their eyes in this long night of ages upon an ideal limit, beyond which plants and animals would cease to appear. Now, this line of demarkation between the rocks which are without vestiges of organized beings and those which contain fossils is nearly effaced among the surrounding ruins. On the horizon of the primitive world we see vaguely indicated a series of other worlds which have altogether disappeared. Perhaps it is necessary to resign ourselves to the fact that the dawn of life is lost in this silent epoch, where age succeeds age, till they are clothed in the garb of eternity."

About the middle of chart O you will see a stratum of the conglomerate mentioned in the above quotation. It represents the bro-

ken rocks from many different strata, which have been hurled from original locations, pell-mell together, to the depth of hundreds of feet, and then subjected to enormous pressures, which crowded and welded them again into solid rock.

Eozoic means "dawn of life," so that geologists have taken that name for the unknown thickness of rock which shows some vestiges of life, and the term "Azoic" for the "no-life" period below it.

Dr. Steel holds that the oldest rocks now known on the surface of the globe are Eozoic, as there is every probability that none of the original crust has survived the tremendous changes which have since occurred. At any rate, whatever life did exist, was so extremely near to "no life" that it is difficult to distinguish it from non-living forms.

Protozoa are called "systemless animals," which seem to be constructed upon no particular plan—one shape is as good as another, and many of them propagate by simple

division. If a Protozoan happens to think of two different engagements which should be filled at one time, he wastes no time in trying to decide which one to ignore. He simply pulls himself apart in the middle and serenely fills both engagements.

When some Protozoa want to eat, they just wave the edge of their bodies until they paddle up to some little morsel of nourishment, and then proceed to wrap themselves around it, to digest it with the outside of themselves. Such animals have but one organ, and that is stomach; no outside or inside, special, as either side can become inside at will. In fact, the infusoria, such as shown on the chart in a drop of water highly magnified, are so exceedingly simple in construction that we can regard them as being but a trifle higher in the scale of evolution than the chrystals which are shown farther down. Even the inanimate molecules of inoganic matter have their affinities, attractions and repulsions; and a *single atom of oxygen* knows enough to pick out what it

likes from a dozen other elements; so I fail to see any "missing link" between the protoplasmic Zoophite and the more inorganic protoplasm.

It seems to me that Nature sets to work the moment she has any chance whatever, and goes to constructing organized forms. If conditions are unfavorable for vegetable or animal life, she makes chrystals; so we see that the lowest regular forms are chrystals. When the melted interior of the earth is thrown out and confined in some suitable place, the melted rock will form into columns, with regular sides. In some parts of the earth there are immense quantities of these basaltic columns. Fingal's Cave is a noted example of this formation.

Here, where we are, in strata more than twenty million years of age, "ripple marks" have been found stereotyped on the rock, which prove that waves rolled upon the shore, under the action of the wind, the same as to-day.

Chart O covers fifty thousand feet of

strata, and you must take this into consideration in observing it; for some of these charts cover only a few hundred feet.

The bottom of the Laurentian takes us to where the rocks are quite hot. In fact, we could not go down into a hole, as far as this, without being burned to a crisp.

In this journey we have penetrated deeply into the bosom of Mother Earth, in an ideal way. In reality, the geologist makes his discoveries on the top of the ground, in most cases, or near the top, upon the upturned edges of the strata.

In some parts of the Alleghanies the upturned strata is exposed for twelve miles, so that we can trace formation after formation, as we have theoretically traced them in this course of lectures.

In some places the melted rock has welled up from some tremendous volcano or other vent, and has covered great regions all over to a depth of thousands of feet. Colorado and some parts of other States are covered, more or less, with such a deposit.

The Colorado River has cut its way, inch by inch, down through this deposit of hardened lava a mile deep. Yet all this erosion was but an "incident" in the historical geology of our continent.

But few persons, if any, are capable of forming any sort of a conception of the enormous work of the elements in this very erosion. Entire mountain chains have been worn down to a level, and horizontal strata deposited upon the upturned edges, thus left on the surface. In some places in Pennsylvania great sections of the country have been turned up, like a great fold, ten thousand feet in the air, to be afterwards slowly worn and ground down by the action of water and ice, until the whole was again reduced to a level.

Prof. Lesley says, in speaking of such wonderful works:

"Near Chambersburg, Pa., there is a fault twenty miles in length, and the depth of the dislocation is 20,000 feet; and yet a man can stand with one foot on one side of this

fracture and the other foot on the other side. What has become, then, of this immense mass of material 20,000 feet in height? It must have been swept into the Atlantic by the denuding flood. If this had not been done, a bold precipice would have stood there nearly four miles in height and twenty miles in length. Long ages must have been required for water to effect such a denudation."

Think of it! A fault, or dislocation of strata, *nearly four miles in vertical height!* Mount Washington seems like something of an elevation, as it towers far above the surrounding mountains; yet that is only about one mile in height above sea level.

Just imagine a convulsion of the earth capable of lifting a mass of rock, like a whole county or state, four miles upward! Beside this Mt. Washington is a mole hill.

We have now reached the unstratified rocks, which extend down to the melted interior of our globe, unless there is a space between the outer shell, and a white-hot ball

of melted matter revolving free in the center. There are many reasons for believing that such is the case, but we will not go into that discussion at present.

In this fascinating journey, we have seen the character of the denizens of the earth gradually changing from man, with his intelligence of a high order, down to the lowest conceivable forms. We have seen the highly complicated and grandly differentiated parts of physical structure, slowly changing, step by step, until we got to where but one organ constituted the whole animal—the single organ of assimilation and nutrition. What must we conclude? Simply that mind and body, soul and spirit, must have evoluted together, step by step, through all the ages. That, just as the humble Trilobite was the highest result of the tremendous duration of the Silurian age, so man is the highest result of all the ages of geological history.

It is idle, and worse than idle, to talk of "creations" in a world where everything shows transformations only.

Not one human being ever saw an organized form on this planet that had not developed exactly according to the laws of evolution from preceding forms. Not a place can be found where inorganic matter has been taken by any Supernatural Being, and fashioned into a thing of life.

Millions of lower forms of life lead up to each high organism found on our globe.

No place can be found where, in all the realms of Nature, a single act of "special creation" has been performed; yet we see everywhere the proof of evolution going on forever and forever.

LECTURE IX.

Evolution of Species.

EXAMINATION OF DIFFERENTIATION AND DEVELOPMENT FROM EXISTING SPECIES.

EVOLUTION ALL ALONG THE LINE.—LINKING OF SPECIES.—VEGETATION APPROACHES THE LOWER ANIMAL LIFE.—LIFE FORMS THAT ARE NEARLY INORGANIC.—CHART OF SPECIAL LINKS.—RELATIVES OF VARIOUS DOMESTIC ANIMALS.—THE QUADRUMANA AND THEIR APPROACH TO HUMANITY.

IN pursuit of the facts relating to Evolution, we are not obliged, by any means, to confine ourselves to the geological eras of the past. We have around us, to-day, thousands upon thousands of life forms which illustrate the wonderful law of evolutionary progress. This illustration not only extends throughout all the domain of animal

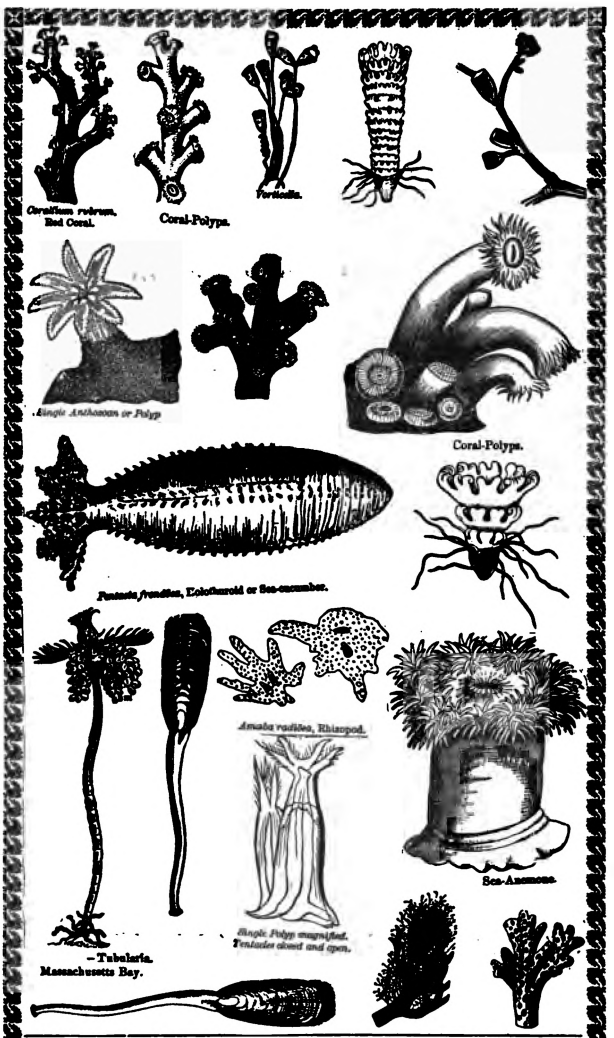
life, but we trace it downward through the myriad forms of vegetable existences.

Evolution is not only going on among the higher forms of life, but we have every reason to believe that steady progression is going on all along the line, from the atom upward. This means that, under proper conditions, protoplasmic life will develop from aggregated atomic and molecular combinations to-day, as well as in former eras. Not only this, but that they are doing so, all the time, and that they are advancing from protoplasmic to higher forms.

Mammals are differentiating gradually, and new varieties are coming into existence. In the vegetable kingdom the progression goes on in full as marked a manner. When we descend, even to the infinitesimal vegetable and animal life forms, only visible under the microscope, science has demonstrated that a change is going on. New bacteria, new infusoria and microbes are developing. That is why new diseases appear from age to age, and diseases of former

periods either disappear or change greatly in virulence and general character. Fruits, flowers, shrubs, trees, grains, bulbs, roots, seeds, nuts, and all forms of vegetable life, are undergoing differentiation and evolution. This being the case, we would naturally conclude that there should be a correspondence between the various branches of life representatives—that they would be united by a general tie, as we noticed that the planets of our solar system were. In other words, we might look for intermediate links between the various species, orders, classes and branches.

Zoology and Botany demonstrate that our expectations are abundantly realized; for we find, not only all species of animal life, grading to each other by easy stages; all species of vegetation approaching each other by means of intermediate forms; but even the two great divisions themselves approach each other in the Protozoa, and even in much higher life forms, so nearly as to almost, if not quite, defy separation.

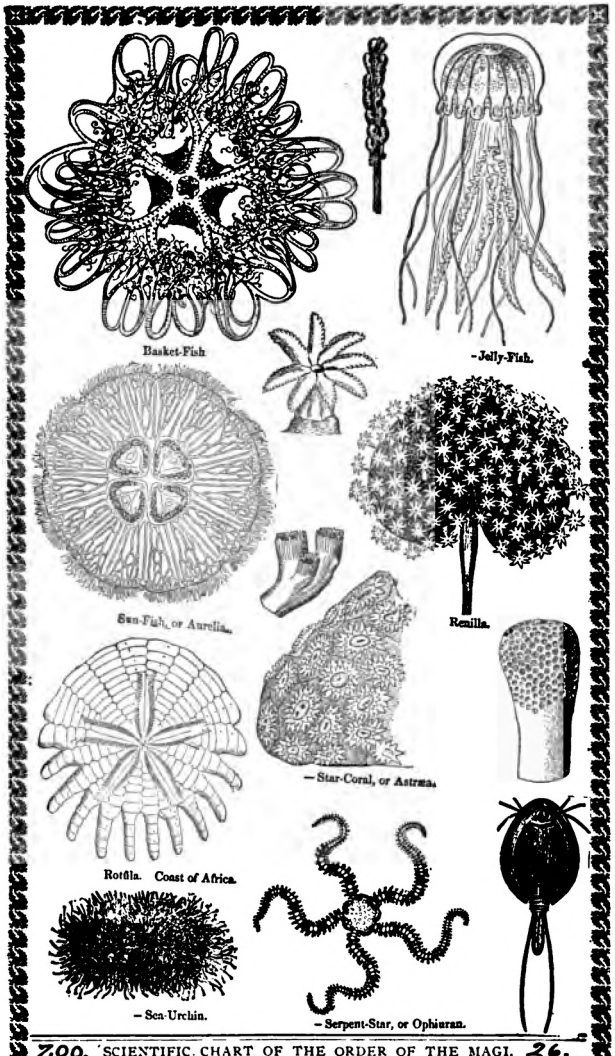

Coralium rubrum.
Red Coral.
Coral-Polyps.
Single Anthozoan or Polyp
Coral-Polyps.
Pentacta frondosa, Holothuroid or Sea-cucumber.
Amœba radiosa, Rhizopod.
Sea-Anemone.
Single Polyp magnified.
Tentacles closed and open.
Tubularia.
Massachusetts Bay.

We shall speak more particularly of some of these links farther along.

CHART 25 shows a number of forms, all of which belong to the Animal Kingdom; yet they nearly all resemble plants and flowers. Some of them, when alive, resemble plants, and when dead they look like stone. The Rhizopod, near the center of the chart, is the strange little "any-shaped" animal, which we have talked of many times. He is all stomach, outside and in. He is so nearly a simple lump of "inorganic protoplasm" that scientific men were obliged to examine him attentively, a long while, before discovering his true place in nature.

CHART 26 advances us another step, and introduces a few of the thousands of strange and remarkable forms nearly allied to those in the preceding chart. The Jelly-fish is a queer animal, which is so nearly composed of water that to dry him out leaves, practically, nothing. He is really a mass of jelly.

The Basket-fish is another strange animal, forming a link between Star-fish, Jelly-fish and Cuttle-fish.



ZOO. SCIENTIFIC CHART OF THE ORDER OF THE MAGI. 26.

Chart 26 contains many interesting life forms. To go on and give the hundreds of graduated links between classes of animals, would be too great a task, in this kind of a work, for they are linked together by thousands of almost insensible gradings, where only a slight differentiation exists.

CHART 27 illustrates a very few of the numerous links between branches of the "tree of life." The Pipe-fish is a snake, but, having the gills of a fish, becomes a fish. The Eel is nearly like a water-snake; then the Mud-eel, or Siren, has the body of a snake, the gills of a fish, and one pair of legs near the head, thus establishing an approach to the alligator tribe. One fish, the Barramunda, violates all rules of fishdom by habitually crawling out on the land to sun himself and procure a change of diet.

The horned toad has characteristics of several higher, as well as lower, animals than himself, so he links several classes.

The flying fish gives a hint of the birds, to come much higher in the scale, while the

Flying Fox, Java.

Orang-Outang.

Flying Squirrel.

Vampire.

Water Mole.

Spider Monkey.

Apteryx.

Flying-fish.

Pipe-fish.

Horned Toad.

Zoo. SCIENTIFIC CHART OF THE ORDER OF THE MAGI. 27

real bird, the Apteryx, stands upright, has absolutely no wings, and has a body covered with hair like the ordinary quadrupeds. On the other hand, one of the most unique links known is the Duckbill, or Water Mole. He is claimed to be a connecting link, without any dispute, between birds and mammals.

The bill of a duck is attached to the body of an otter, with the usual hairy covering of most mammals. He has spurs on the inside of his ankles, exactly like a male domestic fowl. He has an inner coating of fine, feathery hair, impervious to water. His fore feet are padded, and have a web-like attachment, which can be folded up at will. His hind feet are like the feet of a goose, except the nails are protruded beyond, like the foot of a quadruped, as he is. He dives for his food, in the same manner as a duck.

The head shown in the chart is that of a Lemur, an animal of Madagascar, which forms a sort of link between the lower quadrupeds and the Quadrumana.

The Spider Monkey forms another link

in the rising chain, with his graceful tail, partly smooth and partly bushy. He seems a cross between two or three orders of quadrupeds.

The great Vampire Bat, a swiftly flying animal, is neither a biped or a quadruped, bird, fish or fowl. His arms are wings, his feet are hands and wings; his body is covered with fur. He has a head like a mouse, or a fox. The big-eared Bat has tusks like a wild boar. All the bats of our time are pigmy descendants of our giant friend, the Pterodactyl, of geology, with a head like a crocodile. (See D, Chart 36.)

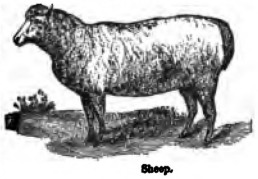
The Flying Squirrel and the Flying Fox are other types which exhibit the apparent evolution of certain extreme forms toward other classes.

The Orang Outang is another and higher step upward in the chain of evolution, and he leads us well up toward the lowest savages among men.

Among other remarkable mixings of characteristics, we might notice the Ceta-

cea. Whales *look* like fishes, *swim* like fishes; yet they are not fishes, but regular carnivorous Mammals. It is not generally known that a whale has shoulder-blades, humerus, radius, wrist-bones and five fingers. That it nurses its young, and is an air-breathing animal, is more generally known. The Manatee, or sea-cow, adds to the other peculiarities, that of having its body partially covered with hair.

If we could picture a continuous succession of plants from the lowest forms up, step by step, to the highest, and then branch off to the animal kingdom, and from the lowest in that, go on, step by step, in each case giving the next highest, or nearest; then going on up to the lowest undeveloped savage, and grading men, by easy differences, until we came to the highest and grandest Caucasian, you would be surprised to note the very small changes necessary in any portion of the chain. But such an exhibit is beyond our present powers, as there would need to be more than a thousand forms in



Sheep.

Goat.

Prong-horn.

Musk Deer.

Gemsbuk.

Common or Virginia Deer.

Mountain Sheep, or Big-Horn.

Reindeer

Moose.

the great chain. In lieu of such an illustration, we have arranged plates containing the relatives, near and distant, of various well known domestic animals.

CHART NO. 28 gives a few of the quite numerous relatives of the Sheep. It would take three such charts to show his wild relatives, and then we would not know where to draw the line. Besides this, we could give a chart exhibiting the changes, under domestic evolution, of the sheep himself, which would show wonderful differentiation.

CHART NO. 29 shows the domestic Cow and her relatives, leaving out many of them. The foot of the Llama is given to show how evolution produces a pad to protect the foot, and we see how that pad becomes larger and thicker under such conditions as the Camel is placed under, he being obliged to walk upon hot and burning desert sands.

CHART NO. 30 shows us the common, domestic Cat, and some of her numerous relatives. There is a very great difference discernable between a common Cat and the

Foot of a Camel.

Auchenia Lama, Llama.

Jersey.

Foot of Llama.

Bison, or American Buffalo.

Ayrshire.

Yak.

Gnu.

Musk Ox.

Lordly Lion; yet they are all of one family, with links between them, all through the chain. The adult beasts do not bear much resemblance to each other; but their young exhibit the family likeness remarkably. Young Wild-cats, Leopards, Panthers, Tigers, Pumas, Jaguars and Lions all resemble kittens, and, when a few days old, play about their mothers and act exactly like those beautiful household pets.

CHART NO. 31 is designed to show the domestic Dog and some of his relatives, near and more remote. The various species of wolves are nearest to the dog in relationship. Foxes, and a number of other animals, are omitted, in order to exhibit the co-ordinating species to a greater distance. Thus, the Prairie Dog is not a member of the same order, even; neither is the gopher, yet there are intermediate links all the way between the dog and them.

The Dog family seems capable of a large amount of differentiation under intelligent cultivation. If we should form a chart with

Zoo. SCIENTIFIC CHART OF THE ORDER OF THE MAGI. 30.

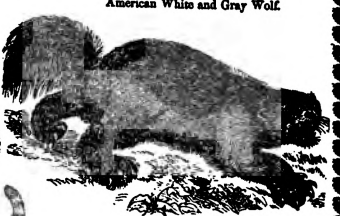
nothing but dogs exhibited, the wonderful differences between the various specimens would be almost as great as between animals of entirely different orders. Contrast an English Pug with a Greyhound; a Spitz with the noble Newfoundland; a Black and Tan with a St. Bernard; or contrast all of them, one with another, and the effect of breeding and evolution will be manifested. But the wonderful varieties found in dogs could be duplicated, probably, with any animal known to us, provided men found it worth their time and attention to breed them carefully.

Horses are so well known that the student will experience no difficulty in calling to mind the marvelous development made, even in our own short lives. Think of the evolution in trotting horses, where the 2:40 record of forty years ago has been gradually reduced to 2:07. Another century will see the record brought down to less than two minutes.

Mastiff.

American White and Gray Wolf.

Hyena.



Wolverine.

Common "Coon."

Raccoon.

American Badger.

Skunk.

Ichneumon.

American Sable.

Striped Gopher.

White Bear.

Prairie Dog.

The beautiful Zebra is a wild member of the horse family; so, also, is the wild Ass.

CHART NO. 32 exhibits a few of the many relatives of the Chimpanzee. There are a large number of them, ranging from animals having the general form of quadrupeds, with hands instead of feet, up to the higher branches of the quadrumanna, where the form and general carriage is a good imitation of man. There are seventeen species of the Quadrumana, forming a ladder of development clear from the order of Carnivora, which mostly consists of quadrupeds, up to the lowest varieties of men.

An examination of Chart 32 will give you an idea of the chain of species, although the following links are not in the illustration: Specter, Saki, Mandrill, Babboon, Rhesus Monkey, Barbary Ape, Proboscis Monkey and Sacred Monkey. All of the above named possess many human characteristics. The bodies of all the quadrumana are covered with hair, which serves as a natural protection, in lieu of clothing.

ZOO. SCIENTIFIC CHART OF THE ORDER OF THE MAGI. 32.

The law of development is such that coverings of hair, feathers, and everything which protects the body, change to suit environments. Take the dog as a sample: The great dogs of Greenland and Russia have heavy, shaggy coats, while the hot climate of Mexico and Central America has developed a hairless dog.

It is a well known fact that men who have been cast away on uninhabited islands, and have thus became "wild men," have become covered with a heavy coat of hair within a few years.

If such a change would come about in one generation, what might we not expect in a thousand years?

In the lower right-hand corner of the chart the face of a gorilla, of the wildest and most untamable type, is shown, together with an arm and hand of the same beast. One can see, at a glance, that this fellow would need a great many thousands of years' development to make a Mystic of him. His spiritual and intellectual faculties are very

low, indeed; but his self-esteem is higher, and his stubborn, war-like, destructive and animal propensities are highly developed in comparison.

Many of the species of Quadrumana possess long hair about the head, extending under the chin, in excellent imitation of the hair and beard of human males. Note the Bear Howler, Gibbon, Siamang, Black-faced Monkey and Guenon. The Marmoset shows an earlier and more exaggerated form of the same appendages.

Having conducted our inquiry, step by step, up to the borderland of humanity, we will stop here and rest until our next lesson, when we shall take up man, himself, and "weigh him in the balance" as one of the orders resulting from this wondrous chain of evolution.

LECTURE X.

The Ascent of Man.

THE DEVELOPMENT OF INTELLIGENCE UNDER THE GENERAL LAW OF EVOLUTION.

THE GREAT ERROR OF THEOLOGY.—MAN NOT IN A DEGENERATE STATE.—MORE ENLIGHTENED TO-DAY THAN EVER BEFORE IN HISTORY.—THE LINE OF INTELLECTUAL DEVELOPMENT.—PERSISTENCE OF THE QUINTUPLE EXPRESSION.—OUR LITTLE ANCESTOR OF THE EOCENE.

ONE of the greatest errors in Theology, aside from the fundamental error of Special Creations, is the supposition that men were in a high, pure, noble and perfect state, originally, and have reached their present "low and degraded" condition through "falling from grace."

The theory involves not only a double falsehood, but a perfect mass of absurdities, to support it. The first false idea is that men ever were perfect, or anywhere near perfect; and the second, that men are worse now or more degraded than in former ages. All history tends to refute both of the suppositions. The further back we go into the history of any nation, the more barbarous, ignorant, uninventive, and bloodthirsty we find them. How long ago was it when our own boasted civilized Anglo-Saxons were a fighting, murdering hoard of robbers and pirates? Do we have to go very far back to find our ancestors burning innocent women, under the plea of their being witches? Even the history, written by themselves, of "God's chosen people," exhibits them as but little better than an organized band of murderers and robbers. This same people are, to-day, among our most law abiding, only seeking wealth through commercial advantage. No, there is no degeneration to be found, except in limited cases, or waves.

The general trend of all humanity has been upward.

The believers in revealed religions consider that the world is more wicked and "fallen," because it has advanced and evoluted out of their dogmas. The back-woods "Cracker" of Georgia is yet intensely religious and superstitious. The cultured citizens of Paris, Berlin, London, New York or Chicago are not overburdened with superstition. But the former is a relic of a past age of ignorance, while the latter are representatives of the world of modern thought. The Church points to them as examples of degeneracy.

It is a well known fact that large cities show a preponderance of crime; but that is easily accounted for in several ways:

First. Large aggregations of people within small area of territory afford much greater opportunities for the commission of crime.

Second. The better opportunities for the commission of crime, and subsequent escape, is an attraction to criminals, of all grades, to operate in large cities.

Third. Crimes committed in one large city of, say, two million inhabitants, make a much greater showing than the same number committed among two million of people scattered throughout an extensive country territory.

Fourth. Large cities are supplied with smart, well paid reporters, who make it a business to report and fully exploit all misdoings.

Therefore, it is customary to point to large cities as "sinks of iniquity," as moral cess-pools forsaken by the Deity. Yet, in those very cities, thousands of costly church edifices point the way to the supposed Heaven above, and thousands of high salaried ministers weekly preach the plan of salvation, which is "free"—of taxation.

The people of to-day are more refined, better educated, more inventive, more tolerant, less conceited, and actually more *truly religious* than those of any other epoch within our historical reach.

How came man to be higher developed than any other animal on the earth?

This is a pertinent question, and we shall attempt to answer it in accordance with the natural law.

In the first place, man is not a higher development, only in one thing, and that is intellect. The elephant, mammoth, whale, and hundreds of other animals, have gone far beyond man in bulk, as well as strength. The fish can beat him in swimming, the bird in flying, the horse in running, the dog in scenting, the eagle in seeing, the gopher in digging, the gorilla in fighting. But, in spite of all this development, in certain ways man is master of all, entirely through his intellect. Man is the most helpless of all animals, yet he masters all others. He makes a machine stronger than the mammoth; his steamer outswims the whale; his telescope and microscope outsees the eagle; his firearms enable him to outfight the ferocious gorilla, and so on through all the list. It is true that, in some things, the lower animals still have the advantage; for instance, the bird in flying, or the dog in fol-

lowing a scent; but these are merely minor and special qualities.

So marked is man's intellectual development beyond that of all other organized beings on the earth, that he has considered himself a sort of "special creation" apart from the rest of the animals. He has looked upon himself as a higher being, with a "God-given intelligence" given to him in some occult way from outside. This is a wholly gratuitous assumption, which cannot stand the light of true science one moment. The fact that man has developed one faculty—the brain—far beyond that of any other animal, does not prove him to be the special pet of some high and mighty being, any more than the development of a shell a foot thick on the Armadillo; or of tusks thirteen feet long and weighing five hundred pounds, on the ancient elephant; or the beautiful fur on the seal; or the magnificent plumage on a bird or a butterfly, proves those animals to be special objects of some Being's care.

The fact is, that man is nothing but a continuation of development. His frame is just like the frame of other mammals; his blood, flesh, hair, skin, nails, internal organs, and all parts of him, are on the same general plan, made from the same chemical combinations, subject to birth, growth and decay, exactly as is the case with all the others.

Now, we can safely assume that, as man possesses the one superior quality, called intellect, above other animals, there must be a reason for it, and that reason we have a right to look for.

The entire secret of development comes from the law of necessity—the struggle for existence. The immortal Darwin discovered this law, and other grand men have reaffirmed it time and again. But there are some minor branches of this law that have not been touched upon very much. One is, that animals are constantly developing beyond the line that leads to intelligence; that is, they have become possessed of qual-

ities which have enabled them to exist and hold their own against other animals and against all their environments.

In all such cases, the development of intellect has been stopped. *Every kind of evolution must have a reason for it.* Every organ must have a use, or it would never develop. And, *per contra*, when an organ ceases to be of utility it tends to disappear gradually.

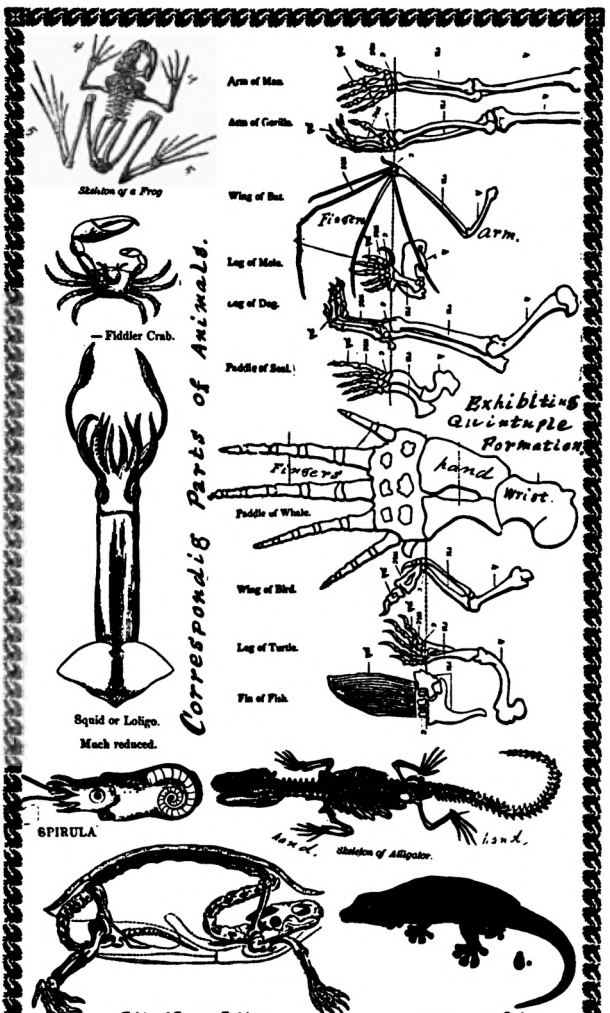
We have seen, in our journey into the earth, how the little hoofs of the Tertiary horse became gradually extinct, until that animal has but one toe on each foot. When the animal was obliged to traverse bogs and quagmires during that early period he had use for those other toes, as they prevented his sinking into the mire. As the earth grew drier and harder he had less use for them, and they therefore grew smaller and smaller until they disappeared. The horse was a small, five-toed animal at the same time that the progenitor of man was possessed of the same. In fact, there was but

little difference, if any, at the beginning of the Eocene, between the two animals.

Developing from the lizards of the preceding ages, the first mammals naturally possessed the five-toed form, which has so persisted through ages past.

CHART No. 33 is designed to exhibit the line of development through which the arm, wrist, hand and fingers have passed. The same is also true of the feet. You cannot help but see that the paddle of the whale is related to the hand or foot of man, as well as many other animals.

We can trace this quintuple formation down through lizards, frogs, turtles and bats, until we find, as it were, but crude beginnings in much lower animals. Even away down in the Silurian period we find faint glimmerings in some of the differentiations of the Trilobite. Fiddler crabs, loligo squids, and even the low-down spirulas, have the "five-on-a-side" formation. So we conclude that five is a natural physical number, as is ten, and that it has per-


Skeleton of a Frog
Fiddler Crab.
Squid or Loligo.
Much reduced.
Correspondig Parts of Animals.
Arm of Man.
Arm of Gorilla.
Wing of Bat.
Fingers
Arm.
Leg of Male.
Leg of Dog.
Paddle of Seal.
Exhibiting Quintuple Formation.
Fingers
hand
Wrist.
Paddle of Whale.
Wing of Bird.
Leg of Turtle.
Fin of Fish.
SPIRULA
hand.
Skeleton of Alligator.
hand.
Skeleton of European Tortoise.
Gecko.

sisted all these ages, and culminated in man, because it is a good and useful number to possess of such valuable members as fingers, toes, claws, etc. If more such members had been needed, more would, probably, have been developed. If less would have served, one or more would have became extinct.

We can see, in the case of Man and the Quadrumana, that the fourth finger, which is not called upon to act so strongly in grasping, as it does not come readily against the force of the thumb, has degenerated in size, and is called, everywhere, the "little finger." The toes have degenerated, in regular order, under the same conditions, varied much, however, in man. I doubt very much whether mankind will have much of any toes, worth speaking of, two thousand years from now. If they do have, it will be because a large portion of mankind go bare-footed, or wear sandals.

The remnants of the hair, which we inherited from the lower animals, yet remains

upon our bodies in a stunted form; and it is a well known fact that the practice of cutting the hair short upon the heads of men is gradually operating to make them thin haired and bald headed In nations where this practice is not followed, the males have as thick and heavy hair as the females.

Now, what are we to conclude? Simply that man has developed through a line of ancestors, whose various members have been *obliged to use intelligence in order to exist.* That those branches from this line which were able to develop some organ or organs, qualities or surroundings, which would enable them to exist with but little intellectual development, have "fallen by the wayside," as far as intellect is concerned. This is not only a reasonable view, but it is borne out by all the facts observable. It is even true when applied to men at present on the earth. Where do we find the men of brains, of inventive genius, of intellectual power and growth? Clearly, in those parts of the globe where man must use such qualities

to succeed in life, against the vast competition of others.

The hustling New Englander, the rushing Middle State Yankee, the Western "rustler," the hardy and hard-headed Englishman, Irishman, Scotchman, Frenchman, and many others along the line of the Temperate Zone, all bear evidence to the effect of climatic conditions. If men had been kept in a "Garden of Eden" through all the past ages they would have been unintellectual "chumps." Had all the men of the earth lived along the equator, we would have been pounding corn in a hollow stone yet, in place of running it through the magnificent mills we now possess.

When our little forefather began to fight the battle of life, many ages ago, he found himself almost naked and exposed to the attacks of mighty mailed beasts, who roamed the land over and crashed through canebrakes and brush, ready to devour any poor beast who chanced in their way. With such surroundings, our little ancestor said,

in his small mind, "I will climb a tree." In doing this little act he used his intelligence, and found that he had left his enemies mostly behind him on the ground. But he must still guard himself from the climbing reptiles, and even other species which had learned to fly. Some of these had enormous eyes, with which they could see at night. Against such enemies our little friend was obliged to hang on, hand and foot, and even bring his tail into use. He had, also, to keep a bright lookout; he must be ready to hide, or to run from tree to tree, in order to outwit his powerful foes. In this manner he developed "sharpness" and cunning — qualities so prominent in many of the quadrumana. At the same time, his feet became gradually developed into "hands," while his tail grew long, slim, strong and pliable. Thus we see our ancestor gradually drawing away from the "protected" animals, for which Nature had apparently done so much, and receiving for his departure the gift of increased brain.

The same law holds ever thus. The trials and tribulations through which we pass, although seeming hardships, are, in reality, the elevators of mankind.

Those who bask in the sunlight of prosperity, are not advancing in the Soul-Light as they would under more adverse conditions.

This is the great "Law of Compensation," which, like the Correlation of Forces, ever preserves the balance of the *Scales of the Infinite.*

LECTURE XI.

Structural Development.

DIFFERENTIATION OF PARTS AND ORGANS UNDER ENVIRONMENT.

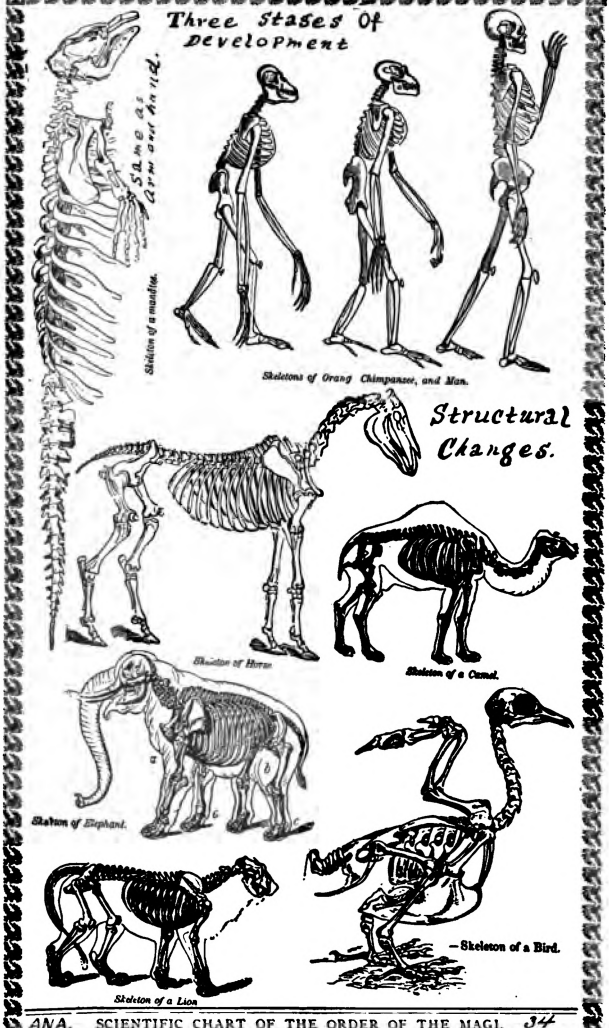
COMPARATIVE ANATOMY.—THE ELEVATION OF THE QUADRUMANA.—OUR ANCIENT ANCESTOR.—THE DEPARTURE IN TWO DIFFERENT LINES.—DEVELOPMENT IN OTHER DIRECTIONS.—DEGENERATION AND EXTINCTION OF SPECIES.—SURVIVAL OF THE FITTEST.—EMBRYOLOGY ILLUSTRATED.—EVOLUTIONISM THE GRANDEST VIEW OF LIFE.

THE preceding lecture left our friend, the monkey, developing his brain and wits in the battle of life. He soon became an expert at climbing, and swinging himself by his arms. But this exercise had its influence on his structural development, for, while his legs remained about the same, his arms lengthened gradually, until, when

standing nearly upright, his hands would touch the ground.

I wish to call your attention to Chart 34, where you will observe the length of the arms of the orang, and note their wonderful development. The head of the same animal can be seen at the bottom of Chart 32, and you will readily see that he is one who is fully able to defend himself on the ground. Indeed, that is just what he did do. He disdained to climb trees, or to flee from his enemies; so, as a natural consequence, he developed his fighting qualities, ferocity and strength, at the expense of his brains, and the result is seen in his low, retreating forehead and his brutish eyes and jaws.

But other members of the quadrumana developed in other directions. Some managed to reside where conditions were more favorable to quiet life; they were therefore able to leave the trees and pass much time upon the ground. The effect of this is seen in the Chimpanzee, by a shortening of the arms. This change of structure went on


Three Stages Of Development
Same as Arm and Hand.
Skeleton of a manatee.
Skeletons of Orang Chimpanzee, and Man.
Structural Changes.
Skeleton of Horse
Skeleton of a Camel.
Skeleton of Elephant.
Skeleton of a Bird.
Skeleton of a Lion

until its culmination in man; where the arms are again normal, for they are the same length as the legs.

The comparative anatomy illustrated in Chart 34 is well worth studying. Note the separation of the bones in the arms and legs, especially developed in the forearms of the three skeletons we have been considering. The same split formation will be found also in the bird's wing, the turtle, frog, whale, dog, alligator, and many other animals. Note the "arm and hand" of a Manatee, the gigantic sea mammal, and you will at once see how very short and dwarfed they are, in comparison with the length of the body of the animal; while, at the same time, they are thick and strong. It is easy to see why this is. Living in the water, the progenitors of the sea cow had nothing whatever to "stretch" or lengthen the arms, while the resistance of the water to them, as "paddles," constantly tended to strengthen them.

Now let us go back to the progenitor of that noble animal, the horse, who lived co-

temporaneously with our forefather. Instead of climbing a tree, Mr. Equus said, "I will run away from danger," which he proceeded to do. *Right there was a dividing line on intellectual and structural development.* It was very slight at first, but it led to mighty changes later on. To run away from danger is an impulse, with but little reason connected with it; but to remain on the spot and outwit the enemy is an act of reason.

From that dividing point came the two great branches which have been growing further apart ever since. One gave us a long line of lives, extending up to man; the other gave us a line equally as long, extending up to the horse. All the members of the latter, as well of its branches, have been noted for their fleetness, grace, beauty and gentleness. The horse is a "good" animal. He does not plot nor seek to kill other animals; but he has developed "out of the line of intellect."

The Camel is another animal whose anatomy corresponds with that of the other

quadrupeds. But he came up through a line which were, evidently, subject to adverse conditions as to food and water, while he was forced to travel upon hot sands. Instead of hoofs, he has pads on his feet. He has developed a large hump, where fat is stored up, to draw upon when he is without food; and he is provided with an extra water stomach to hold water for his use when he cannot get a supply of it as needed. All these little useful "extras" possessed by the Camel, effect his anatomical structure but little, for they are all in the fleshy parts. See chart 34.

The Elephant illustrates another phase of development, where the tendency was toward massiveness. He possesses a heavy frame-work, a thick skin, and was able to escape his enemies without climbing, running or jumping. So his line developed enormous tusks for use and defense, and a long, flexible nose, which we call a "trunk," which is of the greatest service to this order of animals. What the arm and hand is to

man, the trunk is to an elephant. With his short, thick neck and ungainly body, he would be helpless without that useful appendage. The development of the proboscis, in that class of animals, dates back to the Age of Reptiles.

The Lion exhibits another style of development, where cunning, strength, agility and ferocity, with a love of blood, combined to produce the frame seen in chart 34. Cover that frame with muscles as strong as steel wires, and you have the murderous, treacherous member of the cat family. There are many relatives, some being merely sneaks, with but little courage.

In the family *Avis* we have another departure from the intelligent line. Birds developed the quality of flying, which raised them at once above the dangers on the earth's surface. The consequence was that all their progression went toward wing power, guiding themselves, and in rapidity of motion through the air. Some of the branches did not attain all these qualities.

Some failed to develop wings, because their bodies became so fat and heavy that they were too lazy to fly. So their "arms" became extinct, instead of developing into wings. The bird family also produced a peculiar arrangement of foot and toes, by which they are enabled to hold on to a limb while asleep. The hands of the quadrumana would be useless for such a purpose.

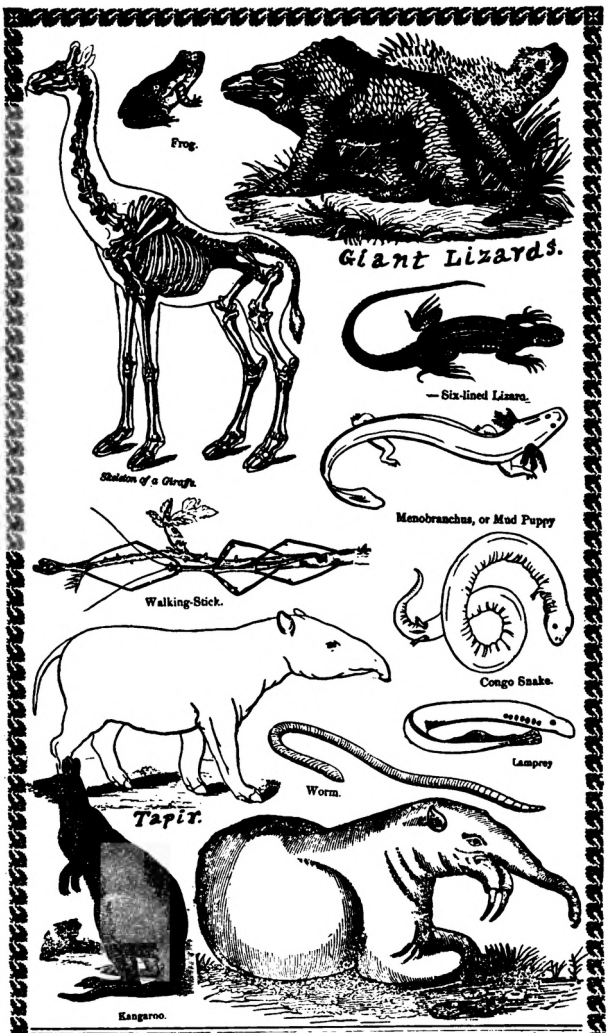
Some birds took to the water, so we find another numerous family of them, consisting of many species, provided with web-feet for swimming on the surface. Others are provided with long legs for wading in the water. The entire family of birds have gone out of the regular line of intelligent evolution, because they are in a condition where they do not require much reason in order to exist.

We could go on and take up orders and species, one by one, and particularly examine the structural changes brought about in each, through evolution under environment. But the task is too great. The same general laws obtain throughout.

You can understand the causes operating to lengthen the neck and fore legs of the Giraffe, the nose of the short necked Tapir, of the Eocene age, until it became the short trunk of the great beast of the Pleiocene, and the longer trunk of the Elephant of the Post Tertiary Period. You can understand how the great Saurians came out upon the land, and increased the length and strength of their legs by use, while their unwieldy tails grew smaller and lighter from age to age. You can understand how the pairs of short legs of the Congo snake, removed far from each other, were but rudimentary forms, which eventually led to the more fully developed limbs of the many tribes of lizards; how the thick fish became a slim eel, a snake a siren, a Congo snake a crawling lizard and a walking dry-land "Giant Lizard," nearly in the form of a mammal quadruped.

A CONSIDERATION OF CHART 35.

Some of these things can be better understood, perhaps, by referring to the chart.



ZOO. SCIENTIFIC CHART OF THE ORDER OF THE MAGI. 35.

Compare the jumping Kangaroo with the Giraffe, and notice the difference in the development of the neck and fore legs. The giant lizards shown in chart 35 are the terrible monsters alluded to above, and also in the fifth lecture. (See page 87). The Tapir shown is of the Eocene. The other monster, below him, is from the Pleiocene. He is to be found on page 74, in his place in the formation.

On chart 35 we have a representation of the strange animal called the "walking stick." He has developed a general form, corresponding to a piece of dead branch. As he is very sluggish in his motions, it requires a sharp sight to detect him among the small limbs of a bush or tree; hence he escapes with his life from the numerous birds, who would gladly "invite him to dinner." There are a great many animals possessing this peculiar style of protection from enemies. The tree toad, the chameleon, and large numbers of reptiles and insects, as well as many kinds of birds, have

developed such qualities. Some of them have the strange property of changing color, to conform to their surroundings. Some animals change periodically, so as to become white in the winter and gray in the summer.

All these peculiarities have been brought about under the law of the "survival of the fittest." The species which possess any peculiarity which gives them an advantage in sustaining themselves against antagonizing environments, will survive; while those not developing such qualities will gradually perish, or "run out."

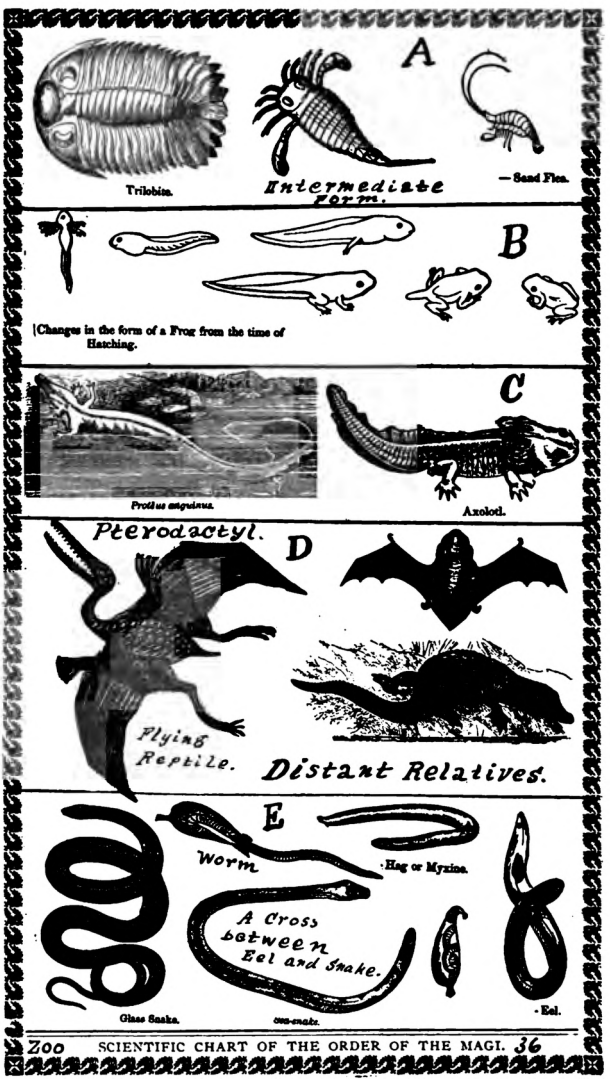
We can see this effect going on all abont us, even among the races of men. The Indian tribes of America are becoming extinct under this law. The whites, being possessed of superior intelligence, are able to run out the native tribes. The Indian, with all his natural bravery and cunning, is no match for the white man's improved firearms and training.

The natural result can be foreseen. The wild buffalo is becoming extinct, from his

contact with man—a superior animal. The great wingless bird of the last century has become extinct.

DEGENERATION OF SPECIES.

Some plants and animals, instead of becoming extinct, or, on the other hand, progressing to some higher form of life, seem to retrogress in size and, perhaps, in functions. It is not so certain as to the latter, however. It is actually known, though, that some animals, like the hermet crab, have degenerated very greatly in structure, through leading an idle and aimless life. You remember the Trilobite of the Silurian? Well, you will be surprised, perhaps, when I tell you that one branch of that ancient family, who once "ruled the earth," *has degenerated to the common sand flea.* There were good reasons for this, of course, and we do not know, really, whether his changes are a retrogression or an advance. We will show you his picture in the next chart, No. 36, so that you can judge for yourselves. Section A shows the three forms, and you


A
Trilobite.
Intermediate form.
— Sand Flea.
B
Changes in the form of a Frog from the time of Hatching.
C
Proteus anguinus.
Axolotl.
Pterodactyl.
D
Flying Reptile.
Distant Relatives.
E
Worm
Hog or Myxine.
A Cross between Eel and Snake.
Glass Snake.
Eel.

can see how some peculiar characteristics have remained, down to this time.

I do not propose, in this series of lectures, to go into the great field of Embryology. That field is full of wonderful proofs of evolution; although it is a branch which is not adapted to a work of this character. But I want to touch upon it a little.

There is a strange law, by which the skilled scientist can "follow back," as we might say, into the line of development through which animals have passed in their upward march, by observing the different phases undergone by them from the eggs to the fully developed animals. Section B shows the changes in the form of a frog from the time of hatching from the egg. The eggs of a frog cannot be distinguished from the eggs of a number of other animals, and its increase in size, and hatching, resembles the same process which takes place with the ovum of much higher animals. But the frog, being an organization low in the scale of development, is launched di-

rectly into life in the form seen at the left. Right here we see a strange thing. The young tadpole is provided with air-breathing, external gills, corresponding to the Proteus and that class of Amphibia. But the frog is higher than they, so the little fellow loses these appendages and becomes a fish, and a lively fish, too. After enjoying himself quite a while, in this form, as a "pollywog," he developes a pair of legs. He then corresponds to another class of animals, spoken of heretofore. His next change transforms him into the form of a higher branch of life—the lizard, with four legs. He next dispenses with part of his long, lizard-like tail, and becomes a "short-tailed lizard. Lastly, he sheds the tail entirely, and jumps out upon a log as a full-fledged frog, ready to live on land or in water. He is possessed of lungs, but, strange to say, he breathes through holes in his skin, as long as the latter is moist, so that he can live with his lungs removed if he is kept wet.

Section D exhibits an ancient "flying dragon" and his modern relatives, the bat and crocodile. The latter belongs to a very distant branch, however.

Section E consists of other distantly related organisms.

This lesson has introduced us to much food for thought. How much more uplifting is the conception that all these peculiar adaptations of structural forms to surrounding circumstance has come through a natural law of development, instead of by the personal act of some Being.

I say that it is a more uplifting and ennobling thought, for it is certainly belittling to any conception of an Almighty Being, of unlimited power, to conceive of his deliberately creating such specimens of life as we see all about us. Monstrosities and mistakes abound on all sides. Think of an omnipotent being making a bedbug or a plant-louse. Think of His making such an awkward and ungainly animal as a lobster, with claws and other appendages enough for three or

four other animals. Think of His making a skunk, or a thousand-legged worm.

But the great law of Evolution does away with all such crude conceptions, and we understand that bad things can be evolved as well as good. That monsters, more deadly to humanity than the rattlesnake, exist in such minute forms as to be invisible to the naked eye.

In short, the Science of Progression under environment, enables us to cut ourselves loose from the fallacious theory of "Design," and stand upon the solid rock of Evolution.

LECTURE XII.

Marvels of Life Forms.

—o—

STRANGE AND WONDERFUL DEVELOPMENTS IN THE DOMAIN OF ZOOLOGY.

—o—

EVOLUTIONARY CHANGES SOMETIMES DEVELOPING USELESS ORGANS.—SOME ORGANS WORSE THAN USELESS.—DEVELOPMENTS OF BEAUTY AND UTILITY.—WONDERFUL BIRDS ILLUSTRATED.—MARVELS OF THE SEA.—PERSISTENCE OF LIFE FORMS.—REFUSAL OF ABRUPT DEVELOPMENT.—THE SIX-FINGER EXPERIMENT.—WONDERFUL DEVELOPMENTS IN ALL FIELDS.

UPON a careful examination of the many life forms which have existed on our globe, we are struck with the fact that, in the great work of differentiation, many strange forms have been evolved. Some wonderful faculties have been developed to accompany the strange forms; and, although from our limited view, many ani-

mals seem to be unnecessarily equipped with certain appendages, we can confidently presume that there is a use for all parts, or that there has been a use in the past. In some cases, however, we can see plainly that certain parts are not only useless, but actually dangerous to the owner.

The short, stumpy tails left to many animals, such as the short-tailed apes, brown bears, etc., seems to be of no earthly use to the animals; but we can understand from our studies, why the animals have them. The "vermiform appendage" is believed to be of no use to man, and, on the other hand, is the means of his death in hundreds of cases. In this case, we are not left to conjecture as to why we have that dangerous organ, for the lower orders of the mammalia have the same thing in its larger and more perfect state. In the Quadrumana it begins to deteriorate, and in man becomes an absolute menace to life. The time will come when it will completely disappear.

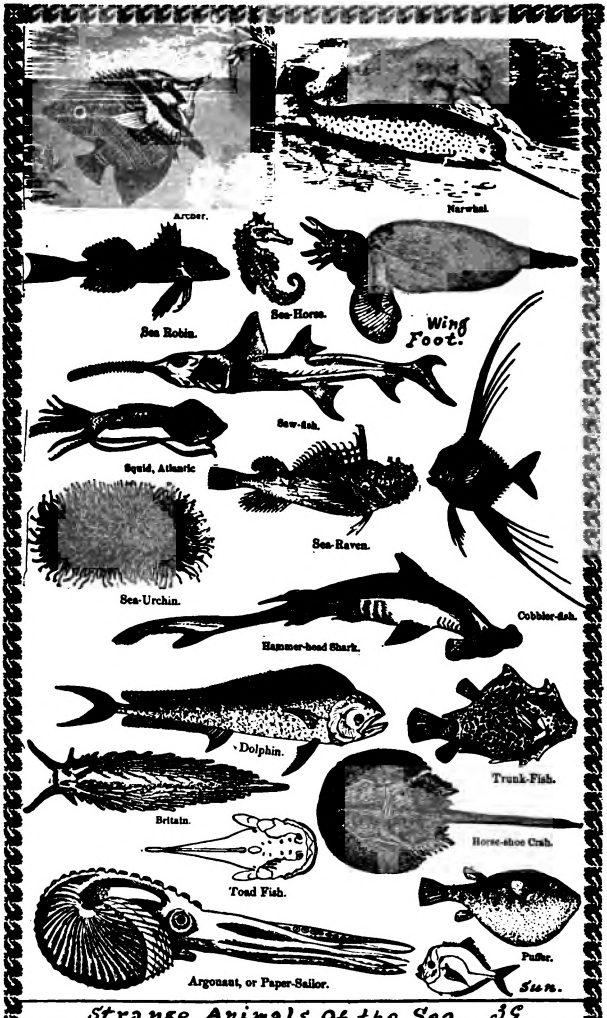
Some animals have teeth, before birth, which entirely disappear soon after that event. They are descended from animals who had teeth at the corresponding stage of development, and the tendency has not yet wholly disappeared; although now utterly useless to the animal.

CHART 38 gives us an illustration of sixteen birds, each one of whom is remarkable for some strange or odd development. The Trojan possesses such an enormous tail that it is a damage to him and a hindrance, but it is unquestionable that this appendage, as well as the magnificient one shown below on the Lyre-bird has been developed as a thing of beauty. The vanity of many birds is just as real as any foible in our own natures. The peacock is proud of his tail. The Flamingo has an immense head and bill and very long legs, with web feet. You can see at a glance, that he is fitted for wading and swimming. Note the difference between him and the Curlew, who is noted for his long bill. The well known bird, the Whipporwill, possesses

Ave. SCIENTIFIC CHART OF THE ORDER OF THE MAGI. 35.

a queer bunch of bristles in its mouth, which is of use in entrapping the swiftly-flying insects upon which it feeds. The Brown Pelican, Toucan, Puffin, Scissors-bill and Cross-bill, each possess something unique in the line of bills. Each of these birds find good use for the queer beak.

As such an organ cannot well pass as a thing of beauty, we can understand that it developes entirely under the law of utility. The Humming bird is noted for his small size, beauty of plumage and rapidity of wing motion. The Penguin, uses his wings only as paddles, so they have degenerated to mere flippers. Another strange bird, not shown on chart 38, is the Apteryx. His feathers are so near being hair, that they are more than a cross between the two. He has no wings, but possesses a long beak and the regular feet of a bird. He is a good mate for the Duck-bill, in chart 27, where this queer bird will be found; as one is a quadruped bird and the other a biped *non-descript.*



Strange Animals of the Sea. 39.

Zoo. SCIENTIFIC CHART OF THE ORDER OF THE MAGI.

The most learned Naturalists have agreed in believing that the bird family are a "side development," united at both beginning and end with other orders of life—a "loop," as we might say, from the chain of progression.

CHART NO. 39 takes us to another element—water. Here we have nineteen species of fish, and other sea animals akin to fish. There are thousands of strange forms, ranging from animals so small that a thousand could be laid upon a spot the size of a period in this book, up to enormous fish and great sea lizards of past periods. The chart only gives a few of all the queer developments, and those not the strangest.

The beautiful "Archer fish" is not only provided with an elegant form, with many ornamental points, but he also possesses an accurate gun, in the shape of a mouth, with which he can shoot a fly several inches away. Some varieties of this fish have not yet developed the peculiarities mentioned. The strong spur of the Narwhal, like the sword of the Swordfish, and the saw of the

Saw-fish is an interesting appendage. The animal called the "Wing-foot" is another queer link. He has a head related to the cuttle tribe, in a mild way, while he has wings in the place of fore legs, which are used as paddles. The Squid, on this chart, is one of a numerous family, noted for their activity and deadly grasp. Some of the larger varieties are called "Devilfish." They are all invertebrates, and rank as a higher development of simple jellyfish of preceding ages. The Sea Urchin is another wonderful animal, covered with spines and suckers, thousands in number. You would not think that he possessed a "shell," but he does, underneath all those outside appendages.

The Sea Horse, Cobblerfish, Trunkfish, Toadfish, Puffer, Sea Raven, Sunfish and Sea Robin are each possessed of some special development. The Dolphin has a queer shape, and more development of fins than any other fish. Many ancient works speak of this animal. Another animal, which possesses such a strange development as to

have called out pages of description, in various books, is the Argonaut, or "Paper Sailor." He is a connecting link between the Nautilus and the Squid.

While speaking of the Nautilus, I will mention, that he is the sole survivor or living representative of more than two thousand fossil species of the same order. There are six species of the genus now living. The funny shaped Horse-shoe Crab, is a queer animal. He is a cross between several orders of life, and therefore retains the traces of both ancient and modern forms. He has two pair of eyes; one pair compound, as in insects, and the other pair simple, as in fish, and all the higher animals. This crab is also related to our ancient friend, the Trilobite, once the "king of earth." Strange to say, this animal is also called the "King Crab."

I shall not attempt to go into the extensive field of strange development further. We have seen enough to fix it firmly in our minds that nature responds to almost any

call made upon her, *if she can only be given time enough to bring about the changes slowly.* She will not respond suddenly, for that is contrary to the law of evolution.

Everything goes to prove that life forms change almost imperceptably, but constantly. While species are confined within certain limits, by the law of fixity, there is a constant tendency to differentiate the varieties of each species to the confines of other orders of life.

In some cases, we find that animals of the same genus, although of different species, can be crossed in breed. But, in all such cases, heretofore discovered, nature refuses to go on with the development one step further. She will accept the comparatively sudden production of an apparently new species, like the mule, for instance; but she repudiates the job from that time on, by stopping the succession. This is a characteristic by no means confined to the animal kingdom. The vegetable kingdom is noted for many examples of the kind. By bud-

ding and grafting, many fruits are produced, which are crosses between distinct species, but the seeds of each fruit will not produce a succession.

Right here we have another proof, if such is needed, of the close relationship existing between the two great kingdoms.

To me, this law of life presents one of the most beautiful characteristics of the great law of development. It is as if nature should say: "I have my own way of working, slowly but surely. I put down my work to stay. When I have produced a form, under a long steady demand for the same, I am not going to throw it aside in a hurry. In fact, I am opposed, upon principle, to throwing it aside at all. The most I will consent to is a gradual change, as circumstances demand."

Any little peculiarity which is produced "momentarily," as it were, such, for instance, as the sixth toe, or an extra finger, ranks as an "accident," so to speak, in Nature's work. A few years ago, a French

Savant undertook the job of experimenting along this line. He advertised for a male and female who possessed either six toes on each foot, or an extra finger on each hand.

He was successful in finding two people, who were in no ways related, who had the sextuple form of hands. The couple were united and bore offspring.

This man reasoned, that if ever nature had an opportunity to propogate a freak member, she had it then. But she refused the chance offered, and the three children of the couple were all destitute of the six fingers.

It turned out like the Irishman's pedegree, where his great grand-father, his grand-father, and his father, each had a wooden leg: "But, wud you belave it, I was born with two as sound legs as any kid ever had under him."

Examine where we will, the same great on-marching sequence of cause and effect ever confronts us. Nature's productions, always bear the stamp of permanency, ex-

actly in proportion to the length of time taken to evolute them.

Another law is, that the higher an evolution is in the scale of being, the harder it is to produce it. Beginning low down in the scale, we find plants and trees of all grades, readily reproducing parts, or partially reproducing them, which have been amputated. A new limb, or a new root, sprouts forth to take the place of the old. But, even in plants, there are parts which are usually vital to the organism. Parts, which if removed, will kill the plants. When we come to the lower orders of animal life we find the same law in force.

Some animals may be cut into four or five pieces, and each piece will swim away and set up life on its own account, as a new individual. Several species of animals propogate by breaking into two pieces, which, in turn, break into two others, and so on. The Crab can grow a new claw, in place of a lost one, while some species of lizards can drop their tails, when in a tight place, and

afterwards grow new ones. This quality reminds us of the fact that at a certain stage of life, the "pollywog-lizard" drops his tail and becomes permanently a tail-less frog. We observe a fine foreshadowing of the frog, in the case of the lizards above mentioned.

Our lesson of to-day teaches us many grand truths. We see that the law of nature, by which she presents an almost limitless diversity of structure; and yet is constantly bounded by an invisible line, which precludes a chaotic crossing of fixed forms; holds good in the fields of Zoology and Botany, as well as in the domains of Chemistry, Astronomy and Physics.

As there are strange and wonderful forms developed in the animal world, just so we find strange planets, like Saturn; odd suns, like Algol; queer nebulæ, such as the Dumb-bell or Great Spiral; wonderful comets, like the great multiple-tailed comet. We have strange plants, like the fly-catcher; marvelous forces, such as electricity; wonderful vibrations, as the "X ray;" and, in short,

which ever way we turn our investigations, we find wonders opening to our view.

Friends, we are but mites in a Universe of Marvels. An Infinity of Life and Motion surrounds us, even as the broad Atlantic surrounds the tiny speck of developing protoplasm.

LECTURE XIII.

Progression Universal.

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EVOLUTION IS A PRINCIPLE WHICH APPLIES TO EVERYTHING ON EARTH.

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EVOLUTION OF LANGUAGE, ORTHOGRAPHY, RELIGION, INVENTION, MORALS, ETHICS, SCIENCE, HABITS, CULTURE, REFINEMENT, GOVERNMENT AND LAW.—THE LAW OF SURVIVAL OF THE FITTEST.—SAME GENERAL LAW APPLIES TO ALL.—THE NATURE OF INFINITE LAW DEFINED.—'THE UNIVERSE IS GOVERNED BY FIXED LAWS.'—DEMONSTRATED SCIENCE, AS A RELIGION.—UNDERSTANDING OF EVOLUTION, THE BULWARK OF THE RELIGION OF THE STARS.

THE great and grand principle of Evolution and steady progression under favoring conditions, is not confined to the production of life forms, or the shaping of worlds, suns and systems. It is a universal principle, that applies everywhere.

Language is a product of evolution. Old words are dropped entirely from a given language, in the same way that certain organs became extinct in given animals. New words come into use in the same way that new organs are evolved.

In some cases, environment is such that the entire language falls into disuse and becomes a "dead language." This corresponds to the total extinguishment of certain species of animals. Again, a long period of time changes the meaning of words, until the resulting language can scarcely be understood. Prolong the time and it becomes, to all intents and purposes, a "new language," so-called. But, as a matter of fact, there never was such a language as a "new language," except in a restricted sense, which we shall hereafter mention.

All the great languages of earth have roots in common, which indicate a connection far back. Two or three attempts have been made to artificially produce a language without waiting for the slow and natural

process of evolution. Even these attempts were based greatly upon existing languages, but they would not stand. I do not believe that any language will ever be "made" or "created," which will be used regularly by any people.

Orthography is another constantly evoluting and changing quantity. With all our standards of spelling, words are bound to change steadily in construction, and even in definition. The change is scarcely perceptable in ten or twenty years; but two or three hundred years make such great change, that one can scarcely read a book, understandingly, in his own language of two hundred years back.

The people of England and the United States spoke the same language once. Now the differentiation is remarkable, considering that we both use about the same standards. Nearly all English books have such words as color and honor, spelled "colour" and "honour." They simply have not evoluted out of that old and awkward spelling, while

we have. Only thirty years ago, a man would not have dared to use the words "catalog" or "plow," hardly. The correct thing was catalogue and plough. The necessities of our last war changed the awkwardly spelled words "piquette" and "corps," to picket and core.

But, on the other hand, vain attempts have been made by reformers to artificially hasten, or make sudden changes in orthography. One New York journal worked manfully for years and years, by precept and example, to change certain words, as follows: "hav, giv, lov," and many others, where the dropped letter is never sounded. But the other papers of the United States would never follow suit. Had they all taken up the plan, our final "e," in that class of words would have looked odd by this time.

Religions are all evolutions. Each new religion, so called, is but a graft upon an old one. A gradual change takes place in religious thought until the progressive element, in a given church, become obnoxious

to the conservatives, then a separation takes place. The new cult is christened and launched, to in time, become again split.

Thus the work of evolution goes on in all the churches. But, every time a creed splits off, the old stock becomes slightly changed, and the consequence is, that creeds are becoming obsolete, the same as some animals have become extinct. Hear me predict: The time will come, before many thousands of years, when the Christian religion in all its branches, big and little, together with all the other great religions of our earth, *will be as dead and extinct as the Trilobite of the Silurian.*

Why, I heard things openly preached in the pulpit, such as infant damnation and endless Hell-fire and brimstone, when I was a boy, that a minister would not dare preach in Chicago to-day. You might find a place somewhere in the back settlements of some benighted country where you could hear the same preaching now. But that is simply according to the law of evolution.

"Australia possesses some species of animals, Marsupials, which became extinct ten or twenty thousand years ago in other parts of the earth."—*Darwin.*

The theory, that a Supreme Being ever gave one, of all the six thousand religions of this earth, to man, is absolutely contrary to the laws of evolution and the facts. It is as absurd as the entire theory of special creations must ever be, to thinking men and women.

Inventions are the work of evolution. The Locomotive, the Rolling mill, the Telephone, or the Bicycle, as each is to-day, is a product of evolution. Each improvement is a differentiation of what existed before. A wheel, a shaft, a pully, a cam, a crank, or some other device is added here and there, and the machine grows more and more perfect.

The law always holds good, that the more liberal minded and advanced, as thinkers, a people are, the greater their inventive genius. That is why rapid evolution always goes hand in hand with progress.

The machines, of every description, in use to-day are "survivals of the fittest," just as much as the orders and species of animals and plants are.

Morals, Ethics, Science, Habits, Culture, Refinement, and every quality or practice of which the human race is capable, are constantly evoluting. What would be considered perfectly moral in one age, becomes highly reprehensible in another. What would be thought now of a State which would hang men for stealing two pounds sterling. Or of one which would countenance an inquisition, or the burning of heritics, or reputed witches.

But, we should remember that there are certain useless or detrimental organs still retained among animals which are only survivals of a past age. Therefore, we would look for some survivals of the past systems of morals, ethics, science, etc., mentioned above. And we find them, too. For there are places and people who are on that plane yet. There are those who would per-

secute with fire, for opinion's sake, or kill those whom they suspect of communing with the unseen. There are persons, yet, who firmly believe that our earth is not a globe, but a flat plain, although such belief is nothing but a survival of a barbarous age. All over our poor, downtrodden earth, men are made miserable when they might be comparatively happy, simply because we are full of excrescences of past errors, which have survived all the usefulness which they once possessed. We are to-day using systems of statescraft, finance, trade reciprocity, land ownership and taxation, which are directly intended to produce great misery among millions of human beings. Yet, such is the persistency of anything once established under the law of evolution, that we cannot get rid of these things, *except by the action of the same law.*

All those who see these things, and therefore desire to *amputate them at once*, are placed in a position to be called cranks and fools, for their pains. Some people think

that the expression, "the survival of the fittest," means the survival of that which *ought to be perpetuated*.. But such is not the case, by any means. The meaning could be expressed better, thus: "The survival of that which is best calculated to withstand all the antagonizing influences which tend to annihilate it." A bad thing is just as likely to be evolved and to hold its own, as a good thing. Some lies have stood for centuries, against all the assaults of truth.

The poison and fangs of a serpent, the perfume of a pole cat, or the ramifying and corroding roots of a cancer, are evolutions, just as much as are the luscious peach or strawberry, or the grand and beautiful thoughts of a poet. A celebrated writer has lately said: "all that *is*, is right." Another quoted this, and said: "all that *is*, is wrong." I beg leave to differ with both of these gentlemen, and put it thus: "all that *is*, is neither right nor wrong, but simply *is*." Whether a given thing is good or bad, right or wrong, depends upon circum-

stances and the opinions of individuals. The odor of the skunk is no doubt a "good thing," to the animal himself. The unlimited power of an autocrat or a tyrant, is a "good thing," *for the tyrant himself.* A system of finance, that enables a few to live in idleness, upon the slavish labor of the many, is a "good thing" for the ones who profit by it. Every single one of these survivals of past ages will remain, until they are evoluted out of existence.

I have wandered a little, perhaps, from my regular line of thought, in my efforts to impress upon you that evolution is a general and inexorable law, from which there is no escape. We cannot run counter to it any more than we can to the law of gravitation. And this reminds me, that there is a widespread fallacy in the minds of humanity, as to what a "law" is, and the nature of it. We all know what a man-enacted law is. Men can enact almost any law; but such law *is not a law*, only in a limited sense. Men pass a law, "No person shall commit lar-

ceny, under penalty," etc., etc. But people *do* steal every day and every hour. The law is, therefore, only nominal, and fixes a punishment for the infraction. But Nature's laws are different affairs altogether. They are not made or created; makeable or creatable.

A Christian friend, in an argument with me a few days ago, said: "not a law exists except some one made it or passed it." "How about this?" said I, "twice two make four; two things put with two others make four things; that is one arithmetical law of thousands. Now, who made it?" "Why, God did," he replied. "If God had wanted to, he could have made the law so that two things put with two more things would have made five or seven."

Comment is useless. Any person, with half a spoonful of brains, aught to be able to see the fallacy of such assertions as that.

Yet, the entire doctrines and creeds of thousands of religions are substantially based upon just such errors. Of course,

as we go up into more intricate subjects, the error becomes more involved and not so easily seen. For instance, a real intelligent, and quite scientifiic gentleman, not long ago, said to me:

"What a beautiful law of the Almighty that is, that the square of the base, plus the square of the perpendicular, of a right-angled triangle, should exactly equal the square of the hypotenuse."

"Why," said I, laughingly, "do you think some being ever made that law?"

"Why, certainly I do," he replied.

"If that is the case then, it follows that there must have been a time in the past, when the square of the base, plus the square of the perpendicular, of a right-angle triangle, would have made *some other number than the one produced by squaring the hypothenuse.*"

He looked dumfounded for a moment, and then began to look foolish, as he replied: "Well, I declare, I never thought of that, I must look this thing over a little."

The more he looks, the more he will find that the only *absolute laws;* that is, those which *compel;* are laws which are never made and are unmakable. They always have existed and always will exist. It seems to me, that the understanding of natural law, is what constitutes religion. That is, true religion. If I am right, then it follows that the non-comprehension of such law, is a concomitant of false religion and is irreligious. As an entire denial of, or conflict with, the great facts of science has always been a principal characteristic of so-called "revealed religions," we can see that my supposition has much to commend it.

In this light, the immortal Humboldt was a grand religionist, and enunciated a beautiful religious truth, when he said: "*The universe is governed by fixed laws.*"

The great Darwin, when he formulated the laws of Evolution, was a "revelator," more truly than were the founders of many religions of men.

If Truth; scientific, demonstrated truth, is not religion, pray what is? Superstition, dogmatism, ignorance and falsehood, cannot be real religion, however honest their promulgators may be.

The grand and marvelous truths of Evolution constitute a bulwark, which guards, like a strong wall, the domain of Mystic Science. That wall guards the Religion of the Stars from the assaults of the cohorts of superstition.

My dear friends, it is not enough for us to *believe in evolution;* we should understand it, appreciate it, and be able to expound it unto others, that we may thereby elevate mankind from the bogs and morasses of darkness, to bright and shining heights upon the Mountain of Science.

LECTURE XIV.

Beyond the Physical.

THE ASTRAL BODY OR SOUL, BUT A HIGHER EVOLUTION OF MATTER.

PRINCIPLES OF NATURE.—MATTER AND ENERGY.—TRANSFORMATION OF ENERGY.—DIFFERENCE BETWEEN ORGANIC AND INORGANIC ENERGY.—THE SPIRIT IS ORGANIZED ENERGY.—ELECTRIC ENERGY, THE "SOUL" OF A PLATE OF ZINC.—RE-INCARNATION OF ENERGY.—THE PRINCIPLE OF SEX AN EVOLUTION.—THE PART HEREDITY PLAYS.—NATURE OF THE ASTRAL.—ATOMS FURNISH THE BEGINNINGS OF ENERGY.—CONTRASTED WITH MEN.—DEMATERIALIZATION OF SOLID MATTER.

WE have been dealing thus far with mental and physical evolution. We have traced the formation of a solar system and a world. We have then examined that earth step by step from a ball of gas to an inhabited globe. Again, we have patiently dug downward

miles and miles into its outer crust, and have minutely examined the strata and fossils found therein. Then we examined the surface and carefully compared living species under the light of Evolution's laws.

But now, my friends, we are to undertake a higher and more difficult task, for we are to apply the laws already discovered to the salution of that higher expression which extends beyond the physical. We shall attempt to make the investigation as easily understood as that which has gone before.

Certain fundamental principles should be thoroughly understood, in order that confusion may not arise in our minds as we pursue the higher investigation. Therefore, we will lay down these guiding principles as far as possible, now.

FIRST. *Nature's laws do not go part way and then come to an end, or substitute some other law of action.* This means, that when we find the law of evolution regulating the production of species up to the point where we have found it, we can confidently look

for the action of the same law in any higher advancement, or expression.

SECOND. *Laws are eternal and omnipresent.* That is, they have always acted and always will act, and they operate everywhere throughout the universe in precicely the same way.

THIRD. *Matter in motion constitutes energy.* That is, without motion of matter, either in mass or vibratory, we could have no energy manifested.

FOURTH. *Neither matter or energy can be destroyed.* They can be constantly transformed, but cannot be annihilated. A vibration of atoms, or molecules cannot come to a stop, in a given expression, except by being transformed into some other motion. Conversly we have the following law.

FIFTH. *No motion can exist, except upon the transformation of some other motion into it.* That is, every expression of energy in the universe is a cause, and at the same time an effect. In other words, energy must be eternal.

I presume that you are all more or less familiar with my lectures on the human soul, published in the *Religion of the Stars*, so I shall proceed as if you understood a great deal about the matter already.

The body is composed of organic atoms in a certain state of vibration.

The mind or spirit dwelling therein, is composed of organized atoms vibrating at a much higher rate.

The astral or in-dwelling soul, is composed of still finer atoms, organized still more highly and vibrating more rapidly.

All these three parts unite to make a living man; and each of them came from some preceding expression.

Just as there is inorganic matter and organic, so there is inorganic vibration and organic. The vibrations of light, heat, electricity and all such forms of energy are inorganic. Organized motion, of the higher etheric atoms, produces mind. The astral is an evolution from all lower expressions of organic motion. Therefore the astral is

simply a persistent evolution of mind. You have seen, in former lectures, where that persistance of energy as applied to the physical, produced traits and principles which have survived during millions of years. For instance, the "Quintuple Expression," as it is called. Now, the same general law of fixity acts all the way up, and the persistance of the spirit produces the astral body, *the only part of man which survives the wreck of ages.*

At first, the astral is so little advanced above the spirit, that the two are nearly in equilibrium. They cannot exist separated from each other, and one just balances the other. They can be separated momentarily, but they will rush together again instantly, or else they must be incarnated in some other newly formed body. This is the case with nearly all metallic compounds. For instance, take this plate of Zinc; this is an elementary, inorganic body. Its soul is inorganic; that is, it cannot think or act. But every atom in that plate of Zinc has its

positive and negative polarities, and its soul or inner principle, has the same two-fold expression. That double expression is the inorganic spirit and astral. To separate these two principles, we must destroy the Zinc. That is, we must "kill it," in its present body. I dare say that is a new idea to most of you. But death is only a transformation and a liberation after all, and we can subject this Zinc to the same process.

We can kill this, as "Zinc," and make it into "Sulphate of Zinc." In so doing, we liberate a certain quality, which has resided therein, which is really a metallic soul energy. It has a twofold nature, and can be made to manifest itself under proper conditions. Of course, we choose to call this manifestation "Electricity," and give its two phases the terms, positive and negative. But we must remember that such terms are only names given by science, to explain an unknown force.

As the mind is an electro-magnetic manifestation, and as the soul, astral, or whatever

terms we may use to designate it, is also a magnetic manifestation, we have a perfect right to assume that all matter is endowed with "soul energy." Further than this, we know that such soul energy is liberated on the death of a physical form, both in the inorganic and organic worlds. Besides this, we know that in the inorganic world the energetic vibration thus liberated, will re-incarnate in another compound, which is nearly enough like the one destroyed.

This is the principle of the storage battery. It is true that inorganic energy can be raised by the motion of magnets, which temporarily disturb the ether, but this manifestation is but the taking of a portion of the great earth soul for a time, to again be returned to earth. There is a low form of sex in the atoms, molecules, plants and lowest life forms. This sex principle which begins in such shadowy forms at the bottom, becomes a fixed differntiated principle in the higher forms of life. But, although regarded as fixed, there are excep-

tions, where, in isolated cases, the energy of past ages shows itself in a double sex in one individual. This is a condition common to atoms, many plants and low forms of animal life. Oxygen is a male and female atom combined. It acts as a male element towards the female atoms, Hydrogen, Potassium and several other monads. It unites with the male element Carbon as a female. In fact nearly all atoms are double sexed.

Among the various principles evoluted during all the millions of years of the past, we can regard sex as one of the most perfectly fixed differentiations in existence. When we come to consider that the very propagation of life forms depends upon this twofold differentiation, we are not surprised. Then again, when we take into consideration the fact that the attractive, or "love principle," originating in the atoms, is another strongly fixed and highly evoluted energy, and that each in turn depends upon the other. We realize that the two are "stronger than death;" that they extend into the great

beyond and follow the evolution of intelligence to the highest spheres.

THE GREAT LAW OF ENERGETIC VIBRATION.

Energy cannot be destroyed; therefore, as souls, either high or low, are energetic manifestations, they cannot be annihilated. This is the entire basis of a future state of existence.

These vibrating souls are immediately re-incarnated on liberation, unless no new body is available, which has a vibrating expression which co-ordinates therewith. If none such is at hand, the soul is liberated as an astral energy, which may manifest itself in many ways. A stick of wood has been robbed of its vegetable life energy. But it has its chemical organization, its "soul of union" of the elements, Carbon, Oxygen and Hydrogen, still intact. We drive them apart and liberate the soul force by means of fire, which destroys the organization. This energy can be re-incarnated in other motions. In fact it *must be*, as that is the law of energy.

When organization has arrived at a point where it becomes intelligence, it is but a higher form of energy. We might illustrate this by means of a telephone line and instruments, although it is necessarily a crude representation. The wire, and both instruments, are entirely filled with the normal etheric vibrations, which are unintelligent. That is, they are not organized so highly as intellect.

Mr. Andrews now speaks into one of the phones and utters words which convey intelligence: "*Say, Mr. Smith, hurry home; your house is on fire.*"

This sentence is at first an organized air vibration, pulsating in harmony with a thought vibration in Mr. Andrews' brain. This vibration imparts a corresponding one to the metalic diaphragm of the phone. That causes magnetic pulsations in the magnet, which imparts organized vibration to the normal inorganic vibrations already in the wire. At the other end the entire series is reversed, and Mr. Smith, having a

nerve, which conveys the vibrations from the air in front of the phone to his brain, is enabled to interpret the vibrations, so that he receives the intelligence.

Now, you can see how persistently that vibration, when once organized, followed through all those changes, yet remained intact. It had to traverse the domain of mind vibrations, air, magnetism, electricity and nervous vibration. Yet it remained organized to the end.

We have seen heretofore, how the persistence of principle results in certain forms. Must we stop when we come to the unseen universe of spirit and say "evolution ends here?" No! for the same grand law still persists. Souls are evolutions, just the same as are bodies, and are evoluted under the same laws.

THE LAWS GOVERNING HEREDITY.

From preceding unions of fixed energies, we inherit our physical bodies, with whatever peculiar tendencies as instruments, may be imparted to them by conditions and in-

fluences existing in the bodies furnishing the impulse and the magnetic surroundings at the time of growth and completion. The body may be adapted to certain diseases; some part may be weaker than it ought to be. It may be given a tendency to large growth or small. There may be a large space for expansion of the intelligent spirit which is to be evolved therein. Or there may be a tendency to smallness of brain room, which will dwarf the new intelligence and not allow it a good manifestation. All these are environing conditions. But there is one part which had nothing to do with all this, directly, and that is the astral. That is not an inherited quality, except as an inheritance of past ages of progress. The astral is an evoluted, energetic intellectual entity, resulting from the effect of the submergence of a long line of intelligent energies therein. In the atoms we have attraction, a form of love; selection, a form of choice, adaptability to environment and an entire conformation to mathematical laws.

In the pentad atom, nitrogen, we see a very early form of the wonderful five-fold formation which has so persisted during the ages. The element which "takes hold of others with so light a grasp and lets go so suddenly," as one chemist puts it, almost causes us to trace the analogy up even to the delicate five-fingered hand of man, with its deft quickness and power. Is it not wonderful, friends, that the very meaning of five is "sudden changes" and "change," when nitrogen compounds are noted for their sudden changes? Scarcely an explosive compound is known which does not contain nitrogen. Take the bivalent atoms, such as oxygen. Two and four stand for accomplishment and construction, union and satisfaction. Make and finish. The two hands of man are typified. All chemists know the great work accomplished through the energetic powers of oxygen and the great "construction" powers of carbon, the quadrivalent atom. One represents the desire, the wish, the want nature. Hydrogen pos-

sesses this quality. Good for nothing, in itself, as an energy of form, it rushes to its union with oxygen and "satisfies" that element and controls its energy in the union, even as a gentle and affectionate woman, unable to construct herself, should join with energetic, impulsive man and control him through her peculiar powers. Nearly all the vegetable world is made up of those three elements last named.

I have spoken thus briefly upon a subject which is almost infinite. I could extend the comparison to all the elementary atoms. I could then show the changes taking place on the union of atoms, forming molecules, but such an exhaustive enquiry would make a large book in itself. We see the same work going on to-day with men and women that begins with the atoms. First, the individual. Second, a close union with another, who attracts. Third, union with others—the family. Fourth, the aggregation of several families into a society. Fifth, union of societies into States and large communities.

This is but a higher manifestation of the atom, the molecule, the compound molecule, the looser union of the latter in still greater compounds, and those into a mass of matter. Each atom preserves its individuality, and yet is merged within the whole and bound by its governing laws.

To me it is as plain as a, b, c, that the desires of the atoms are merged in the greater and more complicated desires of the higher evolutions, which are all formed from those atoms. We have no other source from which the energies of soul force could start. Being ever existent in the atoms, those invisable potencies are the foundation of all. You will now understand why it is that molecules must be organized and constructed by lower forms of life, before they can be appropriated by man. We are surrounded by a sea of free nitrogen, yet we cannot appropriate an atom to our use. Each atom of that element must enter into combinations which will prepare it for its entry into man's economy. We need phos-

phorus, to think with. But not a speck of that can be used in our brains until it has been organized by beings beneath us in the scale. The humble oyster sucks in animalculæ and absorbs them from the sea, and these infinitesimal beings are so much lower in the scale of evolution, than is the oyster, that they are capable of absorbing phosphorescent compounds direct. We, in turn, can absorb the oyster and appropriate the organized phosphorus.

It is believed that many of the elements going to the composition of the human body pass through several organisms, from diatoms upward, before reaching man.

In considering matter in its various manifestations, we are apt to think of it as something to be seen and handled. Yet such a thought is very misleading. We should remember that atomic and molecular aggregations must be very great and much condensed before becoming visible. Air is made of three elements, mixed, not chemically united—oxygen, nitrogen and argon.

Each of these gases appear as opaque solids, under some conditions; yet, as air, they are perfectly invisible. It is believed that not an element or a compound exists but what will disappear from view and touch when its ultimate atoms are made to vibrate rapidly enough, or in larger orbits.

I am aware that a chemical and scientific view of the soul in man is not a popular one. Men have so long looked upon the spirit or soul as being something "God given," supernatural, or something intangible, or made from "nothing," that they do dislike to hear the truth. But, popular or unpopular, we must stand for the truth as we find it, and must therefore regard the soul like the body, as an elemental, vibrating, evoluted, entity.

LECTURE XV.

Onward and Upward.

THE HEAVEN OF THE FUTURE IS A HEAVEN OF ADVANCEMENT.

A SELF PERPETUATING UNIVERSE.—MESSENGERS OF THE HEAVENS.—NEW SUNS BLAZE OUT IN SPACE.—ADVANCING TO HIGHER PLANES.—THE GREAT BROAD GAGE ROUTE OF EVOLUTION.—THE GREAT LAW OF LIFE.—ABSURD BELIEFS OF PAST AGES.—EVOLUTION OF THE DEITY.—ONE RELIGION WHICH GOES ON FOREVER.

HAT is the next step in Evolution? This is the important question. It will never do for an evolutionist to set up a barier to progress. It is contrary to all the laws of nature. Neither can he set up any "end" of time, as to the universe. If any amount of "time" would be sufficient to bring everything to an end, or a state of physical and spiritual equilibrium, it is demonstrable that everything

would be in that condition now. Inasmuch as "time," or duration, *cannot have a beginning*, any problem into which time, as an entirety, enters, must be regarded as infinite. Fortunately we have abundant evidence that the universe, as a whole, is self perpetuating; that is, it renews itself by a constant round of energetic actions, and has always done so, and always will.

In this work, comets, those mysterious "messengers of the heavens," play an important part. To live suns the comets bring changes of electric and magnetic energies. To dead suns they bring new life by plunging bodily into them. Live suns repel the negative portion of a comet, and thus drive it off in the form of a gigantic tail. Comets far off in space, do not possess tails. It is only as they approach the sun that they begin to possess such appendages. But an old and worn out, cold sun, dragging its family of dead worlds in silence after it through space, does not possess the repellent powers that a live sun has. It "attracts"

with all its former power, but the other quality has departed. The first great comet which comes plunging towards such a sun, from out of the depths of space, hundreds of billions of miles distant, will make a dead shot for the center of it. It will strike the sun with all the accumulated energies of momentum. The impact alone would be sufficient to furnish tremendous quantities of heat, but, in addition to this, it would break an immense hole in the dark crust of the dead sun and let out the fiery matters from within. The hydrogen of each body would immediately flame out, and a "new sun" would be seen by astronomers in far off systems.

As a sun lasts many millions of years, we could not expect such an event to occur very often. But, among such a vast multitude of suns, there are so many dead ones that one is liable to be resurrected at any time. In fact, it is nothing uncommon for a couple of such cases to occur in a century.

In all such cases there is a "new heaven and a new earth" for some system.

But where are the souls of men all this time? Do *they* go on forever? They do. The next plane of life above the physical is but one of numerous planes—infinite planes of advancement. We keep coming to this earth of ours, as a boy goes to school, term after term, until his graduation. When we have developed sufficiently to rise entirely above and independent of the flesh, we can cut loose from this planet and rise to higher realms. But we have much to do to arrive at that degree of perfection. We must not only lift *ourselves*, but we must lift the entire intellectual and spiritual development of earthly humanity.

We can raise ourselves, individually, but a little above the common level. Therefore the general level must be raised. Individuals are like waves on a lake, surrounded by mountains. The waves may strive in vain to wash down rocks which are above their reach, or to climb to the tops of the hills.

But, if the level of all the waters can be raised, then the waves can rise to higher places.

Do not imagine you can cheat the laws of evolution and by some hocus-pocus rise to higher planes before you are prepared for them. As well might the Trilobite of the Silurian have attempted to climb a tree, as our friend the monkey did a few million years later. As well might the frog attempt to fly, like a bird. As well might the person who cannot comprehend the "secrecy" of the truth, attempt to wade through the waves, without wearing a mantle of charity, in a vain attempt to comprehend the marvelous majesty of the universe.

In short, the laws of evolution are constant and infinite. When we rise to higher planes of existence we must do it under the law of being and must evolute to the state required on that plane. When you are on the archangelic plane you must be fit to be an archangel. You must have graduated as an angel of the light and have helped others

"onward and upward" as stars in your crowns.

The old idea taught by the churches, as a relict of the dark ages, that the future state of existence is simply a great undefined "place of rest," a heaven of peace, with no progression and with nothing to make existence desirable, except to sing songs of praise forever, has done more to make atheists and materialists than all else put together. It is not to be wondered at that such ignorant ideas should repulse intelligent people. A heaven of stagnation and eternal rest, of perfection, although in the presence of a God a million miles tall, with eyes like small suns and a tongue like a two-edged flame of fire, would be worse than eternal annihilation. It would get to be a bore in less than ten million years. Then what would you do during the eternity to follow? No, friends, we believe in no such a heaven. Heaven and hell are both our portion, and they are everywhere. We have both within us, and we have only to make the latter as small as

possible and the former as large as we can. We are all traveling onward over the great broad gage railroad, which starts in the eternal past and extends into the great eternal future. Each terminal is veiled equally from our sight. Some of us travel in a day coach; some in a freight car, or even an open flat. Some snooze comfortably in a sleeper, while others revel in a palace car, and drink champaign in a gilded dining car. Some, as tramps, are glad to ride on the bumper, or the frame beneath the cars, amid the noise and dust. Some brave souls stand at the throttle and "look ahead" along the track, while others oil the machinery and shovel in the coal. Some cranky individuals even get out on the cow catcher and proudly point to the head light on the engine as *their* light. But the whole great train is thundering on towards the common goal. It passes among cleared fields of beauty and flashes over broad, sparkling streams, to again shoot into dark forests, where slimy reptiles slowly yield the right

of way. But "on, on, ever onward," is the motto, and nothing can stop the "Train of Evolution."

But oh, my dear friends, there are so many stations along this great line. All kinds of stations—little and big; and many side tracks and spurs running out into the dark forests and into bogs and morasses. How many passengers stick to the main line? Few only, for any great length of time. Some stop at the city of Self Conceit for a long time and imagine they are of great importance to the universe. Others leave the train at Scandalville and wear out their shoes very soon. Some get angry at the conductor on some part of the train and jump off in a gravel pit and spend their time hurling stones at the train. Some get off and join a gang of road agents and proceed to pile up rocks and logs on the track, in the vain endeavor to stop the train. They do delay it often, but the obstructions are removed by willing hands, and on again the train dashes. Many persons who have been

led off by some spur track into the woods, are delayed in getting back to the main line. One of the worst places along the road to delay passengers, is a place called "Vanity Fair," a town near Self Conceit. Millions of passengers are so taken up with the attractions of that town that they remain there a long time. A traveler named Bunyan once visited that place and "wrote it up" in order to warn passengers against stopping there, but the warning only helped to advertise the place all the more.

Mystics, cast your eye back along the track as it traversed the forests of the Carboniferous, or the dark morasses of the Triassic. All along the way you have seen the passengers of all grades departing from the straight line and running off. You have seen the results, as shown in our charts, where innumerable life forms left the line, never to return to it. See that you are not like they, but capable of sticking to the main line through storm and tempest, although assailed by every device of ignor-

ance and all the attractions of gilded vice.

THE GREAT LAW OF LIFE.

It is not to be wondered at that in and during the "childhood of races," men should be puzzled over the great secret of life. Knowing nothing, or next to nothing, regarding the great secret of the universe, evolution, they were naturally thrown back upon the assumed theory of special creations. Not possessing the "golden key," they failed utterly to unlock the secrets of nature. Intuitively they believed in a future state of existence, but that existence was filled with the most wonderful and grotesque mass of absurdities which could be conceived. Gods and devils, hells and heavens, brimstone and fire, winged angels and cherubims, all with no visible means of support, peopled the unknown and illimitable space about us. The "bottomless pit" was well named, for it, like the entire system of fables, was "bottomless" indeed. Poor man! How thou hast tortured thyself in thy ignorance. And to-day, in this enlightened XIX Cen-

tury, how much better is man's condition? Some better, for the work of evolution has been going on steadily. Civilized man has discarded the gods of stone and wood, before which he formerly gashed and tortured his poor flesh, and has set up a great tyrant in the high heavens for his worship. Do you know why? Simply that in the course of mind evolution, intelligence arrived at a point where almost anybody could point out the utter absurdity of a stone god being of any use. The next stage of progress, large numbers of potent gods ruled the world. This was during the Grecian period. It took a very smart man in those days to even remember a small percentage of the gods' names. Finally this got too transparent and men could see the absurdities of the system. So great Jove and all his contemporary gods and goddesses were dethroned from the heavens and the Jewish Elohim took the power. But, in time, this cruel being began to change, to evolute. At first he was only "above all other gods." He was the "God

[illegible] somewhat [illegible] I [illegible] them. [illegible]

[illegible] admitted [illegible] changed [illegible] more humane [illegible] monster [illegible]. Even [illegible] has come in for a share in the work of evolution. There are grave suspicions in the minds of church members that hell is not so hot after all. That "eternal punishment" is not exactly eternal. The most zealous and morose old Deacon, with a bump of conceit on his head as large as a turnip, can not but realize that even he would be satisfied to have his worst enemy burn in fire twenty or thirty thousand years, and leave out the sulphur at that. But only a century ago men believed in all that is horrible as they could believe in anything.

GOD HIMSELF IS AN EVOLUTION.

This statement must be readily admitted by all unprejudiced students of ecclesiastical history. The God of one age will not fit the

needs of the next any more than the stage-coach of sixty years ago could fill the needs of to-day. The heaven believed in to-day would be useless as a place of happiness a thousand years hence.

But there is one God and one heaven which will suit the people of a thousand years hence, or ten thousand years ahead, on this planet or on another. One religion which will be the same to-morrow and forever. That God is the infinite intelligence of the universe, Om. That heaven is the future state of constant progression to all eternity.

That religion is the scientific truth of the ages, which is true here and everywhere, which vibrates like the light waves, from planet to planet, from star to star, from cluster to cluster throughout the universe; *The Religion of the Stars.*

SOME REMARKS REGARDING THIS ANCIENT ORDER.

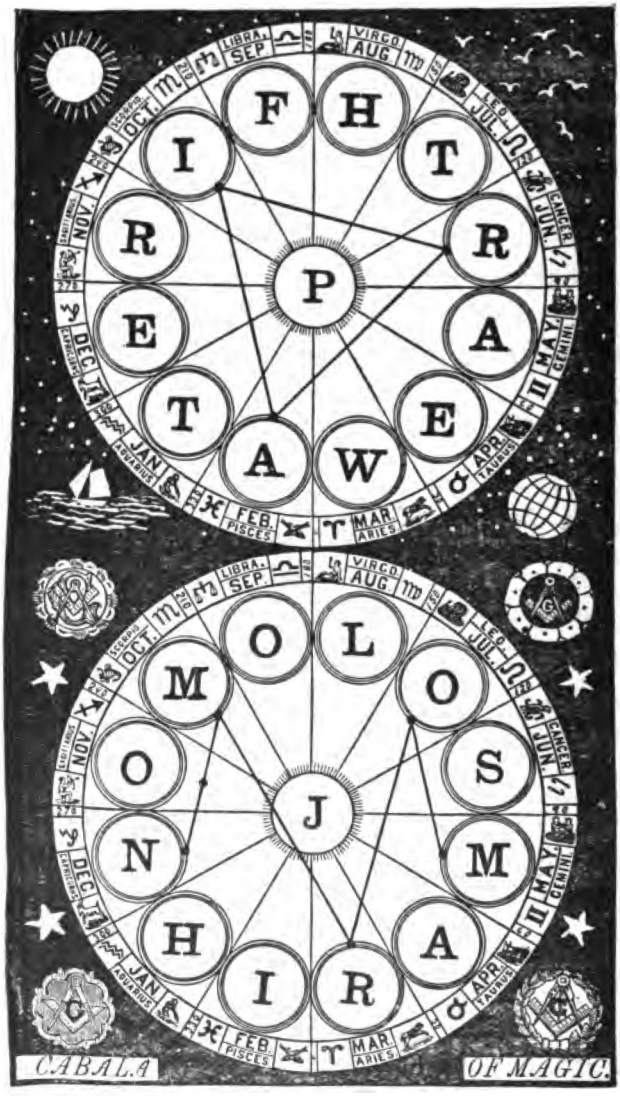
THE order of the Magi is the oldest secret society in existence. Members of this society, from the kingdom of Atlantis, were the founders of Egyptian Mysticism and the instigators of the first grand monument to the stars, the great pyramid of Cheops. This pyramid was

calculated and built under the auspices of the astronomers of the Mystic Brotherhood. Other pyramids were constructed later, by various kings, simply in imitation of the first.

The secrets of the Brotherhood have been handed down from one sworn member to another, and the time waited for when the earth should again arrive, by evolution, to the point where the work could be reinstated.

Science, alone, has always awakened the bitter antagonism of the champions of superstition. But, when mystic philosophy and religion are also coupled with science, we cannot expect anything but the most terrible opposition. Events have fully justified this view; for, advanced as the XIX Century is, we realize that humanity is hardly prepared for mystic truth.

Enemies arise on every hand. Friends betray, and many violate the most solemn obligations, under the maligne influences about them. One hundred years ago death


LIBRA SEP.
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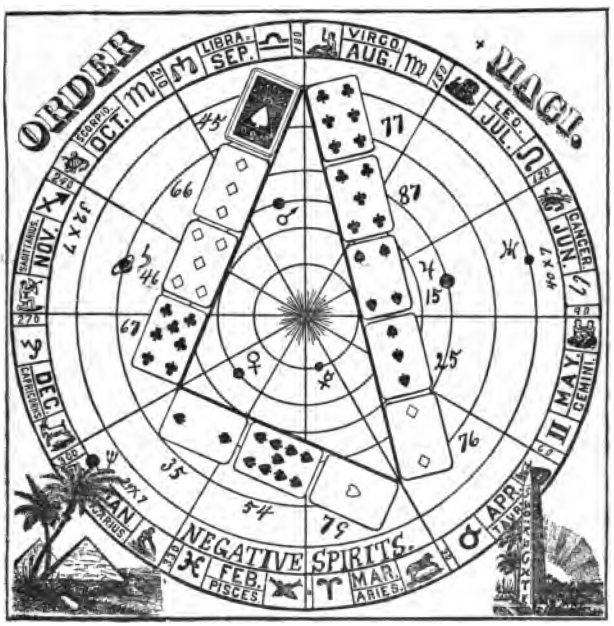
ARIES MAR.
PISCES FEB.
AQUARIUS JAN.
CAPRICORN DEC.
SAGITTARIUS NOV.
SCORPIO OCT.
F H I T R R P E A T E A W E
O L M O O S J N M H A I R
CABALA
OF MAGIC.

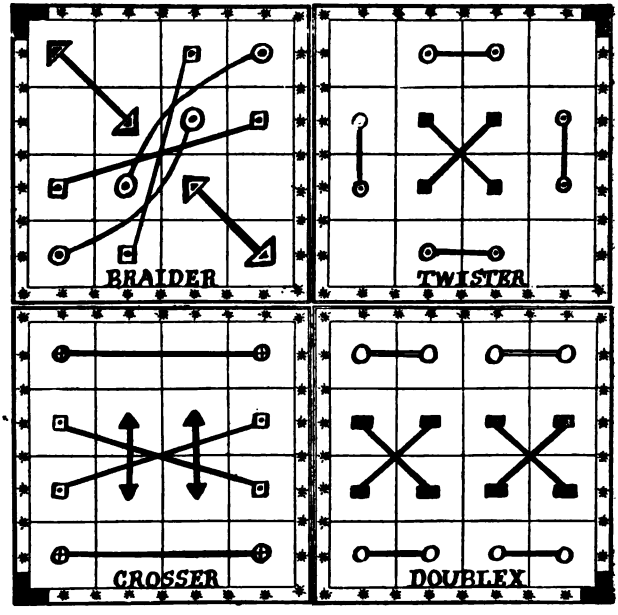
would have been the portion of the teacher of mystic philosophy. To-day we have evoluted some, for bitter enmity and treachery, falsehood and vituperation are about all we need expect.



MAGIC TRIANGLE FROM MYSTIC TEST BOOK.

The Order of the Magi is so called from the fact that it is devoted to study, not of miracles, but of real magic and occult laws.

White magic, or "Innocent Magic," is that which has no malicious intent and is not designed to injure others, or the one who practices it. The study embraces numerous lines of thought. It deals in the marvels of numbers, geometry and the spirits of numbers. It deals in mystic squares, triangles, crosses and various phenomenal illustrations which exhibit wonders in figures.



TAROT CHART FROM MYSTIC TEST BOOK.

Among other wonders on our planet we have the "little book," called the Test Book, which is known to out-siders under the modern name of playing cards. This, in itself, is a marvel of magic, co-ordinating as it does with the numerical relations between man and the solar system. This is all explained in the work called the Mystic Test Book.

THE CHART OF XIX CENTURY FACES.

In this chart we have men and women of all sorts of professions and ranks in life—princes, presidents, printers, dukes, millionaires, hotel clerks, athletes, writers, speakers, preachers, reformers, ladies of society, political leaders, and many others. They are mixed together in one view as a fair record of the people of to-day. I wonder how many of them you can name from the pictured faces.

Another branch is the "Cabala of Magic," which is a tremendous department by itself. This deals in the magical properties of names in combination, together with certain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sentences of importance. The revelations by means of the Cabala are wonderful. We give a few specimens of the charts used in the various lines. Of course, astrology, being an occult science, it has always been held in high repute by the Magi. But it, like everything else, is regarded by them as simply an expression of the natural law. Unless all the universe is a miracle, we recognize no such thing.

We believe that all scientific truth is a part of the true religion; that natural science lays the foundation, while occult science leads us up into the unseen or spiritual universe. We believe in goodness, purity, kindness, love, harmony and charity. Peace on earth and in heaven and good will to all.