HEREDITY

AND

HYBRIDISM:

A SUGGESTION.

BY

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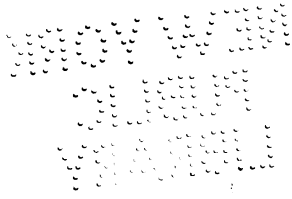

★ Dr. JOHN S. BILLINGS.

INTRODUCTION.

In a little book, now out of print, entitled "What am I?" published two years ago, the design of which was to present a popular sketch of a Man, his mental physiology and psychology, the course of thought was necessarily directed backwards to the first stages of human existence. Seeing that a man *is* and *what* he is, the question could not be evaded, *how he came to be*—what was *the very first stage* of his being?

Upon this followed other questions, scarcely less important or more neglected by science.—Whence came *the germ* of the Man?—What was its structure?—How did it grow?—How was its shape moulded?—What life is?—How the man lived and why he died? It was while pursuing these inquiries—especially in reference to the expansion of the seemingly shapeless germ into the complicated structure of the Man—that my attention was attracted to two very singular facts,—

1st, that *two* parents are required for the construction of organized beings, and, 2nd, that organized beings are of *duplex form*, that is to say, not shaped as one whole, but of two distinct halves joined together, and those two halves always differing from each other more or less.

The next question that presented itself was—if there be any and what connexion between these two facts?

Investigating the theories of reproduction, I found that two only had prevailed. The first attributed the germ of the offspring, that is to say, the offspring itself, to the mother; the father being supposed to contribute merely a vivifying *aura*. That a father was required for the production of the offspring was undisputed, and as it was necessary to account for this, the theory of an *aura* was invented and accepted without the slightest consideration given to the facts—as, indeed, theories are wont to be, even by scientists, because it is more easy to invent a theory than to investigate facts. But as *the facts* began to be noted, this convenient assumption was found to be inconsistent with many of them and especially with those presented by vegetable physiology. Then the second and latest theory was propounded—that the germ is

provided by the father, and that the mother supplies merely its cradle and nutriment. This removed many of the difficulties attendant on the *aura* theory—but it left unexplained some other facts, especially the duplex structure of the body, the inheritance by the offspring of the mental as well as the bodily characteristics of both parents, and the curious phenomena of Hybridism.

Reflecting upon this, it appeared to me that the difficulties thus presented would be at once removed if the fact were that, instead of the offspring being a single germ produced by one parent only, it were formed by the junction of *two germs*, one contributed by each parent. On this suggestion, the cause of the duplex structure of the body, of the duality of the mind, and of the junction in the offspring of the mental and bodily characteristics of both parents, became instantly apparent.

If true, would it not be found to solve the problems of HEREDITY and HYBRIDISM?

The more thought I gave to it, the more extensively and closely I compared the facts with the suggestion (and I offer it as a *suggestion* merely), the more I was satisfied that it had in it some

substantial truth and I ventured to submit it to the consideration of the readers of the treatise I was then writing.

The book itself received but scant notice from the reviewers although, strangely enough, it found such favour with the public that an edition of 750 copies was exhausted in nine months. The suggestion of structure by two germs, as being the solution of many hitherto insoluble problems in Physiology and Psychology, was received with considerable approval by a few of its reviewers, and by many of its readers. Numerous communications were privately made to me by Scientists whom the question had interested, and who professed their opinion that it well deserved further consideration, for that, if it be the fact, its importance to practical as well as to theoretical Physiology and Psychology could not be exaggerated.

Encouraged by these expressions of approbation I brought the subject under the notice of the *Anthropological Society* in a paper on "Hybridism," which provoked considerable discussion, the eminent Physiologists present recognising the importance of the question. It was admitted that a strong *primâ facie* case had been made for the suggested explanation of the hitherto unac-

countable duplicity of the structure of organized being, but reserving, of course, decided opinion on a proposition so novel, until further investigation and more thought could be given to it. But all agreed that it deserved the most careful consideration.

In the volume that first contained the suggestion, there was no space for more than a short statement of it, with a few of the many facts on which it was founded. The paper read to the Society was necessarily limited in length and therefore the utmost brevity of treatment was adopted. The references to the like structural scheme in animal and vegetable forms were few and the question was consequently very imperfectly presented.

Hence the production of this more formal treatise, in which an endeavour is made to present a larger view of the subject. But still it is an outline only, nothing more, indeed, than a mere sketch of it being practicable to myself. But I venture to hope that, if the suggestion should be approved by some who enjoy more leisure, they may be tempted to take it into their charge and make an extensive application of the facts to the theory,

with purpose to see if it will endure that, the only sufficient, test of scientific truth. I trust that I may venture thus far in the assertion of its claim to consideration that, unlike the previously recognized germ-theories, it is not merely a theory, but is supported by a large number of *facts.* The old notion of a *vivifying aura* is a pure conjecture. The later theory of a paternal germ moulded in a maternal matrix is little better, for it leaves wholly unexplained the phenomena of *Heredity* and *Hybridism.* It may be at once admitted that direct proof by scalpel or microscope is probably impossible in any case. The structure of the actual ultimate germ of an organized being—the *point* which constitutes the germ of the individual man, or beast, or plant, before it begins to be developed—is probably too minute to be perceptible to our senses, even with the aid of the most powerful instruments of science. But not the less is its existence a certainty. There must be a beginning before growth—a something that grows. It may be inconceivably minute, but our limited senses at their utmost range can perceive only a very small circle of the boundless creation by which they are encompassed, and beyond which circle of our sense perceptions lies the infinitely

small as well as the infinitely great. Our knowledge of those imperceptible magnitudes and diminutives alike can be obtained only by inference from the facts and phenomena that come within the range of our perceptions. By investigating these we are enabled to deduce probable conclusions as to forms, forces, causes, and facts, which our senses are unable to perceive. This is the rational and really scientific course alone to be adopted for the examination of the first stage of existence in organic structure, and this is the task to which I invite the reader.

I need not say, perhaps, that I have adventured to submit this suggestion of the *structure of organized living forms by the junction of two germs*, with a perfect foreknowledge of the fate that attends whatever is new, alike whether it be visionary or substantial. Whatever disturbs accepted theories is offensive to the holders of them. Dogmatism is not the failing of one class alone. The dogmatism of Scientists is at least equal to the dogmatism of Theologians, with less excuse, inasmuch as Science *professes* to be progressive, while Theology rightly boasts its fixedness. If silent contempt will kill a new heresy, it is the readiest method of suppression. If

the heretic voice is heard nevertheless, the next weapon is abuse and ridicule. Happily the thumb-screw and the stake are for the present out of fashion, although for how long they will continue to be so may well be doubted in the present revival of religious rancours. But the moral rack is even now not spared in scientific controversy, and imbecility or insanity is freely charged upon those who disturb the self-complacency of men who have staked their reputations on their own dogmas. Facts are denied. Inferences are disputed. Whatever tells on one side is paraded with pride; whatever weighs for the other side is declared to be a deception or a delusion. If, in spite of all endeavours to put it down, the new truth lifts its head by virtue of its own inherent strength and worth, they who denied and denounce it say that it is *not* NEW—that it was known ages ago. Then comes the final weapon. "Of what use is it?"

This is the ordeal to which novelties in science are invariably subjected, and the process is so universal that some good purpose is probably served by it. Perhaps it is that due investigation by argument and discussion may be compelled before the judgment is pronounced. Probably it may be in accordance with the law of develop-

ment, that permits only of progress by slow steps. However it be, I have not resolved to send forth this suggestion to the world without being prepared to see that fate attending it with which experience has already made me familiar, and to which, truth to say, I have become somewhat case-hardened. I offer it for what it may be worth. I shall not be disappointed if, on due examination, it should be found to be without foundation; but I shall be well pleased if it should ultimately be received as a truth whose recognition may throw some new light, however small, upon those most obscure problems of Physiology and Psychology —the phenomena of *Heredity* and *Hybridism.*

EDWARD W. COX.

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HEREDITY AND HYBRIDISM.

WHEREFORE are *two* parents required for the production of organised structure having that self-contained and self-directing power we call *Life?*

Recognising the great truth that Nature* always employs the most direct and simple means for the attainment of her ends, the scientific equally with the popular mind would certainly have pre-supposed that the reproduction of a living organism by another organism similar to itself should be a power possessed by that organism alone and that the product should be a perfect likeness of the parent. This would be the most simple and

* Desirous to avoid theological controversy, I use this term as a conveniently neutral name by which to designate the *force*, whatever it be, that moulds matter. I intend by it the creative power, the potency which, according to Dr. Tyndall, there is in matter for every form of life—the potency of something other than matter, as it appears to me; the unintelligent force the Professor can only find—the intelligent Providence I cannot choose but see.

obvious method of propagation. The undeveloped *germ* might be a *fac simile* of the parent, but innumerable circumstances during the years of growth would certainly modify the resemblance and bring about extensive variations.

There is, undoubtedly, what appears to be a waste of power in the requirement of *two* parents for the production of that which might have been more readily produced by *one*. But as Nature never wastes power nor works imperfectly, it may be reasonably concluded that some design of vast importance is involved in this universal requirement of *two* to accomplish what might well have been the work of one.

Instead of the simplicity of plan and directness of action observed in all the other operations of Nature, we find that in this supreme exercise of creative power two parents are required for the reproduction of organised life. The law is almost, if not entirely, universal. There are some apparent, but few, if any, actual exceptions. The process of fertilization may be hidden from the eye of the observer, or it may, as in some of the lower forms of life, extend to two or more generations, or it may be performed by a species of hermaphroditism. But it is a natural law that *two* parents shall be required for the structure of an organized being having life, whether it be animal or vegetable. Man is not exempt from this law. If there be excep-

tions, they have not been discovered, or, at least, their existence has not been decisively proved.

The universality and inexorableness of this law of organic life appears to indicate the presence of some overpowering though unrecognised cause, peculiar to organic structure, for it is found to govern that structure only. The living form alone demands two parents for its production. Apparently there has been a departure from the most simple and direct scheme for the most indirect and imperfect. Is such a cause anywhere to be found? Is any peculiarity of structure to be discerned that will explain the resort to a process seemingly so clumsy and needless? That is the question to be here considered.

But before we proceed to this inquiry, it would be desirable to take note of some other considerations that may help to explain the facts to be presented.

Foremost of these is the great fact of *the resemblance of the offspring to the parent.* A sheep always produces a sheep, and not merely does it produce a sheep of some kind, but a sheep of the same kind as herself, subject only to certain modifications that will be treated of hereafter. Nor this only. The offspring is also a sheep bearing more or less of *personal* likeness to the parent. From this it may be reasonably concluded that the process is not, as we are accustomed to consider it, the production of a *new* life, but, as it has been

correctly termed, although not in the same sense, a process of *reproduction*. The lamb is not wholly a new being, but an offshoot from, or continuation of, the life of the parent, precisely as the bud is an offshoot from and continuation of the life of the plant. Between the sheep and the plant there is, however, this marked difference; the lamb is severed from the parent after a time definitely limited and then maintains an independent existence, while the offshoot of the plant continues its bodily connection with the parent until they are forcibly severed, when, if placed in the conditions necessary for growth, the bud becomes an independent being and is able to maintain its existence for at least the natural term of its life; that is to say, for the time during which it would have lived if it had continued in bodily union with its parent and no accident had cut short the existence of that parent. From this the *probable* conclusion (for it yet remains to be *proved*) is that the germ of the lamb is extruded from the organization of the sheep much as the bud is extruded from the organization of the plant, and that its life is a continuation and a part of the same life, animating an organism the germ of which was in the parent. The probable suggestion would be that, *cæteris paribus*, (that is to say, if no circumstances intruded to modify the result) the offspring should be an exact repetition of the parent. This, indeed, appears to have been the conclusion announced by Dr.

REDFERN in his admirable address at the meeting of the British Association at Belfast in 1874, as shown in the following passage:

> Yet with all this change there is an invariable transmission of the parental characters by continual descent from particle to particle as each takes the place of a former one, and thus each organ continues to discharge the same functions from year to year. Animals of the same kind retain the old number of organs, the same shape of body, and similar modes of life. There is no sign of commencing life, no coming of new vital power, no production of life out of living matter. The original life extends its limits; it operates in a more extended sphere, but it is the same life; it operates in the same way; it never fails to be recognizable in the individual by the same character as it had when it was first known. Whatever other functions it discharges, it acts continuously in obedience to the first great law, it increases, and multiplies, and replenishes the earth.

But we must pursue this inquiry another step. How the germ is eliminated from the organism, and how it is produced or introduced there, we are, as yet, wholly ignorant, because we have neglected to inquire. Its presence there, however, is certain. Conjecture may be permitted in such a case, if it be accepted as conjecture only; and the suggestion I venture to propose for the consideration of Science is,—if it may not be that the germ is thrown off from the nerve structure (which is the animal, in fact) by a process nearly resembling that of gemmation as actually seen in the lower organisations and notably in vegetable life;—that the germ so extruded is taken up by the blood and eliminated from it by the gland whose special office

it is, and in that vessel awaits the occurrence of the conditions necessary to its development into a living organism?

There is another suggestion which, in the present imperfect state of our knowledge, may be entitled to consideration inasmuch as it certainly reconciles many grave difficulties attendant upon the former one. I offer it for what it may be worth, *as a suggestion merely*. To make it clearly intelligible to the reader, I must ask him to carry his thoughts still further backward into the elements of things. Whence the germ of the future being? Trace an organised structure, whether of man, or of animal, or of vegetable, from its first perceptible existence through its expansion and growth to its maturity. No point of time and no condition can be indicated, upon which even to hazard a conjecture, as being that in which the germ of the future offspring is first lodged in the structure of the parent. Unless this be effected by some direct act of creation from without (an hypothesis not to be entertained, when it is remembered that the same direct interference would be required in the production of all germs, not of man only, but of every rabbit, mouse, bug, gnat, and cabbage), the conclusion is inevitable, that if the germ comes into the parent from without it can only be through the medium of the air breathed or the food eaten. But the whole body of the parent is constructed of the particles that

composed the beef and bread and other materials of its dietary. Even in the womb the offspring is fed by the food of its mother, as afterwards in the cradle. If the germs of the future progeny come to the parent from without, they *must* be contained in his or her food. But the ox borrowed his flesh from the grass. If the germ of the man came from the ox, it must have existed in the vegetable that supplied the material for the flesh of the ox. The grass, in its turn, obtained all, or the greater part, of its own substance from the mineral stores of the earth and the gases that are in the air. If, therefore, the germ was in the grass, it must have come from the earth. Thus, by a direct and not distant link it is distinctly proved that, if the future germ is not in the parent germ, but is introduced into the organism after its growth begins, it must have come from some other source—animal, vegetable, or mineral—unless, indeed, we accept another suggestion, more familiar to poets than to philosophers, that every germ contains within it all future germs, as it was said of the acorn:

> And countless forests slumber in a shell;

—a pretty fancy that will not bear the disenchanting touch of the wand of science.

Now if it be that the germs of the future progeny are taken into the organism of the parent with the food, the question at once presents itself,

how it comes that the germs of men are latent in the earth so as to pass from it into the vegetable, thence into the animal, and thence into the man? But such an hypothesis involves yet a greater difficulty; for, if this be the true history of a germ, it follows that the germs of all organized beings are identical and that it depends upon the conditions under which they are developed what they shall become when brought within the nerve influence of a living organism; if of a human being, that germ taking the shape of a man; if of a sheep, becoming a lamb; if of a cabbage, growing into a kale. This is sufficiently improbable.

But there is a practical objection to it in the fact that, alike with a man, a sheep, or a cabbage, the developed germ bears an *individual* as well as a tribal likeness to the parent by whom it was assimilated.

Thus, then, by a process of exhaustion, we find ourselves reduced to *two* alternatives of origin for the germs of organised beings. Either,

1st. There is a homogeneous germ of life, common to all organized beings, which is scattered profusely everywhere, brought to us in our food, and thence absorbed into the organism, eliminated by it, and when finding the necessary conditions for growth taking its form and character from the nerve organization with which it is associated; or,

2nd. The germ is *not* a distinct individual, nor a new creation, nor in its vivification a new being; but it is an offshoot from the nerve organisation of the parent, probably thrown off by a process somewhat resembling that of gemmation in vegetable life, and which is often visible to us in the manner of reproduction by the lowest form of animal life; being, as Dr. REDFERN asserts, a mere continuation of the same individual life, a part severed from it and thenceforth maintaining its own* separate existence, itself again dividing and reproducing *fac-similes* of itself, and so forth, indefinitely, until disease or accident destroys the organism or renders it unproductive.

There is no apparent necessity for this co-operation of two parents in the production of an organized being. For aught that science can discover, reproduction might have been accomplished by the ostensible parent alone. If the germ is the product of one alone of the two parents, and the other parent supplies but an aura to vivify, or a

* This was not my view of it when I wrote the treatise "What am I?" I then maintained the derivation of the germ from the food eaten, and traced it back to the mineral composition of the globe, and thence concluded that the same germ took any organized form, according to the cradle in which it chanced to lie. Further reflection has satisfied me that the more probable process is by division and separation from the parent, and that it is in fact the continuance of *the same life* as that of the parent. The very interesting and important consequences of this hypothesis, if correct, will be considered in a future part of this treatise.

cradle to nurse (which are the only two alternatives as yet suggested by science), there is no conceivable cause why the real producer of the germ should not have brought it to perfection without such elaborate contrivances as are actually resorted to. Noting the simplicity which prevails in every other work of Nature, and which becomes the more apparent the more perfect our acquaintance with her, it is impossible not to suspect some lurking fallacy in a theory that attributes everything to the one parent who conceives, nourishes, and brings forth, and almost nothing to the other parent. Is it not probable that more may really be contributed by that other parent than hitherto has been assumed?

Nevertheless, although the *primâ facie* probabilities point to the conclusion that the father is at least equally potent with the mother in the process of production—and there is a mass of facts, otherwise altogether inexplicable, that tend to confirm this conclusion—the scientific dogma seconded the popular notion. For ages it was asserted, as an unquestioned truth, that the mother was at once the producer and the nourisher of the germ, and that the father contributed nothing more than a conjectural undefined, imperceptible aura, or vitalising influence, —(of whose existence there was no proof)—by which it was that the germ supplied by the mother was first stimulated into life, afterwards to be

moulded, mind as well as body, by the mother, and by her to be brought into the world constructed wholly of the material she alone had supplied to it! No less strange, and altogether inconsistent with the assumption, was the fact that this production of the mother alone was often found to partake as much and often more of the shape and character, bodily and mental, of the parent who provided merely the supposed aura, as of the parent by which that new individual being was produced, fed, nursed, and structured.

The absurdity of a theory which had held almost unquestioned sway for centuries was first seen when Physiology began to trouble Pharmacy and to put to flight the many fallacies in which the Doctors had indulged. No attempt had been made to prove the existence of the asserted aura, nor to define what it was, nor how it operated, nor in what manner it could possibly mould the bodily structure of the embryo or impart to it *mental* characteristics. The more rational and probable hypothesis began to make its way slowly to adoption, that the father supplied the germ and that the mother was merely its nurse. This explained some of the difficulties attendant upon the *aura* theory, such as the combination in the offspring of the mental and bodily characteristics of ***both*** parents. But it left many more unexplained.

This solution of the problem, however, appears

to have been accepted by the very few who troubled themselves to give any thought to the question, and it is one of the perplexities of Science that they should be so few. *A priori* it would be conjectured that the first and most eager inquiries, not of scientists only, but of all educated minds, would have been directed to *themselves;* that the knowledge most anxiously pursued would have been that of their own structure; how they first came to be; how they were introduced into the bodies of their parents; how they grew; what the intelligence is and what its relationship to the body; by what process they think and feel; what is the mechanism of the mind and how it is moved and directed; how life is sustained; how disease comes, and what it is, and how it can be cured; by what process the machine falls into decay; how it dies; what becomes of it when it dies; if there be a soul as well as a body; if the soul dies with the body, or if it lives after the death of the body; how and where it then lives, and what are the conditions of its new existence. These are not merely speculative questions about which we may, as Professor TYNDALL preaches, amuse ourselves with hoping and imagining, without possible means of ascertaining the truth. All of them may be examined as *physical* questions, and ascertained by scientific experiment as *facts in nature* to be observed, and tried, and proved, precisely as are all

other *scientific* facts—as we show the existence of the sun, the presence of the magnetic force, the physiology of a plant and the structure of a stone,—testing them and proving them *scientifically*, apart from the dreams of poetry or the dogmas of theology. This, I repeat, might have been anticipated of any beings endowed with reason and reflection, memory and forethought. But the fact is otherwise. Not merely have these subjects of momentous personal interest received no greater attention from the scientific and the cultivated than others of infinitely smaller moment to mankind, but they have been treated with far less of notice and regard than other branches of knowledge. More minds have been occupied in learning the history of a stone than the history of the human body; more thought has been given to the propagation of a plant than to the origin of a man. More time and intelligence have been devoted to the composition of a comet than to that of ourselves—whether the comet has a nucleus, and what it is, than whether *we* have souls and *what they are*, of what that soul is composed and what are its capacities and destiny.

At this we can only wonder, and ask, why it is? But it is not the less a duty to endeavour to attract some degree of attention to these subjects by showing how much of interest attaches to them, apart from their immediate bearing upon the wellbeing and progress of humanity.

The very foundation of the study of man, as an individual and in society, of *Physiology* and *Ethnology*, and of the larger and vastly more important science of *Psychology*, is the subject now under examination. What is the source and beginning of life? How do we come to be? By what process are we so structured? These are surely inquiries of the highest interest. Yet they have been the most neglected of any. Their determination more or less affects all the other branches of Physiology; but all the rest have been preferred before it.

We have arrived then at this point: *All organized structure* above the very lowest (and probably that also) requires for its production the *junction of two distinct organized beings.* In whatever manner this junction is brought about, the result is the same. Every organized structure above the lowest has *two* parents. One such organized living thing cannot reproduce its like without something being contributed to the structure by another organized living thing having a certain degree of affinity with it.

Assuming the offspring of organised being to be but the germ of another organised being vivified, it has been for ages a disputed question by which of the two parents that germ is produced;—if by the parent in which it is apparently lodged and by which it is borne, nourished and brought forth, or if by the parent who apparently does nothing

but impart life to the germ, which cannot be developed without the aid, whatever it be, of that vivifying parent.

For centuries the universal opinion of the few scientists who cared to think upon the question was, that the germ was in the mother, who found for it a matrix and nourishment, and that the other parent effected nothing more than the stimulation of that germ into life.

But how it was vivified, or why Nature should have resorted to such a needless complication to produce a result (if that were all) which might so much more readily and certainly be produced by giving the power of vivification of the germ to the parent who produced and nourished it, appears never to have occurred to the few who troubled themselves—if any did—with thoughts upon the question.

In recent times, however, opinion upon this point has changed, mainly by reason of investigations into the manner of propagation by plants; and now it has been accepted, almost universally, as being the more probable, if not positively proved, that the germ of the future organised being is supplied by the father, and that the mother provides merely a cradle and food for that germ.

This theory removes some of the most formidable of the objections that presented themselves in overwhelming array against the theory of a maternal germ vivified by an aura from the other

parent, for it does not leave altogether unaccounted for the fact that the offspring is seen to resemble the father as frequently as it is like the mother. That a mere aura could stamp upon a mere germ such characteristics as the shape of a finger-nail, or a talent for music, was so monstrous an absurdity that the marvel now is how it ever came to be accepted for a moment by any rational being. But every day reveals the profound ignorance of physiology that prevailed even among the scientists of a century since, and which is still but slowly being dispelled. It is at least conceivable that, the germ being from the father, it is stamped with his characteristics and that it is impressed with those of the mother also, more or less, according to circumstances arising in the course of her contribution to the development and growth of that germ. But a few only of these characteristics can be thus explained. Many remain for which no sufficient cause can be assigned upon this theory alone. Something more is wanting to complete the explanation and to cover all the facts. We have doubtless thus advanced some way towards the solution of the problem, but we have not reached the whole truth.

Such were the steps by which, while giving to this subject the thought required for the description of "a Man" designed in a little treatise published not long ago, I arrived at the conclusion that something further yet remained to be investigated

before we could understand clearly how the man, as we see him, could come from the germ, as Science supposed (for it did not *prove*) that germ to be.

Then it was that the fact occurred to me that man is a duplex structure—that is say, that he is not formed of one whole, but of two distinct halves, joined together—that he has two sets of bones, muscles, nerves, and two brains. True, there is but one head, liver, stomach, and intestine. This at first sight seemed an opposing fact. But further examination showed the internal structure to be substantially the same as the external frame, the only difference being that the position was reversed, and instead of the point of junction being side by side, as with the framework of bone and its appendant muscles, it was, from the necessity of its position within the body, and the requirement of one heart, one liver, &c., only a junction of two halves before and behind. Tracing these internal parts from their point of union with the external frame at the neck, it will be seen at once that one-half of the whole springs from one side of the body, and the other half from the other side, and that they unite at a median line throughout, precisely as two halves of the external frame are united. That which was at first advanced by some of the dissentients as being opposed to my suggestion of *a Double Germ*, further investigation has proved to be a confirmation of it.

But even if the fact were not so, unity of the intestinal apparatus would in no way affect the combination indicated by the manifest duplicity of all the rest of the structure; for it might well be that the duplex nerves uniting for the formation of the internal parts (the heart, stomach, lungs, &c.), should produce a homogeneous structure, instead of two distinct and differing parts put together; so that the argument based upon these assumed facts would be of little or no weight even if the assumption were true.

Looking beyond the human structure, it will be seen that all organised being is built after the same fashion. It will be found, on close inspection, that all other animals are so made; and so likewise are all vegetables. Every leaf is duplex; so is every part of a flower. All organised being is, in truth, formed of two halves joined together at a median line. Nothing organised is structured as one whole, as is the scheme of all inorganic Nature.

Observing these facts, the question occurred to me, Wherefore this remarkable method of constructing an organised being? Why is it always and everywhere, from the highest to the lowest, from the most complex to the most simple forms, duplex, and not, as any sculptor, or scientist, or human artificer would have made it, one whole instead of two halves joined together? There must be some substantial reason for this. There must be some

powerful and universal cause to produce this universal effect, for which there is no apparent motive and by which no reasonable purpose is served.

Then I bethought me—is there any other universal fact which might have some bearing upon this universal fact?

Reflecting, the thought occurred to me that there is such a fact;—a fact equally inexplicable by any useful purpose for it that can be discerned —namely this—that *two parents are required for the production of every organised being.*

Is there, then, a connection between these two great facts in the architecture of organised being —the *requirement of two parents and the duplex structure?*

The conclusion instantly flashed upon me These two great facts in animal and vegetable physiology stand in the relationship of cause and consequence. They explain and supplement each other. The double structure is the effect of the double parentage. The twofold parentage produces the double structure. Two parents are required, because the body is constructed of two parts. It was admitted that each parent contributed something to the formation of the offspring, but we did not know what it contributed. I am not aware that even conjecture has ever attempted to assign the part contributed by each parent so as to afford a rational suggestion of the manner in which the

result is brought about. *A double structure by the junction of two germs*, one contributed by each parent, clearly explains all that was inexplicable in the ancient theory of mere vivification or nursing.

Thus came the first idea of structure by the junction of two germs, instead of the mere development of a single germ, which I ventured to offer to the judgment of other minds,* but which, encountering the fate of all novelties in science, was received with warm approval by a few, but with almost angry denunciation by the many, who manifestly looked upon it as a heresy, to be suppressed by silence or scared away by abuse.

If two parents are required, each to supply something to the structure, as is the undisputed fact, there can be no cause to conclude that one contributes more than the other. If not, and they contribute equally, inasmuch as we know certainly that one contributes a germ of the future being, is there any ground for supposing that the other contributes something not a germ or of less importance than a germ? If so, the conclusion would be that in all probability each parent contributes a germ.

But *two* germs: how are they to be disposed of?

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* In a treatise entitled "What am I? a Popular Introduction to Mental Philosophy and Psychology," in 2 vols. (Longman and Co., 1873), now out of print.

Why two to form one being? How are these two germs to be combined in one structure?

Examination of the structure itself supplies the answer. There we find a clear explanation of the cause of the duplex structure of organised being, man, animal, and vegetable These are obviously, as we should in such case expect them to be, compounded of two germs, and if so structured, there can be no question that one germ is supplied by each parent. Hence the scheme of the structure is not by the carving or moulding of one homogeneous form, as would be the manner of making a structure the product of one being alone, but by the putting together of two distinct halves, which would be precisely the plan to be pursued if the structure were formed by the junction of the distinct products of *two* beings. From this arises that otherwise inexplicable fact, the necessity for the combination of two parents for the production of one organised being. We shall see presently in what manner this contrivance secures many most important objects attainable only thus.

Let us now inquire to what extent the facts confirm this antecedent probability of a double germ.

The manner in which the junction is effected is plainly to be seen by the least curious eye. Each half of the frame is joined to the other half at a median line.

But what causes their general uniformity, their

common growth, in due relationship one to the other, the union, not of form only, but of vitality and of mental function, so as to constitute of the two distinct halves one distinct individuality in appearance, in consciousness and in mental action?

By a simple process of whose objects and uses physiologists have hitherto confessed their entire ignorance. The result has been attained by the crossing of the nerve system from one side of the body to the other. If the body be structured of two germs, this simple contrivance of nerve force flowing from the nerve centres of one germ and directed through the entire organism of the other germ, would produce the result, that the nerve force of the one would vivify and direct the expansion and growth of the other. The consequence of this interchange of forces would be the impression of the characteristics of germ B. upon germ C., and of those of germ C. upon germ B., so that a very near approximation of form and character, bodily and mental, would be the consequence of this intermingling of the two nerve forces. There would thus be produced a general resemblance with specific differences. This is precisely what we see.

A sculptor modelling a man would not construct two separate halves and then join them together; or, if he did so, he would exercise all his skill to make the two halves so like that the keenest eye should detect no differences in them. Nature

works more perfectly than the most skilful sculptor. If she had produced statues as she produces men, we may be sure that she would have made them as perfect as the sculptor desires and designs them to be, but from the imperfection of the human senses is unable to make them. Nature, departing in this from her habitual perfection, has made men so clumsily that the two halves of the body of the most perfect man ever made by her were *unlike!* Whence this exceptional imperfection of her work, if, as hitherto assumed, she constructs a man as one whole, as a sculptor constructs him? But this seeming clumsiness is accounted for if, instead of making him as one whole, she makes him of two parts, each part supplied by a distinct and separate producer.

If we trace the consequences of such a structural scheme, it will be seen at once how completely it explains much that is otherwise inexplicable; how it suggests the rationale of inherited characteristics, mental and bodily; the transmission, not of form only, but of diseases, tempers, talents, idiosyncrasies of all kinds; the strange mingling of the characteristics, not only of both parents but of their ancestors also; the predominance in the offspring of the traits, sometimes of one parent, sometimes of the other; the cropping out of family peculiarities after intervals of one or more generations. It supplies an obvious solution of the hitherto perplexing and unsolvable problems of

Hybridism, clearly showing the laws by which it is governed, and the reasons for them; how and why varieties are permissible to a certain limit and then cease, and what is the cause of that tendency to return to the original stock which is observed continually in vegetable life, but which, being of much slower development, has been less noted in animal life.

Moreover, the suggestion of a double germ, if it be true, extends to *all* organic structure having life, to vegetable as to animal existence, and in this offers a still more vast and varied field for observation and experiment. It is in the vegetable kingdom, indeed, that investigation may be most effectively pursued. Whatever is true of the one is true of the other. We have the vegetable world under our almost absolute control, and can experiment upon it with ease and rapidity. With the animal world experiment is more difficult. With Man we can do little more than observe; we are are unable to control. But if all are subject to the same law of generation; if all are produced by the same process of two parents, a germ being contributed by either parent, and by a junction of these two germs, the results of experiments tried with the vegetable world, over which we have extensive control, will be applicable to the animal world, over which we have imperfect control, and to Man, over whom we have no control at all.

We will now proceed to trace some of the prac-

tical applications of this suggestion that the duplex structure is caused by the junction of two germs.

It perfectly explains the otherwise wholly inexplicable mingling in the offspring of the mental as well as of the bodily characteristics of both the parents. In such case those of the father or of the mother would predominate according to the amount of vital energy possessed by either germ. The necessary effect of two nerve forces working together would be seen in the formation of the structure. If the nerve or vital force of the two germs were equal, the product would be intermediate in resemblance to both. If either were more powerful than the other, the most vigorous nerve force would direct the action of the united force to the extent of its superiority. If such a condition could ever be, that the germs of both parents possessed precisely equal nerve power, the result would be an offspring in which all the actions of the combined forces would be equal within, modified only by external circumstances. Where the nerve energy of either excels, the result would be regulated by internal tendency as well as by external conditions, and there would be that decided resemblance of the child to the predominant parent which must be the subject of daily observation by all who use their eyes. Could any conceivable *aura* do this? Impossible. But if not thus, how is the fact of inherited qualities to be accounted for? All the explanations hitherto

attempted have utterly failed to offer the slightest solution of the problem. Some have attributed the likeness to the father to mental impressions of the mother conveyed sympathetically to the offspring. But this is at once answered by the fact, that the children of a blind woman as often resemble the form and features of the father as the children of women who have sight, and a child will thus inherit the features of a father which were unknown to the mother. But if it be, as the contention here is, that the maternal germ is supplied with vital force and formative nerve energy by the paternal germ, and the paternal germ by the maternal germ, it is evident at a glance how it comes that by the union of the forces, each modifying each, the product is stamped with the characteristics of both parents, those qualities being predominant to which the greater formative nerve force chanced to be directed.

Thus it is that Nature accomplishes the design of infinite variation within certain prescribed limits. By no other means could it be so simply yet so perfectly effected. On no other hypothesis can the results we see be so reasonably and clearly explained. An aura *could not* do it. No conceivable nursing by the mother of a germ supplied by the father will explain the unquestioned facts of the resemblances to and differences from both parents.

If the germ be in the male, and the female

but finds for it a cradle and food, as is the only other suggestion, save the aura theory, how is it that the male alone possesses germs? Whence do these come? for unless they are new creations, they must come from some place. Think for a moment what a germ is. It is the embryo being, and so far a structured being that it actually possesses the bodily and mental characteristics of both of its parents; for after it has been deposited in its first cradle, the womb of the mother, the father can impart to it no further character, mental or bodily. All, therefore, that the ultimate living being exhibits of the shape in body and mind of its father must have been imparted to it when it was taken to be nursed by the body of the mother. Consequently a germ is not, and cannot be, as some unreflecting persons have imagined, a mere protoplasm or cell; it must necessarily be a thing having life, and shape, and qualities. If such it be—as who that considers the facts can for a moment doubt—then we are at once supplied with an obvious clue to the manner of germ growth and how it becomes a human being. There is, in fact, but one probable solution of this problem,—that the process is not by construction but by *development*. The germ itself is an infinitely minute creature which, on finding its appropriate cradle and food, grows by expansion. One of the conditions of its expansion and growth into a complete and organised being, is an union

with another germ capable of such an union by reason of a general similarity of shape and probably other characteristics. The germs of human beings, even if different, are so similar as to permit of this junction. The germ of another animal is too unlike to permit of such an union, and therefore sexual connection produces no offspring.

By what impulse the germs of the male and of the female unite in the very earliest stage of their separated existence, we are of course wholly ignorant. This only we know, that of thousands of germs brought into contact, but one fulfils the conditions requisite for junction, perfects the junction, and grows with its companion as one being. In other animals the number is subject to extensive variation, and in the lower classes of animals and in the vegetable world it is sometimes enormous. But this is plain, that according to the perfection of the *nerve structure*, so is the capacity limited for the junction of the germs, or for the ability of the mother to maintain them.

And here I will venture to offer, as a suggestion merely, and as no part of the argument of this treatise, a hint which may possibly be deemed by some readers worthy of further examination, inasmuch as if there be truth in it, it would throw a blaze of light upon this obscure subject.

May it not be that the germ as it is produced in the parent is a *fac-simile* of the parent —not of course as he (or she) may chance then

to be moulded by accidental circumstances, but as the nerve structure was originally developed, and has normally expanded. Development is the work of the nerve structure until it attains to maturity. When that matured nerve structure throws off germs structured like itself, may it not be by a process somewhat similar to that of gemmation in the lowest forms of organised being? But it will be answered, perhaps, that if the germ be a *fac-simile* of the parent, all such organic life would be uniform—that is to say, all human beings would precisely resemble each other—and so would it be with all tribes of animals and plants. But is not this a clue to the hitherto unexplained need for two parents of one being? This is the contrivance by which that uniformity is effectually prevented, without introducing that disorderly multiplicity of shapes which would be the consequence if no resemblance were preserved between the germ and the parent. The manner in which this object of diversity with general resemblance is brought about is now manifest. Individually the germs are like their several parents; but being united so as to form a double structure in which the nerves of the two united germs cross, each giving vital and formative force to the other, the necessary result is a formation intermediate between the two, having some of the characteristics of both; infinite diversity within a certain undefined limit being produced by the

modifications caused in either germ by the formative nerve force of its allied germ.

But the question of structure by a double germ is in no manner affected by the suggestion whether the germ is or is not a *fac simile* of the *nerve structure* of the parent (not of the body it builds), although, if true, it would make the *modus operandi* more obvious. It is also in strict accord with the Darwinian theory, which maintains that development and progression are caused by repeated exercise of some bodily or mental faculty so modifying structure that the modification artificially made in the parent is transmitted naturally to the offspring. That such modifications are not perfectly reproduced in all cases is obviously due to the influence of the associated germ contributed by the other parent.

It has been objected to this suggestion of a double germ, that if such be the method of structure, the offspring should be precisely intermediate between the parents in form and character. And so it would be were the germs always exactly equal in nerve force. But, in fact, they are never so. One germ always possesses more nerve force than the other germ, and the characteristics of that one will consequently predominate in the united germs. That is the *rationale* of the familiar expressions: "This boy is like his father;" "that is like his mother;" "this one has his father's face, but his mother's temper," and so forth, the expla-

nation of which is, that the paternal germ was more vigorous in the one, the maternal germ in the other, while in the third, the paternal germ was the more vigorous generally, but the maternal germ was stamped with the large development of the passionate temperament of the mother.

These likenesses and unlikenesses to the two parents are more remarkable in the mental even than in the bodily characteristics of the offspring, thus confirming to some extent the suggestion that it is the character of the nerve system of the parents that is transmitted to the germ. In the bodily structure, where the mind is not called into action, an intermediate product between the parents appears to be the rule, as seen in what is called cross-breeding, as in the mulatto. Indeed, all cross-breeds of different colours exhibit the influence by both parents equally. In the mulatto, the nerves that make the colouring matter are acted upon by the double influence of the parental germ, that would have produced a white skin, and of the maternal germ that would have produced a black skin, and the result of the combined influences is a skin neither black nor white, but a tint exactly intermediate. No mere aura will account for this.

A germ produced by that mulatto uniting with the germ of a white woman produces an intermediate hue between the mulatto tint and the white parent, and so does the junction of the germ

of a black woman with the germ of the mulatto produce the intermediate hue of blackness—but the depth of tint in each case would probably depend much upon the relative vital forces of the uniting germs. Hence it is that in mulattos and other half-cast families the degrees of colour vary considerably among the children of the same parents—the type of one or the other parent being more marked as the germ of that parent chanced to predominate in the structure of the child.

Thus, also, is explained the remarkable cropping out of certain family characteristics of body, or mind, or of both, even after some two or three or more generations. The process would be somewhat after this fashion. An ancestor possesses some marked and powerful characteristics of mind or of body. The germ produced by him resembles him in these, and if it could exist alone, without a junction with another germ, we should have a *replica* of the father. But nature has required the junction of two germs for the formation of a man, and the amount of modification thus brought about depends upon the predominance of the nerve force supplied by either germ. If that of the father prevails, the offspring will resemble the father in form or character. If the germ of the mother prevails, the offspring will more resemble the mother. If the father has some strongly marked characteristics, their force may

be modified, or even subdued, by the greater force of the maternal germ.

Now, suppose a child to be "the mother's child" (a popular expression which means only that the mother's germ has contributed the greatest amount of nerve force and that, therefore, the child resembles her), and by reason of her predominance some of the characteristics of the father are repressed. That child grows to maturity and produces a germ which is stamped with the characteristics of the family from which he has descended as also with his own. If that germ be united with a germ inferior to itself in nerve force, the characteristics which the germ of the father possessed would repress the characteristics of the mother, and being now predominant, the features, mental and bodily, of the parental ancestry, or some of them, would reappear. And this might occur, not once only, but often in the course of generations, exhibiting that "cropping out" of ancestral character so often noted—a problem of which no rational solution has been attempted hitherto.

HYBRIDISM thus receives a practical explanation. A limit is assigned to it alike in animal and vegetable being. The limit of Hybridism is the relationship of the two germs. They must be so like that, when united, they can grow into a form having a certain amount of symmetry in the two halves of the structure — sufficient, at least, to permit the functions of life to be carried on. The

heart must be enabled to pump regularly. The nerve system on one side of the body must bear so near a resemblance to the other as to possess perfect community of action. If these necessary conditions of union in development do not present themselves, the germs cannot join, or if they join, nothing comes of it—there can be no growth and the imperfectly constructed being perishes in embryo. Hence it is obvious that all the stories of monstrous births are myths. Such productions are simply impossible, because there can be no junction of germs so dissimilar as to preclude common action.

We now learn also how it is that mules are bred and why they are barren. The germs of two parents, say, the ass and the horse, are sufficiently alike in general structure to permit of their junction and expansion into an animal partaking of the characteristics of both parents, the formative nerve force of the one germ, by the simple contrivance of exchange of the nerve systems, modifying the shape and character of the other germ and *vice versâ*. But the mule thus produced is barren. Why? Physiology has failed to advance a probable solution of the problem. A mule is not deprived of sexual organs, only it cannot reproduce. The problem is readily solved by the suggestion of a double germ. The changed form of the mule is the limit of practical dissimilarity. The germ of a mule, being itself one degree removed from

the parent stock, is so far dissimilar from the germ of either the horse or the ass, that the two are unable to form such a symmetrical junction as is requisite to vitality; the departure from the normal shape is too great for healthy life.

It is still a problem if mules produce germs, although their germs cannot become matured offspring. Most probably they do. No reason can be assigned why germs should *not* be in the mule equally with the horse or ass. Whatever be the process by which the germs of future beings are introduced into the organisation of existing beings, the conditions for their production must be the like with all. Either the germs are created in the body, or they are introduced into the body in the food that builds it, and if in the food of the horse or ass then in that of the mule. If germs be generated in the organism of the horse by gemmation, or some other process, it may be reasonably presumed that they are so produced also in the organism of the mule, but from some cause not known are incapable of development. It is true that anatomy does not reveal to us the actual presence of germs, either in process of gemmation or otherwise; but we are not therefore the less assured that the germ of the future offspring is contained in the body of the parent and consequently must have come into it by *some* means. The truth is, the *actual* germ is too minute to be perceptible to

our very limited senses. With the aid of powerful instruments we can perceive its envelope, perhaps, but not the ultimate entity—the *mere point* that constitutes what may be termed the *concentrated* organised being—the *monad* of the man, the beast, or the plant.

And here I must, for a moment, diverge somewhat to vindicate the possibility of a mere invisible point containing a nerve organization in miniature. This can best be shewn by an illustration familiar to all, but the marvel of which has probably occurred but to few. A lens receives on one side of it the rays of light proceeding from a vast range of landscape. Mountains, rivers, lakes, forests, fields, trees, bushes, even flowers—countless millions of objects and, therefore, millions of millions of distinct rays of light are gathered within the circuit of the lens. At the focus of the lens all these rays of light are concentrated to a point not so big as the head of a small pin; yet, compressed within this pin's point, and diminished to it, are contained the forms of all those multitudes of objects, perfectly painted as they exist on the landscape itself, as we learn from this, that the rays pass out from the focus to the other side of the lens and there, again expanding, reform a picture as perfect as that which entered. This will show how rude and insufficient are our notions of the small as of the great—notions, indeed, that are conceived only in their relation to ourselves. Thus

it will be seen how possible it is for the absolutely perfect to be found in the infinitely little.

With this conception of what a germ *may* be, although its structure is imperceptible to our senses even with the help of the most powerful microscope, and assuming that two such germs must be united for the formation of an organised living being, it will be at once apparent why a mule cannot reproduce. Its germ being, like itself, a departure from the type of either parent is consequently so different in form, or in character, or in both, from the germ of any other animal of its kind, that union of the two germs for the formation of a structure competent to the functions of existence is impracticable.

The explanation hitherto given is somewhat vague. Nature, it is said, desires to limit variation in the types of organised being so as to prevent an infinite confusion of forms, and therefore she has made mules infertile, to secure that the departure from the type shall not exceed one generation. This is true as a proposition. But no attempt has been made to show, or even to suggest, *by what contrivance* Nature has effected this purpose, and it is the manner of doing it, and not the design, that has a practical interest for the investigator. The suggestion here ventured of the construction of organised beings by a double germ affords that explanation. Of its sufficiency I must leave others to form their own judgment.

Misshapen births are inexplicable on the single germ theory; but they are readily explained by the suggestion of a double germ. Children with two heads, four legs, or three arms; or two distinct beings united, like the double girls exhibited a short time since, cannot be accounted for by any influence of an *aura*, nor by imperfection in the formative force, whatever that may be.

The "Two-headed Nightingale," as those girls were called, was formed of two distinct human beings, each constructed of two perfect germs. In due course they would have appeared as twins; but, by some unrevealed accident in a very early stage of development, the nerve cords on the adjoining sides of the two embryos became intermingled at the waist, and instead of forming two separate bodies they grew partially into one, that part of the united body becoming common to both. That such was their true condition is proved by the fact that this part of the body, and only this, was subject to the equal consciousness of both. Either of its joint owners could feel impressions upon that part, and move and direct its motions without the consent of the other partner, although not *against* her *will*. If one desired to move the muscles in one direction and the other in another direction, the result was that no movement ensued. But if one *willed* more powerfully than the other, that *will* prevailed and the joint muscle moved in obedience to the more powerful command. It would be of

the greatest possible interest to Physiology if it could be ascertained whether there is duplicity of structure in any portion of that part of the united structure which is common to both. Are the bones formed by the junction of two bones? Are the muscles duplex? Are there two sets of nerves? Is there any abnormal condition of the muscles or tendons indicating the original presence of two formative forces acting together? Some of this most desirable knowledge could be obtained by accurate examination of the living body, but the rest only by careful dissection of the dead form. There is small chance of such an opportunity offering with a human being. But similar cases are not uncommon among animals, and if the next double-limbed calf or lamb that may be produced were to be examined by a skilful physiologist with this view, some facts would doubtless be ascertained that would throw much light upon the relationship of nerve structure to development and growth. In this, as in all other investigations of Physiology and Psychology, much more is to be learned from examination of abnormal conditions, when the action of the organic forces is imperfect or irregular, than from the study of those forces when they are working smoothly and regularly and their presence is indicated only by results.

But we talk of deformities, forgetting that all of us are more or less deformed. The most perfectly shaped man or woman is *un*symmetrical—that is

to say, there is a marked *un*likeness between the two sides of the body. The two sides of the face (which is the most seen and therefore permits of more accurate study) will be found *always* to exhibit considerable differences. Probably no two sides of any human face are precisely alike. It is the same with every limb. No pair of limbs is shaped alike. One hand is almost always larger than the other; so with the foot; so with the leg and arm. One side of the body is usually stronger than the other. It has been answered to this, that most persons fall into a habit of using one side of the body more than the other and hence its greater strength. But the obvious reply is, that we use the strong side most because it *is* the strongest. This is especially to be noticed in left-handed persons, who are usually left-footed also, but do not therefore use the left foot more than the right, save for the purpose of springing from it. But these dissimilarities of strength, and size, and shape, are as plainly to be seen in the infant as in the adult, proving them to be the result of congenital causes and not of habit.

It would be a curious subject for inquiry, by persons who have leisure and opportunity, how far, in respect of strength and similarity of shape, each of the two sides of the body resembles the father or the mother. The collection of a large number of such observations would go far to determine the important question here raised as to the parent-

age of the embryo, whether it consists of one germ vitalised or of two germs united, and if it be one germ only, from which parent it comes. Assuming general resemblance to one parent to be the consequence of superior nerve energy in the germ of that parent, it might reasonably be anticipated that the portion of the structure to which that parent most contributed would bear the greatest resemblance to him or her. Is it so in fact? Only an extensive series of observations can determine. But in pursuing such an inquiry it must be remembered that the germ in neither parent is a perfected form, like the completed human body, but probably nothing more than a nerve plexus compacted into an almost imperceptible point. When the two germs of the two parents meet, unite, form an embryo and grow together, it is not (as this suggestion has been misrepresented by some of its critics), that the two germs link themselves together side by side by an act of volition, but that the two germs, which are undeveloped nerve centres, adhere by some attractive force, according to some law not known to us, gradually unfold themselves, shoot out their nerve threads each one to the opposite side of the embryo, and proceed to build the body by the process of each nerve attracting to itself from the blood of the mother the various materials requisite for the construction of that portion of the frame to which it belongs. But the nerve force possessed by the nerve threads

flows from the nerve centre, and that nerve centre combines in unequal proportions the nerve forces of the two germs, which are there conjoined. The formative force possessed by the nerve threads is thus the product of, and therefore proportioned to, the natural force of the germ from which it radiates, modified by the force of the germ with which it is associated. Consequently the product is a structure having the characteristics of both the parent germs, in relative proportion to the nerve forces of the two germs, modified also by accidental external circumstances and by internal conditions impossible to be traced. Nor is this all the extent of likeness and variation. These are to be seen, not merely in the general structure but in its parts. Not only may the germ of one parent possess more *general* nerve force than the germ of the other parent, but particular parts of the nerve system of one may be more powerful than the like parts of the other, and then the characteristics of those parts will predominate; with the consequence which we see, but have never yet been enabled to account for, that although the general resemblance may be to one parent, a single feature or characteristic, bodily or mental, is found precisely to resemble a like characteristic in the other parent, as in the frequent instance of the form of the hand, of the fingers, of the finger nails, and even more often in a special talent or peculiarity of disposition.

Nor are these curious combinations of resemblances and differences limited to bodily characteristics. They are at least as frequent and remarkable in the mental qualities. The reason is obvious. The brain is the instrument by means of which the Man communicates with the external material world and his fellow beings. It is through the mechanism of the brain that we see, hear, feel, think, imagine, reason, and so forth through the whole catalogue of the mental faculties. In strict accordance with the double structure of the body there is a double structure of the brain. In fact, we have two brains, as we have two arms and two eyes. If the suggestion be true that the cause of this double structure of the body is the double germ (accounting for the requirement of two parents), the duplex brain is due to the same cause. This double brain is no longer a theory, as in the days of Gall and Combe. It is proved by the conclusive experiments of Hitze and Ferrier. They have shown that, by exciting the action of one side of the brain, motion is produced on the *opposite* side of the body. This proves conclusively—(1) That each half of the body is to some extent distinct from the other half, and (2) that the brain is undoubtedly duplex; that it works in parts and not as a whole, and that different parts of the brain have different functions. The evidence is as yet insufficient if we have ascertained what precise portions of the brain are devoted to the

various functions of the mind. This is at least doubtful, and much experiment and observation must be made before any location of the seats of the mental faculties can be confidently affirmed. The fact of present interest to the subject of this treatise is that the brain is double, for therefore all its faculties are double. In the normal condition, these dual organs act together as perfectly as do our two eyes, and we are not conscious of the duplex existence or the double action. But in abnormal conditions, when this relationship is disturbed by disease or otherwise, the two organs act independently, one working alone while the other is dormant, or both working with consciousness of the action of one only. This is the *rationale* of the "Unconscious Cerebration" so ably asserted by DR. CARPENTER.

Precisely as the comparative vital force of the two parental germs determines the development of the form of the framework of the body, in the whole and in its parts, so does it determine the form of the brain and of the two halves of the brain, and in this manner it is that there is produced in the offspring more or less of the *mental* as well as the bodily characteristics of both parents. In mental character, indeed, this union of the qualities of the two parents may be better studied than in the shape of the body, for they are more obvious to the casual observer. The fact, indeed, is undisputed, that these resemblances and differences,

and combinations of differences and resemblances, in the characteristics of both parents or of the ancestors of both are actually found in the vast majority of mankind. It is within the personal observation of all who use their eyes and ears.

The only problem for Science to solve is—*how* this inheritance of mind is brought about. No physiological explanation hitherto offered has approached to a solution of it. Always nine-tenths of the facts were left *uncovered* by the theory. The suggestion here thrown out for consideration has at least the recommendation *that it supplies a rational and probable explanation of every fact in Heredity and Hybridism.*

The accepted hypothesis of the production of the germ by one parent only is attended with another difficulty. Whether it be by the father or by the mother, the capacity to produce germs cannot be a matter of chance; it must be regulated by some law, and that law must have relation to sex. If the germs are introduced into the body in the food that builds the body, they must come in the food of one sex only, and not in the food of the other sex. If they are germinated—that is to say, *created*—in the body, then the one sex possesses the capacity for such creation and not the other sex. For the purpose of this argument it matters not to which sex the creative capacity is assigned—the conclusions are equally absurd. Unless it be

assumed also that each individual germ contains within itself the germs of all the future generations to spring from it—a supposition too preposterous to be seriously entertained — each individual germ must come into the body from without. It must enter at some stage of the life of that body—When? It must come from some place — Whence? It must have some definite form, some qualities and characteristics—What? There is no very wide field for speculation. But two modes of germ production are *possible*. The germs are *taken into the body from without*, or they are *created in the body*. If they enter from without, it can only be in the food eaten or in the air breathed. But the germs of Men are not likely to be floating about in the air; therefore they must come in the food. As the food is either animal or vegetable, they must come in the beef or in the cabbage, If in the beef, they must have been bred in the ox; if in the cabbage, they must have hidden in its tissues. Whence and how did they come *there?* Tracing backward their genealogy thus, we are landed in a hopeless perplexity. Say, however, that so it is (and only so can the prevailing theory of single-germ production be supported), we are confronted by another difficulty—how it comes that to one sex only is given the privilege of extracting the germs of human beings from the food eaten? Again; whole tribes eat vegetables only and eschew animal food, yet they undoubtedly pro-

duce germs, so that germs are certainly not eliminated from the flesh of animals.

Turning to the other theory of germ production, which I have ventured to suggest as being the more probable, namely, that the germs are not introduced into the body from without, but are there self-generated by a process similar to that of gemmation in vegetables, the germ being an offshoot from the organization of the parent and a part and continuation, as it were, of the life of the parent, the assumption of propagation by a single germ from one parent alone is still more improbable, for it involves the consequence that gemmation is a faculty of one sex only and that, according to the present prevailing opinion of physiologists, the father.

And this raises another very important but as yet very obscure problem, of considerable moment in these questions of *Heredity* and *Hybridism*—at what stage of the existence and development of the germ is sex determined?—Is the individual germ, whether introduced into the body or formed in it, male or female? Or is it not neuter, its sex being determined by some as yet unknown law at some later period of its development? All the physiological facts indicate neutrality in the original germ. The structure shows indecision for a time. It is manifestly adapted to take either sex as the conditions of development may require. If the suggestion of structure by the junction of two

germs be correct, there can be little doubt that the germ is neutral; that the sex is determined after the junction of the two germs in obedience to some law, and this neutrality accounts for the survivals in one sex of the specialities of the other sex. Do not the mammæ, and other like indications found in all males, indicate that they were constructed to fulfil the functions of either sex, according to the influences predominating at the period of development when the sex of the united structure is determined?

It is stated above that the offspring would thus represent in greater or less degree its parents and its ancestors. The manner in which what are termed family features, in form and character alike, adhere for generations, sometimes disappearing and then cropping out, as it were accidentally, often at long intervals, may on this suggestion of structure by a double germ be thus accounted for. X, the offspring of B and C, inherits quality No. 1 from B, quality No. 2 from C. X unites with D, and the offspring, Y, inherits from X qualities Nos. 1 and 2 and from D, qualities Nos. 3 and 4. If these are four distinct qualities of mind or body, not in any way neutralizing each other, Y will possess the four qualities and transmit them to his offspring. But, practically, this rarely or never occurs. Modifications will certainly be introduced by the junction of the new germ in the production of each successive generation. D conveys to Y some antagonistic quality that represses, although it does not

destroy, some quality inherited from B. In the next generation, the new germ, being defective in the quality, derived from D, that had repressed the quality derived from B, resumes that quality in its original vigour and we see the characteristic of the grandfather cropping out again. So it may be through many generations and after long intervals of repression. The quality originally implanted is there, but it is held in abeyance under the greater force of other inherited qualities. On the contrary, a feature of mind or body, inherited in great power from one germ or combination of germs possessing the same feature in excess, may be merely diminished, not repressed, by a succession of unions with germs having that feature in a lesser degree. Or a feature might be indefinitely increased if for several generations the two germs were to possess that feature in excess.

A large volume might be devoted to tracing these combinations and their results, with illustrative references to *facts* that would present themselves abundantly in proof. But the object of this little treatise is not to exhaust the question, nor even to investigate it profoundly, but merely to attract the attention of others, who may have more leisure, to what has appeared to me to be a new field for examination. Therefore I pass on now to the few remaining considerations.

If the suggestion be true of Man, it is true of animals also. If *we* are constructed by the junc-

tion of two germs, so are all animals. It has been answered to me that some low forms of life have not two parents. But wherever we have been enabled to trace the action of generation, something more than mere self-production has been seen. Where there has appeared to be no junction of sexes, there is found in many cases to have been an impregnation at some early stage of being, or the existence of a species of hermaphroditism by which the process is performed within the body. In other cases, if such there be, it is more probable that similar contrivances prevail than that they should be exceptions to what is an undoubted law of Nature wheresoever we are enabled to trace it.

Perhaps some readers will say, "You have made out a good case as regards Man and Beasts, but how do you apply your suggestion to Birds and Fishes and the other creatures which are produced from eggs? The egg is extruded by the mother and it contains but a single germ, which becomes the chicken, or the cod, or the tadpole."

It is only a distinction of words, not of facts. The offspring of all organised being is cradled in an egg. We are all, in truth, *hatched.* The only difference between one living being and another is, that in Man and the higher animals the embryo is hatched within the body of the mother in a very early stage of its development and completes that development in the womb, being fed directly by the blood of the mother; whereas in birds, fishes,

and most of the lower animals and in vegetables a store of nutriment is contained in the egg brought forth by the mother, from which the material is extracted wherewith the developing nerve system builds the body about itself. Strange as the assertion appears on the first statement of it, it is a fact that every seed is an egg and the tree or plant whose embryo it contains is produced by precisely the same process within its shell as is the chicken or salmon. There is an embryo, visible to the eye, which is the germ of the future organised being. When the conditions occur that favour its development, this embryo expands, and nerves or filaments shoot from it in definite forms, pervade the substance of the egg and extract from it the material required by each for the formation of that part of the structure to which that nerve or filament belongs. Thus we learn that the contents of all eggs that are extruded from the parent before the germ is developed, animal and vegetable alike, possess all the materials required for the construction of the body of the being there to be produced. The chicken comes from the shell a perfected form.

But what is there in this tending to confirm the suggestion of a double germ? Does not the production in an egg produced by one parent only rather suggest the development of a single germ?

The answer is obvious. The hen bird can produce fatherless eggs. These eggs are, to all appearance, as complete as perfected eggs. They are

filled with precisely the same materials for constructing the chicken. There is certainly a germ in each of those eggs. The microscope can discover no difference between the barren egg and the impregnated egg, save that, when the latter is extruded from the body of the hen, the germ in it is duplex having two layers instead of one. In fact, the process of development has already commenced. It began when the ovum was impregnated and while yet it was merely a minute point.

What is absent in that fatherless egg, the lack of which deprives it of the power to produce a chicken which is possessed by the egg lying by its side, the product of the same mother? The eye seeks in vain for a structural difference without or within. What is the vivifying influence that is wanting to its fertility? It is surely a monstrous exercise of fancy to assume that merely the influence of an *aura* could suffice to change the egg from barrenness to chicken-bearing. Something has entered that fertile egg, not when it was incrusted with a shell and had grown to maturity, but when it was only a nucleus. What is it that so enters and causes such a miraculous change in the destiny of an egg? If not a mere *aura*, it must be a part of the future chicken. We may throw the *aura* theory aside as ridiculous. Then if not that, it is *a germ* that is deposited there by the second parent. But there is already a germ in that egg. We cannot see it in this early stage of extreme littleness,

but we know that it must be there in the beginning, because we find it when the egg is produced by the mother alone, without alliance with another parent. If there be already a germ in the hen's egg and a germ is also conveyed into that egg from another parent, that egg contains *two* germs. We find now a germ formed of two layers, and considerably larger than before impregnation. Of what use are two germs in the same egg, if they do not in some manner influence each other? We find but one germ in two parts. Has the other perished? If not, what has become of it? The answer is obvious. The paternal germ has joined the maternal germ. The two layers are the two germs. They grow together, and the duplex structure of the chicken is the consequence of their junction.

Thus tracing the process of production in the egg of a fowl and finding in it almost demonstrative proof of the existence there of two germs, one contributed by each parent, we have the strongest presumptive evidence of the union here suggested.

And inasmuch as Man, Animals, and Plants, as well as Birds and Fishes, are produced in eggs, the conclusion is inevitable that the same law prevails with all, and that the process of reproduction is as it is seen to be in the eggs of the bird and the fish. The egg, which is provided by the mother, contains a germ that is eliminated from the mother, which mother germ is joined by a germ transmitted from the father, and the new organised being thus derives

its parentage from both, partaking of the qualities and forms of both, the twain being unequally developed according to the relative strength of the nerve forces of the two parents.

And the same process is manifestly performed in the production of *vegetable* life. There are male and female plants and flowers and parts of flowers. No known plant is really self-produced. *Two* organisms are required to produce *one* new one. There must be two parents for every vegetable, as for every animal and every Man. In all, the process is substantially the same. A germ proceeding from one parent is received, nursed, and brought forth by the other parent. The ovarium and its apparatus is the womb in which the pollen (or germ) is received and nursed. What is that germ? Precisely what the germ of the man and the animal is—an embryo plant—a plant in miniature—a plant compacted together—the nerve skeleton of a plant compressed into an invisible point, embedded in food, which its mother has supplied, sufficient in quantity to provide material for its growing and expanding structure, until it is competent to maintain itself. What is this *growth* but *development?* The plant is not made by some formative force from *without*, playing the sculptor's part and modelling it. The bud grows by an expansive force from *within*. The oak is but the development of the tiny speck in the acorn which has been produced by the addition of a

pollen germ to something that was cradled in the ovarium.

In vegetables, as in animals, the question has always been, *whose was the germ?* The ready answer was the same formerly—the mother plant bears the seed, the pollen does but *vivify* it. Nobody seems to have questioned what *vivifying* means, nor what the process is as a *reality* and not as a mere speculation. Others said that the pollen was the germ and the ovarium merely its cradle. But the difficulty remained, how it could be that a mere vivifying influence should change the shape of the plant by imparting to it the shape of the parent, or how, if the mother plant merely nursed it into a seed, there could be communicated to it the shape and qualities of the mother. This is perfectly explained by the suggestion of a double germ. And this suggestion is confirmed by the fact, so inexplicable otherwise, that vegetables are of duplex structure, not only every leaf, but every part of every flower being not a whole but two parts put together and, in the majority of cases, the point of junction being marked by an obvious medial line.

While this sheet was passing through the press. a paper, contributed to the *New York Tribune* by so great an authority as Dr. Asa Gray, on the question "Do varieties wear out, or tend to wear out?" to a considerable extent confirms the contention of this little treatise, that the requirement of

two parents for reproduction indicates some purpose vastly more important than a mere vivifying *aura* or influence; the probability being that something is contributed by both parents to the common offspring, and that the duplex structure shews this something to be another germ. Dr. ASA GRAY is writing especially of vegetable reproduction, but all that he adduces is equally applicable to animals and to man. He is arguing that propagation by buds has a limit, but that there is no limit to propagation by seed, which is always the produce of the union of *two* organisms. He says:

If it be asked how the asserted principle is proved, or made probable, we can here merely say that the proof is wholly inferential. But the inference is drawn from such a vast array of facts that it is well nigh irresistible. It is the legitimate explanation of those arrangements in nature to secure cross fertilisation, either constantly or occasionally, which are so general, so varied and diverse, and, we may add, so exquisite and wonderful, that, once propounded, we see that it must be true. What else, indeed, is the meaning or use of sexual reproduction? Not simply increase in numbers, for that is otherwise effectually provided for by budding propagation in plants and many of the lower animals. There are plants, indeed, of the lower sort, in which the whole multiplication takes place in this way and with great rapidity. These also have sexual reproduction, but in it two old individuals are always destroyed to make a single new one. Here propagation diminishes the number of individuals 50 per cent. Who can suppose that such a process as this, and that all the exquisite arrangements for cross fertilization in hermaphrodite plants, do not subserve some most important purpose? How and why the union of two organisms, or generally of two very minute portions of them, should produce vitality, we do not know, and can hardly conjecture. But this must be the meaning of sexual reproduction.

Does not the suggestion of the double germ completely answer this question?

There can be no reasonable doubt that the general scheme for the propagation of their kind is the same in Man, animal, and plant,—that is to say, a germ is eliminated from the organisation which, to a considerable extent, if not precisely, resembles the parent. This germ requires for its development the assistance, in some manner, of another parent, either to vivify or to nurse it; or, as is the suggestion here submitted to science, the germ is an offshoot from the parent, a part and a continuation of the parent, closely resembling, if not a *fac simile* of, the parent itself and a part and a continuation of the life of the parent. This germ can become an independent being only by junction with a like germ, eliminated from the organism of the other parent, whence the hitherto unexplained and otherwise unaccountable requirement of *two parents* for the production of *one offspring*. As already stated, there is much difficulty in observing this process in man and in animals. But plants can be carved and submitted to the microscope, alive or dead, without fear of the criminal law or the Royal Society for the Prevention of Cruelty to Animals, and with no risk of censure in the newspapers. If the physiological process of reproduction is, as here contended, substantially the same with the plant as with Man, varying only in the contrivances adapted to their

several necessities, the origin of the germ, the manner of its formation, its extrusion from the organism of the parent, its cradling, its growth, and its final appearance as an independent being, can be learned by observation and experiment in the case of plants, and so far as the difference of circumstances will permit, the same scheme of reproduction might confidently be accepted as applicable to Man and the lower animals.

Looking, then, at the process of reproduction in plants, what do we see? Germs of plants, resembling their parent, are extruded from the parent by a process called gemmation. Each of these buds is a distinct being, for it lives when severed from the parent. Has it not carried with it a portion of the parent's life, of which is it not, in fact, a continuation?

It is said, with some probability, that the bud, even though severed, and itself reproducing buds, can live no longer than the natural term of the life of the parent from which it was severed. This is, however, as yet unproved, although many facts in vegetable physiology point to such a conclusion. Be that as it may, these leaf buds, in obedience to some unknown law, often become flower buds, and then, instead of a life that *by severance* might be continued for a limited time only, they change at once their form and their character, and that life is devoted, not to self-sustainment, but to the formation of the apparatus necessary

for the reproduction of a new and independent being.

But for the production of this new and independent being a new condition is imposed. *One* parent produces the *bud*; but *two* parents are required for the production of the *seed* which cradles the germ of the new plant. These two parents may be distinct plants, or they may both be found on one plant, or both may exist in the same flower; but wheresoever located, two parents are required, even although they may be on the same stem, in the same calyx, in the same cavity—one must be "fertilised" by another or there can be no new plant.

What, therefore, does *fertilising* mean? When Scientists use the word what do they intend by it? I do not ask a definition of it in words which are only synonyms for the term itself, nor in words that are mere words, carrying no definite notion of any definite act or thing; but what *process* do they thus name? What is actually *done?* What change is *made?* *How* is the result brought about? By what specific *contrivance* is it that the germ produced by one of the vegetable parents, which would perish if left alone, is converted into a living organised being by the mere contact of something proceeding from the other parent? *What* is that something and *how* does it operate to bring about so marvellous a change?

Is it not as here suggested—that the require-

ment of two parents for the production of the seed, which is to be a new plant, is not demanded for the production of the bud (which also is part of the parent plant), because the new organised being is contained in the seed and constructed of *two germs;* the object of this being to produce infinite variation of individuals with a limit to divergence from species? And is not this probability confirmed by the undoubted fact, that the organised being so produced is structured, not as one whole, but of two dissimilar halves joined together? Does not the very fact that has been advanced against this suggestion—that in some plants both the parents are part of the same structure—go far in support of it; for how overwhelming must be the necessity for two parents, when a fertile seed cannot otherwise be produced by the plant, even when both parents are existing together in that plant? Can any mere *vivifying aura* account for this? If not, can any other rational explanation be offered?

How the plant is developed we do not know. With animals, the nerve system expands, and grows, and builds the body about itself. Plants have no nerve system and no substitute for it that is perceptible to us. Yet they grow into definite, though infinitely diverse, forms. What with them is the formative force? It is not likely to be applied from without in vegetable more than in animal structure. It must therefore proceed from within. Whence does it come? How is it

generated? How is it directed? These are mysteries that invite the examination of Science. The pollen germ has the characteristics of its parents. It is almost invisible, yet we know that it must be impressed with the shape, the qualities, and the idiosyncracies of both its parents, for, if they differ, the offspring is a hybrid. Variations are so produced almost at will. If the seed, which is only a germ embedded in food for its own maintenance, be the product of parents produced on the same plant, it will be developed into a plant similar to that from which it sprung. Why? Because both the germs of which it is constructed are the same in character. But if impregnation be made with the pollen of another plant, of the same kind but varying in shape or hue, the result will be an offspring intermediate between the forms or hues of the two parents; thus repeating precisely the process which produces varieties in Animals and in Man.

These facts, moreover, strongly confirm the suggestion already made, that the germ of each parent is a *fac simile* of that parent, and that all the infinite varieties of form and character in Man, in Animals, and in Plants is due to the junction of the germs of two parents, necessarily producing modifications, all the combinations of which are beyond human calculation.

A volume might well be written upon the practical applications of this suggestion of organic

structure by a *double* germ, one supplied by each parent, as proved by the duplicity of that structure. All living forms, Man, Animal, Vegetable, are *double*—that is to say, they are not one whole constructed as a whole, but two halves joined together, always more or less unlike, having points of resemblance and of difference obviously derived some from one parent some from the other, and which indicate a greater share by both parents in the product than has yet been assigned to them. The suggestion of a double germ accounts naturally for hereditary characteristics and tendencies, mental and bodily, and for the mysteries of hybridism — why some animals are fertile and others are not; why mules are barren; by what contrivance it is that Nature has produced infinite variation in individuals, a large variety of species and an extensive intermingling of allied races, while restraining such a departure from the original type as would people the world with monstrosities. It explains the processes which the gardener, ignorant of the physiological reasons for them, adopts for the production of varieties by hybridising, or for the purpose of fertilizing merely. If it be true that Nature's method of securing these objects is by the union of two germs, one being supplied by each parent, practical horticulture, no less than *Physiology* and *Psychology*, will have secured a firm foundation, from which a new departure may be made into the region of

speculation no less than into the domain of fact, with the assurance that it will be no longer necessary to weary ourselves with conjecture, for from this standpoint we shall be enabled to pursue with some confidence the solution of the many problems that surround the great question of the beginning of existence, how we are formed and how we grow.

SUMMARY.

It will be convenient to sum up the argument of these pages.

Two parents are requisite for the production of organic being.—Wherefore?

The accepted theory formerly was, that the mother produced the germ, and that the father contributed to it merely a vivifying *aura*. But the existence of such an *aura*, or how it operated, was not only wholly unproved, but no proof of it was ever attempted.

Better acquaintance with Physiology dissipated that delusion, and the later and generally accepted theory has been, that the germ of the future offspring is contributed by the father, and that the mother merely produces for it a cradle and food. In other terms, that the ovum is only a dwelling in which the germ is received and fed until it is so far developed as to escape from the shell within which it is confined.

All organised living beings — Man, Animal, Bird, Fish, Plant—are produced in eggs. The only difference between them is in this: that in the higher order of beings the germ quits the egg —in common phrase, is *hatched*—in a very early

stage of its expansion, within the body of the mother, and there is nursed until the structure is so far matured that it can maintain an independent existence; in birds, and in most fishes and insects, and in all plants, the germ is matured in the egg *after its extrusion* from the body of the mother.

Birds often produce eggs without an union with another bird, but those eggs are barren. Nevertheless they contain a germ, and all the materials for the structure of the chicken. But the germ supplied by the father is wanting, and without that the mother germ in the ovum is infertile.

What part, then, does the paternal germ play that when it is present the egg that before was barren is made capable of producing a chicken?

One germ disappears and the other germ is enlarged and presents two layers. The evidence points to the conclusion that the two germs have come together and united, for the new form now looks like one germ.

Is there any fact that supports this probability?

Yes. All organised beings will be found to be constructed, not as one whole but as two halves put together, the nerve systems interchanging and having double organs, not of the body only, but of the brain also.

This duplex structure of organised being strongly supports the presumption raised by the process of egg-growth and impregnation, that organised struc-

ture is produced by the junction of two germs, one being supplied by each parent.

This will be found to solve many of the hitherto insoluble problems of *Physiology*, and to explain the mysterious phenomena of *Heredity* and *Hybridism.*

Moreover it covers all the facts.

The design of the preceding pages is to set forth some of the facts and arguments that have suggested this hypothesis. If they do or do not this is a question for the reader to determine.

It is offered by the Author as a *suggestion* merely. It is not advanced dogmatically as being *proved.* It is submitted to the public in hope that it may direct attention to a subject of incalculable importance to *Physiological,* no less than to *Psychological,* science; and that Scientists may be induced to give to it further investigation and reflection.

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