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THE BIOCOSMOS

The Processes of Life
Psychologically Ordered

BY

DENTON J. SNIDER

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BIOCOSMOS

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GENERAL INTRODUCTION.

CONCERNING EVOLUTION.

Charles Darwin, supreme biologist of all time, and as we title him, the Hero of the Biocosmos, replying to certain objectors who caviled at his use of scientific terms, replies: "It is difficult to avoid personifying the word Nature," and he seemingly does not try very hard to overcome the difficulty. But why does the mind instinctively speak of Nature as a person, thus endowing it with a psychical element? Does this belong to Nature, or is it forced upon the same from the outside by ourselves? Here indeed we touch the deepest problem of Nature—a problem which she is always bringing up to the surface. Darwin in the same passage goes on to say: "I mean

by Nature only the aggregate action and product of many natural laws, and by laws the sequence of events as ascertained by us." A collection of natural laws apparently self-executing is Nature according to the conscious definition of Darwin. So he proceeds to think himself rid of the intrusive personifying tendency in his exposition of his science. But Nature herself some how refuses to be treated in that impersonal way, except perchance by little fragments. Now we hold that the instinctive procedure of Darwin as naturalist is far truer and deeper than his expressed intention; the naive observer in him is a much greater man than the definer or metaphysician.

In the same connection he takes occasion to reply to the animadversions upon his use of his pivotal category, Natural Selection, a term whose easiest meaning is Selection by Nature. This certainly indicates that Nature proceeds by some sort of choice involving Will. Darwin speaks of the objectors who say that "the term Selection implies conscious choice in the animals which become modified, and it has even been urged that as plants have no volition, Natural Selection is not applicable to them." Certainly lower animals and plants are not conscious, are not Egos; still they have a psychical element in Life, and there

is the selection. But Darwin throws up the sponge: "In the literal sense of the word, no doubt, Natural Selection is a false term," and so again he seeks to eliminate the psychical implication of his own great vocable: "Natural Selection is the preservation of favorable individual differences and variations, and the destruction of those which are injurious." Thus he thinks he has eliminated that insidious personal equation which has already given him so much bother. Still it remains and must ever remain, for it is not merely his own, or subjective, but it has its counterpart in Nature herself. Another complaint he utters in the same paragraph: "It has been said that I speak of Natural Selection as an active power or deity," that is, as a supreme Person ruling all living things, vegetal and animal. Better and more prophetic it would have been to make Evolution a kind of God dominating Darwin and the whole Nineteenth Century.

It is not often that we can catch Darwin examining the ultimate categories by which he does his thinking. On the whole he picks them up without criticism, for which he evidently had little taste or aptitude. Still his instinct for the right word is correct; Natural Selection must be deemed a very happy term which helped make the fortune of the author's

theory. Only when nagged by captious objectors, would he seek reasons for his verbal usage (as may be seen in the above passages); which reasons in our opinion do not strengthen his cause. Natural Selection as a term has more truth in it and more virility than Spencer's phrase for the same thing: "the survival of the fittest," though Darwin himself seems to accept the latter as a kind of synonym. It, too, seeks to obliterate the psychological side of the process, and thus shows a pallid, rather soulless expression.

Now, the foregoing trouble in the greatest biological book of the ages (see *The Origin of Species*, Chapter IV) has continued down to the present, and is by no means yet overcome. That unwelcome psychological intruder shows himself a sort of marplot in the onward march of biology, and cannot be put out. As his presence is always manifested in life from the lowest to the highest forms, our purpose is to acknowledge him, not merely as an alien guest, but as a rightful possessor, in our Biocosmos, which must have in every stage and shape the twin elements, the physical or material and the psychological, both being joined together in an immediate inseparable unity which constitutes the living thing, from the lowest cell to the highest organism.

Still one cannot help asking about the func-

tion of this psychical element in Nature. In its final aspect it is the connecting principle between all her separated forms millionfold, for Nature in her outward appearance is separative, from the invisible atom, electron or etherion, to the largest star or nebula. Now, the bond of connection between all these diversified portions of the physical universe is psychical, or mental, if you wish. The word *Nature* implies some kind of unity or common ground of generalization, which underlies its every division. To know Nature truly is to unify all her differences. Still further, we are not going to rest till we ask: What is the source of this psychical activity which streams through the whole phenomenal world and joins it to the universal fountain-head?

I.

NATURE'S ORIGIN.

Many a scientist in these days has remarked on the tendency of Natural Science, supposedly so concrete, to become abstract and metaphysical. During the present century it burst forth in a reaction against speculative Philosophy, especially in Germany; but it is getting to be quite as speculative as any Philosophy. This movement is in the order of evolution, we hold; it shows Nature striving

to get back to its origin in the Universe which can only be a thought, or more adequately stated, the universal psychical process of mind. This point we shall unfold somewhat.

Nature is a part of a greater whole, yea ultimately, of the greatest whole, of the very All itself. And every part of Nature, or part of the part, even to the least, must be a part of this All. So we may grasp, in an external way, the divisions of the physical world. To this view we can now add the reflection that every part of a Whole, in order to be such part, must have the process of that Whole. For instance, each member of your organism—hand, arm, foot—must possess the organic process of the entire body; thus it is truly a member. Accordingly every minutest particle of the universe presupposes that universe, and is connected with the same in the unseen bond which we call the psychical. All true science as universal seizes this unitary principle of every manifestation of Nature, and carries it up to its original source, which can only be the universe. So Natural Science is not to stop with knowing the particular (as it often does). Nature can be known only by knowing the great Whole of which it is a part, and from which it gets its ultimate process. This, too, must be psychical, a fact which we may look into for a little while.

Back of every human consciousness lies more or less distinctly the Great Totality which we have already appealed to under the name of the Universe, the All. This concept is verily the elemental one, beyond which there is none other; we might call it by analogy the primordial mind-stuff out of which every Self arises and becomes an individual. Of this origin the latter always carries the mark or impress, and in its deepest moments drops back into its genetic source which is the Universe, whence arises man's thought as universal, that is, bearing the stamp of the Universe. When the mind becomes truly creative, it re-enacts the creative act of the All, it returns to and shares in the very source and genesis of its own being. Such is the deepest significance of man's universality, though he be merely this finite individual.

Now, this Universe of ours, with its intimate relation to ourselves has long excited the interest of the profound sages of the race, as well as of the humbler run of people. Its primal division into God, Nature, and Man, is familiar, even popular. But the further reflection is not so well known, that these three form a process, yea, a psychological process, which must therefore, be prototypal of all other processes, being the universal one, just that of the Universe itself, and creative of the

rest, even down to the most minute, to the microscopic cell. Accordingly we say that the Universe has three divisions primordially—God, Nature, Man, and that these, being psychical, form the process of the All-Self, who creates the human Self, and indeed all created things, in his image more or less approximate. It is necessary to designate this supreme originative process of the Universe by a special term: we call it the Pampsychosis.

To formulate this absolute process of the one Great Totality, fountain-head of all creation, has been the work of the loftiest spirits of mankind—for instance the founders of the world's dominating Religions and Philosophies. These have sought in a great variety of forms and vocables to bring home to man this ultimate creative process of the All. The result is, we have the religious Norm and the philosophical Norm, to which the time seems to be adding a third, the psychological Norm—all of which have one and the same content—the Universe (see further elaboration of this subject in our *Ancient European Philosophy*, Introduction).

In the present book, Nature is treated psychically. As the second stage or phase of the All-Self (Pampsychosis), it bears everywhere in its divisions large and small, the impress

of its origin. This is its psychological element, which has been already stated to be the connecting principle which runs through all the separate forms of Nature and interlinks them together in their primordial genesis. Thus we catch a glimpse of the universal science of Nature—of Nature belonging to and generated by the Universe.

Moreover the psychological element is in me as Ego, as self-conscious, whereby I come to know all the diversity of Nature as process, which is at bottom identical with mine; otherwise I could not know it. Of old the philosopher observed that he could only recognize his own in cognizing the object. That is, the process of his Self (or Psychosis) must identify Nature's process (or Psychosis) with his own, and then connect it with the genetic process of the Universe (the Pampsychosis).

In this connection a passage from one of Darwin's letters is significant in which he acknowledges that it is "impossible to conceive this immense and wonderful universe including man with his capacity of looking far backwards and far into futurity as the result of blind chance or necessity." Thus we behold the great scientist summoning before himself the Universe and trying to account for it in some way, as being the origin of all origins, "including man." Still he does

not invoke it (and well it is for him that he does not) in accounting for the origin of the species, his unique scientific task and achievement. Meanwhile, however, he unfolds and formulates the leading category of his age, and plants it firmly in the consciousness even of the common people—Evolution.

So there is some thing beyond Darwin according to Darwin; he is but a stage of his own principle universalized; Evolution must evolve also, according to its own innermost logic, and become a part or constituent of a new and completer Evolution.

II.

NATURE'S EVOLUTION.

At present the trend of Natural Science sweeps toward expanding, applying, and in a measure reconstructing the Darwinian theory of Evolution. It has been carried into fields which Darwin knew not of, and transformed in ways of which he probably never dreamed; it has been made universal, it has categorized the age, it has builded itself into the public consciousness. The time was ready and calling for its true utterance, of which various forms had already been given before Darwin. These voices also the true-hearted listener should not fail to hear.

Darwinism is by no means identical with Evolution, which had been announced long before the time of Darwin and was more or less secretly fermenting in the spirit of the age. Still it is more profoundly intergrown with his name than with that of any other man. He popularized it, injecting it into the deepest current of the folk-soul of his century. In the introduction to his book on the Origin of the Species, he has given a brief account of some anticipations of his view, which puts stress upon Evolution of a certain kind, namely, by Natural Selection, the Darwinian kind.

The Nineteenth Century, as we look back at it, shows its own peculiar mental bent, its psychical trend, which it has over and over again in diverse ways expressed as a category of thought. This category is the aforesaid Evolution, which is strictly a philosophical term, even when ejected from the mouth of a philosophy-hating scientist. The Nineteenth Century (of course there is no need of adhering strictly to its yearly bounds) was evolutionary in its highest spiritual activity as well as in its supreme self-expression. In Philosophy, in Poetry, as well as in Science, it has found utterance through the greatest masterpieces of the century. Of this fact we may take a short note.

The philosopher proper of Evolution is unquestionably Hegel, who ranks among the greatest of his guild. His first important original work lay in the domain of the History of Philosophy, whose systems of thought from the old Greeks down to his time were put into an evolutionary line which finally evolved into his own system as the latest and most complete. Thus Hegel quite at the start of the century (perhaps a little before) came into possession of the Evolution of Thought, which indeed may be deemed the ideal prototype of Evolution marching toward realisation during the ensuing years. Indeed he had extracted it from its long antecedent historic wrappage and revealed it in its pure Forms or Ideas, as well as in its inner connection. In the introduction to the foregoing work (History of Philosophy) it is significant to notice what strong and repeated stress he puts upon *Entwicklung* (Evolution), as if he already felt the pressure of the new spirit of the age for its pivotal term or category. In his next book (*Phenomenology*, 1806) he unfolds the method in tracing the subjective mind through its stages from lowest to highest. But his greatest work in this field is his *Logic* (the larger one) which is an Evolution of the "pure essences" of the Absolute Intelligence (of the Logos) as expressed in the

categories of Philosophy. This last work has taken its rank as one of the supreme masterpieces of human Thinking. It may be regarded as the unique instance of Pure Evolution, as it exists in the Absolute Mind "before the creation of Nature and finite Man" (as Hegel puts it himself). So it is the evolutionary Idea going in advance of the reality, which, however, is soon to follow. In this fashion Hegel the philosopher proclaims the Thought of the Century in its primordial unalloyed essence. It should be added that Hegel in his life embodied his philosophic principle of Evolution, for he has very distinctly his personally evolutionary period. Thus he biographically as well as philosophically manifests the fundamental character of his Century; his life incarnates his thought. (For a fuller view of this phase of Hegel, see the essay upon him in our *Modern European Philosophy*, especially the section headed *The Evolutionary Hegel*, p. 654, etc.)

Still, Hegel, philosopher that he was, showed his inherent limitation in the matter of Evolution when the latter was to incorporate itself in Nature. He allowed only the ideal Evolution, which determined, as it were from without, all the shapes of the physical world. He has left us a considerable book on *The Philosophy of Nature*, which, amid

many profound insights, makes us conscious of the externality of his method. when he claps his abstract logical categories upon the processes of Nature. Not so many years before Darwin he declares that "the rise of the more developed animals out of the lower must be rejected by the thinker." Thus he denies Evolution as immanent in Nature, it holds with him only of Thought. This is a bad mistake of Hegel, which Darwin is to correct. Indeed it contradicts Hegel himself, who therein undermines his own principle of Evolution as universal. Still he brings sharply to light the inherent difficulty of every Philosophy of Nature, which applies abstract categories externally to natural processes. It may be here added that a Psychology of Nature proceeds in a very different way.

Darwin, therefore, in the spiritual movement of the century, supplements Hegel's logical or metaphysical Evolution with organic or biological Evolution, which is immanent in Nature. To be sure, Darwin knew nothing of Hegel, and did his work of his own inner impulse in a different country with a wholly different environment. Still it is a point of supreme interest to see the Spirit of the Age uttering itself through both, though in different ways and in different, yea opposite spheres. The sphere of the one was the Cre-

ative Idea or the Absolute Mind; the sphere of the other was Nature; yet both had ultimately the same thought, the deepest of the Century, and both spoke even the same word—Evolution, which was now to manifest itself in every stage of the universal Norm, already described. So we may say that the time had come when the Universe itself must reveal its evolutionary phase, which is to remain the spiritual heritage of the race. It should be added that Darwin by no means traversed the whole field of Nature, but confined himself chiefly to its organic stage, nor did he exhaust that. At present there is in scientific investigation a noteworthy trend toward inorganic Evolution. Darwin also started or at least gave a new impulse to what may be called psychic Evolution in Life, which has had such a remarkable development into a new science known as Physiological Psychology.

Nor should we forget the expression of Evolution in the realm of Poetry, very diverse in form from Science and Philosophy. Goethe's *Faust* is justly regarded as the poetic masterpiece of the Century, and the latter's supreme artistic expression, Goethe himself as scientist is deemed one of the precursors of Darwin in organic Evolution. But he was essentially the poet rather than

the scientist. In the First Part of *Faust* he has set forth the Evolution of Mephistophiles, "the Spirit that denies," who unfolds through a variety of shapes starting with the denying Faust and concluding with the appearance of the traveling scholastic. Nor is this the only case of the Evolution of Forms corresponding to internal character, in the poem, whose adequate interpretation depends largely upon an insight into this fact.

Interesting by way of comparison with *Faust* are the utterances of Tennyson in regard to Evolution. They are in the form of external reflections rather than woven into the very texture of the poem, as we find in the case of Goethe. The striking lines of *In Memoriam* have been often cited:

So careful of the type she seems,
So careless of the single life,

alluding to Nature. Then comes the peculiar Darwinian response:

"So careful of the type?" but no
From scarp'd cliff and quarried stone
She cries: "A thousand types are gone:
I care for nothing, all shall go."

Such is the negative conclusion of Tennyson, in accord with his theme and doubtless

with his character. It should be added that Darwin has something more affirmative than the poet, for new and indeed higher types are always being evolved out of the vanishing old ones. The *Origin of Species* was published ten years later (1859) than the dated dedication of *In Memoriam*; so the Darwinian idea was in the air, and indeed in the social circumstances of the time.

Philosophy, Science, and Poetry had, therefore, uttered the deepest spiritual trend of the century, each in its own manner and in its own domain. Hegel's *Logic*, Darwin's *Origin of Species*, and Goethe's *Faust* remain three supreme masterpieces of human genius, belonging to one period and expressing one content ultimately; three very different voices we may well deem them, but all proclaiming the pivotal message of their time. And that is the reason why they are the masterpieces of the century, epoch-making we say, but really epoch-voicing. They tell the character and designate the place of their epoch in the unfolding of man toward his goal. What we have called the Pampsychois they utter in its latest temporal manifestation. The universal Spirit speaks through all of them its most recent evangel, which is that of Evolution.

But the question rises: Is this the last word

of the ages? Is Evolution the finality? Probably not. Undoubtedly it has come to stay; a spiritual treasure once gained is never wholly lost. Even the atom, first conceived and stated in the old Greek world, has found a new life in our modern science after a millennial subsidence. Still nobody can now be satisfied with the Universe as atomic, except by a kind of reversion to the thought of an age long since past. Such relapses, by the way, are not so uncommon. But the problem is whether Evolution itself is going to evolve and thus become a stage of itself. Is it somehow to transcend itself through its own inner movement and bring forth something quite different? The Eighteenth Century was a negative, revolutionary Century, battering down the past, as may be seen in its acme and most typical manifestation, the French Revolution. But it evolved quite its opposite, the Nineteenth Century, which is essentially positive and evolutionary, conserving and renewing the past, yet with anarchic and destructive seams running through it everywhere, the inheritance of a former time. If Revolution evolved Evolution—the negation undoing itself—what will Evolution evolve as its successor, perchance in our Twentieth Century?

It should be emphasized here that Darwin more than any other man made Evolution the

conscious possession of his age. Philosophy, especially Hegel, is understood only by the precious few, while Poetry hides its meaning in the outer image so that many never penetrate to the soul of its utterance—witness for instance the vast army of commentators on *Faust*. Nature's Evolution, accordingly, has been the mediating principle of the age for making the same conscious of its own deepest thought, aware of its very self; hence springs the present dominating significance of Natural Science in comparison with Philosophy and Poetry, both of which, however—and let it not be forgotten—deliver the same message. This is what the complete man is to hear in all its forms. Darwin is, therefore, the genius of Evolution, who brings down the Spirit of the Age to the people; stated in other phrase, he mediates the Pampsychosis when it has become evolutionary, with the folk-soul, of the Century. Such in all ages has been the function of the hero or genius; and as Darwin's field was mainly biological, we may pedestal him the hero of the Biocosmos.

Still the question cannot be kept down: What after Darwin? What is Evolution going to do with itself?

III.

EVOLUTION OF EVOLUTION.

Ultimately Evolution will have to be applied to itself, if it be truly universal. It must be tested at last by its own principle, subsumed under its own law; what then becomes of it? And the author of Evolution we have to consider as evolutionary in himself, as subject to his own process, as an example of his own work, as something evolved.

It is by no means the least fact of Evolution in the Nineteenth Century that it evolves its evolver, Charles Darwin. It makes him corporeally appear in his rise through thousands of bodily forms, from the lowest to the highest, after the procession of untold aeons, possibly a hundred million of years, if we may dare suppose with some scientists that life on our planet began so long ago. It is no wonder, then, that such an appearance is mightily acclaimed by the time. For every man sees now his true genealogy—if not his own origin, at least his physical history; he begins to understand himself organically. Evolution of life has been going forward in a dumb unconscious way for all these millenniums; but now it gets a voice for the first time, yea an historian who looks back and in-

dicates the stages through which it has passed up to the historian himself. Evolution, therefore, has evolved the evolver evolving Evolution, as far as life goes, and thus shows a cycle of present completion.

It is manifest, however, that there is another and deeper act here than the physically evolutionary. Darwin's Ego or Mind is what returns to his corporeal starting-point, and traces the organic forms till he comes to his own organism. That psychical return lies outside of life, yea, outside of Evolution in its more special sense; which, however, it grasps and describes. What is its place and significance? Just here we may glimpse possibly a flash of the coming century with its own doctrine which reaches beyond Evolution, though including it. Darwin consciously evolves the organic world, but unconsciously has evolved his Ego performing such an evolutionary act. That is his unique achievement, and makes him the unique man that he is. In his work of Evolution he suggests and instinctively employs something greater than Evolution, great as it is.

We must inspect the inherent character of Evolution, and see what it will do to itself. It takes for granted an immanent principle in Nature which projects itself into a line of living forms, and thus manifests itself in a

kind of organic ladder from bottom to top. But we have to inquire after this formative energy which is pre-supposed in Evolution: What is it and whence comes it? What could have set it going and have imparted to it the general tendency to rise in the scale of excellence? Evolution does not answer such a problem; it simply assumes the given principle and points out its transformations. Accordingly something lies back of Evolution, propelling it onward, and for the most part upward. Darwin in spite of himself, at times even under his spoken protest, introduces such a power, usually by the name of Nature or Natural Selection. Evolution, therefore, cannot completely evolve itself, it has to invoke an energy outside itself to make a start, and to drive it on. When it has evolved itself entirely and universally, it must have evolved its pre-supposition, that which originates and performs its process. Evolution thus shows itself but a part or phase of a greater movement; through its own inner dialectic it calls for the completion of itself. When Evolution reaches the end which returns to and makes the beginning, when it has evolved the principle which starts it and propels it, the ascending evolutionary line is transcended, and rounds itself out into a cycle. What is it that has this self-returning power?

Evolution must at last run upon its secret demiurge which is an Ego unfolding and formulating it as a doctrine or as the fundamental thought of an epoch. Such an Ego is itself an evolution of the ages and makes its appearance in the fullness of time. The Universal Spirit (or the Pampsychois) was evolutionary in the Nineteenth Century, and manifested itself peculiarly in Darwin, who, receiving the impress of his period, became also evolutionary and uttered the supernal message to his contemporaries.

Such, indeed, is the function of the Genius in the progressive sweep of the ages—he is to express in word or deed the spirit of the time to the people, who are dumbly ready for the message. The Great Man of the period in one way or other, is the mediator between World-Spirit and the Folk-Soul. Be he political, literary, scientific—soldier, like Caesar, statesman like Lincoln, poet like Goethe, biologist like Darwin—he is the great mediator of his epoch, between what we may call the upper world and the lower world, between the universal mind in its movement and the individual who is to be filled with and to become conscious of the same—when we may pass on to the next stage. Darwin, therefore, is the incarnated Genius of the Century, more than any other scientific man; biologist he

was it is true, but he had the power of making his particular science universal, of causing his special category (Evolution) to be applied to every other department of knowledge—history, philosophy, institutions, and finally even theology.

Of course there can be heard in these days the anarchic protest against the work of the Genius in the World's History. Lombroso and his disciples have sought to show that the Great Man of the Age is mostly crazy; but really he is to be conceived as the sanest person of his time, who communes with and shares in the universal Reason in a deeper sense than any other mind. Just on this ground he may be thought to be mentally out of order, but one cannot help thinking that the man who deems just the world-historical Genius to be crazy is himself the crazier.

Undoubtedly Nature had long been evolving, from the very beginning in fact, though without the presence of the evolutionary consciousness; but it is now made conscious of its evolution through the Ego of Darwin, who thus stands at a grand node of Nature's unfolding. Man was indeed conscious or self-knowing long before the Nineteenth Century, many thousands of years doubtless; still he was not conscious of himself as evolved, of his evolutionary principle. But the fullness

of time had come for just such a thought, and it was Darwin who rendered it the spiritual possession of the race. He it was who made us aware of the evolutionary idea of the All-Self (Pampsychosis), not its only idea by any means, still one of its ideas, peculiarly that of his epoch. Darwin was truly the child of his time; he could not have done his task in any other period or in any other country but England; the age had to whisper to him its evangel and the folk-soul had to be prepared for listening. Whereof something will be told more fully in a later chapter.

IV.

THE PHYSICAL AND THE PSYCHICAL.

Repeatedly has it been expressed that Nature is inherently dual, the second or separative stage in the process of the Universe. Evolution manifests this dualism in its own way, perpetually striving to overcome it, yet always dropping back into it again. Hence Evolution has the appearance of a struggle between two forces, an inner and an outer, neither of which can altogether conquer the other.

In all Life, micro-organic as well as macro-organic, in the smallest unicellular organism as well as in the largest multicellular organ-

ism, the two elements are present, physical and psychical. Moreover their presence is in every part or point of the vital body, wrought together in an indissoluble union, which will not permit one to exist without the other. Body is in the soul and soul is in the body; their unity is, as we say, immediate. Even if the one be essentially determining and the other essentially determined, neither can do without the other and exist. To be sure, we shall find that the psychical element will reach a stage in which it can separate from its embodiment and be self-determining within itself; but that stage is beyond Life, transcending indeed Nature, though it is her goal and very aspiration. Such is the deepest dualism of this sphere (the Biocosmos), its two-sided oneness; we might name it Life's bi-lateral symmetry, which runs through every plant and animal. The two sides, however, are not simply fixed in their twoness and opposition; the living soul is always getting outside in the body, and the living body is always getting inside in the soul; the two counter conceptions we must somehow grasp together: the internal keeps externalizing itself and the external keeps internalizing itself—this is the double process in vital action. The dualism of Nature is always present in Life, but is always being overcome,—from which view-

point we may again see that the Biocosmos is the third or ever-returning stage of total Nature.

When we seek to unfold the process of the cell, as a nucleated oft-dividing mass of protoplasm, the activity we call a psychosis; that is, its genetic movement is after the order of the Psyche, which thus furnishes the typical form of life, the creative energy, and, it may be added, the end toward which the vital world or Biocosmos is advancing. The psychosis is the basic process of the Self both as individual and universal, and is that secret but very active determinant of the cell and of all Life which the biologists are pursuing with such an outlay of industry and talent. The difficulty with it is that it cannot be coaxed to show itself under the most penetrating microscopic eye, and yet is present and on duty. It is often recognized as the architectonic principle in the living organism—the cunning artificer who is ever building and rebuilding the outer structure according to his idea. But that idea—how can we catch it with a lens? Really it can be overtaken only with our own Psyche, cognate to it, and able to unite with it just in its process which is also psychical. To be sure, Life's Psyche is immanent in its material shape, is one with its physical matrix as we see in the cell. The psychosis in the

present case, therefore is the organic or vital one, not as it is in itself; when the Psyche is its own matter as well as its own form, we have advanced out of Biology into Psychology proper. Still, Psychology, when rightly grasped, is the universal science, which construes itself and all other, namely, the special, sciences, having in itself the typical and indeed genetic form of them all. So Biology as a special science is not only psychical but also psychological; in fact it is the immediate unity of the physical and psychical elements as already stated; but as science it is ultimately the pure psychosis, seeing and formulating itself in Life's particular psychosis.

So fundamental is this point for the intelligent study of Nature that we may symbolize it in two names, one of which has been already used: *Physis*, the Greek word for Nature, found in numerous English compound words, and *Psyche*, the Greek word for Soul, also well-known in many derivatives. These two personified existences—we may for the nonce consider them as Hellenic Gods like Zeus and Hera—have joint possession of our Olympian Biocosmos, and dwell together in a peculiar marriage, their children being every form and process of Life and partaking of the fundamental traits of both parents. The lowest vegetable form as well as the highest animate

organism show the twofold strains of Physis and Psyche, though in very different gradations. These twin deities are completely intertwined and intergrown; the smallest microscopic cell, yea, the least granule of the protoplasmic mass of the cell are their common progeny, and manifest their common basic character, physical and psychical. Still this double godhood of the Biocosmos is deeply discriminated within itself, the twins are very different from each other, quite opposites indeed. Psyche is the unseen, the architectonic, ultra-microscopical; Physis is the visible, the extended, the material of the edifice furnished from the outside by the Cosmos, which is also in its way psychical. Moreover, of the two divinities, Psyche is the aspiring, the limit-transcending, also the controller of its mate Physis, who is heavy, terrestrial, unwinged, and furnishes all the microscopy generously to the scientist. It may be added that Psyche is not altogether contented with her life-lot; she feels herself clogged by her other part, though also divine; she longs for separation, when she is completely self-controlled and autonomous—a state which she will yet attain, though in all Nature this remains an ideal end. Still when she has gained her autonomy, and separated from her associate she will feel herself finite.

one-sided in fact, and will have a recurrence to his presence, for Physis, too, belongs to the Universe.

Now it is this Psyche which gives the chief, yea, the insurmountable trouble to the biologist, always pushing into his horizon, yet always escaping him when he tries to grip her or to witness her secrets with that cunning magnifying eye of his. At present biological division seems to be the grand mystery, springing from some inscrutable source; the cell divides, the nucleus divides, so does the nucleolus and the protoplasmic granule, yea, even the hypothetical biospore (Weissmann), pangen (De Vries), biogen (Verworn). For the self-separation of the germinal principle has to take place: but why and whence?

Of course such an ultimate division in its source carries us out of Life to its determinant, which is psychical. It is important to note in this connection, that Biology has begotten its counterpart, Physiological Psychology—whose title couples the twin elements already mentioned, Physis and Psyche. This new science takes for granted the immediate unity of the physical and psychical elements in the total evolution of Life since its first appearance on our planet. The outer vital act has always manifested the inner psychic act, so we behold in this field an experimental

Psychology of the laboratory, which is to witness the internal procedure of Psyche shown in the external phenomena of Physis. But of course this Physio-psychology cannot be deemed the true Psychology, but simply preparatory. Still it has its significant place as the counterpart and necessary concomitant of Biology, which, as at present carried on, is quite too much inclined to leave it out and to treat the vital process as chemical or even electrical, that is, as diacosmical. The unitary science must be bio-psychical, and has to be ordered not from the side of Natural Science but of Psychology. It is really the Psyche which determines the Physis, though in experiment, we make the Physis determine or rather manifest the Psyche.

So in our Biocosmos we shall try to keep the twin deities together without neglecting the part of either. Above both of them is indeed a higher God, the highest, the pampsycheal Zeus we may for the occasion call him, who rules not only Nature, but the total Universe of which Nature is a part. Or, to draw upon William Shakespeare in this mythical adumbration, the Ariel and Caliban of Life belong together in one island, and are servants, yea complementary elements of the one supreme ruler of their world, who is Prospero, and who keeps both these refractory

opposites in submission to his order. Still we are not to forget that the all-ruling Prospero is himself a Psyche.

Somebody may here think a question: Is there a science of this Psyche as such—a science of the soul (or ego) in itself? Undoubtedly, and its processes are what we must see as determining Nature, yea in the supreme glance as being Nature. This is a stage of the Universal Psyche, which shows itself as not only determining matter for instance but as being matter—which statement by the way is no denial of materiality. The Psyche as individual determines its organism (or Physis), but as universal it is the Physis in one of its phases. Evolution manifests Nature's effort to overcome its primal estrangement, and to return out of separation. In a different sphere (the Cosmos) Gravitation may be said to show the same striving to return to the first unity. But when Nature has transcended its dualism, then it is no longer Nature, it has gone over into another sphere.

In the long-protracted struggle of Nature between Physis and Psyche, which is the victor? And what is the victory?

V.

THE HUMAN FORM.

The culmination of Nature's hierarchy of shapes is finally embodied in a shape—the last physical shape, it would seem, and a kind of resumption and transfiguration of them all. The life-stuff receives its ultimate incorporation, and appears incapable of rising higher. The Psyche repelled by the refractory material, is thrown back upon itself, and starts a new world of its own, that of consciousness. Therewith the drama of Nature with its long line of shapes—we may even call them characters—has concluded.

It is agreed that the highest manifestation of the Psyche in the Physis is to be seen in the Human Form. From the beginning there has been a gradual evolution of physical shapes of life till man has been reached, who is supposed to be the topmost rung of the ladder. So we see hanging down the aeons that marvelous chain of life-forms, every link of which is different from yet interrelated with the rest. Moreover every link manifests some gradation of the psychical revealed in the physical, till the supreme revelation in man is attained.

Given an elemental life-stuff or protoplasm

we may conceive a spirit entering the same and moulding it into living shapes, as the fabled Prometheus formed the clay into human beings. Here, however, he forms all animate Nature, and vegetal also, into the vast ladder of organisms from the simple unicellular microbe to the supremely complex body, in which he finally moulds himself. Such is the creative artist in creation, shaping himself upwards (really none other than our Psyche) till at last he brings forth the highest artistic shape, that of himself embodying the whole line of shapes below him. Embryologists tell us that the human embryo starts with the single cell and evolves through many lower kinds of animals, probably representing the entire gamut of animality down the geologic ages. A German investigator tells us that he can trace a hundred remnants of inferior creatures in our organism. It looks as if Psyche, having built the ladder on which she has ascended step by step, has drawn it up after her into the highest story of her human temple.

Something continuous, though invisible, runs through and holds together this long gallery of separate living shapes—an ever-creating and advancing continuity, not accessible to the senses or to the microscope; and just here the trouble of the scientist comes in,

caused by the presence of that elusive sprite, Ariel-Psyche, who is properly the connecting as well as propelling principle, and who has the habit of being specially active at the important transitions of evolution.

In this connection the question persists in always returning: Has our Human Form then attained its maximum of development? Is the future man, as long as the sun lasts, to be quite like us? This would mean that the outer evolution of animal Forms has practically come to a close, that the Psyche has reached her culminant manifestation in the Physis, that the artist working over the plastic life-stuff, has succeeded in producing his masterpiece after the labor of at least one hundred million of years (as some geologists reckon). Earth's shape-building Titan, the Prometheus of Nature has now modeled his ideal in the Human Form, the prototype of the highest beauty, and doubtless the visible presentation of himself, insofar as he can be moulded into finite limits.

There are many signs, however, that this outer evolution of the Physis is to be followed by the inner or pure evolution of the Psyche, who no longer finds the plasticity of the life-stuff adequate to her self-expression. A sort of fixity of the Human Form has taken place, so that there is little difference be-

tween the organisms containing the lowest and highest human intelligence. Such is the most significant turning point in the entire stretch of animal evolution: the change from a physical to a psychical plasticity, which already began to show itself decisively in the era of the anthropoids.

In order to get the bearing of this subject, it is worth while to go back and mark the most important nodes of the evolutionary ascent of living shapes. Very sharply is it recognized that man has a vertebral column in common with a long ancestral line down to the Fishes. We may start with that portion of the animal kingdom now called the Chordates, from their distinctive member known as the notochord. Of these the vertebrates are a division whose beginning is usually placed far back in the Devonian age. But when did that vertebrated fish begin, or how? Doubtless in the sea, and man still shows in his organism traces of having once lived in the water, where his backbone first started in its primal simplicity. But the next great node in the evolution of the vertebrate animal was when it became a mammal, evolving the mammary gland specially in the female—which probably took place in the Carboniferous era, estimated variously from ten to fifty millions of years ago. Again we have

to question: At what place and How? Did the great transition occur at a single point in a single family and possibly in a single species of animals? Or did the Mammal spring forth cotemporaneously over a vast area? The greater likelihood is that it, having been formed under favorable conditions, spread from a common center. The recent excavations of the Fayum in Egypt, indicate that it must have been at a very early period, a prolific seat of Mammalian life, possibly its original breeding source. At any rate our muscles, our organs and their mutual relations were formed as they now are in those transformed vertebrates when they became suck-giving and sucklings—a most weighty node of life's evolution, since the mother now begins to appear, though the female had long existed already. Another important node may be mentioned in the development of animals: the placentata, those which have evolved a placenta (afterbirth) in connection with gestation. Again this new organ belongs to the mother for the reproduction of the higher order of animals. That is, the evolution of the completer organs of maternity seems to be connected with the advance of the animal world toward man, even if the placenta (or its first germ) occurs sporadically in some Invertebrates. The

Marsupials may be taken as the order best representing this transition, some having a placenta and some none. They seem at present to be on the way to geologic extinction, being found chiefly in Australia (the opossum is said to be the only American Marsupial). But in the Mesozoic time these animals were scattered everywhere. The Nile valley was probably the center of their original development and distribution.

Accordingly the hitherto pronounced characteristic of the evolving line of animals was their formability—the apparently easy response of *Physis* to *Psyche*. But the change to a greater rigidity of shape is already noticeable in the higher apes. A curious fact is that the zoologist of today has thrown overboard the order *Bimana* as including man alone and apart (this order was first designated by Blumenbach and retained by Cuvier), and on anatomical grounds has classed man with the apes, monkeys, and lemurs. That is, man is no longer distinguished as two-handed (*Bimana*) in contrast with the four-handed ape (*Quadrumana*), for the skeletal organisms of both are practically the same. So both are now put together into one order called the *Primates* (an old Linnean designation), in spite of their enormous difference as to intelligence. In fact, man

is said to differ less in body from an ape than an ape from a monkey. Thus the fixed shape of the animal kingdom seems to have been essentially attained, the life-stuff no longer responding to the formative artist Psyche, or very slightly. The outer plasticity of the Human Form appears to have culminated and rounded itself out to a finish. It should be here noted that some lower animal shapes of the far-away past have shown themselves very persistent, enduring all the changes of the geologic ages till the present without any essential change of form. An oft-cited case is the Brachiopod *Lingula*, which, starting in the Cambrian era, is still found today. In like manner, the common crayfish, whose origin goes back to the Carboniferous era, retains essentially the same shape it had then, even with changed habits. So in the line of animal evolution there have been strains of dogged persistence of form quite from the beginnings of life. Other humble cases might be cited, prophetic, as it were, of the coming rigidity of the highest physical shapes. But the main evolutionary stream of animality has shown the aforesaid plasticity till the Primates are reached.

Is man ever to attain the point at which he may be able to control his shape by controlling the conditions which determine it?

Mr. Darwin's thoughts on the human influence over Natural Selection in plants and inferior animals have called up the application of the same principle to man himself. Can he take a conscious part in making his own body, or cause it to evolve along certain transcended lines, as the breeder does the sheep or cow or pigeon? A famous attempt in this direction was Mr. Galton's Eugenics or stirpiculture. Certain communistic societies have had the same end in view, for instance the Oneida. Can man tap afresh the fountain of his body's plasticity, now almost sealed, and start it to flowing again, but in obedience to his will? Doubtless, such a work will be more difficult than that peculiar control over the vegetal life-stuff in producing new forms, which has been attained by Mr. Burbank in California. There seems, however, to have been no culmination of plant-life in a fixed form, like that of animal life in man.

We come back to consider the rigidity of the animal shape, which rigidity, it is said, has gradually increased from the marsupials up to the human being, that is, through the whole line of placentate vertebrates. But just in this cessation of outer evolution there rises the inner evolution; corresponding to the decrease of plasticity in the *Physis*. is

the increase of plasticity in the Psyche. In the almost stationary body of the *genus homo* (excepting the brain, which keeps enlarging) there is an evolutionary line of mental forms from the lowest Australasian to the highest Caucasian, comparable to the graded shapes of the animal kingdom. One biologist has declared that these variations of intellect in the one almost unvarying human shape are relatively greater than the whole gamut of the vertebrates, from the Fishes to highest Primates. The proposition has been made to have a new internal classification by the standard of mind into species, genera, families, orders. Taking the races of men together from the lowest to the best, we observe a line of psychological forms of the greatest variety, in one nearly invariable organism.

It would seem, then, that the Psyche, having quite lost its evolutionary power over the Physis, has turned back upon itself and proposes henceforth to evolve that. In other words psychological evolution has now evolved itself in its own right, capping physical evolution, and is evidently going to have a long career in the future. To be sure there is the racial chasm between the far inferior and the far superior man, and this chasm in certain directions seems quite impassable already, and is possibly widening. But in the coming

million of years of psychical development in the progressive man, what is to be the trend? It is quite soul-stretching enough to think of such a prophecy without attempting more than the faintest foreshadow. The power of association seems to be the line on which mental mankind is at present most distinctively evolving.

But before going further, we should glance at the fact that the Psyche reaches the point of turning back upon itself, grasping itself and therefrom unfolding itself. What is that process but Consciousness, which has now broken through the shell of the Physis, not yet into the sunlight but into the earliest crepuscule of self-knowledge? That is, the human Ego has arrived, hitherto only immanent in the Physis, implicit, a potentiality evolving to reality. After the long separation in Nature the Psyche has come back to itself in the individual man, has risen to self-awareness, and is a Psychosis with its own inner self-divison and self-return, no longer a physically encumbered Psyche. But herewith the entire realm of Nature is transcended, having run its course of separation from and in the Universe (or All-Self), and returned to its fountain-head, with which it has become one even in its separation as individual, who is now psychical man. Or, in the terms already

employed, the Psychosis, while preserving itself as individual, is united with the Pampsy-chosis as universal, completing the same in its triune process of God, Nature and Man, which constitutes the fulfilled cycle of the Universe. The primordial fact, therefore, of human consciousness (or the Ego) is that, ere it can become, it must share in the universal or divine consciousness. Man, to know himself, must at the same time know the All-Self, though both knowledges be at first very faint. Our single Ego is not drawn out of itself merely, but must tap the universal creative Ego.

It is fitting to ask when and where this transition, this breaking-through of consciousness took place, perchance like the chick out of the egg-shell. No doubt the change was slow measured even in millenniums. The antiquity of man is now thrown back into the Tertiary at least a million of years ago, as the geologists say. As to locality, Egypt again looms up as the probable starting-point. The Nile may well be regarded on Nature's side as the father of conscious man. No other river, no other part of the globe furnishes so many favorable conditions for the rise of human Ego. The Nile fed its early anthropoid children with a hand which reached from an unknown source like a deity,

and thus nursed a God-consciousness, inter-linking it with human consciousness. Then arose the earliest association of man in an institution, doubtless the religious, with which was intimately joined the political institution. As late as the time of Herodotus the observant historian could declare that the Egyptians were still the most religious of peoples.

Conscious man, therefore, probably spread out from the Nile, that unique stream-bed of our terraqueous globe, where he broke through into his double Self-awareness, not only that of his own Self, but likewise that of the All-Self, the two indeed being united in the one basic process of consciousness. Certainly the most important node was just that in the movement of humanity, yea of all animality, possibly of total Nature as far as our planet is concerned. We have already noticed that Egypt was probably the center of the great Mammalian transition of the Vertebrates, and even the Vertebrates may have started there. For that matter the original protoplasmic life-stuff in which took place that primordial transition from the Inorganic to the Organic, from Unlife to Life, may have been the Nile slime whose proliferous energy has been famed from time immemorial. Not without parallel significance is the fact that

Egypt was the home of the first human civilization, of the earliest institutional association of man, and perchance the breeding-nest of Life itself. Very suggestive from this point of view is that old recumbent statue of the Nile-God still to be seen in a Roman gallery of sculpture, with all sorts of creatures crawling over and indeed out of his body, which seems at every point to be sprouting into living things. Ancient Art would appear, accordingly, to have grasped and embodied the divine paternity of Life in old Father Nile, who was also an object of worship in this character to his immediate human children strown along his stream.

The conscious man is not only aware of himself but also of his fellow-man as conscious, and as participating in the All-Self. Thus they have something in common, yea the common universal Self, known to both equally in the very act of consciousness. Here is the primal uniting point for man's association in institutions. Undoubtedly the non-human animals, even the insects manifest already an instinctive association for mutual security and co-operation, marvelously foreshowing conscious association, which, however, indicates the passage of a grand nodal epoch. Conscious men first unite in their common All-Self (Pampsychosis) and build

their earliest institution to Him as their God, who also indwells their earliest temple, the abode of the religious institution. From this germinal source evolves the whole institutional world; even the Family, the sexual relation of man and woman, rises out of animality into the institution, at least in the beginning, through the religious sanction, which stamps it with its own seal of permanence, unity, and universality.

But what of the future, watchman? Hard to foretell in any detail; still a little with becoming modesty may be glimpsed. It is highly probable that man's development is to move just on this line of institutional association, with which he dimly started far back yonder in the twilight of his first consciousness, perchance on the Nile banks. All individuals, while retaining and unfolding their individuality to the fullest, are to be socialized in a common solidarity of institutions which are to make possible and to secure the free growth of the individual to his supreme spiritual stature. A world-union only can bring forth the world-man and the world-people in their full freedom. Already the statement has been taken up by the popular mind that man is a social product, the child of association—the completer the association the greater the child. In the political insti-

tution we may often hear the aspiration to federate the nations and even the races. Seers, poets, and philosophers have long since expressed it; seemingly the ancient Stoic had already some such ideal. In general the proposition seems to hold good that the lower the man, the people, the race, the less their power of institutional association, which is getting to be known as the final test of human worth and efficiency.

Still the strong counterstroke to this trend of mankind is not to be omitted. Always moving with, yet struggling against institutionalism is found its fierce antagonist, anarchism, which, however, takes many forms, from bitter bloody destruction to mild moral suasion. In literature there has ever been a loud anti-institutional voice, often that of the genius of the time, like Byron and Walt Whitman for instance, and even Goethe during one period of his career. And this deeply hostile spirit has not failed to proceed from the word to the deed as in the French Revolution. So the supreme institutional movement of humanity has its opponents within its own ranks both doing and protesting, who make up the negative element belonging to the complete process.

The unity of man through institutional association would seem to be the outlook. Not

a pantheistical swallowing-up of the individual is here prefigured, but that co-operant order which secures the individual in his free development. And finally to make the biological connection, it may be stated that even the simple living cell shows this power of association. It unites, for instance with its fellow-cells in order to form the human organ, yea to form the total human organism, with a marvelous variety of adjustment in the one little cell-life. But this biological organization of each individual is to be carried up into the psychological organization of all these individuals who thus become one associated whole, which we may faintly forecast as the universal institution of the race. Possibly, then, man may be able to master the cell-organization of his own framework, and to mould anew the Human Form consciously.

Still at present the plasticity of the life-stuff to the indwelling Psyche appears to be halted for a period of inner development and higher association. But therewith we have moved out of the science of Nature into that of Psychology proper, which, though succeeding Nature in the order of development must finally go back to it and organize it anew, putting it into its ultimate scientific place in the great totality of all science, psychological and physical. So man may now deem

himself to be in the epoch of the plastic Psyche, whose forms are pouring forth with dazzling rapidity into the world of reality. And we may dream of some future return of the plastic Physis, shaped no longer purely by the instinctive impulse of Nature, but by the conscious purpose of Man, who ultimately needs not to take anything for granted in the Universe, except the Universe with himself thrown in.

But such a time is far removed and cannot much concern us now; so we shall come back to the theme which lies directly on our path.

THE BIOCOSMOS.

PRELIMINARY.

We now enter the sphere of the Science of Life whose appropriate designation is known as Biology. But the ordinary usage of this term, which is indeed somewhat variable in meaning, does not fit the conception which we seek to formulate. So we adopt a cognate word which also has the merit, for us at least, of suggesting through its termination its connection with the two correlative stages of Nature which have preceded it.

If we should translate the word, taken from the Greek, which is employed as the title of this book, we would call it Life's Cosmos, or Order. The subject is, therefore, the ordered Life on this planet, since we are cognizant of none other. Now this ordered Life must embrace not merely the activity of Nature but

also of Man in his attempt to construe and formulate the same—which gives the science of Nature. It is Man who turns back upon the physical world and seeks to re-order it according to its own genetic principle, and then to precipitate this into human speech. The Biocosmos, therefore, to be complete, must include not Life alone, not the Science of Life alone, but likewise the Mind making this Science.

Moreover, in the sweep of total Nature, the Biocosmos is but one stage, the third, which has the universal characteristic of turning back upon itself and thus finishing its cycle. The animated world has the pervasive trait that it can be stimulated to some kind of self-movement, which involves the life-round of taking up and giving out. The oak develops the acorn, which in turn becomes the oak producing the acorn; the falling leaf whirls to the source whence it came, the earth, ready to begin over. More pronounced are the circuits of the animal body—nervous, circulatory, muscular. Deeply grounded is this self-returning principle of the Biocosmos as the third stage of Nature; it is what the mind is ultimately to see and formulate, and thereby identify with itself. Its process is psychical, must be so, else the *Psyche* never could get it.

There are accordingly two other stages of Nature as a whole which are antecedent to the present one, and which we name in order Cosmos and Diacosmos. The first is essentially gravitative, and manifests the varied unification of matter after its equally varied separation, and thus gives rise to what is generally known as the mechanical world. The second stage (Diacosmos) is the separative, and as the opposite of unity-seeking gravitation may be considered degravitative, or radio-active in the wide sense of the term. Already in the Cosmos is to be noticed a *radial* force which arises in the case of a rapidly rotating body, and flings off an outermost fragment in opposition to gravitation. This is the way in which the sun as nebula is supposed to have ejected the planets of the solar system, which still remains cosmical or mechanical, since this ejective or radial energy is in the end controlled by gravitation. Thus it is that the planets, after having been thrown off by the sun, remain in its gravitational empire and circle about it in their orbits. From this point of view we are to make a distinction between a radial (cosmical) movement and a radio-active (diacosmical) movement. An instance of the latter is seen in Light, which the Sun rays out far beyond his system, without return apparently, as may

be inferred from the luminosity of other distant suns in starry space. Light, therefore, illustrates the degravitation of the Diacosmos, even it is can be weighed, and separates and keeps on separating from its solar source to the extent of its energy. The term Diacosmos embraces what is usually included under Physics and Chemistry in the scientific nomenclature of to-day.

These, then, are the two stages which precede the Biocosmos, and with it form the total process of the physical world. The Order of Life (Biocosmos) is, in this view the self-returning stage of Nature, in which stage the latter, after its separation, is seeking to get back to itself. To take an example: Heat, the diacosmical radiant, falling upon a plant, has its energy transmuted into the round of vegetal life, which moves from the bursting seed into root, stem, branch, flower, back to seed, its starting point. Thus Heat, with its radiative energy undulating outward to infinity, is made to wheel about and work in a cycle through a living thing. Or, using our general terms, we may say that the Diacosmos with its radio-activity, is transformed into a self-returning circular activity through the Biocosmos which controls it to the purpose of life. The same is true of Light, Electricity, Chemism, of water and air—in fine of the

whole Diacosmical realm. Life, in the universal view of Nature may be deemed to have this object: to assimilate to itself and thus to vitalize the ever-separating radio-active principle of the physical world—in other words, to elevate the Diacosmos into the Biocosmos, to make air and water, Heat and Light live. For it is agreed that Life is the higher. Nevertheless Life is still of Nature and bears within itself Nature's dualism. It has not the completed self-return which belongs to the Psyche, is not spiritual; it is still corporeal, in the material body, which, however, must in its turn be transcended. Still in the Biocosmos every piece of matter, even infinitesimal, gets endowed with the self-returning principle inside itself, and so is animate, organic. Such is the great third stage of Nature which unites the two other stages. For the living thing is still cosmical and gravitative, as well as diacosmical and radiative; the bit of vitality falls back to the earth, even if it lift itself for awhile from the earth. The original separation of Nature from the All cannot be overcome by life.

At the start we are to consider the surprising limitation of the Biocosmos compared with its two correlative spheres. For the Cosmos as well as the Diacosmos reach out to an indefinite extent in the physical universe,

are indeed often called infinite; while the Bioscosmos we find circumscribed on all sides, in Space, Time, Quantity. Of this fact we shall take some notice in detail.

I. In the first place, Life, as it is found on our globe, exists nowhere else in the Universe, as far as we know. Under the conditions given by our earth, it can hardly endure on any other planet, though some have thought that Mars may be inhabited. Of course, there can be imagined a vital activity very different from ours—an animal heat, for instance, equal to the heat of the Sun, and the Sun has been sometimes held to be an animal. Still, as far as we can at present discover, Life is a unique terrestrial gift.

In the next place planetary Life regarded as a whole, is an exceedingly small part—relatively not more than a microscopic point—of the total amount of matter of our globe. One scientist has estimated that all living organisms taken together—the sum total of Earth-life—to be not more than one ten-millionth part of the material whole of our terrestrial sphere. This estimate does not take into account the physical universe outside of the Earth-ball, which is also non-vital, as far as we can tell. As to quantity, therefore, all Life, conceived together in mass, is

exceedingly small, compared with Unlife or the inorganic Earth.

In the third place, the thermal limits of terrestrial Life are equally striking. Heat, the diacosmical radiant, plays a most important part not only in generating the planetary system as a whole, but also in vitalizing our globe. Yet the bounds are sharply drawn: too much Heat or too little destroys Life, which, however, thrives on a certain amount of it. Take the 180 degrees of the Fahrenheit scale between the freezing and boiling points; the middle 100 degrees constitute the range of temperature in which the vast majority of organic beings exist. To be sure there are exceptions both among plants and animals which transcend the limits each way, hot and cold; still these exceptions do not get very far from the border, but hover around the general range of Life's temperature—the before-mentioned hundred degrees (or perchance a little more). Here the fact must be brought out that this heat-scale of terrestrial vitality is but a small part—a dot as it were—of the total scale (or spectrum) of thermal energy in the universe. The heat at the surface of the sun has been variously estimated, say from 8,000 to 20,000 degrees Centigrade, and even more; but with any of these measurements we see to what a little speck of a

heat-scale our Earth-life is confined. It may be added that our sun is by no means the hottest star, but it is reported by authoritative scientists to be about half burnt-out, having already dissipated the moiety of its heat-giving energy.

In the fourth place, as regards Time, Life is and has been confined in what seems impassible limits. We at this moment exist because the Earth is cooling off; once it was too hot, hereafter it will be too cold, according to scientific prophecy. Thus Man, and indeed the total Earth-life is limited at two temporal boundaries in the Past and the Future, and is properly moving through a transitional stage of the globe, from the beginning to the end of the organic world. It is supposed that this Earth-life started about one hundred million years ago at which time our original terrestrial fire-ball had cooled down to a point which not only permitted but possibly generated the first protoplasmic vital stuff (Protobioticon) out of which have evolved all the plants and animals of the geologic ages down to the present moment. A long period had elapsed—doubtless several hundred millions of years—before this epoch of terrestrial vitality arrived. At what turn of the æons the Earth-life will expire is of course conjectural; some say another hundred million

years at least are its due. Thus the heat-scale of life, after having lasted so long, is to vanish from the globe according to present science, which in this way sees the thermal principle slowly failing, and makes the Diacosmos bring on the death of the Biocosmos.

Here it should be added that the other Diacosmical radiants, Light and Electricity, are quite as necessary to Life as is Heat. In their case, too, vital action lies between too-much and too-little. There is a light-scale of Life, and an electric scale of Life; in both these cases also comes up the question of the final extinction of Earth-life with the waning of the Sun. The problem likewise presents itself in regard to other solar systems. For instance, does the same heat-scale of life prevail in the supposed planetary retinue of Sirius, or of Arcturus? We may be curious enough about our nearest stellar neighbor, Alpha Centauri, to ask whether it has in its train a planet corresponding to our Earth with a similar Order of Life (Biocosmos)? Unanswerable are all such questions, but they help illustrate the limits of our terrestrial Life, which, like the Life of the individual, has its period of birth, bloom, and cessation, according to the present Diacosmical trend of science. Still we cannot help interrogat-

ing science herself: will you yet rescue our Biocosmos from extinction?

Other limits of the Earth-life may be mentioned. It can hardly reach above seven miles or so of the atmospheric envelope of the globe; on the other hand, it does not extend very far below the terrestrial surface; thus all living things exist on a thin globular shell. There are also seasonal and zonal bounds to vital activity upon the Earth's surface. Scientists have brought to light a curious fact about carbon dioxide (carbonic acid gas) in the air. The animal expels it, the plant takes it up; too much of it in the atmosphere destroys the animal, too little of it the plant. Something similar may be said of other aerial ingredients in reference to Life, for instance, oxygen. The vital principle hovers on every side between too-much and too-little; all Life, be it of the whole Earth or of one individual, seems to hang fated between two mortal extremes.

In some such fashion we have to draw the limits of our Biocosmos. It is the one living speck in the whole physical universe, as far as man's knowledge goes, and we, each one of us, are but a little brief speck of that speck—a microscopic microbe of the All. Very limited in size and quantity, in place and time is not only individual existence, but

the sum total of vitality. Life is, therefore, inseparable from its overwhelming negative counterpart, Death, which bounds it on every side. Sad, tragic, quite unendurable would be the outlook for thought, if mere Life were the be-all and end-all of our terrestrial career. But Life is only a stage of Nature, and Nature herself is a stage of the larger and largest process, in which Man participates through mind.

Very small is, then, the Biocosmos, a mere point in the physical universe; still we have to think that through this point the boundless Cosmos as well as the Diacosmos have to pass in order to attain the end of their creation, whose outcome is the conscious Self. This point of Life is a kind of pivot on which the vast separation of Nature begins to turn back toward its source; each living individual is a little pivot of that sort, and shows in himself and in many organic functions (such as the circulation of the blood and other fluids) the vital round of the totality of which he is a part.

II. Quite as there is a heat-scale of Life, so there is a heat-scale of chemical affinities, above or below which such affinities grow weak or vanish altogether. You have all seen the avidity of the metal potassium for oxygen; throw a piece of it into water and it will

take fire, decomposing the water for the sake of the oxygen with which it unites in a flame, and releasing the hydrogen. The experiment is indeed suggestive, and would seem to forecast the time when people will burn water for heating and illuminating purposes. But the significant fact in this connection is that potassium loses its power at very high or low temperatures; Davy, in 1807, separated it from potash through electrical heat, whereby it gave up its affinity; Dewar, who reduced oxygen to a liquid by cold, has said that potassium "will float untarnished in liquid oxygen"—just the opposite of what it will do when immersed in water at the ordinary temperature of Life. Thus the heat-scale of affinity in case of potassium has a unique parallellism with the heat-scale of living things, as already given; like animals it seems to take up oxygen between certain degrees of temperature.

In the present case the behavior of potassium may be taken as typical of Chemism which shows a striking adjustment to the heat-scale of terrestrial Life. We cannot yet tell much about the chemical condition of matter at very low temperatures; there is no spectroscope of intense cold such as we have of the heat and light of the heavenly bodies. At the life-temperature of the earth—say

generally between the freezing and the boiling points—Chemism would seem to have a tendency to the multiplication of its elements, and to an easy combination of them into compounds. But when we turn to the intense heat of the sun and stars, there is the opposite tendency, namely, to prevent compounds and to reduce the number of chemical elements. Such a compound as water would not be tolerated in the sun; it would not simply be converted into vapor but decomposed into its elements, oxygen and hydrogen. But our sun is by no means the hottest star; this trait, according to the spectroscopic investigations of Lockyer, belongs to two stars in the constellation Argo, which, however, have no oxygen. But they do have hydrogen, and what would seem the earliest form of it, called proto-hydrogen, with some other fainter, possibly undeveloped chemical elements (such as proto-calcium and proto-magnesium), and also with at least two terrestrially unknown elements. Now all this suggests the inorganic evolution of the physical universe, especially on its chemical side. There is the indication (though not the proof) that the eighty or more present elements known to chemistry have been evolved from one primordial substance of which proto-hydrogen, marked by the spectroscope, may be the first chemical

derivative. But what is this primordial substance? Ether, we would say, though this is as yet far-off conjecture—ether itself being still at large, never having been caught and caged by science. Still it is worth while to note the intense stress of the time upon this inorganic evolution as the due counterpart to organic evolution, which so illumines the name and work of Darwin, even if he was not the beginner thereof.

The hydrogen of terrestrial water, which enters so largely into animal and vegetable life, has thus a very hoary ancestry, reaching back seemingly to the first stage of visible stellar evolution, to the time when our sun was in the thermal condition of the very hottest stars of the firmament (the two in Argo, according to Lockyer, against whose views, it should be added, there is considerable protest). Oxygen appears later, in the group represented by the star Alnitam, very faintly at first. These two elements, however, do not chemically unite on any star seemingly; not till the earth has been ejected by the sun and has cooled down toward the thermal life-scale, does water appear in its three forms, two of which, the solid and the vapor, almost mark the bounds of vital existence. Such is the remote genealogy of the liquid we thoughtlessly sip; it is the chief

mediator of life, the solvent of nature, the purveyor of food, of heat and cold, to plant and animal. To be sure all the chemical ingredients of our organism show a far-off stellar ancestry; for instance, the lime in our bones is carried back to the earliest group of stars (Argonian) in proto-calcium. This element (calcium) becomes very prominent in our Sun from which the Earth derived it, but chiefly if not entirely in the form of compounds, for the pure metal calcium can only be found in the chemist's laboratory. Its affinity for oxygen (like the typical potassium) is so strong that it cannot persist at the Earth's life-temperature.

Thus we begin to glimpse the outlines of the evolution of the chemical elements, apparently from one original element in the far-off hottest suns of the sky. Not only this, but there would seem to be also an evolution of chemical compounds, which a too intense heat (and probably also cold) render impossible. The import of such a fact is very significant for Life, since both plant and animal are chemical compounds. To be sure they are something more. Protoplasm, the so-called physical basis of life, has a number of compounds, such as phosphates and other salts, as well as the elements hydrogen, oxygen, carbon, nitrogen. These, having been evolved

and cooled down to the vital scale of temperature, are seized and employed by a Power for its end—we might call it the Demiurge of Life, the creative principle of the animate world. For Chemism of itself cannot produce Vitalism, though it be the latter's immediate agent and condition. Nor is the vital spark the electric spark, yet the former doubtless employs a good deal of electricity, though under strict control.

It should be added that the chemical elements have something which pushes or directs them in their evolution toward an end. From the starry depths they may be seen dimly coming down this way in a kind of progression one after the other, till they reach our Earth's life-temperature, when they are slowly gripped by a new sort of energy, and from a state of separation and independence are whelmed into an organic process of whose round they are the subordinate constituents. In other words, there is interwound through all Life a psychic factor, which has an immediate connection with the physical element in every particle, determining it from within, and propelling it forward by organic evolution to the ultimate purpose and end of Life. But there is also an inorganic evolution (as above set forth) in which the psychic factor is certainly present and active (it is neces-

sarily implied in every kind of evolution), but not yet fully internalized in the physical element, which it controls, therefore, more from the outside. Thus we come anew to the chasm which separates the Inorganic from the Organic, though we have a new line in the thought-chain of their unity through their similar evolution. Still their evolution remains twofold, and will not directly evolve one into the other.

Necessarily the alert reader is bound to ask, Whence comes this psychic factor, which exercises such sway in both evolutions, though this sway be different in each case? That same subtle, yet all-dominating Psyche we have seen ordering the Cosmos as well as the Diacosmos, even if somewhat externally. Indeed all Nature must have this psychological side by virtue of its primal origination from the Universe as Self. And the ultimate science of Nature must be psychological for the same reason; moreover our individual Psyche could otherwise never come into communion with her, could never understand her action or penetrate her meaning. Scientific investigation is finally the Psyche of the scientist trying to sleuth the Psyche of Nature, secrete and entangled in its material body. The one must recognize and indeed identify

the other in alien wrappage, which, however, as vital becomes an integral part of it.

Thus we may trace an outline of inorganic evolution antecedent to and preparatory for organic evolution. It should be stated that the above exposition follows mainly the lines of Lockyer, whose methods and results have been sharply attacked. Doubtless his work must be corrected and extended; still it seems to us to be in the right direction.

So in struggling to reach back of our Biocosmos to its sources, we come upon the chemical elements of it first, which seem ready and indeed striving to unite in the highest act of Life. But of themselves they are quite powerless for such an end. It is true that many scientists seek to express the vital principles in terms of Chemism. But that simply disintegrates and deadens the living thing, leaving out its very essence, namely, Life. What is the link here missing? It is at this point that the ghostly intruder again appears, that Psyche, who has so often troubled the scientist, and in her spectral way makes the transition through Chemism from Unlife to Life.

So the vast separation of Nature has in the Biocosmos reached the much-divided realm of living individuals, everyone of which has within itself the round of the Psyche,

though still incorporate in the Physis. Each separate particle of the Universe now is striving to be complete within itself, to have the process of the All as its own, not merely outside of itself but also inside. It lives as individual, be it the microscopic cell or the total Earth-life, for the latter is but a small vital speck in the entire Cosmos, as we have already seen. The limits of Earth-life make it an individual bounded in Space and Time like the rest of us, moreover it as living individual is also but a transition between birth and death, a stage of the process of the universe, the third stage, which is finally to return as a whole to its cosmical origin. Geologists tell us that we in our Earth-life are just now passing out of the last glacial epoch of the Pleistocene, into a succeeding epoch of heat or perchance torridity. So the terrestrial individual has its periods, which, like man's, are to be passed through. But the fact which is here impressed on the mind is that the Biocosmos is individuated both as a whole and in its minutest parts, the infinite divisibility of Nature seeking to turn into the living act.

III. The origin of Life invariably comes to the front in any thorough-going comprehension of the vital principle. Its beginning in time on our Earth has been quite freely

announced by science, of course, with considerable difference in the number of years. Then comes the question: How did it begin? One scientist has suggested that Life was originally brought to our globe from the outside, by a falling meteorite perchance. This view (if it be not a joke) leaves the vital starting point where it was. Then there is the theory of special creation, which need not trouble us further. Still again rises the view that the origin of life, the origin of the world, the origin of man, are inexplicable, unknowable; that origin itself is a contradictory conception and had better be dropped from our thought. Darwin, who wrote the *Origin of Species*, particularly disclaims any knowledge of the Origin of Life.

Still the biologist has to treat what he calls Biogenesis (the genesis of Life), if this be not indeed the dominating theme of his science. Two theories have hitherto been held in this field. The one maintains that every living thing springs from an antecedent individual which is alive; it requires Life to beget Life. Such a view always presupposes the vital individual. Still the mind must query, how did the primal living thing get to be? But science on the whole shuns this question—for many people the really *vital*

one—and confines itself to the round of individual Life.

The second theory of the Origin of Life has long been known as Spontaneous or Equivocal Generation, and now goes under the scientific name of *Abiogenesis*. Here the point is that Life is sometimes generated out of non-vital matter. Popular belief has not ceased to cling to spontaneous generation in certain cases. Decayed meat is still supposed to breed maggots; and horse-hairs in stagnant pools will turn to little snakes—every farmer-boy has seen them. Formerly many scientific men, from Aristotle down, held the same view. But the current began to set in the other way, especially when Redi (1638) showed that meat would decay without producing maggots if protected from flies and other insects. The newly discovered microscope revealed a new world of infusoria which were for a long time deemed to be spontaneously generated. But this position was attacked, and after many experiments oft repeated with new precautions, the science of to-day with a few lingering exceptions doubtless has declared itself against Spontaneous Generation. It has succeeded in sterilizing quite all supposed microbe-breeding liquids, chiefly by boiling, as the component protoplasm enters usually into its heat-rigor below

the boiling point. Yet there are exceptions: for instance, the spores of bacteria cannot be boiled to death, but must be burned—heated to nearly a hundred degrees (F.) above the boiling-point.

Still there is difficulty with this conception of Biogenesis, and the difficulty springs from Evolution. If our planet evolved from an inorganic condition to an organic at some time in the past when it had cooled down to a heat-point consistent with Life, as is generally said by scientists, there must have been a transition from a pre-vital to a vital stage. Which, then, has to go to the wall as a universal principle of Nature, Evolution, or Biogenesis? Thus we run back again to the edge of that chasm between the animate and inanimate realms which Evolution has not yet been able fully to pass. The most colossal step in Nature, that from Matter to Life, or from the dead to the living, Science with her experimental proof has not been able to take. Meanwhile Nature's laboratory before our eye is always doing just thus: transforming the inorganic into the organic. It may be said that in a way the inorganic is forever seeking to become organic, it wants to live. The end and scope of Cosmos and Diacosmos is to be Biocosmos, in which they have their higher fulfillment.

The result is that a careful examination of the scientific mind of today, which holds to Evolution, will find a lurking unconscious belief in Abiogenesis, notwithstanding the conscious denial. Undoubtedly in plant and animal as individuals all life comes from life, passes from the living parent to the living offspring. But the third great form of life, besides that of Plant and Animal, Earth-life we may call it, has a decided tendency to transcend this narrow vital cycle from individual to individual, and to whelm into Life's limited round the quite boundless realm of Unlife—to transmute the non-vital element of its being into the vital. The sciences of Plant and Animal (Botany and Zoology), cling to the Life individual as their theme, wherein matter is already organized. But how, whence did they (Plant and Animal) get organized? The life-principle is taken for granted in this single bit of earth called a living thing, and its process set forth in detail by the science of Biology; still back of this process works another process, with the transformation of its inorganic side into its organic. Most scientists agree that this had to take place once, according to Evolution; but it is probably taking place all the time. Every living thing has to die, has to go back to the beginning and be dipped again

in the original inorganic element whence it arose. All organic bodies have this fate of death and dust hung over them from birth. Such a transition, the end of the organism, is but a stage of the larger Earth-life, which is perpetually individualizing and re-vitalizing its non-vital part, this being much the greater, as already said.

Thus we may well affirm both kinds of generation—inorganic and organic—each within its sphere. Biogenesis rules inside the round of the individual Life, of Plant and Animal; Abiogenesis cannot be eliminated from Life conceived as a totality, from the Earth-life in its completeness. All three forms of vital manifestation—Plant, Animal, Earth—must be considered in the Biocosmos, which treats them separately, as well as in their process together.

It is, therefore, highly improbable that the transition from Unlife to Life took place just once (or perchance a few times) on our Earth many millions of years ago, and that since then Life has proceeded by its own inner evolution. Science thus seems to be taking its cue from its old enemy, Theology, which makes all living things originate primarily by divine fiat. Interesting still, as showing the aspiration of science, is the attempt of Bastian to reach the true *archebiosis*

or the beginning of Life, though Pasteur experimentally refuted the experiments on which he based his conclusion. More suggestive still is the story of the *Bathybios* (or Deeplife), in whose mazes both Haeckel and Huxley, most eminent scientists, got entangled. Masses of animal matter had been found, it was claimed, strewn on the bottom of the ocean at a great depth (more than 2,000 fathoms), in beds thirty feet thick. Here then was supposed to be the original protoplasmic life-stuff (Protobioticon) in the warm tropical seas not far from the Canary Islands (so reported by Haeckel, and at first accepted by Huxley). Thus the missing link between the Inorganic and the Organic had been actually found, and the rejoicing was somewhat similar to that produced by the discovery of the more famous missing link between man and the ape in the fossil *Pithecanthropos* (ape-man) of Java. But science now declares that the *Bathybios* is a delusion, though the supposition lay near that the strange Sargosso Sea in the midst of the Atlantic (still a mysterious phenomenon in a number of ways), might have been the original source of Earth-life, which started in the water somewhere, according to most scientists. Perhaps, too, it still might be regarded as the reservoir in which Earth-life, ever passing away, is fed

from Unlife, and thus re-vitalized from its primordial fountain. Purely speculative are all such suggestions, and yet they hint the unconscious aspiration, so deeply implanted in science, to get to the sources of Life. Already in antiquity the conception of an universal genesis was not unknown; the Greek philosophers threw out flashes of it, and ancient Homer has suggested animal transformation in that remarkable symbol called the Old Man of the Sea, Proteus with his multitudinous metamorphoses—our latest science saying that life and man arose in the sea, of which process Proteus may be imagined as a far-off prototype. The Roman poet Lucretius also suggested a common genesis of plant and animal from the All-Mother, Earth. Thus the philosophers and poets have uttered long since the inner bent and aspiration of Nature which the scientists also reveal in their way which way is not the by-gone philosophic or poetic insight, but the modern prosaic industry of investigation.

IV. Another set of terms pertaining to the Origin of Life, Science has elaborated along with the conceptions expressed by them. Everybody has noticed that the living individual produces its like; the acorn will not produce a hickory tree, a hen's egg a turkey, a cutting from a grape-vine a fig. This principle

has been endowed with a technical name *Homogenesis*, the genesis of like Life from like—of course through the individual. The living organism reproduces its species, it is said; species includes those of a kind. But the species are many and very diverse, even if alike in certain characteristics. Evolution, however, demands that these diverse species have a unity of origin, and thus clashes with Homogenesis, quite as we saw its thrust against Biogenesis. But the collision now is inside the realm of Life, not of the organic with the inorganic. Thus Evolution creates difficulty with what seems an immediate sensuous fact: the descent of like Life from like.

On the other hand there has been some belief, both popular and scientific, in the opposite doctrine known in the books as *Heterogenesis*, the genesis of the unlike Life through the individual; or as is often said, the like produces the unlike (an expression not logically correct). Very wide-spread is the belief that a vegetable may sometimes produce or become an animal, and the reverse; one kind of Life is transmutable into another—quite as we noted people believing that a non-vital object, like a horse hair, might turn vital and crawl. In poetry and mythology, without doubt resting on popular faith originally, is found the doctrine of metamorphosis

throughout the world. Of course such credence is directly opposed to science which, however, has given us the remarkable transformation of the butterfly and other insects till the return to the first shape. But this is not Heterogenesis proper, which the scientific mind on the whole is inclined to deny.

Now the fact is that Life as a whole, the Earth-life, has brought forth many very diverse individuals and species, from the amœba to man. Indeed, the ever-varying forms of both Plant and Animal are more striking than anything else about them. This diversity of living Nature in the matter of species is what started Darwin on the road to find their unity. The Earth-life, accordingly, has been heterogenetic, producing vital difference in abundant quantity; on the other hand the individual life of Plant and Animal is homogenetic, producing the like in its offshoots. Thus the universal Life in its productivity shows a character quite opposite to the individual Life, which the scientist so fully records. It must bring forth the unlike as well as the like, difference as well as sameness; in fact, these are two sides of the one process of total Earth-life which must have begotten the present variety of Plant and Animal (Heterogenesis) during its long continuance, and which also includes the repeti-

tion of the individual life (Homogenesis) of Nature.

At this point we are to note another stage of the vital act which lies intermediate between the foregoing extremes. It is this: the individual does not produce his like wholly, but always with some change; no child is quite the same as the parent, even if similar. The great diversity of species is brought about by slight differences ever increasing through heredity. This is the fact so strongly enforced by Darwin in accounting for the origin of species. The like, therefore, does not produce the like or the unlike altogether, but what may be called the similar, which grows more and more toward the different. No name has been given by science, as far as we are aware, to this important kind of genesis, but we may call it in correspondence with the other two designations *Homoiogenesis*, or genesis through the similar. The term recalls the dispute in the early Church regarding the nature of Christ, when the two theological parties were respectively named Homoousian and Homoiousian. To the Darwinists particularly the conception of *Homoiogenesis* is much more significant than either of the other two sorts of genesis, being really the mediating link which connects the unity and variation of species, and upon which Nat-

ural Selection does its work. The Earth-life may be conceived as unfolding from its first protoplasmic sameness into the latest differentiation through this mediating Homoigenesis, which thus is in its way a bridge between the beginning and end of vital forms, especially in the view of Darwin, in whose mind, however, the Earth-life is more implied than expressed.

Here we are to note the new phase of Biogenesis, which springs from the so-called Doctrine of Mutation, or the sudden birth of a different species from that of the parent. This theory was some years ago brought to the notice of the scientific world specially by Hugo De Vries, a Dutch botanist, who observed a flower, the primrose, bringing forth, not merely a new individual similar to itself, but a new species quite distinct from itself. So *Heterogenesis* again came to the front, now supported by the close observation of the trained scientist. De Vries does not deny the Darwinian evolution by slight differences, but grafts upon it his additional principle. Thus there would seem to be at work in Nature both kinds of generation of species—the slow and the instantaneous. This brings a fresh conception into science. It would appear that every kind of plant and animal may vary in an hitherto unsuspected way, namely,

in the speed of specific reproduction. Some have the power of persisting in about the same organism for countless geologic ages, like the well-known *Lingula*, which is still alive from the Devonian Period. On the other hand there are ancient species which, after much variation, have died out, seemingly having exhausted their elemental life-stuff. The suggestion rises that there may be constructed a gamut which shows the varying ability of each plant and animal to reproduce new species. Still further, it is declared that this power of specific reproduction has its periods of rise, culmination, and decline in the life of each species, vegetal and animal. One is inclined to think that the generation of another species is a higher and more exhausting act than the generation of another individual simply like the parent. Interesting is the fact that every living thing bears in it the tendency to break out the bounds of its birth, and show a limit-transcending quality; it will not be confined to the transmitted forms of its species. To be sure only a few will burst the barriers and move on a new line, though probably all possess somewhat of the same impulse. Those capable of making the transition from the old species and of reconstructing one of their own may be deemed the geniuses of the animal and vege-

tal kingdoms. Such deviations from the normal type have long been known to the gardener and the breeder who have given them the popular name of "sports," which, from being once deemed mere freaks of Nature, have now become a recognized part of the theory of the origin of species; so the genesis of Life has traveled back and taken up again Heterogenesis.

Here it may be added that man in his original separation from his ape-like ancestor has been considered a "sport" by certain anthropologists. That is, far back somewhere in the Tertiary Period the common progenitor of ape and man brought forth a remarkable deviation from his own regular type which then and there bifurcated for all future time into the simian and human lines of evolution, as we see them today. From this point of view we have to regard ourselves as having originated in the "sport" of a pithecoïd—a fact of ancestral as well as scientific interest, though its truth is questioned.

Truly the time reflects itself not only in the science of Nature, but in Nature herself, who is found to possess all our human tendencies, though in a very remote, implicit way. Even the plant seems to have its reformers, its barrier-bursters, its prophets leading it out of the old into the new. That famous little pri-

mula of De Vries, a kind of a runaway from the garden of civilisation or perchance a floral rebel, has the appearance of having wearied of the transmitted order, of its inherited species and of its narrow social bounds; then, having somehow gotten the opportunity, it makes a break for liberty and establishes a new species which perpetuates itself and thus gives a peculiar flowery immortality to its founder who otherwise had died merely a nameless individual. In like manner we still hear of the founder of States—Romulus, Theseus and so on. Thus the work of the Dutch botanist started a considerable ripple in biology and science generally, and if we listen closely, we may catch an echo of it in the institutional world of man.

V. Already Earth-life has been mentioned a number of times, and a general conception of the significance lurking in this compound word has been pre-supposed in the reader. Some special remarks upon its meaning may here be given, to be followed later with a view of it in the total order of the Biocosmos. It is correlated with Plant-life and Animal-life, to which it is joined in the present work as the third kind of Life, namely Earth-life. Evidently it signifies the sum total of all terrestrial vitality, which, as far as we know, is the sum total of life as such in the universe.

It includes not only plant and animal, the microscopic and the macroscopic organisms, but also what may be called the extra-sensible life-world, from which the seen life-world emerges and into which it returns. The transition, already mentioned, from the Inorganic to the Organic, and back again, must lie in the realm of Earth-life, and cannot be left out of a complete view of Biology, to which it has become as necessary as Ether is to Physics, though both be speculative. The rise, bloom and evanishment of all individual life take place in and through the Earth-life, and constitutes its process, or at least a part of the same. Vegetal and animal forms have their vital round, appearing and disappearing; but this vital round is but a stage of a far larger vital round, that of Earth-life.

In this connection we impinge upon the question: Is there a given amount of vital stuff in the universe—a fixed quantity, so much and no more? This corresponds to the well-known law of the conservation of energy, of which one form may be deemed vital energy. The Earth-life can be regarded as the store-house of all individual life, both arising and departing—passing from the Inorganic to the Organic, and from the Organic to the Inorganic, in a ceaseless cycle. In general one can see the means which the Earth-life takes

in order to produce its vital round: it individuates a primal life-stuff (often called protoplasm) into innumerable plants and animals which still further develop into species, families, orders, etc. The living individual, to which, as microscopic cell or as large organism, Biology has quite confined itself hitherto, must be grasped ultimately as but one stage of the total terrestrial process of Life. The vast reservoir of vital energy out of which the living individual of every sort is born and to which it returns through death, belongs to Earth-life, whose chief struggle is to transform the overwhelming non-vital mass of our globe into the vital, which, however, never gets beyond one part in ten million, according to an estimate already cited. So this fixed quantity of Life-stuff (if it be fixed), seems always to be fighting for itself, namely, for Life against Unlife. An eminent authority in geology has stated that the sum total of Life in the past geologic ages appears to be about the same as it is at present, though its differentiation into plants and animals has been very different in different periods. If that be so, it would seem that the Organic is not gaining on the Inorganic, but barely holding its own in the battle with the non-vital world environing it on every side to infinity—which drawn battle has been going on

these hundred million of years. In such a view the earliest vital mass (Protobioticon) started with a given amount which it has been evolving ever since into higher and higher organisms, measured by a standard which can only be *psychical*. The quantity of Life has then not increased since its first launching as a little speck in the ocean of its gigantic enemy; but its quality has improved instead. Thus the Earth-life, conceived as all vitality embodied in a single shape, has had the function to evolve itself from its primordial stuff through individuation toward the perfect organism, which is now considered to be man's body.

Such, then, is the outer struggle between the Organic and the Inorganic in the development of Earth-life, but this has also what may be deemed its inner struggle. Each single living thing in the reproduction of itself must draw on the contents of the reservoir of Life, which holds a limited quantity according to supposition. Well-known is the ability of a pair of rabbits through propagation to monopolize the Earth-life of a given territory, unless vigorously suppressed by other vital forms, including man. There are protozoa capable of multiplying at such a rate that all living existence would turn back to protozoan unless the increase be stopped

by destruction. Plants likewise have the same prolific energy in tapping the general source of vitality that they seem able to absorb it if not halted in their reproduction. It would appear that each living species has the bent to take the whole Earth-life as its own for its kind. Moreover, all living things, plant and animal, must have food, whose supply is limited; the individuals of the same species would at last fall into conflict over sustenance. The surface of the globe would soon be too small for the exploitation of any vigorous species in the matter of propagation and subsistence.

Thus the Earth-life in its totality has its bounds; though it includes all individual plants and animals, it too is an individual. Within it each living thing arises and passes away; has it the same destiny? That is again the problem of the extinction of our globe, which springs upon us in these scientific days from many sides. The Earth-life is still going on, youthful, it may be, but more probably in its middle age—the only individual of its sort in the universe. Herein it differs from all vegetal and animal existence, and of course from us. A thousand years of Earth-life is hardly a day, in comparison with our lives. What its vital round may be, and how long it will last, can only be guessed. What, however, is

manifest, is that the living things on our globe—plant and animal, protozoa and metazoa—have a relatively brief duration, and seem but instruments of a total Life, helping to bring it forth and then vanishing. Still they participate in it, though constituting but a little stream of flickering individualities which flash in existence for a shorter or longer moment. The vital stream is indeed a small one, if we contrast it with the circumambient non-vital matter through which it seems to be trickling down Time. Each wee life of a microscopic amœba is a petty flash of this general Earth-life which manifests itself in the vast complex of living individuals, plant and animal, and yet is therein an individual itself.

Accordingly it is said that the Earth with all its Life must pass away, like one of its own brief micro-organisms, when its round is completed. Thus it is merely repeating its own history in the small and smallest of its living individuals, each of which foreshadows its fate, for it, too, must vanish. The cycle of our Life from birth to demise is, therefore, the impress of the Earth-life upon us, and upon every object alive. The vital spark which comes from it is endowed with death as well as with birth, both of which are likewise its own. It reproduces itself in its children. To be sure this universal individual,

Earth-life, has not yet gone through its one cycle. A tick on the clock of the universe is an easy million of years; the period of Earth-life, we are told, must be many myriads of millenniums. And still the end must come in Time.

If this Earth-life, like one of its minutest microbes, goes through the process of birth and cessation, is it not itself but one evanescent individual of the All-Life (Pambiosis)? Some such conception rises and has been held, but it lies beyond all proof and stretches the most elastic limits of thinking. It is conceivable that many millions of planets like ours are dead and buried throughout the dark graveyard of space; indeed, whole suns and their systems are extinct, having lived their day, and are awaiting resurrection into light and life. So some astronomers have reported to us, fortifying hope. Still we have at last to take the Earth-life as individual in the total universe, a drop, as it were, in the vast reservoir; but that there is another drop of life anywhere in the cosmical spaces we do not know. It is natural to suppose that ours is not the sole vital appearance in all creation, or that our conditions of life are not the only ones possible. For instance, a wholly different heat-scale from our hundred degrees is conceivable; indeed, every hundred

degrees of the heat-scale of the universe—possibly a hundred thousand degrees—can have its corresponding life, which everywhere may be the movement from the Inorganic, through the Organic to the Psychic, the latter being the outcome and end of Nature.

Our Earth-life, accordingly, is for us the all-embracing Life, its final real circumscription; but ideally we may regard it as a mere cell of the universal Life, no more comparatively than one of its brief unicellular organisms, a microbe of the living Universe. We should emphasize, however, that each individual life, minute as it may be, has in it the total process of the Earth-life, which also begins, flourishes and passes away. Again we have to re-think and re-apply the thought that every part of a Whole, in order to be such a part, must have in it the movement of that Whole. Earth-life is, therefore, a needed element of the Bio-cosmos, which is to include the totality of Life. We may here state that science has made little use of the conception of Earth-life, though it would seem to be the necessary complement of individual life, vegetal and animal. These two vital forms have filled the horizon of the biologist. And the past products of the Earth in its long evolution, organic and inorganic, have been set forth in the science of Geology, which ought to reveal to us not

merely a dead, but a living Earth-life in its process ever going on. Thus Botany and Zoology, both of them essentially sciences of the manifold individual Life, would find their fulfillment in the Earth-life, the one great living organism creative of all the rest—the one universal living individual we may consider it relatively, even if it too must perish like its own ephemeral butterfly.

Evidently Life's struggle for existence, taken in all its phases, embraces much more than the wrestle of individual with individual for existence. Let us note the cases. (1) There is first the struggle of Earth-life itself with the overwhelming mass of Earth's non-vital matter, the never-ending conflict between the Organic and Inorganic, whereby the latter is in a wee point transformed into the former. (2) Then there is the struggle of each species seemingly for the whole of this Earth-life, whereby it falls into conflict with other species. (3) Finally, comes the struggle of individual with individual of the same species for their common means of subsistence, whereby results Natural Selection. It is this last phase of Life's total struggle for existence which has been emphasized by Darwin. But the first phase, that of Earth-life itself struggling with its gigantic enemy, is what presupposes and includes all the rest.

And when Earth-life has run its course, all other kinds of Life will pass away with it, as it embraces them all. Great as it is compared to our organisms, it is very small compared to the universe—a little living cell of the All, we may deem it, yet genetic of our microscopic cells.

VI. We have touched here the conception of the cell, looking in the other direction, that is, from the large to the small, and not from the small to the large. Cell-life with its minuteness is in striking contrast to Earth-life with its magnitude, at least for us; for we naturally place ourselves between the two, gazing both ways in wonder. The individual man is ever pushing toward the infinite, or rather toward the two infinities, as we may call them for the nonce, the infinitely large and the infinitely little—he being a kind of mean between the two extremes. In the Cosmos we have seen how he has traveled from sun to star, from the visible to the remote invisible nebula; while in the Diacosmos we have observed him moving in the reverse way, toward the small and smallest of the material world—toward the molecule, atom, electron, perchance the etherion. But now in the Biocosmos we have come upon its minutest individuation, the cell, which bears within itself the pivotal principle of life. It is seen with

the microscope, which is verily the telescope reversed, and revealing to us a wholly new world of living individuals. For the cell has life—that is its fundamental category.

The word *cell* is not the best one for the thing. This is not a hollow chamber or cup holding a fluid in a wall or enclosure; at least such is not its general character—a natural conception of it from its name. On the contrary the cell must be grasped in its simplest form as a mass, which tends to the globular when it is single, as in a unicellular plant. Still it is capable of assuming many forms, both by itself (as in case of the amœba), and by association with other cells. Sometimes, indeed, this mass hollows itself out, and builds for itself also a pretty firm wall (found in plants more than in animals); then it becomes literally cellular, though this form, as before said, is not by any means the prevailing one. Probably the earliest observer saw such cells first, and gave the name which is now too strongly entrenched in the science to be expelled.

The next point in the conception of the cell is to consider how this, its mass, is organized. It shows the following main divisions: first, the central principle of it is the so-called nucleus, a rounded definite shape, long ago recognized by Fontana (1781), but without

seeing its significance, which still seems to be growing. The second fact here is that this nucleus is in a state of self-separation; it appears always in the process of giving off other nuclei, or nucleoli, of reproducing itself by a sort of fissiparism or segmentation. The third important fact about the cell is its mass of formative material called protoplasm, which embosoms the nucleus and its process. This protoplasmic mass is described as a viscous, somewhat transparent substance, often quite homogeneous, but oftener granulated or even reticulated. The part that it plays is not yet settled; but it may be deemed the environing element or body which sustains the nucleus, stimulating and possibly evolving its process. Whence it comes, or how produced is not known; even whether it be organic is a question among biologists. Doubtless it is an early stage (though not the earliest) of that transitional bridge which reaches over from the Inorganic to the Organic—which bridge has not yet been traversed by science, yea not yet been reached probably. Still it is worth while to notice that in this protoplasmic mass external to the nucleus are floating numerous small bodies, passive, seemingly non-vital, probably rejected waste from the laboratory of Nature, which prepares this protoplasm, and which lies as yet beyond the

microscope or any chemical re-action. Indeed, there is no little discussion among biologists whether this protoplasmic mass should be called *living*, though it is hardly dead or inorganic. Various intermediate terms have been suggested in order to avoid the difficulty, which predicates something living before life; for life is regarded as belonging to the cell-organism as a whole and not to any of its parts or members, least of all to the most external part or member. Yet if the cell as a whole be alive, each member of it must share in such life, in order to be a member (as our hand or finger is alive till cut off).

But amid all these questions we come back to the main process of the cell, which, according to our conception, should start with the nucleus as central and germinal, then pass to its self-separation or genetic act, which is finally completed by the protoplasm or body. Thus the process of cell-life is a continual generation of itself; its function and, seemingly, its sole function is a ceaseless reproduction of its kind, and so it is the prototype of the genetic continuity of all living things through the species. The individual cell begets the individual cell, and just that is its business—verily the primal business of life, which is to keep itself alive and going. The plant and animal, each of which is a large

number of associated cells, will repeat as a whole, in its generative process what this, its smallest vital constituent is doing, undoubtedly with great variety. Still this cell-individual is its prototypal unit, not simply ideal but actual and visible, yea creative; we may deem it the miniature pattern after which Creation works in small and large, reproducing it not only in the microscopic cell itself, but in the hugest of all animals now known or that have ever been known among the monsters of the geologic ages, the whale measuring eighty feet and more in length. Its billions of cells are doing, each in its own life-process, quite what it as total animal is doing.

Accordingly in the cell we observe individual generation, birth, maturity, age and death. It goes the round of life from start to finish; indeed, just that is what makes it alive. It has the primordial vital process, at least as far as our present knowledge extends, even if the cell has been supposed to consist of still more minute cellules beyond the reach of the most powerful microscope—a conjecture, by the way, not at all improbable. But just now the cell may well be deemed the pivot upon which the Biocosmos turns. It is the germinal point of every living thing in the universe; it is the ultimate vital constituent, out of which all other forms

of life, vegetable and animal, are associated. It is no wonder, then, that the biologist has come to occupy himself with the cell; he is probing to reach the original source of himself, as this living individual, and therewith of all humanity, yea of all life. But if he should reach a new, more elemental shape beyond the cell, would that be the end of his search? It may well be doubted, for he has not yet attained the infinitely small, he has not yet come to the end of an infinite series—nor will he. He has not yet passed the bridge between the Inorganic and the Organic—the real object of his hot pursuit, even if unconscious. Meanwhile the scientist will precipitate for us a great deal of most valuable knowledge, his very science, indeed, through his endeavor to scrutinize the Inscrutable—which, of course, he never will. It is no abuse of him—we intend it as a due recognition of his worth—that he does not, in the long run, know what he is about. Well, who does? Nature is not self-conscious, in fact, ends where self-consciousness begins. The scientist becomes one with what he works in, and shares in its deepest character; he is unaware of his ultimate end, and, so is Nature, though both are working for it with all their might. The scientist is unconsciously teleologic, as well as Nature, though he often re-

pels the teleologic view with heat, even with bitterness. But we hold it to be his chief excellence that he does not altogether know what he is about; if he did he would not be the true scientist; he could not be the desperate investigator, if he saw that what he was really investigating was the Uninvestigable (called by Goethe *Das Unerforschliche*). Darwin revealed Evolution with unparalleled industry and power; but he was unwittingly evolving Darwin as the grand end of evolution. He saw, indeed, Evolution, but he was unconscious of what he had really evolved, namely, the evolver of evolution as the crown and summit of the whole evolutionary process. Quite unknown to himself he had evolved an evolution which could go back to the start as well as forward to the finish. But consciously he clung to his limit and so he could, as pure scientist, watch and formulate Evolution proper.

Another aspect of cell-life may be mentioned in this connection. As the cell performs the primal generative act of life, heredity must be transmitted through it from parent to child. All the inheritances of the race, it would seem, have to make this cellular passage. All the species of the earth, plant and animal, have their unitary germ in this wee protoplasmic dot, out of which unfolds the

entire differentiation of life on the planet. The past, with its accumulated stores, vital and mental, has to be put through this genetic point in order to be perpetuated and recreated. Thought, civilisation, morals and institutions, whose bearer is man, have somehow to make the trip with him through the cell to reach their destination in the future. The result is that what may be called cellular heredity has the dominant stress in the biology of today. Its practical application is of far-reaching consequence, especially in the social order; with it is connected Galton's new science of Eugenics, suggesting race-culture, as well as race-suicide.

Indeed, organic evolution has been largely turned into cellular evolution. Darwin had little to do with the cell; it was evidently alien to him, though the chief facts of its structure were known in his time. For instance, Virchow's great book on *Cellular Pathology*, epoch-making in this field, appeared contemporaneously with Darwin's *Origin of Species*. It was, however, the German biologist Weissmann who had the chief hand in giving this bent to his science, through his doctrine of germinal continuity, which regards heredity proper to be transmitted by the germ-cells and not by the body-cells. The chief contribution of Virchow is contained in his famous

aphorism that every cell springs from a cell, from its like, and not from something inorganic or non-cellular. Of course this corresponds to another famous aphorism usually attributed to Haller: All life comes of life, or, in the Latin, *omne vivum ex vivo*. Similar is the expression and also the thought when applied to the egg (*ex ovo*). Now Virchow has likewise Latinized his conception aphoristically in the phrase, *Omnis cellula e cellula*, which has had a marvelous currency, streaming through all biological literature since it was uttered. Great, truly, is the might of the aphorism when rightly forged; this equals, perchance, in influence all the rest of Virchow's volumes, and he has not a few. Still the same difficulty rises here which we found in Biogenesis; it brings us up to that same old chasm between the Inorganic and the Organic, and bids us look into it, perchance a little more deeply and despairingly, and then leaves us. For outside the cell, which is usually declared to be the first living thing by the biologists, must be a stage preparatory to life, which cannot be the protoplasm, since this lies still inside the cell, and is a necessary constituent of it. So Virchow's aphorism *Omnis cellula e cellula*, projects a pre-cellular material of life (*Protobioticon*), which is, indeed,

hypothetical, but just for that reason, the grand object of scientific research.

In a general way we may, therefore, affirm that the present trend of biology, dealing, as it does, so exclusively with the cell, is *micro-organic*, while previously it had been largely *macro-organic*, since it concerned itself about the larger forms and organs of plants and animals, which, however, are composites of minuter units. These vital composites have accordingly, been dissolved, somewhat like chemical compounds, into their original indecomposable elements, wherein lies an analogy of the cell to the atom, though the latter is still beyond the microscope. But the hitherto irreducible atom is just now being reduced to its new constituents, in the opinion of scientists; it is passing through a process of disintegration, and the cell will doubtless move in the same direction, in accord with the tendency of the present scientific mind. Indeed, certain biologists have already struck such a note.

So a certain analogy can be traced between the atom as the ultimate unit of chemism (if it be ultimate), and the cell as the ultimate unit of vitalism (if it be ultimate). Moreover their destiny seems to have a similar outlook in the scientific trend of the time—both apparently marching toward some form of

disintegration. Still they are very different, utterly dissociated from each other; between them yawns again that chasm dividing the Inorganic and the Organic; the atomic limit is drawn impassable, as yet, on one side of this deepest rift of Nature, the vital limit stands immovable on the other. Science has long attempted to fly across, through the air, on the wings of some cunningly constructed hypothesis, but her aeroplane usually capsizes during the flight and drops into the abyss, like that ancient craft of ambitious Icarus soaring sunward. Still just that achievement remains the ideal end of the science.

Finally there remains to be emphasized that marvelous power of the cell which is sometimes called its architectural impulse, but which we prefer to think of under the name of association. The cell combines with its fellow-cells and produces the different organs of the body, changing itself in accord with its new organic function. Thus all the diversities of our organism unfold out of the cell, which seems to possess this inner power of organizing itself into associated wholes of many sorts. Again and again one is reminded of the higher institutional association of man. But of this more will be said later. Here we may add that such associative power in the cell can only be ascribed to the unseen

might of the Psyche, which is implanted in the living Physis, developing and directing the same toward its purpose along the line of evolutionary shapes. Accordingly we run again upon that subtle psychical strain which permeates all Nature, especially all living Nature, and interconnects the same amid all its separate multiplicity of forms—a thread of light (seen only by the unifying mind, however) stringing the microscopic cell together with the highest organism. Of this psychical activity we may extend our glance a little.

VII. In the account of the process of the cell previously given, three stages were outlined in a certain order. Now this division with its order is not an accidental thing, is not somewhat simply picked up by the way. On the contrary, it has its deep correspondence with the Self which grasps it and with the Universe, of which it is an integral part, even if small, and which is at last its creative source. To repeat the process of the cell in brief: first comes the nucleus (not the outer protoplasmic mass, which biological books usually start with), then the separation of this nucleus within itself into new centers, which in the third place divide also the protoplasmic mass and thus become embodied in it as new-born cells. Given the cell as immediate, it is forever separating itself, and re-

turning to itself as a fresh individual. In this process of ever-recurrent individuation, or of self-reproduction, it exists wholly. The cell must be creative, yea self-creative, imaging therein the Creator, undoubtedly at a considerable distance. So, if we ask whence comes this self-creative power of the cell, we have to trace it back primarily to the self-creative All, of which the cell is both a manifestation and a constituent part, even in its far-off minuteness. Indeed, to be a member of the Whole, it must in some way reflect that Whole of which it is a member.

Accordingly one has to affirm that this process of the cell is not only physical but psychical; its movement is in and with matter, but its ordering principle is the Self. Not simply my or your Self, but the Self, the All-Self, if one may so say. To be sure I and you must identify the process of the cell with our own ultimate process, that of our Ego; all true knowledge is, indeed, to investigate the process of the thing with the process of thought. I can never understand the cell till I make it truly mine—appropriate it internally; which appropriation takes place when I fetch up, assimilate, and unite the essence of the cell with my own essence, proclaiming both of us as one in all our difference. Thus there is a bond conjoining us in our cognition,

yea creating us both, namely, the cell and me, who are coupled finally in the act of the Creator, or the Universal Ego (Pampsychosis).

Or we may say that the process of the cell is an impress upon it from the outside, verily, from above, and I bear the same impress, to be sure, in a different and doubtless higher form; that is, I bear it as conscious of itself. Still further that cell-process is not merely an image of the All-process, but is created by it, yea, is created by it creative. So the Creator imparts his own creativity to his Creation, of which the cell with its process is not only an instance, but an integral part. When it is asked whence comes that power of self-division in the nucleus of the cell the answer may be given that such is the fact and that science inquires no further, content with observing and describing correctly the phenomena. Or it may be said that such a question lies not only beyond the province of science, but beyond the limits of our intelligence, being in the realm of the Unknowable. Still, man cannot be quieted by such a makeshift, the search for the creative source of the cell and of all things, man included, continues unremittingly. Millionfold are the details yet to be discovered; but we can now say, as was long since said, though in a very general way, that the creativity of the part springs from the

Whole, that the perpetual self-reproduction or self-regeneration of the individual is transmitted from the ever-creating activity of the Universe itself. Germinal continuity has become the leading concept of today's biology, chiefly through the work of Weissmann; that indeed unconsciously calls for, even it does not yet glimpse, the universal origin, the primordial source of this germinal continuity which courses as yet only through the genetic cells of individuals. The universally creative reservoir—in fact, just the Universe—is waiting to be tapped at its fountain-head by science, which for the most part cries out that the thing can never be done, in that famous shout of Du Bois Reymond: *ignoramus et ignorabimus*.

Coming back to our cell-process again, we may now give to it a name which designates not only its formal order, but its origin as well as its genetic character. It is a *Psychosis*, a psychical process as well as a physical. The first is more the formative principle, the second more the material; each inheres in the other inseparably throughout cell-life and the entire Biocosmos. The psychical side is the mysterious supersensible one to the biologist, which he cannot reach with his microscope or other detectives, chemical and mechanical; still it is present and working, yea, in control.

He often notes its activity as the architectonic principle of the cell, the hidden builder or demiurge thereof; but its origin as well as its character lie in the dark chaos outside of his world, branded often as useless, if not forbidden themes of thought. Still even he cannot help pursuing them, if only to damn them.

It may well be here added that the fighting biologist has somewhat receded into the background since the days of Huxley, who took such delight in exhibiting his expert swordsmanship of speech against his antagonists, especially the Anglican clergy. Even Tyndall, naturally a gentle, lovable soul welters in a good deal of controversy with his peculiar devil, whom he often genially larrups but cannot quite put down. Meanwhile he gives us much important knowledge in a very agreeable way. Some of his scientific writings rise into the realm of Literature through their beautiful, or at least, very neat-fitting form. Huxley, on the other hand, is grandly pugnacious, when the full power is on, which the sight of a bishop seemingly can excite in him; that famous speech of his on *The Physical Basis of Life*—for it is an oration in spirit and expression—smites at times with the ring of Thor's hammer, through which we can often hear the undertone of self-contradiction; it has in passages a furious Demosthe-

nic utterance which, however, on close inspection is worm-holed through and through by a defective logic. Still today, though more than forty years old, as a sample of the Literature of Science it remains of the greatest. In this connection the remark is due that the band of scientists contemporary with Darwin show a sense of style unusual with their profession; the result is that they have added to Literature proper a new department, represented before their time only by a few sparse and humble works (like White's *History of Selborne*). Not a little of the power of Darwin himself springs from his feeling for the right word in the right place; he has for his work the appropriate literary gift which is always felt by the reader. The beauty-winged words of these writers has borne science to the hearts of the people where it must finally have lodgment, if it is to be effective and fulfil its highest purpose. Scientific thought and speech in their less technical forms have become implanted in the consciousness of the folk and have intrenched themselves as a special branch in the belles-lettres of the age. This must be deemed a very significant fact, and gives us a glimpse of a fresh trend of the time-spirit. The scientific thought-world is thus a necessary element or strand of the whole man, but it must not claim total and

exclusive possession of his spiritual estate (which it has been sometimes inclined to do.)

Coming back to the process of the cell, we observe that it has already within itself the process of the Ego, which it is to unfold through a long line of evolutionary shapes of Nature till just that process of the Ego becomes explicit, self-active, having itself as its own content—consciousness. Thus it emerges from the Physis, creates and re-creates its own form at will, is indeed itself simple will. The purposive end of all Life accordingly—Plant-life, Animal-life, Earth-life—is the evolution of the pure Psyche or Ego. Herein we may note that the generative process is wholly in the individual, is in fact his mind, producing its other in itself and as a part of its total activity—self-separating and self-returning. So it is our Self which can now separate from the organism, turn back and look at the same. But when such a Self has evolved not only to the point that it can behold its own individuated form, but the whole ladder of forms evolving up to its own from the cell, then we have reached the stage of a Darwin, not merely as this individual consciousness, but as the consciousness of his century.

Moreover such an act we are to conceive as the supreme overreaching act of the Bicos-

mos, its very consciousness, at least in its present attainment. Doubtless it will evolve to a new stage in the future.

VIII. And now before setting out on our special journey, we have to peer over the coming territory in a little map on which we may mark down the main stages. As the Biocosmos signifies the Order of Life, so we may well ask for a glimpse of this ordering of the subject at the start. Already we have noted the place of the Bicosmos in the total Order of Nature, of which it is the third supreme member or constituent, along with the Cosmos and Diocosmos. But within itself, as here set forth, it shows three leading divisions, which form its process as a whole and which must be conceived ultimately as psychical. These may be in general designated briefly as follows:

(I.) THE CELLULAR BIOCOSMOS: which, in the present state of biological science we have put first, as the cell is deemed the primal unitary basis of Life. The immediate or elemental stage of the total Biocosmos is, accordingly, the cellular; in the language of recent biology, the cell is the ultimate unit of organic Life. Still the cell has its own inner process of separation and restoration, as we have already seen, even if the biologist is seeking among its various divisions for something

more ultimate. And there is something more ultimate, controlling it in various ways, but hardly visible by the microscope. Just this cell-division and on the other hand cell-organisation reveal the work of a determining energy only palpable in its results. The highest act of the Cellular Biocosmos is the organic association of cells, which leads to the next stage.

(II.) THE PARTICULARIZED BIOCOSMOS: that is, the universal cell-life of the Biocosmos is now to be seen particularizing itself into its three leading forms, Plant-life, Animal-life and Earth-life. Each of these falls into its own special line of evolution, which is still further divided into many successive shapes or individuals, from low to high in grade, and from first to last in time. Thus the present is the vast realm of separated Life, of the Biocosmos particularized down to the living individual, which may be even a cell, our previous starting-point. But the emphasis is here upon the association of cells which become organized into many forms, of which the three leading ones we have noted. Especially the Earth-life has a long history which leads up to the self-returning Ego—wherewith a new stage of the Biocosmos begins to be manifested.

(III.) THE HISTORICAL BIOCOSMOS: this is

the product of a retrospective power which has arisen through Nature and is looking back at her, unfolding her stages which are also its own. Thus the self-returning Self (or Ego), in accord with its deepest character, returns upon itself, and sets forth its life-history. Without this rounding-out in its process the Biocosmos would not be complete. The Psyche, hitherto implicit, has now become explicit, and is to unfold its own evolution through all Life up to this final retrogressive act, which may for the present be deemed its culmination. The movement is indeed psychological, though its content is still Nature (or the Physis), but not merely in her individual shapes; these are now united in one universal sweep from the lowest organism to the highest, forming an interconnected whole which ends in man with the aforesaid psychological power. Such is essentially the Darwin deed: the Psyche grappling the Physis in the latter's entirety, which is simply its own evolution up to this self-returning historic act of itself.

Such are some preliminary hints of the scope of the Biocosmos, which indeed seems small compared to the extent of the Cosmos and Diacosmos. Still the goal and consummation of the latter must be deemed this one little vital dot in the universe, though there

may be others which we know not of. Even the mass of the Earth-ball is far greater than the thin green film of Life which enwraps it on the outside. Relatively all living existence is but a tiny moth flitting its brief moment in the light and warmth of the Sun. Still just this tiny moth is the purposive end toward which all Nature moves through its colossal magnitudes and mighty revolutions, and which is its fulfilment and completion. For the Biocosmos is the conclusion of Nature, thus rounding-out the cosmical and diacosmical stages, and evolving up to man, who looks back and reproduces in thought and word his own evolution. This is what we are now to follow out in our exposition.

Part First.

THE CELLULAR BIOCOSMOS.

So we shall designate the first and most immediate part or stage of the total Biocosmos. The cell is the primordial form of Life, its first appearance to the senses; it is, therefore, the beginning. Already we have given a brief statement of its process; here the fact must be noted that the cell has risen to be the leading principle in the science of Life. Biology at present chiefly concerns itself with the cell, which has become not simply an object of theoretical investigation, but has deeply entered, if not quite usurped the practical field of the sciences of disease and health. Medicine has been transformed in recent years by the knowledge and treatment

of the cell. The physician in these days has to be something of a cellular biologist, even if he does not specialize on given lines (like the bacteriologist). The complete view of the Science of Life must include the Science of Disease (Pathology, Nosology), and the Science of Health (Hygiology or Hygienics), as well as the Science of the Cell (now sometimes called Cytology, but far oftener Biology which in this narrow sense is properly a misnomer). All these special departments we put under the head of *The Cellular Biocosmos*, which is itself but one stage, the first, of our entire theme.

The cell, accordingly, being the ultimate unit or the first form of organic Life, constitutes the primal division of biological science as a whole. It is the element out of which all living shapes are constructed, or better, are associated. So it comes that this constitutive element of Life is just now the object of the concentrated pursuit of Life's science. In one sense the biologist has overtaken and caught the cell; in another sense, he is still in the hottest search for it, seemingly unable to catch it. What is the matter?

Very significant is the fact that the Biocosmos is moving scientifically in the same direction as the Diacosmos, whose trend was set forth in a former volume (*Cosmos and*

Diacosmos). The movement in both is toward the small and smallest as constituents of the physical universe. Already we have noted the analogy between the Diacosmical molecule (or even the atom) and the Biocosmical cell; each is in an ever diminishing line of descent toward the infinitely minute or divided. Both therein mirror the character of the science of the time, which is so deeply separative and specialized, but not well synthesized and ordered; indeed the same divisive tendency is largely the character of the age in all thought and activity. Ours is not a great integrating epoch, such as we have seen in other periods of the World's History. This is no lamentation over the time, for Psychology in its universal sense recognizes the separative stage to be as necessary as any other, to be indeed an inherent part of the total process, be this little or large. In the Diacosmos we saw the material divided into speculative molecules, which in due time were separated into atoms, which seemed for a while to be the final resting-place. But now the atom has been disintegrated (so science is saying), and is found to be made up of whirling electrons, which may be compared to particles of dust flying in a room when it is swept, the atom being the room. Each atom of a chemical element (this element was

also the result of an epochal separation of a material object, for instance, water), has now many electrons, which indeed vary in every elemental atom and are supposed to constitute its distinct character. So we whiz from the small to the smaller, but have probably not yet gotten to the smallest. For the electron, the last and as yet least Diacosmical product, is already showing signs of disintegration in its turn; yea, it bore such a sign as its birth-mark in the two antagonistic electricities (positive and negative), of which it is said to be composed. Manifestly the divisive process cannot stop on this side of the ultimate universal element of all elements, now conceived as ether. And this ether cannot fail to have its corresponding small constituent unit, the etherion; and as atomicity has been succeeded by electricity (or electronicity), so electricity likewise must pass down the line and be followed perchance by ethericity. (See *Cosmos and Diacosmos*, pp. 426, 554-60, etc.) This is of course merely glancing ahead, possibly far ahead, and so it runs the danger of all prophecy. But we must recollect that the molecule, the atom, the ion, and the electron are as yet purely hypothetical, and, from the strict scientific standpoint of sense-perception, they are wholly unproved and possibly unprovable.

Still they are the kernel of the Diacosmical science of today, which, as often observed, is getting more speculative than philosophical speculation in its greatest bloom. A necessity of Nature's Science is this, we say: within its field it is running at full tilt towards its unseen psychical origin and control—its destiny.

Now this same tendency of reaching out for the infinitely small in order to get at the source and soul of things, is next to be observed in the Biocosmos. We have already noted the aphorism of the early biologist that all Life comes of Life (*Omne vivum ex vivo*), which we may take as a starting-point. The next step is the cell when it gets fairly entrenched through the microscope in the biological consciousness, whose expression is found in the aphorism of Virchow that every cell arises out of a preceding cell (*Omnis cellula e cellula*). But his is not the end of the ever-diminishing series. The cell under the microscope becomes a large organic object, too large, in fact, and therefore must be biologically divided. The cell has in it floating many protoplasmic points or granules; what are they and whence and whither? They have been supposed to be new cellular units, the seeds of young cells capable of growth and division; that is, possessed of the cell-

process. On the other hand they may possibly connect with the Diacosmical molecule or atom or electron. So they may form a little span of that bridge between the Inorganic and the Organic, the great object of biological pursuit. At any rate, these granules have been conceived to be forms of the organized primordial cell which has likewise the power of self propagation through division. The result is a new aphorism: every granule springs of a granule (*Omne granulum ex granulo*). This contribution comes from a German biologist, Altmann; but it is, we learn, rather discredited by the guild, who feel that such a whirl is endlessly coming to the same thing. Still it shows the inherent scientific trend of the time, and will be adopted, if not in this shape, then in some other at some later date. Undoubtedly, it is a direct offshoot of Virchow's aphorism which in its turn is a derivative, all of them in desperate pursuit of the infinitely small as the great original of Nature and indeed of the Universe. It is truly suggestive, yea, pivotal, to observe how one aphorism germinates in the mind from another, quite like this process of cell from cell. We witness the idea running parallel in evolution with the reality; thus the process of biological science takes after that of its own cell, which is in-

deed its central content. Will it stop? Hardly at its present landing-place, one has to think; the next investigator will divide again, for such division is in him, in his consciousness, as well as outside of him, in the object, yea, in the spirit of the age.

It is, therefore, significant, that many a biologist has predicated already the ultimate cellular unit beyond the cell as at present visible, yea, beyond the granule as the hypothetical basis or source of Life. This tendency is already found in Herbert Spencer's *physiological units* and in Darwin's *gemmules*; here too belong the *biophors* (Weismann), the *plastidules* (Häckel), the *bioblasts* (Beall), the *biogens* (Verworn), the *pangens* (De Vries), the *idioblasts* (Hertwig), and so on indefinitely. Each investigator has a bent for springing upon us a new name, so that these names seem to be also moving toward infinite diversity, like the cell. The above designations are but a few samples out of the lot, and they are already getting a little aged. (See a longer list in Wilson's *The Cell*, p. 291, where the author remarks that his list is by no means complete and that the above terms are shaded with different meanings by their proposers, though all have the one content and show the same trend of the science. It may be added that the cited book

is, at the date of this writing (1911) more than ten years old, which period has been prolific in biological discovery, but even more prolific in biological hypothesis—all of it, however, going pretty much the same way.)

Still in this field of the small and smallest we round up with the concept that life springs only from life. The division seems always to return to its starting point, as if to start over again. So we are inclined to go back to Darwin's hypothesis of the gemmule, which he sets forth in his doctrine of *pangenesis*, holding that the germ-cells contain still more minute cells (his gemmules) separated from every part of the body and thus share in or register the changes taking place in the organism. Thus he seeks to account for both acquired and congenital variations and their transmissions to offspring—round which themes recent biology surges so tempestuously. Darwin hardly introduces the microscope, the grand modern weapon, but theorizes purely in this case. (See *Variation of Animals and Plants*, c. 27). His view was not generally accepted at the time of its promulgation, even by his followers—a fact which we find him very gently complaining about in his correspondence. Still it has been exceedingly fruitful of posterity, though purely an idea; indeed, it may well be deemed

the germ of today's biological discussion, which is seeking so desperately to account for heredity, with the practical purpose of somehow controlling it, or at least directing it into certain improved channels. The Darwinian gemmule, though supposed to be only physical, has certainly produced many gemmules of mind, which are still being born; and again it is to be noted how the *psyche* of the biologists is itself a kind of cellular process in this sphere, the deeper reason being that the cellular process likewise is at last psychical. The gemmule, then, may be considered the germinal idea out of which so much recent biology has evolved. But with it the question again comes up: is it the real origin of Life? Hardly, though it is the origin of itself.

Here, then, dawns a new form of the old aphorism already cited, though this new form has not been expressed as far as we are aware. Following the analogy of its previous Latinized sentences, one may set it down thus: *Omnis gemmula e gemmula*. Such is the fourth aphorism or aphoristic model in this field, uttering the last phase of the biological evolution of the cell, inclusive or perchance typical of all the rest. For it is now confessedly the idea, hypothetical, unseen, ultra-microscopical, whereas the other three,

even the granule, were material, visible under the microscope, and hence realities. The gemmule in its evolution has become as speculative as the atom or electron—a mental object asserted to be physical. The *Psyche* has thus reached the point of affirming on its own authority that it has the *Physis* as sensuous counterpart, though inaccessible to the senses.

Inevitably the question rises about the relation between these ultimate units (of course only at present ultimate) of the organic and inorganic worlds, for instance, the gemmule and the electron. As yet they are refractory and refuse unity; each maintains decidedly its own individuality against the other. Still we have to cast the horoscope of science which, in its own evolution, has become so deeply speculative. The possibility of a common meeting-point between the Diacosmos and the Biocosmos would seem to lie in that as yet very elusive medium known as the Ether, and in its unit (called by us the Etherion) the elemental gemmule of Life may yet be found reposing. All this is only theory and forecast; still on both sides of the line Diacosmical as well as Biocosmical, we note the common trend, as yet separate, but seemingly converging in a point toward the infinitely small. Such we may see in these two

quite identical movements of the two grand divisions of Nature toward a real point of identity which, if never quite to be reached is certainly to be more and more approached. The biological aspiration is apparently to behold the initial point or germ-plasm whence fork the Organic and Inorganic from a common center, to discover the bifurcation of the Diacosmos and Biocosmos, each of which then evolves independently on its own road after its own fashion. In a somewhat similar way the plant and the animal have been carried back to an organic cell from which they both diverge and evolve along separate paths. Such a function is usually assigned to the *Protista*, which, however, must still be carried up to some remoter source or sources, even to the ultimate unit not merely of Life (which is the cell), but of Unlife and Life of all Nature. Psyche has already that unit ideally in herself, and is at present emphatically bent on finding it in Physis.

So our cellular Biocosmos may be deemed the scene of the great scientific struggle of the time, displaying the ideal pursuit of the scientist as well as the strength and also the limitation of his consciousness. For the Ego of the biologist is formed by his work; while evolving the cell, he is equally evolving the evolver, namely, himself. But he is doing

something more and of deeper import: his act is likewise a social act, bearing the impress of his age, of which he is more or less of an utterance. Darwin must remain his supreme prototype, who formulated the deepest strain of his time, with his doctrine of Evolution. That doubleness of Nature lies in both men; it is that of Physis and Psyche, with their perpetual approachment, yet separation still. Will there ever be a final synthesis of the twain, the ideal end of the scientist?

Putting the problem in another form, we may ask, Will the Psyche ever get inside the atom, or electron, and make it live? To some such result it seems to be leading the Biocosmos in its search for the ultimate unit of Life beyond the cell; or we may call it the new cell. To be sure this pursuit cannot stop with such an attainment, for the electron is clearly not an ultimate, it is already going to pieces in spite of the herculean attempts to hold it together. The far subtler ether with its etherion is at work underneath every cosmical and diacosmical form (such as electricity for instance), and is calling for the new synthesis. So we run upon the question, the last for the present; Is the Psyche finally to be found inside the etherion, and thus become the original elemental cell of the Biocosmos?

Here we may well cry halt to the remotely forecasting imagination (which Tyndall, however, makes an important part of the scientists' intellectual outfit), and come down to the present state of our science. As already indicated the Cellular Biocosmos falls naturally into the following three divisions, which form a process together:

(I) *Cytology*—the science of the cell in its immediate manifestation.

(II) *Pathology*—in general known as the science of disease; the negative phase of the cell.

(III) *Hygiology*—the science of health, the restoration of the cell from its negative condition.

The present is a vast field, embracing as it does the whole subject of medicine and healing, with its numerous theories and practices—all more or less in a state of bitter strife. Of course there can be no attempt here to give even a slight survey of the merits or demerits of this conflict of the doctors of physic, in which also the doctors of divinity and even divinity without the doctor have mingled. This field more than any other perhaps, may be deemed the present battleground of the Biocosmos on account of the many combatants, the great diversity of their positions, and the frequent fierceness of their

mutual onslaughts. Still we hope to run a slender line of order through this seething mass which seems on the outside so chaotic.

I. CYTOLOGY.

The first portion of the Cellular Biocosmos deals with the cell proper, its origin, structure and functions apart from its diseases—its positive side we may call this, as distinct from its negative side. This direct positive field of cell-science is very generally known as Biology in the narrow sense, though the special term for it, Cytology, seems to be creeping into use. At any rate the word is needed, though it unfortunately has the wrong implication of a cell being always a hollow thing—against which conception the biologist of the present day seldom fails to speak his protest. But the Greek word *kutos* is a literal translation of the Latin *cella*, and perpetuates the old mistake. Cytology is, then, the science of the cell taken in itself or as immediate, and hence it comes first in the Biocosmos as the basic principle of all Life, as the very beginning thereof.

It is true that this beginning of Life has not yet been found as a sensuous object, and so is vigorously pursued by science—which pursuit will probably last for a long time yet. Here is a term of mind, a category of thought

if you please—the Beginning—which nobody ever saw, or can see with eyesight and sunlight, which is nevertheless to be reached somehow by the microscope in one of its special applications. It were well if the observer would oftener turn his vision within and examine these categories of the mind which he has to use far more than his microscope. For not only does he express himself by them, but he thinks by them, yea, sees by them—or possibly does not see. That microscope which he uses does not exist in nature but is a thought realized through evolution, for the microscope also has its history, and he has to learn carefully how to employ it, otherwise it may fool him, as he well knows. Such is his chief outer weapon; but his Psyche is full of inner weapons, a grand armory of categories given him by heredity and culture, which he had better study a little, else they may deceive him worse than his eye or his eye-glass. The difficulty is that the much-defamed Philosophy is in its deepest purport just the study of these categories of thought, which man has made and precipitated into human speech quite from its origin. The two supreme books of abstract Thought or Philosophy are doubtless Aristotle's *Metaphysics* and Hegel's *Logic*; both these ultimate thinkers of the ultimate turn their inner mental microscope

upon just the categories of mind and describe their character, that every man who handles these basic implements of all Intelligence may know what he is doing, yea, what he himself truly is. The scientist, to his and our misfortune, has imbibed the strongest prejudice against this study of his own brain-tools and often uses them with astonishing awkwardness and ignorance, slashing himself horribly with the keen-edged contradictory concepts lurking in his own words, even to the point of cutting off his own head.

Now one of these subtle categories of Thought ensconced in human language and transmitted down the ages, is just this vocable, the *Beginning* (or perchance the *Becoming*.) And in order to catch the whole sweep of it we must add its negative counterpart, the *Ceasing*—both then will be the *Beginning to be* and the *Ceasing to be*. Let any reader reflect how many times a day he applies to special cases these two thought-forms (called here categories), and he will be on the way to see what really fills his Psyche. This is his mental bag stuffed with acquired or congenital categories, by which he measures everything, to be sure, quite unconsciously. It would seem of importance to take, at times, an inventory of the whole bag (which is the special work of Philosophy, or better yet, of Psy-

chology). Now the scientist (like every mortal) has in his head a bag full of such categories, some of which have been picked up by himself, others he has inherited. But he keeps it carefully tied fast in his unconscious world, showing a kind of terror of it, lest, if he once open it, a Pandora box of ills or indeed of demons would fly out and eat him up. One of the categories, in fact, the main one, of Biology today, is the Beginning—here the Beginning of Life. But the difficulty with such Beginning is, that it is already the Begun; when seen in its minutest form under the microscope, it must have had an antecedent source or cause, it must have been before, and so it is not the Beginning. Such elusive duplicity lurks in this category when sought as an object of the senses, which is the scientific object. If the Beginning thus turns out the Begun, the mind, in intense pursuit of the former, must get back of the latter and find its source in something still smaller or more remote. So scientific research bears the impress of an infinitely regressive series, with an ever diminishing line of forms in pursuit of the Inscrutable. But always the dissidence will be secretly felt or recognized openly: the Scrutable is not the Inscrutable, the Seen (of Sense) persists in being distinct from Unseen (given by Mind); or, to use

other terms, the Particular is not the Universal. And still scrutator will and must continue his scrutiny of the Inscrutable. As naturalist he is inherently and necessarily teleologic; if he should ever attain the end of his investigation, his calling would be gone.

Accordingly, in this ceaseless ever-recurrent pursuit, he is in the profoundest harmony with Nature herself. For she is also just this pursuit of an end by her unattainable, that is, when she once reaches it, she has passed out of herself into another sphere. She is the infinite longing or aspiration for the beyond, which characteristic expresses itself in the endless series—or the unexpressed or indeed inexpressible. Nature, therefore, cannot utter herself, or rather her utterance is the striving for utterance, like the song of a bird or perchance the famous music of the spheres. Ever approaching the goal, she cannot quite touch it—and remain herself. As Nature, so the Naturalist; his consciousness becomes a part of what he works in, despite itself; his Psyche goes back and assimilates itself to that of Physis—which fact is verily its worth and glory. The Ego of the scientist is undoubtedly self-returning or self-conscious, like every other Ego; still it uses this power in its own way: to return upon Nature from which it has

really evolved, and to become one with her, especially on her psychical side, and to articulate her who has no articulation. This the scientist does for his time and people—a service of the highest order. For the evolutionary clock strikes the hour when the man has to go back to his own evolution in and out of Nature, and take the same up into himself that he may make the step in advance.

A little study, then, it is well to give to the leading category or defining term of Cytology, which is declared to be the science of the Beginning of Life, since this tool of mind has its subtle character which ought to be understood by those who employ it as a scientific concept.

When it comes to the right ordering of this cell-science, several points of view may be taken. There are many kinds of cells, for instance, and they show various characters. Some have a far tougher vitality than others, seeming to concentrate a greater strength and intensity of life. Birth, maturation, decline, death move through their periods in the cell as in man, of whom it is in so many ways the organic prototype as well as the constituent. Millions of lives are being lived in our life, each with its rise, bloom and decay. Each inhabitant of the Earth—and there are supposed to be sixteen hundred millions of them

—has at least as many living inhabitants as the Earth, in his own body, or probably in his brains. The cellular population we may thus conceive in every man to be equal to the human population of the globe (usually said to be many times more). Therein he is the epitome of all men, the cell makes him such even in Nature. Moreover, the round of life is always going on with these little creatures—millions of births and millions of funerals from the daily pomp of your individual globe.

It is evident, however, that your organism has its own collective life as distinct from that of its cellular denizens of whom it is made up. In other words, they are associated, and are severally members of a greater whole to whose end they contribute, and which looks after them. They are not autonomous units merely aggregated together, but are subordinated to a center, indeed to many centers in graduation reaching up to the highest. Now this tendency of the cell towards association may well be regarded as its pivotal fact. It associates to form all the organs of the body and then to form the latter's entirety. When the cell becomes autonomous, or more especially when a community of them sets up for itself as independent, disease has started, and a cell-war opens between the rebels and the faithful, which may end in dissolution

or restoration. So a negative, fighting, colliding world dawns far down among these micro-organisms of cell-life.

Perchance the chief interest here is to observe the faint reflex, the far-off forecast, as it were, of human association, of man forming his social institutions. Each individual person strives to become a member of a greater organism which integrates him with his fellow-man in state and society, as the cell pushes for union with its fellow-cell in the animal body. Stages of the same great process of evolution we may deem both these facts, though they be very different rungs of the one colossal ladder, rising from Nature to Mind, a veritable Jacob's-ladder from Earth to Heaven. The cell is already in its way institutional, and builds its world of institutional order, which has its control, its authority, its law, its constitution. It may be said that our human organism, if it be true to that deepest principle of itself which made it an organism, cannot stop in its career of organization, but must organize itself with others of its like. The cell is, therefore, in its supreme aspect, associative, and keeps generating association in its round of life, being the bearer of the same not only through the lapse of time, but up the many-graded steps of evolution. We may say that it shows the aspira-

tion to become purely associative without the physical counterpart which it has in Nature. This instinct of the cell, as it can be called, we may at this point identify as its psychical portion, which determines it to ever-renewed and higher association, whose culminating point in Nature is the human organism. But this is again individual, which must rise out of its limitation, out of its mere individuality, and seek to be universal—which is manifested in association, whereby the one shares in the all. The cell, we repeat, showed that same associative striving in its little framework, which was the Psyche belaboring and unfolding the Physis, or the cell-soul in the cell-body. We have already noted theoretically the point at which the Psyche seems to pass from the outside of Nature to the inside, and Life begins perchance in some pre-cellular condition of matter, wherewith the Biocosmos opens, at least, in thought. Throughout this sphere the cell becomes more and more associative, its Psyche carrying along and evolving its Physis, up the ascending stairway of all organic forms, till at last in human institutions the Psyche gets to be its own self-conscious process and associates itself purely. So we may say that the cell from the beginning has the aspiration in Nature to become institutional though strictly it cannot

reach such a goal without transcending Nature and the Biocosmos, which, however, constitutes its sphere.

Consequently we shall divide this realm of Cytology, the science of the cell-world proper, according to its deepest criterion, which is its associative character. The first of its stages is the pre-cellular protoplasmic mass of vitalism, the potentiality of all Life, Nature becoming cell. The second stage is the cell separated and organized, as self-active and self-contained individual, the unicellular organism in its primal autonomy. The third is the organized multi-cellular stage, the association of cells to form all the higher organisms of Nature, vegetal and animal.

I. *Pre-cellular Life.* First of all let it be remembered that this has never been opened up to the senses, it is as yet a speculative entity, toward which biological science with its varied laboratory equipment is in hot pursuit. Already it has been stated often enough that the First Life (*primum vivum, protobioticon*), has not been reached microscopically or otherwise, and only exists for us as a postulate of thought. Still this is what the grand army of biologists are seeking more or less unconsciously, namely, the physical manifestation of their psychical concept. Can we not find in Nature what exists in our minds

as her very starting-point and source of existence? The result of this search is research which insists upon searching again and again, and approaching closer and closer toward the small and smallest; much is indeed picked up on the way, even if the end be as yet un-reached—whereof the record is set down in works of biology, and constitutes the main subject-matter of this science.

In this aspect pre-cellular Life has its striking analogy to Ether. Both are hypothetical concepts lying far back at the source of their respective stages of Nature. One is the ultimate of the Biocosmos, the other is the ultimate of the Diacosmos, each is conceived as the last constituent, as well as the primal origin of its own distinct sphere. Hence one is the ideal goal of the biologist which he wishes to find real; the other is the ideal goal of the physicist, which he seeks to see in its sensuous counterpart. Psychically, therefore, both scientists are quite alike in their different fields of research; each is hurrying to overtake the incorporate Psyche at its start, to behold the ideal and the real just at the first point of their conjunction. Still further we may push the thought: the ultimate unit of Ether (say the Etherion) may be found to be one with the ultimate unit of Life (say the gemmule),

though both these units today are remotely hypothetical, and yet more remote is their oneness. Still in this way we may take the speculative pleasure of viewing the primordial bond between the dead and living worlds, or perchance the central generative point from which starts the grand bifurcation of all Nature into organic and inorganic, which mighty twins may be well supposed to have had a common womb.

From these far speculative outreaches which have become indeed an integrating element of today's Natural Science, we shall come back to consider a few things about this primal Life (Protobioticon). The first concept which may be formulated concerning it is that here lies the scene or arena of the individuation of Life, the transition from the protoplasmic mass to the first differentiation of the living individual, in whatever earliest form the latter may appear. This pre-organic field may be conceived to stretch between the Inorganic and Organic, to constitute that bridge of which so much has been said. To be sure, one may well ask whence comes this protoplasmic mass which is here taken for granted? Merely the hypothetical starting-point, we may say; but meanwhile the deeper question rises to the surface: What is the origin of that power of living individ-

uation with which this elemental stuff is endowed? Manifestly here we glimpse the psychological strain which runs through all Nature and propels it from without and from within toward the self-conscious individual.

The next point which we may consider is that this peculiar antecedent life-slime, this unindividuated mass vitally individuating itself, must have arisen somewhere and somewhere on our globe after it had reached a certain stage in its planetary evolution. Not when it was a nebulous piece of fire-mist just flung off from the Heliosphere; not when it had cooled down for many millions of years, but was still red-hot and would not allow the formation of water on its surface; a much later epoch must be taken when the Earth is ready with air, soil and moisture, and actually evolves this earliest life-stuff, about one hundred million years ago, according to certain scientists. On some favorable part of our planet it must have started; as the Earth was still hot in portions, it has been conjectured that the Arctic regions first produced those limits of temperature in which Life arises and thrives. Hence from the poles, now grown too cold for vital thrift, the plant and animal have overspread the other zones, which possibly in their turn may get too frigid. And still but a very small part of the

total terrestrial mass of matter ever became vitalized; a ten-millionth of it is one well-known estimate. In many ways Life is limited in quantity; in fact, it often limits itself with a destructive violence. Yet this quantity has remained about the same through the later geologic ages, it is supposed; still one is inclined to think that, as the Earth kept cooling off in the earliest stages, the life-area of it, starting from the polar point, must have enlarged, and therewith in proportion the primal life-stuff must have increased.

So in one form or other we have to conceive a primal original reservoir of life-stuff, be its locality arctic or equatorial, in the Sargasso Sea or in the Nile-bed, or indeed everywhere. Moreover we hardly dare limit this elemental protoplasmic material to early time; it still must exist in some way and be at work, if it could only be found; that first creative living individuation of Nature has never stopped, can never stop but with Life itself.

Given, then, our planetary evolution from the Heliosphere, Earth-life must have arisen in time and place along with the right temperature and other accordant conditions, and attained a certain amount of vital material whose quality has been improving ever since through evolution without much change in

quantity, as is supposed. At a given stage it would seem that the Earth produced its full quota of life-stuff (Protobioticon), which it has kept supplied from that time on, such being all that it could do in this line. When our globe broke through the previous Unlife into Life, must be regarded as a chief act in its evolutionary drama. When long ages afterward Life broke through into Self-consciousness, was also a chief act in that same evolutionary drama; between which two acts lies our Biocosmos; where, when and into what Self-consciousness is to break through, belongs to the future, and will be another great act, possibly the greatest, of our terrestrial evolution. So we may put together some of the huge steps of our planet's journey; such a step we are now trying to grasp in the elemental life-stuff.

The cellular organism which, in its smallest form is already very complex and composite, presupposes some sort of organic material for its use. And we should not forget that this stage is the Psyche getting inside the Physis and starting its internal control of matter. And its method seems to be individuation, the protoplasmic mass is turning to living units, however minute these may be. And in one way or other this is peculiarly the work of the active Psyche (the Psycho-

sis), imparting to tiny points of matter its process, whereby they become alive. Again we may bring to mind that the biology of to-day has as its chief object to catch Nature individuating herself into these living units whose primal forms are cells.

So we are next to pass out of our speculative postulate of a Pre-cellular Biocosmos, its first stage, as yet unrevealed to the strictly scientific eye, but its ever-present necessary pre-supposition and indeed the ideal object of its search and research. We have reached the single cell, separated, individuated, visible, organized, with its own round of life. This is therefore the second or separated stage of the Cellular Biocosmos as a whole—a vast living territory, by no means yet fully explored. We may call it the unicellular world, with an enormous and varied population of individuals.

II. *Unicellular Life.* Actually now lies before us the visible unit of all Life, a complete organism even if microscopic, the first vital individuation, as far as can at present be seen—the single cell. In a sense it is the passage from a hypothetical element to the real appearance, the ideal clothing itself in its material counterpart, the unformed or purely formable taking form to our vision. The organic universe is now seen split up

into its living atoms, or elemental units, in a state of complete separation. Here we may note that this unicellular Life is also multicellular—that is, indefinitely reproduced and repeated. Each is primarily taken as an independent whole with its own entire round of life, even if they be externally connected. A string or mass of single cells is properly multicellular, though not internally interrelated.

Still we have to recall that this elemental unit of Life is an organism which is a result of something gone before; it is a consequent which presupposes an antecedent; or as previously set forth, it is the beginning which has already begun. Thus it keeps throwing back of itself its own starting-point, which the scientist at once sets out to explore as a new object. And so the search keeps on for finding the ultimate unit of Nature, who always turns out twofold, in accord with her deepest character.

The general process of the cell has been given on a former page, with its central nucleus and protoplasmic body ever dividing and forming new cells. In the detailed accounts of the cellular organs and parts, many other items, such as the nucleus, the centrosome, the granules, etc., have been carefully studied and described by the biologist, but

these we shall have to pass over. We behold the leading fact of the self-separation of the body starting in the nucleus which re-unites the protoplasm and forms the new cell. A cellular image of the Psychosis we may well see in this process, which thus reveals its psychical phase.

A good deal of biological discussion at the present time turns on this nucleus. The complete cell has it, but the incomplete cell seems to show it in a state of gradual formation. The *Bacterion*, probably the least developed living cell of Life, possesses the nucleus only in a very incipient stage, if at all—some investigators see it, some do not. The transition out of the pre-cellular Life into the cellular, would appear to take place in the nucleus, which thus comes to be the primal center of vital individuation. A little mass of protoplasm which at the start shows no difference between nucleus and cytoplasm (or cell-stuff) somehow gets nucleated and there-with soon forms a cellular body. The primordial living individual of the planet is then born—the cell, at first quite isolated, independent, unassociated. Again the question rises, Whence this nucleus with its power of self-separation and incorporation? Manifestly here is another node of Life in which Psyche is directly at work, but can be seen

only in the results. Still another point to be mentioned is that these early unicellular organisms cannot with any definiteness be distinguished as plant or animal—such bifurcation has hardly yet taken place corporeally. What is it that determines the seemingly undetermined cell to its future, be this vegetal or animal? Such a problem opens into another prolific discussion of biologists on pre-formation and epigenesis, which must here be omitted. The claim has been made that this unicellular Life is greater in quantity than all other forms of Life combined, that it embraces more than half of the total Life-stuff of the globe.

The Bacterion, then, may stand as the nearest approach to the transition from Unlife to Life. Possibly upon this fact can be grounded its destructive character when it gets a strong foothold in higher organisms like the human. It disintegrates them, turning them back into these primordial cells which lead to Unlife, and which are negative to associated cell-life. Thus the Bacterion has brought forth a special science of itself (Bacteriology) which has an important place in Pathology.

But not all of these Bacteria are destructive, not all have their tendency toward death. Others are life-promoting; in fact, the most

appear of this sort. The human body is reported to be full of these micro-organisms, which perform important vital functions; it would appear that they still are engaged in their original action of bridging over the Inorganic into the Organic for the higher organisms; they are the primordial means in this our living body of transforming Unlife into Life.

The Bacterion is usually declared to be vegetal in character, though not by all biologists; on the other hand the first animal is affirmed to be the Amœba. Both are unicellular, microscopic and are of many different kinds or species. The two would seem to represent the first bifurcation of pre-cellular Life into the two great lines of organic evolution in plant and animal.

The indifferiated mass of pre-cellular Life is transformed primarily into single cells, which, as already recorded, have become the special content of biological investigation. In the cell, accordingly, Life appears for the first time as individuated, as a peripheral piece of matter, with its own inner process continually going on. Here is what we may call its primal divisive stage; there is a separation, approximately infinite, of the original unseparated material into vital centers with their bodies. And having once

started, this corporeal individuation of Life will not stop till it reaches the topmost form of Nature, rising through a long series of organisms, from the smallest to the largest.

One may ask concerning the cause or source of this individuation of Life. Is there no other way for the evolution of the Biocosmos than through the living individual? Nature takes just that method—why? She must, it lies in the deepest necessity of her origin. We notice the same separative tendency toward individuals in the inorganic Cosmos. The sky shows it in the stars, in the nebulae, in the planets, in the Earth which originally separated from the Sun, and became itself an individual, which was to carry forward its own primal division indefinitely. Here we may recur to that fundamental thought from which this treatise starts in the germ; Nature in its total sweep is the second or separative stage in the process of the All (or the Pampsychosis). So in this case, as in every other, we have to go back to the Universe to get the ultimate ground of individuality, which is a phase of its partition. The Biocosmical cell is a living individual, which is perpetually dividing itself anew, repeating itself, reproducing itself. Why does it thus? It is re-enacting the All of which it is a part, and it can only be a part of the Universe but by

having the universal process within itself. And so we have to account ultimately for this inner propulsion of Life to individuate itself—it is therein fulfilling its part and place in the movement of the All of which it must make itself an integral portion in order to be of the same.

But we come back to the fact that the earliest living individual in the universe, as far as we now know, is the cell; with it every organism, however complex, starts on its career of development; also with it the world of organisms starts visibly, moving along the lines of its development. Man begins with incorporating himself in a cell, which has been often called his prison, the original incarceration of his Psyche. It is the cell which connects man (and all living existence) with the past; he receives his inheritance of character from his fathers through the cell; all the progress of the ages has to pass into and out of the cell, the World-Spirit indeed cannot be excused from this cellular experience. It is, then, the point of transition and of transmission from parent to child in all Life and what Life carries—arts, sciences, institutions, civilisations. We may conceive it likewise as the connecting link between what has been and what is to be, the little genetic dot which is eternally propagating the past into the fu-

ture. Very interesting becomes the unicellular *Amœba*, simply dividing itself and reproducing another cell like itself, when we behold it in its farthest significance as the protypal act of Life, even the human. Thus we may contemplate the cell as the first living individuation of the Universe, the primal vital embodiment of the Pampsychosis.

But it lies in the character of the cell that it cannot stay merely a separate individual, or a string of protozoa. It shows the bent to organize itself—a psychical bent, we conceive it; the many divided units push of themselves toward an associated unity, subordinating them, yet preserving them in a new order. This brings us to a new stage in the development of the cell, in fact, its very purpose in the Biocosmos, which it is now to build, being both the builder and the built, even furnishing itself as the brick of the edifice. Or more simply conceived, each cell is now made the unit of association which produces all the varied organic forms of living existence.

III. *Associated Cellular Life.* The present sphere is usually named simply *multicellular* in biological books; but the term gives a wrong suggestion, merely that of a multiplicity of cells, or of a cellular aggregate. Such a conception belongs still to the

separative stage just considered; whereas now we are to emphasize cell-organization, or, employing a more decisive word, cell-association. Moreover this word correlates cellular Life with its highest manifestation in the human form, and even beyond it, hinting human institutions, which also rise through association. All living organs of an organism, and the organism itself show this associated cellular Life, which we are to consider next.

At this point, then, enters a pivotal activity of the Cellular Biocosmos, namely, the association of cells. Cellular autonomy, which we have seen to be the previous stage of the cell evolving from the protoplasmic life-mass, evolves in its turn from its separated, individualistic, autonomous condition into a newly organized, associated Life, in which the cellular community becomes truly manifested and explicit. Still we must not forget that the cell in itself was already the implicit community, and showed many marks of its so-called complexity in its incipient organs. Thus it too manifests the inner propulsion to form all its distinctive parts into an organic whole; this is indeed its psychical side. But the same power will seize the entire cell-body and integrate it with the higher organisms of plant and animal. Thus a multi-cel-

lular associated Life dawns, which is likewise to have a great career, and which has the advantage of visibility, of unfolding within the limits of the eye—which eye is itself a part of the same evolution.

Such is the rise from the divisive principle of the previous unicellular stage of cell-life, the second stage of what we here call Cytology. The independent cell has been produced and then has reproduced itself in Nature with a vast multiplicity, but this individual independence passes over into inter-dependence, the outer relation is transmuted into an inner relation; the single cell gives up its isolation through its own psychological instinct and becomes social, communal, and so reflects from afar the institutional world, toward which it is mounting on Life's ladder.

Moreover the simple elemental uniformity of the original cell changes, adapting itself to its new place and duty in the larger organism of which it has become a member. The cellular structure of each organ of the human body, for instance, becomes different—that of the muscle is not that of the nerve. So we observe a great differentiation of the cell through its associated life with other cells in the same organism. And in different organisms, on the other hand, we find a marvelous similarity of cells belonging to the

same organ, for instance, in the liver, from the low to the high animal. And in this sphere of the cell new relationships appear in organisms seemingly far apart. The blood of each animal has been found to be different from that of any other animal, with relations near and remote. Hence the blood has been made the basis of ordering anew all the animated world. For example, the walrus, through its blood, is declared to be more deeply allied in its microscopic character to the horse than to its next-door neighbor in the same element of salt water, namely, the whale. This suggests a new classification of animals very different from the old one, which looked more to the large outer form or to its bony structure (for instance, to the vertebral column). In such manner the inner circulatory system going around the organic cycle and feeding all its activity, furnishes a fresh basis of the outer system of living forms. So classification is looking to the micro-organic world, having been hitherto macro-organic. And the consanguinity of the total Biocosmos may yet have to be settled and ordered by a microscopic examination of the actual blood-kinship of its entire population, vegetal and animal—for the plant also has its kind of blood. Meanwhile the thought lies open that some more pivotal system than the cir-

culatory (possibly the nervous) may yet be found for the deeper ordering of the present vast rather chaotic menagerie of Biocosmical shapes.

This leads us to another somewhat similar consideration: the Psyche of the biologist himself is in a condition corresponding to the foregoing unicellular stage, as revealed by his works. Wonderful is his cellular industry, but he seems unable to integrate his vast details into a complete organism; cell after cell he adds, keeping up an almost infinite division (a kind of intellectual *mitosis*, to use one of his terms). We conceive the hundreds of biological investigators now found in every part of the globe; each one is reproducing by some sort of fission that original thought-cell of his science till the quantity of individuals overwhelm us with their chaotic multiplicity, and we start to praying for a deliverer: O, for some organizer of this scientific cell-world, some categorizer—perchance a Darwin even with his limited Natural Selection! So, we pray in tribulation of spirit; but the scientist, as the report flies, does not listen to prayer, does not even believe in it; accordingly the outsider has to run his own lines of organisation, if he feels the need of them—which need, as Psyche, he cannot help feeling now and then. So we behold every-

where an associated cell-life, but an associated science of cell-life, with all its members duly ordered and organized, is what has yet to appear.

Will man ever be able to control directly this cell-life of plant and animal, and also of himself? Indirectly he does so already. At present he is occupied with finding out this cellular existence and with formulating some of its laws. But he would seem to be on his way toward getting hold of its associative power, which has so many analogies to his own. Cell-association intimates man-association and is prophetic of it, and may be taken as the primordial push towards it in the movement of Life. Indeed each individual cell of the human organism, as the bearer and propagator of past inheritances, is the arena of conflict between transmitted traits of millions of ancestors, especially if Life on our planet reaches back a hundred million of years. The cell, is, therefore, a brief abstract of the man, his little eidolon, seeking to realize association; yea, we may conceive it as an image, condensed in the smallest space and as yet undeveloped, of human society, of whose institutions it is a far-away pre-figurement. In fact, it is their actual living germ, which is slowly to evolve into the structure of man himself and then into his institutional world.

Of course we are not to forget the part of Psyche in this long evolution, which is already working in the cell and is, step by step, impelling it forward—into what? Into itself as the completed psychological process.

Naturalists have observed the greater success in Life of those animals which associate. It is noteworthy that many insects—bees, ants, termites (white ants)—show a greater power of association than some of the higher vertebrates. Many lines of living animals have failed in the course of the geologic ages—one reason among others being the lack of associative ability. Herein doubtless lies the chief ground of man's persistence through all sorts of terrestrial changes. His evolution is a slender thread running through many thousands of different organic shapes, with an ever-rising might of association, till now his body seems to have reached its limit of cellular formation. That is, his shape does not essentially change, while evolution has gone over into his mind, which is in the very hey-day of its progress. His body appears now static, but his soul is certainly dynamic. And the line on which his physical evolution seems to be moving is institutional association (as already set forth in the Introduction, pp. 50-52).

Man is not the largest animal with the

greatest number of cells—he is far surpassed by the whale and the elephant. Still in him the cellular structure is most highly organized, with greatest diversity and complexity. Nor is he the longest-lived of living existence—there are trees, animals and birds which get older. Still through creating institutions his individual Psyche remains longer in evidence upon our earth than any merely physical shape of vital Nature. Julius Cæsar is yet among us, not to speak of Christ. From this point of view man wins an institutional immortality which is no longer dependent on his cell-life.

The analogy of cellular association to human association is noteworthy. The movement of society in History shows man's mind associative as well as his body. Human souls associate and form bodies (institutional, as a state, or a church, or even a club), as well as human cells. We think of the little Greek City-States as the starting point of European political association, constituting rather an aggregate of separate cells, while the Roman City-State unites them and brings them (often by force) into one organism. Still we must not construe the State or other institutions as biological, as some philosophers are inclined to do. Both biology and political science are manifestations of

the Psyche, and are to get their ultimate order from Psychology, as the universal science.

It should be added here that there are scientists who find in the human body numerous rudimentary organs which await their full development. From this point of view man's organism has not yet completely evolved itself, or realized its possibilities. This is the opinion of the eminent anatomist Gegenbaur. The so-called transcended parts, once useful but now useless and even dangerous (like the *os coccygis*) are far outstripped by the unevolved parts, which are yet to constitute the perfect Human Form. This prophecy, however, seems not at present to be marching toward fulfilment.

But the Cellular Biocosmos falls into conflict with itself, the organism in its associated cell-life has its strife and war, and hence suffers (Pathology, literally the science of suffering). Cells indeed become pathogenic, to use the scientific term. Whereof a little may now be said.

II. PATHOLOGY.

The cell has its negative side, its separative destructive phase, the conception of which has in recent times given an entirely new turn to the science of medicine, or better, the

science of disease (sometimes called Nosology as well as Pathology). The cell becomes infected in hundreds of ways; indeed the primary basic infection of the organism must lie in it as the ultimate organic unit. The bite of a certain kind of mosquito introduces into the cellular tissue of the body a hostile cell or microbe which produces the scourge known as yellow fever. The ordinary organic cells are totally unable to resist the incursions of this terrible foe, who rapidly sweeps to the center of life. Unless he be met by a new power introduced from the outside, he will soon have possession. But first he must be distinctly separated and recognized before he can be successfully attacked; or the bacillus must be found, as the books say. In like manner there is a cholera bacillus, a consumption bacillus, etc. It has always been regarded as a great scientific event when the investigator has fully isolated and described one of these microscopic enemies of life. Still greater has been the jubilation when the scientist has found some counter agent (serum, anti-toxin, anti-septic, etc.), which will single out the intruder and slay him without permanent injury to the other cells of the organism. The most famous name in this field is doubtless that of Louis Pasteur, who has found the antidote for the bite of the mad

dog, of which the bacillus, it is declared, has never been isolated. Still this terrible unseen antagonist is met and conquered. On the other hand, the consumption bacillus has been isolated and is well known; still the special antidote, the personal foe we may call him, seems not yet to have come to the front. Thus a large part of human suffering is due to what may be called a cell-war, which has its analogy to man-war, though the latter involves the entire organism, indeed whole peoples. The cell gets to fighting with the cell, as nation with nation, or race with race. The science of ailment (Pathology) has largely reached down to the cell as the primordial seat of bodily malady, which may affect the whole sweep of cellular life—pre-cellular, unicellular and multi-cellular as associated. That is, the single cell may become diseased, then the association of cells may be broken up by numerous causes; doubtless, too, the elemental cell-stuff (Protobioticon) can get disordered, though this realm reaches as yet beyond the microscope. Possibly the source of rabies, which has never been seen, though the malady yields to treatment, lies back in the source of cell-life itself, in the very fountain of cellular individuation. Here rises to view a great future field for the investigator who may yet through his science discover the

unseen in the Little World and deal with it, as Leverrier through his mathematics discovered the unseen planet in the Large World and designated its locality.

Accordingly Biology in its true conception as the Science of Life must include its own negative, or Life destroying Life. The bacillus is a living thing, yet its function is to assail a living thing. Indeed one of the most striking manifestations of Life as whole is its bent toward annihilating Life, that is, itself. Micro-organisms prey on micro-organisms, as well as on macro-organisms, as the latter prey on one another. Man's food is the living thing, vegetal or animal; he lives by swallowing Life daily. He cannot take the Inorganic for his diet; the plant alone can do that. The invisible cell-war thus rises to an ever-present visible life-war, to which there is no truce. Life in its totality has this deeply negative strand; yea it is self-negative, perpetually it undoes itself. Yet the other side must be noted: through this self-undoing, it is always being re-born. Strangely Life lives off itself in a large measure; Life as whole, the Earth-Life, endures through death. Fiercely destructive, yea self-destructive, it destroys its own destruction. This is the point where we may see the dialectic of Life; inherently negative it is indeed;

yet in spite of this, or rather through this, it negates its own negativity—and so lives on. In the Cellular Biocosmos we are accordingly to behold not only the positive cell in its origin, structure and association (Cytology), but also the negative cell which separates from the immediate positive cell-life, and assails the same both as individual and as associated. This is hence the second or separative stage of the Cellular Biocosmos, which in its separated forms is to suffer its own negation through disaster, disease and death (the sphere of Pathology). A world individuated is necessarily a world of suffering—of assault from without and of ailment from within. Yet just this suffering we are to see as part of organized Life in its totality.

We may well ask: What is it propelling Life in this process? Evidently the Psyche again, which is just this driving force in Life, and which is seeking to evolve the same into correspondence with itself. For it is the Psyche which has purely and internally the power of self-division and self-return, and which is unfolding the Physis toward the same end. Now in the living cell this self-division takes place likewise, but externally, and so produces another living cell outside of itself, which continues the same act of self-

division or of individuation. That is, there is no inner self-return out of this separation of Life; the individual cell halves itself, and the second half (as it may be called) becomes a new individual external to the first, not returning to it and forming one inner process in one individuality. That would indeed be not Life, but Ego or Self-consciousness toward which Life is moving, and which is its secret motive energy. Just now it manifests itself in the self-division of the living cell, but the divided part is not taken back into its source but remains another individual cell, which in its turn reproduces itself in like manner. The first cell, however, having given away its half-life, never fully recovers its primal energy, though it may still throw off other individuals. Gradually it loses its reproductive power, and then its vital activity; the individual cell dies, having exhausted its original store of energy. Death is the manifestation of Life's negative; the mortality of the cell indicates that it cannot restore itself after its own self-division, but is giving up Life through reproducing Life in its cellular progeny. Thus cell-life has its analogy to the so-called infinite division of matter, which is also a search for completing the process of Nature's separation by getting back to the source, though matter as such is

lifeless, non-cellular. The unit of the Biocosmos is not, therefore, an atom or molecule, but a cell with its minute vital process. This cell, however, as distinct from the atom has reached the point at which it can divide itself, and so self-genesis enters with Life. Still let us remember, that the cell persists not, but dies at last through its own inner division which it cannot control but which ultimately controls it as a thing of Nature. The inherent dialectic of its separation is that it must finally separate from itself, and perish.

Now this negative of Life, or Death, belongs to the great totality, is a phase or stage thereof. The living individual through his self-negative act perpetuates himself in another individual. Life continues through its own cessation. So the law runs that still in Nature, Death is properly the death of Death, the negation of the negative, the separation from separation. The highest attainment of Nature is Life, the Death of Life must be accordingly the conclusion of Nature, which as a whole is the stage of separation in the Universe.

If, therefore, we wish to reach back to the primal force which drives the cell to its reproductive division (which is such a marvel to the biologist), we cannot stop till we come to the conception of the universe as psychical

(the Pampsychois) which has the original self-division whose manifestation is Nature. So it comes that all Nature is divisive, and self-divisive, quite to infinity, but she has no complete self-return, though this is what she is seeking, yea what she is manifesting externally. But when Nature overcomes her self-division completely, that is just her end, she has ceased to be, having transcended her original and pervasive endowment. The death of the living individual is, universally considered, the death of all individuation and separation as such, the mortality of all mortality, or the mortal served up to itself dialectically. Here we may glimpse, as the positive result of the foregoing process, immortality, which belongs not to Nature properly, being just her negation.

Pathology, the science of disease, may in its widest sense be regarded as the science of the negative Biocosmos, which has indeed various stages. It has to be introduced with the cell which in many ways may become the source of disease, this being in itself a new separation from the normal process of the organism (indicated in the particle *dis*). Indeed all Nature as separative is subject to disease inherently, which is only a wrong sort of separation—a kind of dialectic in which separation turns against itself. The tumor is

a mass of cells which, still in the body, have declared their independence of the body. This excrescence, as it is called, may be quite indifferent to the rest of the organism, and so not very harmful; but in the cancer we see an actively destructive cellular mass, which produces a virulent cell-war. Each battling side is an organism of cells like two armies, which grapple as organized. Yet each cell has its principle, or is infected, we say; this is usually the source of the whole trouble.

At this point rises the very important question of the place and influence of the Psyche in Pathology. For disease can be dominantly psychical as well as physical; indeed it is more or less of both. As the living cell and every organism are composed of the two elements—Physis and Psyche—so the negative principle starting in the one involves the other. This fact may well be deemed the basic one of all pathological treatment which just now is in the bitterest sort of strife between its two elemental factors, the psychical and the physical. The science of disease should include both. Pathology must at the start seek to give some classification of the great chaotic throng of human ills. We shall run our very brief survey so as to include the negative phases of both Physis and Psyche.

I. *Physical*: there can be an external destruction of the cell, organ and organism. The ill starts from without; the environment crushes in, such as heat, cold, accident. But the physical must pass into the following:

II. *Physio-psychical*: here the two elements of the cell have become mutually repellent, and no longer co-operative. Very often a foreign cell enters, a bacillus, and produces the dissociation or disease. Indeed this is the chief field of disease which fluctuates variously between the two sides, and can become wholly psychical. The ill of a part attacks the Psyche who is president of the whole organism, which is, therefore, sick, inharmonious with itself. Half the diseases are imaginary, but not the less real for that.

III. *Psychical*: the supreme psychical ill taken by itself is insanity, which has many forms and gradations.

It need hardly be repeated that all these classes play into one another; Physis and Psyche of the living organism are in direct unity, and the affection of the one cannot help influencing the other. Still the preceding divisions hold good, indicating the chief locality or stress of the ailment. Though only a limb be injured, the man is sick all over; his entire body is disordered through the little fragment of it. The stone can hardly be

called sick, though it be broken to pieces; each piece remains what the whole is. But a severed limb is different, it lives only through the entire organism, in whose process it shares. It is the prerogative of the living thing to be able to get sick; man, as the highest of life, can become sicker than any other animal, and disease can hit him in more spots. Still he is gifted with greater power of meeting malady through his intelligence. In fact, man has drilled a valiant army of disease-fighters, verily a vast standing army with many branches of service.

Sickness, accordingly, arises when a part or a member of the living organism does not perform its function in the whole through some collapse or injury, or when it sets up its own active process against that of the total body, which then suffers, becomes pathological or the subject of Pathology. This we may divide into three main branches which have been above indicated in general: Physiopathy (affection of the Physis); Psycho-physiopathy (the vast but indefinite middle division, which just at present is having the chief stress); Psychopathy (affection of the Psyche, the realm specially of mental disorder).

But now follows the problem of overcoming this sphere of separation, of negating this

negation of Life, whose ultimate unit, the integral cell, again becomes the center. If there are pathogenic cells (disease-creating), so there are also hygiogenic cells (health-creating); through the latter the Cellular Biocosmos in a special science (which we here call Hygiology) returns out of its stage of inner conflict and disease.

III. HYGIOLGY.

A science of Health must be the counterpart to a science of Disease, though closely connected in the field of medicine. How can the negative element of the living cell and organism be met and mastered is the question of Hygienics or Hygiology.

This is a part of Biology as the science of Life. The seat of all vitality being primarily in the cell, this must be restored if affected. Hygiology (Hygienics) seek to restore the cell, individual and associated, to its original activity, which has been interrupted. So we may deem it a return to Cytology in its scientific scope and the third stage of the Cellular Biocosmos.

Here we observe again an undoing of the separative principle, an attack on the cell foe with release of the cell, which, however, must still have the vital power to resume its normal process. The cell foe may be slain

by the antidote, but if the cell too be slain or mortally wounded, there is no restoration. Or the poison (toxin) of the cell-foe may be rendered innocuous by a neutralizing agent known as anti-toxin. Here lies at present the great field of the physician who by education and habit is inclined to put his chief stress upon *Physis*.

But the striking fact at the present time in the development of the Healing Art is that the *psychician* (so we call him for the contrast) has arisen who puts his chief stress upon *Psyche*, and proposes to cure human ills in that way. The result is a feud which does not lack signs of bitterness. But the surprising thing is the strong popular support which is given to the *psychician* who practices *psychical therapy*, which, by the way, has many forms and names. On the whole he is regarded as irregular by the physician who deems himself regular, and usually denounces his *psychical rival* as a quack and seeks to outlaw him. And the truth will have to be confessed about both sides: too often is the *psychician* an ignorant charlatan, and on the other hand the physician a shallow if learned empiric. At the same time it is not hard to find men of high character in both parties. But this cannot obscure the important fact that the Healing Art (which

ought to make us whole) is today rent in the middle from top to bottom along the line of the elemental constituents of Nature herself, namely Physis and Psyche, which ought to be joined in co-operation for health. Such, we have to think, is the deep dualism in the curative science of the present time, which certainly ought to set about curing itself first of all. For it surely has a lesion (or separation) within itself greater than that of any individual sufferer. So the cry goes up: Where is the Newton of medicine who will unify its two warring sides and make a new synthesis of the science of Health? For it is sicker than any of its human patients, and needs the doctor of doctors, the universal doctor who is able to prescribe the right medicine to medicine itself.

Another peculiar fact about the present dualism in therapeutics is that it reaches over into theology. The act of healing is made a religious act, and its devotees have organized even new churches. This has roused the old church with its priesthood to combat, and it is noticeable that those two ancient enemies, the soul-curer and the body-curer are joining in a common crusade against this new foe. (Quite a little literature already in this line.) To take an example, Mrs. Eddy, whatever else she may

be, is a furiously destructive criticism of the two doctors, the one of medicine, the other of divinity, from the side of the Psyche. Destructive, we say, in the most effective and sensitive manner, for she has taken away many followers of both, and hence is destroying their vocation, and with it their livelihood. That is certainly the most penetrating sort of criticism, not of words alone but likewise of deeds. So the two sides stand in continual battle-line awaiting perchance the coming peace-maker and healer, who will unite both in a new wholeness of health. Certain dawn-signs of him may already be discerned by the eye of hope.

But here we must quit this field of Hygiology and with it the entire realm of the Cellular Diacosmos which has gone its round, as we conceive it, and which leaves us with a return to the cellular structure as organized. The separative hostile cell-life is conceived to be overcome, and its association is now to be regarded as it proceeds to evolve its distinct typical forms of Life—forms of associated cell-life which also have their own divisions and their process. So we are brought to consider the second chief stage of the Biocosmos, which is designated, on account of its thorough-going separative character, as the Par-

ticularized Biocosmos, the association of cells into their particular forms.

Retrospect. Before passing on, we may take a glance back at the Cellular Biocosmos, and trace some of its relations to the Diacosmos, especially in the matter of Chemism, which is the final diacosimeal stage (see *Cosmos and Diacosmos*, p. 543), and is just antecedent to Life, or the Biocosmos. The result is that not a few scientists have resolved the vital process into a chemical one, which it is, but also something distinctively more. Chemism does not control Life, on the contrary Life controls Chemism to its end. This point we may reflect upon a little.

The chemical process presupposes a chemical product which it decomposes into its constituents; thus it tears to pieces its own previous work. On the other hand it recomposes these constituents, making them perchance into new compounds, which again it assails and separates. Chemism is, therefore, always attacking Chemism in its own product, which it will undo, and so undo itself. Yet, it will put together in another way what it has divided. So Chemism has a negative and a positive action, which fall apart while each is ever counteracting the other; each seems to be pursuing the other without overtaking it. The compound is decomposed into its

component parts, which are recomposed afresh, to be decomposed still again. Thus the chemical pursuit is kept up through all matter—neither side ever quite reaching the other. Decomposition negates composition, and is in turn negated by recomposition, one after the other in endless sequence racing through all earth's substances and doubtless through the entire Cosmos.

Now the point which we wish to emphasize is that these two mutually fleeing and mutually pursuing sides of Chemism overtake each other and unite in the process of Life or of the living thing. The organism is perpetually decomposing and recomposing in the same product. Your body as a given compound never ceases while Life lasts, to decompose its food, and to recompose the same into its tissues and organs, which are the means as well as the result of the total chemical process. The stomach decomposes what in the end keeps recomposing it, and gives to it the power of decomposition. From the chemical point of view cause and effect, means and end, come to unity in the living object, which separates what it puts together for the purpose of such separation. Under this aspect we may call Life organized an end unto itself within itself, or briefly self-end.

Indeed the animal body is full of chemical processes but always under command. The air we breathe oxydizes the venous blood, which is thereby chemically changed, so that we may breathe. That is, our breathing apparatus through Chemism creates and keeps re-creating itself. What our muscular system does is just what enables it to do; the power which goes out brings itself back. The organism is indeed the product of Chemism, but just this product produces in turn Chemism, which by itself has no such return. Otherwise stated, the producing and the produced in Chemism are separated and end in separation, while in Life they are in one and form one process. Decomposition and recomposition are cut in two by the chemical process, and are held asunder, while in the vital process, the produced is the producing, the decomposed is recomposed into what decomposes.

Still we are not to forget that Chemism is the potentiality of Life, the latter's two sides shown as separate just before they are united or rather just for the purpose of being united in their higher synthesis. The chemical process seems ever ready to pitch over into Life, but does not, cannot, without ceasing to be itself. Still we may mark its striving in that direction, it longs to over-

come its dualism in the unity of Life. Chemism, as already remarked, is ever negative to itself, it never fails to assail what it has produced as if deeply dissatisfied with itself. Still it cannot overcome and control its own negation, and so it calls for Life to complete its insufficiency. For it is Life which in the living body perpetually remakes the product which it is unmaking. Thus we may conceive Life as a chemical process self-reproducing in its production and hence perennial.

Next we may ask where this movement out of Chemism into Life takes place. Its arena must be the cell in some form, as the ultimate vital unit. This brings us back to that world not yet unveiled, which we have already named the Pre-cellular Biocosmos. The great transition from Unlife to Life moves into the evolving the cell perchance from the atom of Chemism. Of course such a view is as yet hypothetical; it is not based on any known chemical reaction or on what may be seen under the microscope. Still we may well conceive the cell becoming gradually the mistress of the atom, and directing it to her end which is that of Life. The theory of Chemism declares that the cell is composed of chemical atoms, which must have been marshaled by that living cellular energy already designated as Psyche, who appears at just such con-

junctions, with her process self-dividing (as in Chemism) and self-returning (as in Life.)

Chemism must be regarded as the last and highest point of Unlife before passing into Life, the culmination of the Inorganic on its way to the Organic, verily the final phase of the Diacosmos, the deepest separative stage of Nature herself ere she develops into her self-returning vital act. Life is a rounded and complete chemical process, which is always disintegrating its product (as blood, muscle, organ), yet at the same time is always re-integrating what it disintegrates, ever building anew the body which it is tearing down. Thus Life is the secret agent which turns Chemism against Chemism and makes the same undo its undoing, or negate its negative—which process thus becomes the positive and vital. It is no wonder that the negative Eighteenth Century developed Chemistry, first really elevating it into a science, which was also the favorite intellectual pursuit of so many French revolutionists—the Spirit of Man in one of its epochal phases being sympathetic with the like Spirit of Nature. Here again we should note the characteristic fact that Life is a chemical return to its start, that Chemism therein is cycled around upon itself, which act it cannot perform alone; Chemism cannot round

out its own process, but remains deeply dual and separative. On the other hand Life, even in its chemical aspect is an ever self-returning process, overcoming not only the dualism of Chemism, but of the whole Diacosmos, as we have already seen.

Still, lest Life may become too proud over its superiority, we have to emphasize again its smallness, its relatively tiny volume. But Chemism reaches out to the extent of the cosmical universe, it is taking place in the sun and stars, which are burning to the point of luminosity—combustion being a chemical process. And in the interstellar spaces nobody can tell how much chemistry is going on, keeping invisible and perchance awaiting other ways of detection besides that of light. The spectroscope is essentially a chemical instrument, and has revealed to us the stellar fires as the blazes of innumerable cosmical smithies which are forging the chemical elements, hydrogen and the rest. Thus Chemism has its laboratories strewn throughout the physical universe.

And yet we have to think that the chemical act has its purposive end in the vital process, small as this is. The unbounded Cosmos is to be strained through a point, is to be individuated that it reach its destiny and get alive, that it become quick and stay no longer

wholly dead. So Chemism we see undoing itself into and through Life, its immediate goal. Still we have to ask ourselves: Is this colossal factory of the total Cosmos built up just to produce a little speck of Life on our Earth-ball? Probably the same product exists elsewhere, though we have not yet found it. Still further, science declares that the small speck of Life, is destined to be snuffed out, be it the cell or your body, or the Earth's total organism. If that be so, Life will relapse into Chemism, which will again be the highest stage of Nature's Evolution; and the supreme transformation of the Cosmos of Matter and Motion through the Diacosmos of Heat, Light and Chemism into the Biocosmos of living shapes will have come to an end. Such has been the recent scientific view held up before us on many sides, and has to be considered not only in its own right, but as an image of the spirit of science, and also as a deep-seated strain of the present age. Still we have here to add a more recent fact: the discovery of radium, which seems (though its character is by no means fully unfolded as yet) a kind of universal chemical element, which is self-radiative or self-separative, but has the power of recovering the energy which it has given out. Thus it has a speck of the total chemical process within

itself and suggests life—a piece of matter decomposing and recomposing itself. But there is an interval of time between these two acts, and so radium, taken piecemeal, drops back to, or rather stays in Chemism. But if the sun be largely composed of radium, the self-emanating and the self-restoring element, our central luminary would appear to be in no danger of extinction or even of diminution, for while some parts are indeed spending, others are recovering, so that the loss may be always balanced by the gain. Thus within the past few years radium has given new hope to the universe, and specially to our own solar system, and much more specially to our little Biocosmos which is now exulting in the prospect of an eternal lease of Life, in contrast with its former brief lot of a hundred millions of years (according to the Last Judgment of famous geologists). Still our Earth-life may cease, while the Biocosmos perchance lives on, not being dependent upon a single planet. But such knowledge belongs to the future.

And so, at this point, with some feeling of relief we may return to our little Biocosmos, whose second stage is before us and can fully employ us with its vast variety of organs and organized shapes, which we seek to put into some kind of order within itself, as well as in relation to the rest of the universe.

Part Second.

THE PARTICULARIZED BIOCOSMOS.

We are next to see how the Biocosmos, the Order of Life, is particularized, differentiated, specialized. What divisions or stages does it now manifest? These, we may here set down in advance, are regarded as three—Plant-life, Animal-life, and Earth-life. All are distinct and are to be separately treated; yet they are likewise joined together in a certain sequence and form a process.

The preceding part, which considered the Cellular Biocosmos, must be regarded as the immediate or elemental stage of this Order of Life—the primal, constitutive portion—made up as it is of the cell, which the three kinds of Life pre-suppose. Associated cells

with their varied interdependence and adjustment form the living plant and animal as we see them, and the earth, too, in so far as this is alive. Thus we think the Biocosmos differentiating itself along three main lines; or better, unfolding itself into three fundamental Life-forms, which, however, round themselves out into one movement whose theme is what we here call the Particularized Biocosmos.

Nor should we fail to note that this is the second stage of the Biocosmical domain—that of separation, particularity, division. It is true that the cell may be a separated, yea, an isolated object, as seen under the all-dividing, separative microscope. It is as it were the immediate living atom, which has an ultimate sameness, but which is to combine or associate with itself in producing the varied Life-forms. We behold again the march from an essential identity to a wide diversity which is the unfolding of the vital Order. To be sure we have seen that this atomic cell is remorselessly hunted down by the biologist of the present time with his sharp-sighted weapon, so that the cell shrinks to the cellule, to the granule, perchance to the gemmule, which may for the nonce be taken as the universal cell, cell of all cells, prototype and an architect of the rest. Thus the cell seems to be

moving regressively as well as progressively; it is itself claimed to be an association of lesser cells, and thus is but working out its own character in producing the larger Life-forms of Nature.

Here again turns up the question which is so often emphasized in this book: What is it that produces all this division and combination? Who is the subtle Panurge that cannot be exorcised from the minutest form of the cell as well as its largest association? The reader will probably anticipate our answer: Psyche is again present and incarnating herself in all these living shapes from least to largest, and urging them forward to their goal. Just now, however, it is sufficient to say upon this point that the Particularized Biocosmos, our present theme, is the second division or stage, and is such by virtue of its psychical character in the process of the total Biocosmos, which in its turn is the third stage of Nature as a whole. Nor will the true-hearted student stop in his thought till he has carried this Biocosmical process up to its ultimate source in the Universe itself and has identified it as pampsychical.

More pressing than ever is the need of some formulation or definition of Life, though hitherto this has not been absent. At present let us pick it up as a piece of matter having the

gift of moving itself and of sustaining itself from the outside along with an internal assimilation, and of reproducing itself as individual. In all three of these basic acts there is some form of self-return, which may be regarded as the characteristic of Life.

Take yourself as a living thing. A shred of the Cosmos you were in the ancient of days, a streak of nebula such as we still may observe in Orion for instance. Now that cosmical wisp of tenuous fire-mist began to evolve many hundreds of millions of years ago until it attained Life with the power of self-movement and form having self-sustentation and self generation. Thus you became a member of the Biocosmos, doubtless after having had a long cosmical experience (through gravitation for instance) and also a long diacosmical experience (through heat, light, electricity and chemism, for instance). But that was not the end of your evolution: through many a gradation of Life, probably from the cell through uncounted vital shapes, you ascend till you break over the limit of Life into Self-consciousness, truly your goal. Now you can turn back and view Life evolving through its long sequences—which act Life itself could not perform. What is it that can in thought re-evolve itself evolving through multi-myriaded millenniums? That

is you now in the present act—your present Ego as evolved. But of this, hereafter.

It would seem that the sphere of self-movement is extending more and more into the inorganic realm. The self-forming power of the crystal has long been remarked, and speculated about, some observers even going to the extent of attributing to it a sort of life. In the crystal Nature manifests herself as geometrizing purely, and shapes herself regularly in line, surface and solid. Given the material and the conditions, it forms itself after a certain type which is externally repeated in layers, a kind of outer generation; just so much matter shoots into shape, like ice and snow, from water; it assumes fixed limits, it individualizes itself into an outer form. Now, every living thing also has this formative power, it bounds itself in an external shape which characterizes it normally, be it plant or animal. Undoubtedly these shapes become very diversified in life; they are the outward signs of what is going on inward; they show an ascending line from the simplest to the most complex or highest organisms. The crystal is the first external manifestation of this form-making energy of Nature, the inorganic formation which is to become organic, or the shaping power of Life taken by itself before Life. For every living

thing has a material form, an inorganic substrate which it organizes. We can say that in a degree it is crystallized into its typical form, which however is not pure material form like a crystal, but has Life; this moves its form with a certain mastery, it sustains and rebuilds the same, finally it generates the same as another individual. The crystal is accordingly endowed with a certain formative spontaneity (a kind of will in Nature again) over lifeless matter, itself remaining lifeless, though formed. But this formative power of the crystal goes over into Life, which, however, employs the same to its own end, so that vital forms are not those of the crystal. Here, too, we ask what is and whence comes such form-giving energy which can make matter move into a shape, but not yet into a living shape. The crystal, accordingly, we may conceive as pointing the way to Life, though not yet alive, a stage of Unlife which strives to be alive.

The living Form cannot stay merely Form, but must assimilate sustenance from its environment, and keep on assimilating. A continual re-making of itself from the external world is the prime function of this Form, which never stops being formed unless it somehow gets crystallized, like a piece of fossil wood. This is the ceaseless round of As-

similation, the Form's real identification of the world with itself, which only death interrupts in the living thing. The process of Assimilation is, therefore, the perennial battle between Life and Unlife, through which battle every living individual passes with victory and defeat.

Still this living individual reproduces itself not only in its own body, but in another body; it begets its like as we say. This is the generative Process of Life, its highest manifestation, the supreme act of Nature. We see that the living organism has to reproduce not merely its own tissues, but must rise to reproducing a different organism; Life the very lowest has thus a side of altruism, which starts far down in Nature. The microbe's trend, in its simple fission, is to live not merely in itself, but in and for another. Moreover, the generative Process returns to the starting-point and recreates the Form which thus begins anew the round of Life.

Manifestly in all the kinds of Life—vegetal, animal, terrestrial—there is the threefold movement above indicated, whose stages are Formation, Assimilation, Generation. Here again we may discern that inner all-ordering process so often noted as psychical, which never fails at the nodal point to direct Nature. Moreover, we shall find that each of

these stages, formative, assimilative, and generative, has its own process also—the part re-enacting the whole in order to be a part. Now the definition of Life is best conceived in these three terms, with their process. The individual Form which assimilates the external world to itself (so far as needful) and ejects itself into the world as a new individual Form, is alive, and nothing else is. Such a living Form is doubly creative, reproducing itself within itself and reproducing itself in another. It is said by many, perhaps by most biologists, that Life cannot be defined, that what they are trying to formulate admits of no formulation. Such is their inner contradiction in this matter; still they seem to push ahead all the same, seeking to define what admits of no definition. For just this definition, broadly taken, is their science, which must be, therefore, the knowing of what never can be known. But it is well that the scientist on the whole is not logical, if he were, we would lose all the valuable knowledge which he strews along his way in pursuit of the Unknowable, desperately investigating the Uninvestigable. Let the reader duly appreciate the scientific consciousness, which has so deeply inwrought itself into the spirit of our own age. Nor should he fail to note that the naturalist generally becomes as

dualistic as Nature herself in whose workshop he is employed; he cannot help partaking of the character of the element in which he works; he has to become what he does.

But returning from our little excursion, we have still to mark out in advance the kinds of Life—Plant, Animal, Earth—and foreshadow their process. For they—Life-forms we may briefly call them—belong together and constitute one great movement of the Biocosmos, the second sweep of it, here designated as particularized. Only the more obvious distinctions can be summarized for an outlook over the whole field; details will be added later.

(I). PLANT-LIFE. This is in the most immediate relation to the total Life of the Earth, unseparated from the terrestrial mother is the Plant, a suckling continuous and unable to walk. Not self-centered, each organ largely autonomous, yet with a common center which lies outside of them; hence, too, no sensation or very little, and no self-movement or very little.

(II). ANIMAL-LIFE. This is organically self-centered, the organs are subordinated to a center which is within them, and which is itself an organ (the brain). Hence, self-movement or locomotion, in which the organism breaks for a while its connection with

Earth-life; hence, too, sensation, which marks the unity of the organism. Food is not immediate and elemental like the Plant's, but mediated, being vegetal or animal, or both.

(III.) EARTH-LIFE. This embraces the total round of the individual Life of Plant and Animal, each and all, from its earliest stage (Protobioticon) through its entire individuation till its return to its original source in death. It is this Earth-life which sustains the Plant immediately and the Animal mediately; both come from it in different ways, move through it on different lines, and are taken back to it for a new individuation. Such is the comprehensive cycle of Earth-life, which on the one hand individuates itself into Plant-life and Animal-life, but on the other hand is an individual also, with its own round of Life in birth, bloom and cessation.

In this short abstract peers forth the process of the three great Life-forms, we hope, or at least the suggestion that there is such a process. The Earth-individual is the living fountain of all individuated Life on the planet; every Form that is alive points back to this creative prototype of itself; the little microbe as well as the huge elephant is a part or member of the Earth-life, and as such has the essential process of the whole. That is, every living individual pre-supposes its

universal genetic principle, which is the fore-going total Earth-life.

It may be added that the present field, the Particularized Biocosmos, furnishes the supreme opportunity for the comparison of these Life-forms and their manifold evolutionary phenomena. There is a Plant-norm with a double line of shapes reaching from the lowest to the highest and from the remote geologic past to the present; all these vegetal shapes are to be compared and ordered internally and externally in what may be called a comparative Botany. In like manner, there is an Animal-norm, with its double line of shapes reaching from the lowest to the highest and from the far-off past to the present; here is the domain of a comparative Zoology. And the science of Earth-life, Geology, is also largely comparative, embracing the Inorganic as well as the Organic. Thus we discern in the present subject as a whole the Comparative Biocosmos which seeks to order and hence to unify all this diversity of particularized Life according to its essential relationships.

Science has by no means attained any such general principle of biological comparison, though searching for it ardently, as we see by the many shiftings of the standard of classification for both plants and animals in re-

cent years. But the ultimate principle of ordering the Biocosmos must, in our opinion be psychical; indeed the present species, genera, families, etc., are not realities, but ideas—symbols they are sometimes called. Thus Psyche is at work now in this realm of Biocosmical organization, but does not yet recognize herself, and fully behold her own process in the processes of Life.

I. PLANT-LIFE.

Of the three kinds of Life-forms which are represented on our globe, the Plant stands in the most immediate connection with the Earth. It is not yet separated in form from its terrestrial mother, not yet weaned we may say, but sucks sustenance directly from the maternal bosom. We may deem it, therefore, the infant in comparison with the Animal, which is bodily separated from the Earth, though it keeps returning to her at every step. Still it has on the whole the power of locomotion or change of place; it does not cling to one spot like the Plant, but has a limited range of spatial freedom. Thus we can say that the Animal is a more free being than the Plant, and consequently more near to the goal of the Universe, if this goal be freedom. Mother Earth, however, has her own spatial movements, axial and orbital, and carries along her two living families of children, the vegetal and animal, on her breast through her two revolutions. Such, however, may be taken as the first fact of Plant-life: it is not yet spatially free of its nurse, it is still a suckling at the source of its existence and remains so as long as it lives. We may note, however, that there are some seeming ex-

ceptions, such as the epiphyte with its roots dangling in the air. Certain animals, conversely, are fixed to one place and appear to vegetate (the sponges). Still the typical plant has this primal character of being directly rooted in the Earth, whose three main elements (land, water, air) are its immediate sustenance. Thus it is truly the elemental Life-form, feeding on the Inorganic directly, and transmuting the same into the Organic, even if some Plants (like the *Dionaea*) may be supposed to have a relish for animal food.

The Plant is a living organism, with a common center, yet this center is not specialized inside the organism, but lies more on the outside, in the Earth. The result is that the Plant is not self-anchored but fixed in the soil, and that each organ, even if working for a common end, may act quite independently, and one can often be made to take the place of another. Thus the vegetal organism is not a profoundly associated system of mutually interrelated organs, but rather a league (to employ an institutional parallel) of more or less independent members, each of which may perform under certain conditions the total process. So the leaf or bud or shoot may show itself by growth the entire Plant. We cannot wholly deny to the organs of the Plant a certain interdependence, yet it

is relatively external; while that of the Animal's organs is internal in comparison; mutual co-operation of parts is not written so indelibly on the limbs of the tree as on the limbs of the horse. The life of the Plant remains, therefore, a kind of child-life with its rooted attachment to its mother; it never outgrows infancy, for the tall Sequoia of many hundreds of years ever remains a baby at the breast.

Still the Plant is alive, and has the universal process of all Life, which process becomes an emphatic ground of the unity and the organization of the present stage of the Biocosmos (the Particularized). As already indicated, Plant-life will show the three phases of all vital activity: Formation, Assimilation, and Generation.

I. THE FORMATIVE PROCESS OF PLANT-LIFE.

The Plant has an external Form which characterizes it; everybody soon learns to distinguish it from all other objects, even if in micro-organisms it is often difficult for the trained observer to tell a Plant from an Animal. Granted that there is a field in which the two are hardly yet differentiated, the developed or normal Plant-form is not ambiguous, though exceedingly varied. The originative type has many manifestations, all of which are different. No two Plant-forms of

the same species are just alike, each has its own individuality. Also each asserts itself against the other, hence arises that struggle of the individual, Plant or Animal, to exist and to propagate itself—the struggle for existence throughout living Nature, which has been made so famous by Darwin. Every individual Plant, therefore, differs from the rest, varying in form; and this variation may be its fate or its fortune, the pivot on which turns its sweep to death, or to the continuance of life as individual or as species. So the Plant-form has specially in recent times become very important not only in Botany but in Natural Science, its problem being: Can it preserve and propagate itself not only as type but as peculiar individual?

In this connection comes up the remarkable experience of DeVries with his Evening Primrose which he happened to find in a potato field, seemingly a runaway from cultivation. In its freedom it was playing all sorts of antics with its transmitted Form, of which nearly every organ was varying from what it ought to be by tradition; in fact, new organs seemed to be breaking out, especially in the shape of fasciae and pitchers, though these might be called malformations. This variability sported even with the length of life; ordinarily the plant was a biennial, but

could be an annual, or even a triennial. Then each variation would breed its own, and propagate itself, quitting apparently its former changeful character for a settled heredity. Thus DeVries obtained a number of new species, which would keep on reproducing their own kind. So this one Primrose seems to have the power of generating not only individuals but species, and of passing from the regular transmitted Homogenesis to a sudden explosive Heterogenesis, which ejects all at once new Plant-forms, which again become homogenetic. Such is the Mutation Theory (a poor designation of the fact) which to the slow orderly Evolution of Darwin has added the rapid catastrophic Revolution, as a stage of the innocent paradisaical Plant-world, so that this is getting to be as bad as man, quite as much of a fallen soul. In fact one may think of that Primrose of DeVries as expelled, or rather fleeing from the Garden of Eden fixed in a kind of sacred order, to the liberty of the potato patch, where it could rollick in the creation of new Forms, reproducing not only Primroses after the old pattern, but reproducing new patterns in a free diversity of creative energy. The little silent flower, symbol of innocence and submission, has, then, in its heart, too, the revolutionary impulse, the protest against its traditional

limitations, the barrier-bursting Titanic spirit which under a favoring environment will break forth in a kind of volcanic upheaval. So we have to note the Negative in the Psyche of the Plant, where we hardly expected to find it so strongly manifesting itself. Still therein it is a true child of Nature who springs of the deepest dualism of the Universe itself.

Viewed from another side, it may be seen that the Plant, even the humblest specimen, has in itself the sleeping potentiality of all vegetal species, genera, families—yea, of the entire vegetal kingdom. That little Primrose started to reproduce not merely some new specific Forms of itself, but an entirely new Plant-world, which must have lain ideally in it, and have impelled it toward realization. Yet, Time was needed, many geologic ages in fact. But the Dutch botanist (DeVries) came along just in its earliest stage, when it had only taken its first step by reproducing some fresh species. These he picked up, seeing his opportunity, and turned back into the regular reproduction of like individuals by cultivation. Thus the floral revolution was literally nipped in the bud, and the rebel brought back into the pre-established order of garden life.

So much lies implicitly in the Formative

Process of the Plant, which is always taking place in a constituted Form, usually named its organism. This is what we shall now study more specially.

1. *The Plant Organism as a whole.* Before we begin viewing its separate parts, it is well to look at the Plant as a whole. In its highest forms it has the tendency to stand erect, perpendicular to the Earth in its stem, as if showing a certain degree of independence and self-assertion. On the other hand many plants crawl, and others droop, unable to support themselves fully in separation from their source. Thus there is a long line of Plants from lowest to highest in a gradation of excellence, it would seem. Hence, at this point rises the query: What is the criterion of such excellence? How shall we order and grade the Plant Organism before us, belonging as it seems, somewhere in the vegetal hierarchy?

Of the animal kingdom, the king is manifest and generally acknowledged: Man's organism is the highest; it has evolved to the supremacy, even if it be no longer evolving, as some say. Supposing that the Plant and Animal start together far back somewhere in the Protobioticon, they begin soon to bifurcate and each starts developing on its own line of ascent. The Animal in many ways

outstrips the Plant, chiefly because it has shown the power of evolving a distinctly regnant form, the human. The vegetable line also shows in general an upward evolution; the so-called Cryptogam (a designation often discarded today but still useful) is manifestly a lower organism than the Phanerogam or the flowering plant. But what genus among Phanerogams corresponds in the Plant world to the genus *homo* in the Animal world? If we take size as criterion, shall it be the baobab of Madagascar, the banyan of India, or the sequoia of California? Hardly; by the sametest the elephant might be throned as the supreme animal instead of man. The total tree of Plant-life seems not to top out in what is most excellent of its own, as does the corresponding tree of Animal life. The line of evolution through Nature into Self-consciousness toward the All-Self, does not pass by way of the Plant, which seems, after reaching a certain stage, to break off and scatter.

The fact corresponds to the character of the Plant which lacks concentration. Each vegetal part or region is endowed with a kind of autonomy, which will not permit a completely centralized authority like that of the higher animal. The Plant Organism has no true head, as there is in it no true headship. In like manner it has no central stomach, as each

portion of the body does its own digesting. Everywhere the Plant excretes, which is known as its transpiration. A developed single organ of heart or of lungs it has not, yet it has circulation at every point and respiration also, though the latter be specialized in the leaves. It is evident that Plant-Organism as a whole has not yet subordinated its Parts, each of which insists in a manner upon being the Whole, and performing the functions of the same. Though an organism it has not yet differentiated itself into co-operant organs, with their division of labor, and their subsumption under a common control. Comparatively speaking, the Plant is multicentral while the animal as typical is unicentral. Of course the lower animals in this characteristic approach the Plant. Doubtless the best criterion of the grade of the vegetal Organism would be this inner subordination of the parts to the whole.

Goethe's statement of the foregoing fact (in his *Morphology*) has by no means become antiquated in our present knowledge: "The less perfect the organism is, the more similar its parts are to one another, and the more they resemble the whole organism. The more perfect the organism, the more dissimilar its parts to one another and to the whole organism." Now it is the Plant whose organs,

in contrast to those of the Animal, are similar to one another and to the total body. Moreover the same principle is a criterion of grading both Plants and Animals. Goethe goes on: "The more similar the parts, the less are they subordinated to one another; the subordination of the parts points to a more perfect organism." As already indicated, the Plant lacks this subordination of the many organs to the one central organ.

2. *The Plant Organism in its dual symmetry.* The next fact to be regarded in the Plant Organism is what appears a double polarity—it has two poles, opposite yet symmetrical. Roots and rootlets grow downward, seeking the dark; branches and leaves grow upward seeking the light. The intermediate trunk embodies both tendencies: it, as if manifesting Nature's dualism, waxes both earthward and sunward, with a part unseen and a part seen. Striking is this polarity of the typical Plant; indeed it resembles an upright magnetic bar at whose ends above and below are raying out lines of iron filings. Evidently vital energy here divides and moves in two opposite directions, becoming positive and negative, we can say analogically. This may even be the work of electricity, which is now being studied a good deal in Plant-life by scientists. At any rate

we can affirm simply from the phenomenon that the roots are more gravitational and thus cosmical, while the branches are more de-gravitational and thus diacosmical. So we have the right to think of the Cosmos and Diacosmos, each with its own counter energy, as united and mediated in the life of the Plant-Organism, which as alive belongs to the Biocosmos.

This symmetrical dualism of Plant-life we may also notice in Animal-life and Earth-life though in wholly different forms. For instance the animal is divided lengthwise along the so-called median line into two halves which constitute what is known as its bi-lateral symmetry; each side of your body, right and left, is symmetrically twinned to form a rounded whole. The Plant-Organism has, however, its symmetry between its two ends, not between its two sides; is bi-terminal, not bi-lateral. Finally the Earth-Organism is likewise ideally divided along a median line which runs round the globe, and is known as the Equator. But in this case the separation is not terminal or lateral, but spherical; analogously we may call the earth's double symmetry bi-spherical (or bi-hemispherical). The main interest in the present case is to see the three ultimate Life-forms, Plant, Animal, and Earth, each dividing itself into symmetrical

halves, so as to become one in the process of its Organism.

This dual symmetry, present in every organism which Life brings forth, may well be regarded as the impress of Nature herself upon her living forms, showing her inherent dualism in all her creatures. She must be twofold, halved to be a whole, bi-formed to be one form. Life is indeed the unification of the twofoldness of Nature which still remains twofold in its outer manifestation, else it would no longer be Nature. Life, therefore, is always positing the two sides of Nature in the very oneness of its process. This vital oneness is to be identified as the Psyche now gotten inside the Physis, ever overcoming the dualism yet ever replacing it afresh. Such is the round everywhere manifested in the Biocosmos, the outer Form of which we may glimpse in this dual symmetry of the Organism.

3. *The Plant Organism differentiated.* Today there seems a tendency among botanists to separate the Plant Organism into two parts, root and shoot. Under the latter are included the stem and branches with the leaves. Verbally considered, the root is as much of a shoot as the twigs and foliage, though the one works in the soil and the other in the air. But the deeper objection to such

a division is that the stem or trunk is ignored in its double and mediating character between the two extremes, or ends, for it is both root and shoot, growing downward as well as upward, nightward as well as lightward, terminating in rootlet as well as in leaflet. Thus the Plant Organism, if it be divided according to its inner nature and process, must be taken as constituted of three basic members which unite into the one organic whole as vegetal—stem or trunk, root with fibrils, and top with branches or foliage.

The *stem* we put first, as it is the central shaft from which radiate the two ends into their symmetrical systems of ramification—the one in the earthy element, the other in the aerial. Moreover it has the tendency to be cylindrical, in itself and also in its off-shoots (excepting the leaf), which form indicates that the original spherical shape of Nature, which is so common in the bodies of the Cosmos, is elongated by pushing outwards in two opposite directions. Plant-life, germinating originally doubtless from primal earth-life (Protobioticon) expands the first seed-ball as a little round cell into the cylinder, which remains so characteristic of vegetation. Embryonically the stem is first already (the caulicle) to which the cotyledons (seed-leaves) are attached; thus it would

seem to be the primordial source of the other two parts (root and foliage), containing originally within itself their opposite tendencies already mentioned, the upward and the downward, or the diacosmical and the cosmical, which tendencies it keeps active as long as there is life. The stem is also the criterion of the second grand division of Plants, that of the phanerogams into endogens and exogens, though the two kinds of seed-leaf are taken as the basis for the same division (monocotyledonous and dicotyledonous).

The *root* with its system may be regarded as the second member of the Plant Organism, from which it at once springs in germination as the primal separation. Significant is the fact that certain lower Plants have forms which indicate that stem and root are not yet differentiated (in the *Dioscorea* for instance). The root can be seen to have several purposes, but the primary one is to fix the Plant to and in the Earth, whereby it is anchored to one spot, and then to start it to sucking the maternal breast for nourishment (imbibition). Still further, the root can be the storehouse of life for the Plant. It is in general cylindrical like the stem and upper branches, but longer and more irregular and sinuous, since it has to crawl and wind about in many directions to find its aliment, which is not

evenly distributed in the soil. So the leaf and branch can be more orderly and straight in the regular air and sunshine than the root, which has to increase its surface by a vast number of hair-fibres reaching out their little mouths for water and nutriment on all sides. Underground there can be no flattened leaf, which has simply to extend its hand and receive directly the downpour of rain and shine. Many kinds of roots have been described and figured in the books; but here we need only note the fact, so characteristic of the vegetal principle, that any part of the Plant seems capable of being metamorphosed, under right conditions, into the root. We have hitherto spoken of soil roots; but the other elements, air and water, produce roots in certain Plants (instances are the duckweed as water-plant and the orchid as air plant). The same Plant has been known to change its root from one element to another. Moreover the aerial branch of the banyan, the East-Indian fig tree, drops to the earth and takes root, changing to a new stem also. Thus we observe a part of the Plant becoming not only another part, but the total Plant, which even as normal is not possessed of a strong, self-asserting individuality compared to the Animal. The root, babe-like, has to take its food in solution from the soil, and this gives to the

Plant its earthy matter, its fixed element or skeleton, which enables it to stand erect. (Of course many Plants do not mount, but droop and creep). The root, accordingly, fastens the Plant to one place, and imparts firmness to its body; grasping with its thousand little fingers Mother Earth, it begins to suck.

Worth repeating is the fact, as characteristic of Plant-life, that the root can be metamorphosed into stem and branch, and made to put forth leaves. The reason is that there is no central subordination of parts or very little; each organ is similar to the rest and to the whole organism. Hence it comes that each organ can so easily take the place of another and of the total body. That is, the organs of the Plant have autonomy and equality, but small centrality. There is indeed association—that of cells into the organ, that of organs into the organism, that of organisms into plant societies—still this association is relatively weak and immature all the way through, in comparison with that of the animal.

The *leaf* with its spreading system of buds and branches, in other words the typical tree-top, we arrange as the third member of the Plant Organism as manifested in the outer Form. Here we see the strong contrast with the concentration of the stem which holds it

up and from which it rays out on every side, when it is free to unfold, into a rounded, somewhat hemispherical or conical shape. Moreover it is the symmetrical counterpart of the root-system, which also radiates in all directions from the stem as original center. But the root is all puckered mouth for suction, while the leaf is all extended hand for receiving what falls, though it too has pores for absorbing its gifts. The leaf has the tendency to take the horizontal position at right angles to the perpendicular stem, chiefly for the sake of catching the sun's rays on its broad upper surface. By this purpose also the direction of the branches is controlled: they quit the central stem and spread out to carry the leaf to sunshine. From this fact it is evident that the branch properly belongs to the leaf-system which separates it from its original home, and governs its course outward and upward. For it is the leaf which is to get not only light (as the books too narrowly put it) but also heat, yea electricity; we should add, too, chemism from the so-called actinic ray; thus all the diacosmical radiants, as well as chemical energy are taken up by the leaf in the sunbeam. Nor is this all: the two general fluids, water and air, belong in the workshop of the leaf. Thus it will be seen that the leaf grapples with the whole

range of the Diacosmos, fluid, radiant, and chemical, transforming it into the vital sphere or the Biocosmos. The Plant, then, largely through its leaf reveals itself as subordinating the whole separative domain of Nature, and making it over, into the rounded process of Life, the next higher stage. We hail the appearance of the doctrine of heliotropism in recent botany, but it must be vastly extended, and more deeply interpreted. The turn of the Plant to the sun (heliotropism) means far more than its turn to light, important as this is.

The leaf in itself forms a very interesting and significant study of great diversity, capable of being ordered into the image of the total Plant and of all Life, yea of the Universe itself in small. First the leaf differentiates itself into an upper sunward surface, and a lower shadeward surface, then it shows a vast multiplicity of shapes, outlines, sizes, qualities, so that each tree or brush may be said to have its own leaf, and this often varies a good deal on the same bush or even twig. The kinds of venation in the leaf (parallel-veined and netted-veined) seem to indicate a great node in the evolution of Plant-life, conjointly with the two sorts of cotyledons. In fact the leaf may be put into the line of vegetal evolution to repre-

sent the ascent of the Plant out of the first thallus in which it is not yet differentiated from stem and root. Sometimes it has the motile gift like the sensitive plant, whose caprices have hardly yet been fathomed. The leaf has also its varied inner structure, or cellular anatomy; suggestive too is its outer arrangement on the stem (phyllotaxy). But any ordering of these details of the leaf we shall have to omit.

So we conceive the vegetal organism differentiated into its three chief members—stem, root, foliage—which are to be grasped in their order and as a process. In the normal Plant-form this process is going-on all the time. The stem pushes to the earth first, returning to the mother after the first separation of life into the cell or into the thallus. This perpetual movement of the Plant downward or perchance backward to its origin is called its *geotropism*, or the turn to the Earth from which it has to recuperate by incessant draughts of its own elements. But now follows the deeper act. From the sun sprang Mother Earth, who thus on her part has her remoter origin—her solar father we may call him, to whom the Plant goes back for radiance which the Earth cannot furnish. This is what has been already alluded to as the Plant's *heliotropism*. So the stem turns

about and grows in the opposite direction toward its primal creative source, even if far more removed in space and time. There can be no doubt, however, that Sun's provident gifts—Heat, Light, and Electricity together—nursed the first Earth-life, hatched the cosmic egg into the earliest living thing on our planet. Now this process of origination from sunlight all Plants have to re-enact, even if some burrow in the soil. And the animal too goes back to the same source. So the petty bramble is not only born and suckled of the Earth-Mother (in the roots), but is kept alive and made to grow by its grandfather, Old Sol (in the foliage). Stem, root and leaf involve in their genesis the sun and the planet. Verily the totality of Nature is required to produce the smallest physical object, which in turn reveals its far-off origin through its process when this is rightly seen into.

In such a way we behold the Plant Organism rounding itself out through its three constitutive members into the movement of vegetal life. In fact we may observe this round of stem, root, and foliage returning into itself when the branch of the banyan tree drops down to the earth, becoming root and stem as well as branch. So the top genetically bends around into its origin and re-creates the whole Plant without unfolding into the

seed. But the foliage remains as it were one tree-top with many stems and their roots.

Each leaf in the typical Plant, when it has performed its function, returns to the Earth whence it arose and restores the material which it borrowed, thus making its final round. Also the seed, the supreme purpose and end of the Plant, drops back to its originative starting point and is to reproduce the entire Organism anew in stem, root, and foliage. But this involves a new process.

With this differentiation of the Plant into stem, root, and leaf as stages of the one vegetal Form joined into a single process, we have come back to the Plant Organism as a whole united in and through its divisions and differences. The parts are seen to make the totality, not merely as an external aggregate, but as an inner completeness and fulfillment. Such is the outcome of the Formative Process of Plant-life, which presents to us the individual Form of the Plant, as it appears on our earth. Now it is this individual Form with which botanical science chiefly deals, analyzing, comparing, synthesizing it in various ways. But the natural Form of the Plant, the science thereof, and the scientist too must all be seen at last as parts or phases of the same ultimate principle, that of the Biocosmos.

It is true that this Plant-form in the present case was taken for granted; it was, so to speak, something externally picked up and looked at in its outer organization. But the question rises, how is this Form kept going, for it is always in vital activity? This vegetal Form persists in reproducing and re-constituting itself, being both the worker and the wrought; what is continually being made is the maker. Still it has to have material for its work; the living machine has to be fed not only to keep the machine running, but to be always re-making it. This brings us to consider the second stage of the Plant-Organism: its power of assimilating unto itself what is different, of transforming Unlife into Life.

II. THE ASSIMILATIVE PROCESS OF PLANT-LIFE. In the present stage there is a pervasive twofoldness which, though overcome for a moment is posited always anew: the Plant as living individual versus its elemental surroundings which it has to assimilate in order to live and reproduce its Form. So the separation between Plant and non-Plant, between the formed and the unformed, comes to the front; the vegetal individual is now to tackle its opposite and to transmute it into its own organism just through that organism.

The ultimate life-unit of the Plant is the cell, as already indicated; thus we have again

to take a glance at that wonderful little creature creating itself and then building itself into its own house through association. Verily the cell is the brickmaker and the bricklayer, yea even the brick of Life's edifice. It is primarily a self-contained structure, yet it associates itself into the organs of the Plant, which organs do not halt in their associative feat but constitute the total organism of the Plant. And this is not the end of their association, which rises to forming Plant societies, of which recent Botany has much to say.

The Formative Process previously described cannot live on itself, but must be fed from the outside; hence the Plant will attack its environment and appropriate what it needs thereof to its own use. Such are the two sides of the conflict which now opens—the conflict between the Plant and the world external to it, some of which it must internalize and assimilate to its own working Organism. This process goes by various names—nutrition, metabolism, assimilation; on the whole we prefer the last, as best indicating the fact. For the Organism has now to take up and make like to itself what is different and outside; thus it continually is getting back the strength which it spends to acquire strength—and something more. In the movement of the Plant, accordingly, the present

stage is that of difference, of separation, of battle ever won and ever renewed.

On the one hand the Plant has to seize and assimilate earthy matter, water, and air, all of which are heavy and gravitate, and so may be regarded from this viewpoint as the strictly cosmical contribution to vegetal life. On the other hand the Plant must employ and assimilate heat, light, electricity, and chemism, making its own the energies which degravitate and are diacosmical. How the Plant unites in its process of assimilation these two basic elements of Nature (Cosmos and Diacosmos) and makes them constituents of Life (Biocosmos) is to be seen more fully later. Here, then, the Inorganic, in its two great stages is transformed into the Organic. Hence also organs begin to appear with their organism, which is now the vegetal, the first and less complete, not well centered (as is the animal). It has no sensation (or very little); it does not feel itself, or determine its own process but is determined thereto from the outside. Still it has its round of assimilation: the organs give out their energy to regain what they give out.

The Plant gets its food and its force from the outside, food from the Earth and force from the Sun as radiant. The Animal on the contrary gets its food and force from the in-

side, consuming the Plant and thus assimilating inwardly what has been already assimilated outwardly from the Cosmos and Diacosmos; that is, the Animal feeds on vegetal life (and certainly on some animal life too). But the typical animal needs also the outer elements of the earth (water and air) as well as of the sun (the radiants and chemism)—needs both the Inorganic and the Organic.

The function of the Plant, therefore, in Assimilation is to transform Unlife in its elemental forms to Life, that is, to the primal vegetal Life. Its first act must be to appropriate and impart its food—Alimentation; then this prepared food must be circulated through the body—Distribution; finally there is the continual repetition of the Plant-form externally—Growth.

The twofold character of Assimilation in the Plant may be noted further in its two opposite directions: downward for earth with air and water (cosmical), upward for air and for light and the radiants specially (diacosmical). The two extreme organs of Assimilation (root and leaf) direct themselves toward the two opposite sides of the inorganic universe, seeking to bring them together into the living individual, or into the unitary process of the Biocosmos. The stage of Assimilation is, accordingly, the stage of the pitched

battle of the Organic with Inorganic, the latter being in its two main forms, which are pursued and assailed and appropriated by the aforementioned two opposite members of the Plant, root and leaf, which show in their many branchings the ceaseless striving to get at their antagonists.

1. *Alimentation.*.. This in general starts with the Inorganic in its two forms, matter (terrestrial) and energy (solar), and transmutes them into the Organic in its earliest form as living protoplasm. It must be confessed that this very suggestive process which is really a transition from Unlife to Life is by no means well understood in modern Botany. Evidently the two constituents of the inorganic world, cosmical and diacosmical, matter and energy, the static and the dynamic are joined together and made to live through a mediating principle, which usually is said to be chlorophyll, the green substance in the leaf of green plants, and in other parts of the vegetal organism. This life-giving process, as set forth in the recent text-books, bears the very inadequate name of photosynthesis—inadequate, since there must be also a thermosynthesis, and an electrosynthesis, as well as chemism. Indeed a chemical decomposition takes place, that of carbon dioxide whose oxygen is given off into the air, while the carbon

is retained and unites with the ascending water to form the so-called carbohydrates (as sugar, starch, and also the proteids). These are known as organic substances, since they are products of life, of Nature's own laboratory. Also they are the food-stuff of the Plant manufactured by itself out of the aforesaid raw materials. But this cooked food is still to be digested and vitalized into what is called vegetal protoplasm, which is to be carried to and incorporated with every living portion of the Plant. Such is the general outcome of the work of Alimentation, which may be taken as the first stage of the total process of Assimilation: the given outer elements are transformed into a living food-supply, and thus assimilated to the living organism, though not yet organized into it actively.

The aliment of the Plant being thus obtained, it must next be distributed throughout the organism. This is done by means of a distributing circulation, which has a number of streams running through the entire vegetal body on different errands.

2. *Distribution.* In the Plant there is no central heart with its pumping power of circulating the blood; still there are in it various kinds of movement of various fluids. The ascent of the sap is probably best known; but botanists also speak of the circulation of the

protoplasm, which, however, must first be oxidized—decomposed and set on fire by oxygen taken from the air. This is the act of Respiration, for Plants in their way breathe (through the stomates) and aerate the vegetal protoplasm. That is, through Respiration, they set free the energy which results from burning their stored carbon, turning this again into the carbon dioxide which they at first decomposed in Alimentation through the so-called photosynthesis. In the one case the carbon dioxide was taken from the air and decomposed, in the other case it was recomposed and sent back to the air. Thus Respiration undoes the work of Alimentation in order that the Organism may employ for its own use that imprisoned energy which came originally from the Sun with its diacosmical radiants. Here we see the double action of the Plant: it throws off oxygen in one process and takes it up in another; also it takes up carbonic oxide in one process and throws it off in another; thus we behold a twofold and counter round of circulation of these two gases. The purpose of this significant double arrangement is to catch and chain up first the force from the outside universe by Alimentation, and then to loosen it and to distribute it wherever needed in the Organism by circulation.

Likewise there is known to be a double movement of water, ascending and descending. In this connection is to be noticed Transpiration, the process of throwing off water in the form of vapor from the surface of the Plant, especially from the leaves. Thus flowing streams of fluid continually rise through the Plant like an artesian spring, though the cause of this uplift is still under discussion. On the other hand water is always being taken up by root and leaf.

The Plant aliment being thus seized from the outside world, cooked and distributed to the organs, which obtain thereby the energy for doing all this work (seizing, cooking, distributing), what next? Does the Plant-organism continue to make the same old vital round when it is once done growing? Now the fact comes to light that the Plant in a sense never gets done growing; as to its organism it is ever the unfinished and unfinishable, yearly the exogen adds a new layer to its body on the outside, though it be centuries old; in the endogen a similar repetition occurs on the inside (by means of the so-called vascular bundles). So we may say that the Plant is ever striving to get beyond itself, seeking to reach an end by continual additions to itself. Thus it seems to be growing an infinite series. About this growth a few words.

3. *Growth.* The Plant, having shown the ability to release its stored energy and to distribute the same throughout its organism, can now grow, push beyond its given bounds, and thus manifest its limit-transcending impulse as far as this extends. Some Plants keep on reaching out beyond the preceding annual limit, increasing in height and girth for a millennium and more. Still the organism cannot break over its typical form or character; a hickory nut will not spring up into an oak tree, it assimilates itself to its transmitted norm, even if this slowly changes from generation to generation, as Darwin has shown. Of course there has evolved an enormous diversity of Plant-life in the many millions of years that may lie between the *Bacterion* and California's lofty *Sequoia*, which is probably not the latest vegetal evolution on the globe. Still the individual specimen, be it large or small, follows the norm of the species; in its growth it realizes its foregone idea, so that we at once identify it as the fulfilment of its type or ideal pattern. Growth involves also the self-movement of Plants, which, however, has many other phases.

Out of the germ the organs grow, each of which likewise attains its normal limit. The plant, therefore, organizes itself through growth, differentiates itself into its co-oper-

ant members as it waxes into its full norm. Noteworthy is the fact that the Plant has the tendency to reproduce the organs of which it has been deprived, wherein it is quite different from the animal, at least the higher ones. Rootless stems will send out new roots, and stemless roots will put forth stem and leaf. This indicates the lower organization of the Plant, of which each part is able to be the process of the whole, not being differentiated too deeply from the same. There is likewise in Plant-life a periodicity of many kinds, in part externally dependent upon day and night, the cycle of the seasons, temperature, etc. But Plant-life has its inner periodicity of birth, maturity and cessation lasting a few hours in some Algae and many hundreds, perhaps thousands of years in some trees. Here again the vegetal individual assimilates itself to the norm of the duration of its species. But whence comes this species which seems to mould each plant after its foreordained type? On this question a large amount of recent biology has turned.

Through growth the Plant reveals its propulsion to attain the universal form of its kind, to be one with its genetic source; this is its supreme Assimilation. But it remains a striving externally directed; the concentric layers of the oak, yearly added one after the

other, show that the tree has a mighty aspiration for something beyond its reach which it seeks by piling step on step; every year it acknowledges failure, but never fails to make the fresh attempt with the coming spring. Its organism is not strictly governed from within by an established central authority, like the developed animal, which has an organ-controlling organ in its organism. Such self-direction the Plant cannot have through lack of such an organic center. Indeed those external concentric layers continually added to the oak are pushing outward for aught which it has not but longs for, namely, this inner center which the higher animal Life possesses. Thus the Plant never attains its end; if it did it would no longer be Plant; still it never gives up its pursuit; if it did, that would destroy its vegetal character. The Plant has been made the symbol of many things; but its best symbolic suggestion is this undying aspiration, ever disappointed but ever revivifying. So that maple under my window is sending forth an eternal sigh: "I long to have a brain like you, or even like your dog."

Plant language, however, is very differently translated by different translators, and so we pass on to say that Growth is the highest stage of Assimilation which herein not only

rehabilitates old tissues and organs, but reproduces new ones of both sorts. Thus even in and through Assimilation we begin to glimpse the fresh-born individual. The annual layer around the oak from top to bottom is in a manner a new tree with stem, root, and branch; still it embraces its maternal body so closely that it cannot separate and be an independent oak. Thus in Growth the Plant is continually reproducing itself as a part of itself; it re-bears its own form outwardly but not inwardly, and encloses itself in this new external form of which it remains the internal part. Assimilation has completed its round when it has assimilated the outer world not only into the old given organism but into a new one which includes the old. So Assimilation of the Plant has largely re-made what it started with, has re-embodied its first body, yet as a part of that body.

But the next step is the reproduction of the new individual as free, completely individuated, with his own organism distinct from that of his parent. This is the act of Generation, which is now to find its place in the ordering of the Plant-world.

III. THE GENERATIVE PROCESS OF PLANT-LIFE. The Plant has the power of reproducing itself not only in parts observable in Growth, but also as a whole—the total individual re-

creates itself as total. Thus Growth from its movement of expansion, turns back to the beginning and starts the Plant over again in a new individual. Such is in general, the sweep out of Assimilation into Generation; the linear tendency we may conceive bending around to the circular. Or we may consider the preceding transition as that between the two sorts of vegetal reproduction: the one reproduces the organism already given, the other reproduces it new-born; or we may say reproduces its reproduction. Assimilative is the one sort, generative the other. The living individual (here as Plant) recreates its life and starts over again, transmitting its creative energy, of which it becomes the vehicle and which has continued through all Plant-life, yea all Life in the Universe. This persistence of genetic energy passing from individual to individual through many generations is the germinal or reproductive continuity which the biologists are now specially investigating. Assimilative reproduction dies with the death of the individual, generative reproduction may be deemed relatively immortal, being transmitted in the cell or cells (as has been supposed) of the primal creative life-stuff of the planet.

We are also to see that the Generative Process of the Plant returns to the Formative,

which is the first appearance of the Plant in its Form or outer manifestation. Thus the vegetal cycle is completed, the last Process goes back to the first and reproduces that. The physical reality of this round can be noted in the seed which on the one hand is the final outcome of the Generation, but on the other is the starting point of the Formation of the individual Plant. The seed in its round thus shows the vegetal organism returning into itself through its three main Processes (Formation, Assimilation, Generation), and thereby completing its cycle of life. Both have something very significant in common: the Plant-child receives from its Plant-parent the ability to make that same vegetal round in about the same time, starting and ending in the seed. Such a power is, therefore, continuous and persists, being supreme over the rise, bloom, and cessation of the individual Plant, and therein suggesting a limited immortality.

The thought also should be dwelt upon that there is a recurrence of the same Plant-form in the main, or of the ideal model after which the organism seems to shape itself. We may conceive it as the universal or creative type of the Plant, which is always individualizing itself in the special instances; it has been named the *idea matrix* of all members of the

same *species* (or better, *genus*, which is connected with *genesis*, *generation*, etc., in that primordial Aryan root *gen* to beget). When we say that a certain Plant belongs to this or that species, there hovers before us doubtless vaguely the ideal norm thereof, to which we mentally compare it and under which we subsume it. Instinctively we seek for this genetic archetype which manifests itself in individual Plants and orders them, being the true source of classification. Species are indeed many and the Plant-norm has diversified itself prodigiously in the past ages; still it is relatively the persistent principle in the vegetal organism, though it too be subject to a gradual evolution.

With the development of its Generative Process, the Plant stops its growing outward, and turns back inward upon itself as it were, and rounds out its total growth into the seed which contains potentially the whole Plant, concentrating the latter's previous forthright energy toward special parts and projecting the same into a new entire individual. It is true that the old Plant, after a period of rest and recuperation, will start again its growth by accretion, for that is the vegetal character. The oldest tree continues adding its annual layer of new sapwood; it never gets its growth, it always remains young in a part,

and fails not in reproductive power. The animal is different, being more internally directed, not growing into old-age by outward additions of youth to his senile body.

Analogies between Plant and Animal have been often drawn. Oken deemed the brain of the Plant to be the flower with head erect in the air. Others have maintained that the vegetal head was rooted in the soil where was the mouth taking its food and drink. Really, however, it is contrary to the nature of the Plant to have a central brain in control; rather each part or organ has its center and can become the total Plant. Interesting is the comparison of the sexual division of the one flower into stamen and pistil to the Ego separating itself into subject and object which reunite. A kind of outer self is thus the Generative Process of the Plant, as the Process of the Ego is generative of the new thought. Undoubtedly there is a psychical side in the Plant, as there is everywhere in Life, and also in Nature. The ideal continuity of the vegetal type is in me, or subjective; but it is also in the Plant or objective; if it were not mine too, I could not know it. My Psyche is what communes with and recognizes the Psyche of Nature.

The Plant, since it is quite autonomous in its organs and thus relatively multicentral,

has naturally many centers of Generation; each part or organ in fact can reproduce the whole individual. Hence rises the question about the different values of these different kinds of vegetal propagation. Even the sexual process of the Plant is practically confined to one individual, though there be diœcious fertilization. Thus vegetal Generation never quite frees itself from vegetal Assimilation, both being largely in the same organism and therein organically connected. To the complete sexual diremption of Nature the Plant never attains, though striving for it, and giving outer manifestations of it in the parts of the flower. Vegetal Generation remains implicit in the one individual, never getting fully explicit in the two individuals (like the typical animal). So the Plant as generative simply returns upon itself, and makes itself another like itself (or nearly so), for the offspring, being thus limited to the one individual in origin, must incline to be one-strained (not two-strained, as the animal). But the various kinds of propagation of Plants will differ just in this regard, and Nature will help break down the vegetal limit, as in the previously mentioned case of Mutation. In a sense we can say that the Animal is not so self-sufficient as the Plant, since in its case, male and female are not one individual; but just this

limitation is the source of the Animal's greater diversity and higher character. Practically, then, the Plant-world is born and stays hermaphroditic, though with many variations from low to high—the highest being the outer appearance or floral realization of the sexual idea.

Accordingly the Generative Process of Plant-life we shall look at in the following stages: single Generation (asexual), double Generation (sexual), total Generation (the entire line of Plant-life generated in time and at present existent). Thus we may catch a glimpse of the original Plant-norm taking on its millionfold shapes, or perchance the vegetal prototype clothing itself with reality.

1. *Single Generation of Plant-life.* We may repeat once more that vegetal Generation is not centralized, just as little as the whole organism of the Plant is centralized in one organ. Both facts manifest the same basic vegetal character—lack of organic unity, be it in the sphere of self-reproduction or of self-direction. Each member can become the center of the whole, which is thus largely decentered. Generation is accordingly, multicentral in the Plant, though confined to the various parts of one organism; each part under proper conditions is endowed with generative power. That is, Generation

in its present aspect is of one kind (asexual), and springs from a single organ or part of a vegetal individual. Thus we name it Single Generation (uni-parental). Hence it is also called monogenetic, which word hints its derivation from one parent and not from two. Another term applied to this sort of Generation is the word *vegetative*, an unhappy usage, since digenetic or bi-parental propagation belongs also to the vegetable, even if in a more superficial way; while on the other hand monogenetic or vegetative Generation can be seen in the lower animals.

Still the reader who loves the thought of the Plant as well as the sight of it, will not fail to reflect that its genetic continuity is transmitted through single Generation as well as through double. The Plant-norm is perpetuated in one way as well as in another; the specific idea or type keeps re-embodimenting itself in the generative process, though the individual continues to perish. The Plant hands down two things: its living but evanescent finite shape, and also its eternal power of shaping itself anew—its mortal and its immortal portions. The individual vanishes, but individuation eternizes. The product is mortal, the creative energy is immortal. This latter seems to have been given at the start, from the original genetic sources and to

be still preserved in the Earth-life, from which the Plant draws it directly for generating the individual. Now this means of Generation in the Plant is not concentrated into one kind, but varies organically. Still the Plant's reproduction is essentially limited to the one parent, though often with strong protests which indicate at least its aspiration for a higher birth.

Accordingly the reproduction of the vegetal individual can take place in a variety of ways without the conjugation of the floral sexes, stamen and pistil. Indeed it lies in the character of the Plant, that each part, properly separated and environed, will produce the whole. This fact is seen in the development of layers, cuttings, grafts; bulbs, buds, rhizomes, even leaves will propagate the entire organism of which they are members; in fine root, stem, and leaf, will reproduce one another and all together in the total Plant. Assimilative reproduction may be halted in its outward repetition and turned about into generative reproduction; the growth of one part may be transformed into the growth of all the parts. Each organ of the Plant is not fully centralized and subordinated to a common head, but has the tendency to be autonomous (like the cluster of the ancient Greek city-states). Thus the one organism easily

breaks up into as many organisms as there are organs; even the single cell has that power in certain Plants (possibly in all, if the right conditions be found).

Such is the asexual propagation of the vegetal individual, whereby the one parent is simply repeated in its progeny; the same body reproduces itself indefinitely, a kind of quantitative repetition of the one unit. Still even in this seemingly uniform reproduction surprising variations may occur and have been recorded, indicating that also in the vegetal body far-off ancestral traits can lie dormant till favorable conditions may cause it again to spring forth, to the surprise of the botanist. DeVries maintained that vegetal variation was not the slow movement which Darwin so strongly emphasized but might be sudden and catastrophic, producing a new species at a single leap. Still asexual generation is in general, repetitive of the parental form which it originates, and monotypal (hence the use of the word *monogenetic*). But the sexual dualism is also found in Plant-life.

There is an old discussion concerning the sexuality of Plants, which was at one time questioned. Then again this was accepted, but regarded as quite superfluous, since its place could be filled by so many substitutes. But hybridisation, especially the experiments

of Mendel, have shown strikingly heredity in the Plant from both sides. Also its sexual propagation brings forth characters not obtainable by other methods. Still in the Plant sex has by no means reached its destiny. It has, however, something to say, to which we may now listen.

2. *Double Generation of Plant-life.* The reproduction of the Plant is now bi-parental, although the two parents may not be two separate individuals, but two sexual organs or two sets of organs in the one organism. (Hence called also digenetic in sundry botanical books). Thus living Nature has begun to manifest in outward shapes her deepest dualism, that of sex, which, however, drops back into unity in the individual offspring, though the latter may become many. Our Biocosmos has pushed forward to its supreme separation, which it is always overcoming, yet always reproducing. For the living individual is born with the sexual disreputation upon him; the higher he is, the profounder the chasm, which he still has to bridge in order to continue his kind. But floral sexuality is the first quite playful, innocent appearance of sex. We might call it paradisaical.

Two kinds of cells, male and female now appear in the Plant, neither of which (as a

rule) is capable of separate development, but must be fused together in a common nucleus, from which springs the seed and thence the new Plant. One may well ask: What is the purpose of this second more complicated, more circuitous Generation?

In the first place two parental characters begin to unite themselves in the offspring—paternal and maternal. Even though the stamen and pistil be of the same flower, and hence of the same root, stem, branch, and leafage, the seed combines the two-fold tendency of all life, that of father and mother, which exists united in every individual Plant and comes to expression in the double floral organs—the supreme genetic manifestation of the vegetal organism. Then the seed proper, the great storehouse of food both for Plant and Animal, is the distinctive product of sexual Generation as contrasted with asexual, which often has as its object to call forth the seed-making act with its fruit. Moreover the seed is Nature's own work of self-completion in the round of vegetal organization, which is concentrated in the seed. Relatively the asexual process is lower organically, or more artificial and accidental in the higher Plants. Also we have the right to think that the vast variety of the vegetal world springs largely from sexual Genera-

tion, in which the children inheriting from both parents, differ from each. Gradually thus the grand diversity of Plant-life has evolved and is still evolving.

Now comes the curious fact that the flower seeks to differentiate its two sexes as much as possible for the purpose of fertilization. Often the pollen is barren on its own flower, but fertile on a different flower of the same species. To some Orchids their own pollen is poisonous, and self-pollination causes death. Peculiar contrivances of Nature have been pointed out by which the pistil avoids its own stamen. The two organs often mature at different times so that each seeks its counterpart not at home but elsewhere in another flower (the so-called dichogamy). Again, some Plants produce on the same stalk both sorts of flowers, the self-pollinated and the other-pollinated, the first being smaller, lower, seemingly less developed than the second. Finally there is the complete separation of the two sexes into two different households (diœcious), each sex having its own Plant. Pollination now occurs through more external and more remote means—wind, water, birds, insects, even snails, etc.

The loves of the flowers have been celebrated by poets and lovers; but quite as certain

are their antipathies. It seems that the whole flower-world has the bent to separate the sexes as far as possible externally by distance and internally (we may suppose) by character. The stamen on a different tree must be different from the stamen on the same tree and in the same flower with its pistil, though both trees belong to one species. Heredity has had a far wider field for its development in the first case. The flower appears averse, like man to the marriage of sister and brother, though both flower and man have sometimes permitted it.

It has been noticed that the very lowest plants, some of the Algæ and also the Bacterion, though propagated ordinarily by the simplest fission, break out often into what resembles the sexual organization, even if this be of little or no use to the Plant. But thus it shows its impulse. We may call it a longing for the completed sexual form of itself, which comes to realization only in the higher plants, yea in the higher animals, for the Plant never fully transcends its asexual generative limitation. But in its striving for such an end it leaves a long line of shapes graduated by their approach toward the perfect flower, which is always a generative manifestation, ending in the seed. To be sure, the perfect flower is still a problem;

possibly it is yet to be evolved, not so much by Nature as through man's agency. The crossing of species and even genera, for the purpose of improving the breed, has become a significant branch of the vegetal Biocosmos cultivated by persons whose genius seems to be in a born intimacy with the creative Plant-type. Some men are apparently endowed with flower-souls so sympathetic that they can elevate and partly humanize the vegetal organism (so we may consider the Dutchman DeVries, the Swede Hjalmar Nilsson, and the supereminent one, the American Luther Burbank of California). Far-reaching indeed is the commingling of breeds (hybridisation); through it perchance we are on the path to the Super-plant. Nor can we omit the reflection that in a similar way the commingling of the human races, of course with proper selection, is to evolve the perfect specimen of manhood, that Super-man, about whom we hear a good deal of prophecy in these days, and with whom must come of course the Super-woman. Possibly such a Plant will be required as the food for such a Man, so that both will appear together. Not quite so illusory seems that educated edible spineless cactus of Burbank, which is to turn Earth's deserts into a garden and double the food-producing capacity of our globe.

But from such speculative outlooks, which have their rights, we may turn to the actual Plant-world as it unrolls before us, or rather mounts from the humblest form to the highest.

3. *Total Generation of Plant-life.* Evolution has left its emphatic impress on Botany as on the other sciences. One result is that the entire Plant-world is graded upward on an evolutionary line which has a bottom, but seemingly no top. The foot of the ladder indeed rests upon or rather pushes down into the primordial life-stuff (Protobioticon) which, though hypothetical, is the necessary pre-requisite and creative source of all succeeding Life, vegetal and animal. For it is the germinal fountain-head of living individuation, the original home of all vital forms, even of the smallest cell, which comes forth already organized from this elemental plastic reservoir of living things. Here lies the transition from the Inorganic to the Organic, into which the whole science of biological evolution plunges backward, as its indispensable postulate, even if speculative. Only Psyche can say anything about it as yet, though Physis is also there and will in time get to talking about itself, voiced of course by the scientist.

This same elemental life-stuff is the arena

as well as the origin of the primal differentiation into Plant and Animal, which seems to occur with the transition from pre-cellular Life into cellular. This stage is still theoretical, the coercive demand of thought; yet in the earliest organisms it becomes almost visible. For instance, the slime-mold known in science as *Myxomycetes*, sometimes classed as an animal and sometimes as a plant, and sometimes as neither, appears to be one of the living things nearest the point of bifurcation into the two kingdoms. It is primitively cellular or seems to be becoming so; its very diversity would indicate a lack of individuation in such semi-organic material, there being at least 300 species according to De Bary. Such is the next neighbor to the original life-slime on its way from Unlife to Life—a kind of neutral or double plant-animal (*Phytozoon*) which we may take as the best instance of this transitional stage. Formation, Assimilation and Generation, which become so distinctive as the bifurcating lines of Plant and Animal evolve, quite blend together in these early protoplasmic shapes just getting individuated.

The present field has long attracted the attention of biologists who have given to it various names. The best known designation is probably that of Haeckel who calls these

neutrals Protista (an insufficient rubric by the way, since it applies to non-vital things as well). Moreover it is sometimes called the third kingdom of Life out of which the other two fork. Now this pivotal parting of the ways is what we are next to see, if it be possible. In other words the double-natured *Phytozoa* are to split into their two elemental constituents, which are named the *Protophyta* and the *Protozoa*, or the first Plants and the first Animals. The latter line of Life-forms we shall pick up hereafter, when we come to the animal world. Here, however, we may add that the two samples of earliest bifurcation are usually considered to be the *Bacterion* as first plant and the *Amoeba* as first animal, both of them moving almost on parallel lines of evolution. Thus Biology takes its double start in many a text-book and remains double to the end.

But having gotten our first Plant and with it the first faint indication of the Plant-norm (Protophyte), how shall we organize the overwhelming multiplicity of the Plant-world? Perhaps the best start in running an organic line is to divide (after De Condolle) the entire mass of vegetation into the non-vascular and the vascular (without and with circulatory organs for carrying fluids) even if we have later to change partly this divis-

ion. This is the greatest node in the vegetal kingdom, often called the widest chasm in it by botanists, and it lies between the Mosses (Bryophytes) and the Ferns (Pteridophytes). In the Formative Process it is the transition to the leaf, stem and root of the Plant which have not yet been differentiated in the previous forms—Algæ, Fungi, Mosses. But more specially an inner vascular system appears for the purpose of distributing food and fluids through the organism—all of which means a great change in the Assimilative Process. In the Generative Process there is also a considerable advance, as we see in the fern-leaf which bears the spores, the latter repeating the embryology of the thallus and the moss in its development. Though occurring far down among the less showy, because flowerless, cryptogams (now a rejected title in botany) this is the largest leap in the Plant-world proper, though probably the gap will be lessened by fresh discoveries.

For the sake of a deeper synthesis of living Nature we may compare the present division of Plants into non-vascular and vascular with division of animals into non-vertebrates and vertebrates. The correspondence is striking, and has been repeatedly noted, while the attempts at bridging the chasm have been various and are still going

on. But the prime difficulty in both cases lies with the first designation which is merely negative (*non*, not); hence the strong effort to bring the non-vascular realm into a positive order. Thus arises the division, quite general in today's classification, of the non-vascular Plants into Thallophytes (Thallus-plants) and Bryophytes (Moss-plants), both of which are antecedent stages of the Fern-plants (Pteridophytes). But the latter and the whole succeeding higher Plant-life are vascular, that is, have true organs; their cells have reached the point of an associated cell-organization. A thallus is the primitive Plant which is not yet differentiated into stem, root and leaf, though it often shows the strong impulse to put forth these members; it is a lump of life unformed but trying to form itself, in which the Formative Process of the Plant is implicit, not yet realized, but struggling. The Thallophytes make a large group with many species, which take all sorts of shapes suggestive of the definite organs of the higher Plants. The chief interest of the thallus is that it is prophetic of the whole coming vegetal kingdom, being a piece of plastic material in whose manifold variations are foreshadowed (by the artist Psyche) the future shapes of the Plant-world. The two chief classes of Thallophytes are the

Algae, green with chlorophyll and hence capable of preparing their own food, and the Fungi which have no chlorophyll and hence are parasitic on other organisms. The famous Bacterion is a Thallophyte, a fungus parasite, unicellular, capable of enormous multiplication by simple fission, and in some of its forms is the smallest of extant organisms, being unseen by the microscope though known to exist as a cause of disease which may be counteracted by antidotes.

So much for the thallus, that prophetic little blob of life-slime, the primal Plant prefiguring in its way all the rest, being too the individuated starting-point of the whole line of vegetal evolution, as far as science now sees. The next great group, the Mosses (Bryophytes) still keep the thallus, but in a state of decided transition, especially as regards the Generative Process. For sex now begins with organs, male and female (antheridium and archegonium), yet accompanied with a sexless individual. Here the curious fact appears: the sexual produces the asexual and the asexual produces the sexual—which fact is known as alternation of generations. This dual Generative Process is very significant, reaching forward to the permanently sexed higher Plant, and then dropping back to the more or less simple fissiparism of the Thallo-

phyte. So we may regard the Mosses (Bryophytes) as the dual or separative stage of the Plant-world, judged by the highest criterion of its permanent existence, namely Generation. It will be noticed that the Generative Process is adopted as the supreme standard for ordering the ascending evolution of Plant-life; since the introduction of this method, Botany has taken a new departure.

But now we must make a fresh transition, namely to the third stage of the vegetal kingdom. Here the striking outer manifestation is the appearance of the *corm* as the Plant-unit of form, instead of the thallus which has prevailed in both the preceding divisions (Thallophytes and Bryophytes). What is the significance of the corm in this total evolution of the Plant-world? It means that the fundamental vegetal form has now come to manifestation in its triple members—stem, root and leaf—and will stay through to the end. The thallus had no such differentiation, though it showed many pushes toward it, many prophecies of it, many an impulse to reach it—but on the whole in vain. At last the corm comes forth quite fully formed in its three members, though it too will evolve a good deal in the future. Still it remains and thus gives a chief criterion for the third and last grand

division of Plants—the vascular Cormophytes (or the corm-plants). It may be here added that the corm in its present sense is an explication and fulfilment of the thallus which is the first stage already considered; to this we may conceive it as a return, which is also an unfolding of it to its purposive end; that is, the corm realizes and fixes to persistence the many fleeting intimations of stem, root and leaf, which are found scattered through the numerous varieties of the thallus. In fact Nature has everywhere these prophetic hints, and the whole of it is one great prophecy of the completed Psyche: such is truly its poetic side.

The word *corm* in the foregoing sense was first employed by Endlicher, though it had been used previously in Botany with a different meaning. In Greek it signifies literally a stem, with branches and roots lopped off, which therefore belong to it naturally. The term with its group is approved by the famous German botanist and writer, Professor Strasburger of Bonn, in his text treating of general morphology, but is strangely omitted by him in the place where it is most needed, namely in the systematic ordering of the Plant-world. A puzzling omission, yea inconsistency of the learned scientist, but not unparalleled. The demarkation of this su-

preme group, or even the need of it seems not yet to have penetrated our Anglo-Saxon botanical brains, English and American.

The outcome, however, we may now put together: the total Generation of Plant-life shows three grand divisions—Thallophytes, Bryophytes, and Cormophytes; these also form a process together in which we may well catch a gleam of Psyche as the ultimate orderer, who shows herself in the largest sweeps and likewise in the minutest cells, of Nature.

The Cormophytes (De Candolle's Vasculares) henceforth form the center of botanical interest, and they too have a subdivision, which also is seen to be threefold. These are the Pteridophytes (Ferns in which the seeds or spores are developed but not yet separated from the leaf); the Gymnosperms (in which the seeds are separated from the leaf, but unenclosed); the Angiosperms (in which the seeds are enclosed in their distinct house or seed-vessel). It is evident that here the stress is upon the seed (or spore) by means of which the individual plant reproduces itself and so persists as species through time. This seed is, therefore, its essentially genetic principle, its participation in creation itself, of which every Plant is a little living dot. The seed-world, including grains, fruits, ber-

ries, nuts, etc., is thus the vast storehouse of Life on which animals feed, ever renewing their organic existence, and plants likewise get sustenance thence. So arises this increased care of Nature for protecting and preserving in the seed her generative power. The Angiosperm seems to return upon the fern-leaf and to transform it into a seed-house whose walls now guard the precious contents inside; whereas in the fern (first stage of the Cormophyte) the leaf was quite independent of the seed, the master of it more than the servant, though this relation seems already reversed in the fossil Pteridosperm. The seed in general has prepared for man his assimilative life-stuff directly, and also indirectly through the lower animals. But the seed must get its store through the Plant from the vast reservoir of Earth-life, which man cannot bite off immediately. At least not yet; possibly the time may come when he through science may be able to tap the primal fountain of Life without the mediation of the Plant-world. But for the present the little vegetal cell has to individuate all life-energy for the animal, as far as we can now see.

The Angiosperms are the culmination of the Cormophytes, hence of the Plant-world. They are a third stage or division again, and indicate the highest evolution of vegetal life,

though they too will show their own evolutionary ascent. The Angiosperms are supposed to contain more than 125,000 species, a number, probably thirty times greater than all the other Cormophytes combined. The most useful, the most beautiful, the most advanced Plants, from the human point of view, are embraced in the present division; also they are the most conspicuous and self-displaying. A salient phase of their total character is just this manifestation; it may well be deemed that the floral soul, hitherto quite implicit has now come to self-revelation. Hence they were called Phanerogams by the older botanists, who in a number of ways were closer to Nature than some modern ones (of the University Laboratory) who are trying to drive the name out of the science. It may be granted that it is not easy to define, What is a flower? over which question botanists have larruped one another and their much-enduring readers. Yet the prime fact is that the whole Plant-world has now flowered; hitherto dumb it has attained a kind of language; hitherto vegetally unconscious, it has now come to a kind of floral consciousness (though different enough from the human). Indeed we may put together for the sake of comparing the two great kingdoms, the vegetal and the animal, the corresponding rungs

of the two evolutionary ladders. In this case, the Angiosperms and the Primates can be regarded as correlatives, or partially so, in the ascent of Life-forms.

Here it should be noted that the Plant-world like the Animal-world is found to be subject to evolution, though this part of Botany has lagged somewhat on account of its many difficulties. Still there can be seen in general the rise from the thallus to the flower, which is the great fruition. Also the geologic past reveals a successive ascent of Plant-forms, mounting from the eophyton (if it exists) of the Laurentian up to the Mesozoic when our earth, hitherto mainly green, began slowly to flower forth, possibly along with the budding man whose consciousness also was inflorescing. It would seem that Earth-life in that pivotal time was likewise passing through a similar stage to those of man and phanerogam—a stage of early self-manifestation. According to the theory of De Vries, that first flower might have been “a sport,” a sudden saltation out of some backward cryptogam toward floral perfection. So, too, man has been accounted for. But we have to think that both cases must go back to Earth-life as the ultimate source of such mutations.

Thus the Plant has its historic evolution

through the ages, from its earliest germ to the present highest form—this is often called its philogeny. But it has also its embryology or its individual development from the germ likewise to its completed growth—this is known as its ontogeny, which moves on a significant parallel with the aforesaid philogeny. The third form of vegetal evolution is the ever-present total Generation of Plant-life from the germ to the highest Phanerogam. All three lines of the evolution of the Plant move in different ways toward the common end which is the Angiosperm in its supreme flower.

This brings us to the great drawback in the domain of the Angiosperms: the lack of any satisfactory ordering. The central difficulty in our opinion pivots upon the large family or tribe known as the Composite, which the botanists have not been able to put into any suitable place in the total Plant-world. The Angiosperms are divided primarily into monocotyledonous and dicotyledonous—which division takes as its criterion the seed with its embryonic leaf, which may be one or two. But the seed of the *Compositæ* (usually ranked as dicotyledonous), considering the many flowers which grow out of it in a single head, should be polycotyledonous, as are the seeds of certain *Gymnosperms*, such as the pine.

This fact, ideally true, does not, however, show itself in the form of the cotyledon.

Now the point upon which the chief stress is to be laid, is that each Composite flower is no longer a single flower but an associated group of flowers. Such is the unique fact now risen to view: the floral individuals in their turn have advanced to association in one body, which, however, preserves the individuality of each flower that in this relation is called a floret. The whole is surrounded and unified by its own corolla and calyx, which have likewise their own individual character, and which form the peripheral ray-flower. Thus we behold an actual union of associated individuals in the vegetal kingdom, whose last and highest act is just this. We may call it a true federation of flowers with its unitary bond (involucre) enclosing, protecting, and conjoining the federated individuals, each of which may be a complete flower, having its own form and law, we might say its own sphere of sovereignty. Such is in general the Composite flower (a more appropriate title would be associated, or even federated) with its significant union of many into one (*e pluribus unum*). Our most striking flowers are continually bringing this fact before our eyes in the blooming season: the golden-rod, the

sunflower, the chrysanthemum, the dandelion, the thistle, etc.; each manifests the underlying principle in its way, according to its own individuality—the petulant thistle always ready for a fight with swords drawn, the flaunting sunflower always begging for a caress from its sun-god, the modest daisy quite shrinking from a glance into the admirer's face. Yet all of them are associated, having many florets in the one flower. Indeed just this association gives a vast new field for the development of floral individuality; there is no telling what new forms and new characters may be developed from such a floral associative power. For relatively this act has just begun, the confederacy of flowers has but recently appeared in the Plant-world.

It is agreed by botanists that the Composites are the youngest of the Angiosperms, which have been already designated as the youngest of the Cormophytes; that is, the last plants to flower, in the movement of the geologic ages, are just now the flowering plants (Angiosperms), and the most recent birth of the latter is the Composite flower. Again the comparison will come up: the association of men into the federal State is so far the final outcome and crown of the political evolution of historic time; in a similar manner the evolution of the floral world has

reached what we may call a federal flower, which is its present culmination.

The Composites are not only the highest in rank and the youngest in years, but also the largest in numbers of all the flowering families (the Angiosperms). It contains according to the most recent estimate under my eye (1911) at least 12,500 species. It is, however, not well defined or even described; hence the limits of the total group and its salient character have not been distinctly seen. Its supreme conception must be that of the associated flower; other traits, though important, are subordinate. It is inept to classify primarily the Composites by the cotyledon, as dicotyledonous. Its essential criterion is that of association, to which there is a gradual rise from the simplest flowering plant. Such a view, however, breaks down the whole cotyledonous classification of the Angiosperms, which should be graded and ordered by their approach to their supreme form in the Composite group. Moreover, as the Phanerogams (or Angiosperms) have evolved to the point of manifesting their character just in their flowering, this must be what is associated, namely the flower. So the true criterion of ordering the Phanerogams drawn from their essential nature should be

the evolution of the stage of flower-association.

Without going into details we may offer here a tentative arrangement. (1) *The evolution from spiral to cyclic flowering.* The simplest flowers are ranked externally about an elongated axis in a spiral (like leaves). This linear order unfolds into the round. (2) *The evolution of the cyclic single flower to the associated flower.* This has many gradations which are represented in many families. (3) *The evolution of the associated flower (Composite) within itself,* which also shows numerous stages, or degrees of associative (or federative) excellence up to the supreme flower; which flower, however, is a problem.

We may here interject a little personal theory as to the reason why the Composite have not been adequately treated by the European botanists who have of course taught the American. It is that the federative consciousness has been wanting. For the scientific mind participates in the social and institutional order of its nation and age, and is indeed trained by the same in its deepest creative character. Our feeling is, as we look out upon the flower-world with its profound suggestiveness, that the Composite flower is the true floral representative of the Federal Union.

But the Composite is a very large family, containing more than twelve thousand species, as just stated. Which is the supreme species? What flower shall we crown as queen of the floral kingdom? Some have chosen the sunflower, others the golden-rod, still others the thistle, which has a high inner association, and externally an all-sided military armament coupled with ready pugnacity. Still there seems to be no decided supremacy anywhere, we find nothing in the Plant-world to correspond to the superiority of the genus *homo* among animals. As previously indicated, the super-flower is yet to be evolved, perchance by some Burbank with his new art of controlling and improving floral evolution.

Such, then, is in brief the organization of total Plant-life, of which we may here give a short synopsis. The first ordering is represented by three stages which are (A) Thallophytes, (B) Bryophytes, (C) Cormophytes. These last branch out into (I) Pteridophytes, (II) Gymnosperms, (III) Angiosperms, wherein the Plant-world has flowered. This flowering division unfolds into the before-mentioned forms: (1) axial, (2) cyclic, (3) associative. So the entire Plant-world may be likened to the tree (one of its shapes) springing from unseen depths into the visible

trunk which sends forth leafy green branches that finally top out the whole in a many-colored flower-life.

Nor should we fail to note the corresponding realization of the associative idea through many ascending shapes from the primal cell to the highest flower. That primal cell is itself organized as the starting point of present science; first is the association of cells into organs, then the association of organs into the whole organism of the flower, finally appears the association of these floral organisms into a kind of corporation or institution, which is still a flower, with many associated florets, each of which is a complete organic individual within itself, yet engirdled and fortified without by another floral organism which unites them inwardly and protects them outwardly. Thus we find two floral systems in the *Compositæ* (and sometimes traces of more) yet united into one doubly associated flower.

Another phase of vegetal association may be here noted in passing. The terrestrial elements, water (or its absence), soil, air (wind) are causes of a varied grouping of Plants from low to high. Also the radiants, heat, light, and electricity determine what are often called Plant societies. In other words the various diacosmical energies of Nature

influence the conjunction of vegetation in a given territory. As there are diverse societies of men, so there are diverse societies of Plants, which fact has given rise to a new branch of botanical science known as ecology. Water will produce one kind of plant-town (Hydrophytes), dry land another (Xerophytes), and so on. The swamp, the forest, the meadow have each its own vegetal community, which is composed of many sorts of individuals.

But the supreme association of Plants is to grasp them as a whole, evolving in all their variety and gradation after their common underlying norm, which can best be seen in the evolutionary line of the total Generation of Plant-life. It may be said that the entire vegetal world has now flowered and seeded, and thus come to its fulfilment. It has vitalized the Cosmos and the Diacosmos, converting them into the Biocosmos, at the first life-stage thereof. But all along we have seen the Plant as purposive, as striving toward an end beyond itself. It shows itself finally as means for something higher, which is witnessed when the animal takes it as food and thus brings it to fulfil its destiny. Accordingly the animal in its origin and evolution begins to dawn upon our vision. But this throws us back to the starting-point, to that original bi-

furcation of the life-stuff into Plant and Animal, of which the first and most immediate line has been traced in the foregoing account.

It should be stated, however, that the evolutionary succession of Plant-life, as just given, has been sometimes questioned. Recently the declaration has been made that the Bryophytes (Mosses) are a kind of relapse from higher forms, as they occur only in the later strata, as far as known. Even more surprising is the statement now heard that the monocotyledons are younger than the dicotyledons, be it a forward or backward movement of Plant-life. This view has the tendency to undermine the cotyledon as the essential criterion of ordering the Angiosperms. Fossil botany is beginning to supply some missing links like the Pteridosperms, in which the fern-leaf bears a true seed, not a spore like the fern of today. One Plant, a sort of yew called the Ginkgo (Maidenhair) has survived from the Paleozoic and Mesozoic when its distribution was world-wide, in a single species now found in Japan and China only as a cultivated Plant and sacred—which fact has probably preserved it from extinction, for it hardly belongs to the flora of our day. Thus a vegetal product of Carboniferous condition has crept down the ages in a solitary example, and has succeeded in

living with the much later Angiosperms in the fierce struggle for existence which has wiped out so many of those oldest Gymnosperms. Perhaps the chief reason why the Ginkgo tree has been preserved is that it bore an edible fruit which is still sold in the markets of China. This quality of it was doubtless appreciated by the primitive man who may have interfered in favor of it as a food-producing Plant, against the young and more vigorous Angiosperms which had already begun to flower seemingly with the early human flowering.

Many of the experts in fossil Botany are now saying that there is no certain geologic record of non-vascular Plants, which appear to have no power of perpetuating their forms in the rocks. The history of Plant-life on the globe would then begin with the Cormophytes in which the vascular system is first unfolded. Here lies, we may note again, that widest chasm in the Plant-world, as botanists declare, which may yet be bridged over by the discovery of intermediate forms.

But already the Animal has appeared in its own norm as distinct from the Plant, and has evolved on a somewhat parallel line to our time, with its own characteristics. The Composite flower we have placed in the highest rank, as it is no longer merely an isolated in-

dividual but is an association of many flowers, having a specialization within itself of stations and duties, for the outer floral band or bands can show a different form and function from the inner florets. Still they are one community—a communal flower with a kind of communal organization. Then each seed of each part will bring forth the total flower; indeed the asexual cutting may reproduce the Plant fully sexualized, thus each portion, even the cell, has in it the process of the entirety—has in it the generative or enduring element as well as the assimilative or mortal element, of the vegetal organism. Still in the *Compositæ*, we must here observe, the center of protection and union appears on the outside, in the enclosing band (involucre) which holds the community together. Thus in its highest manifestation, the flower must be deemed to have its unity external, it is combined or associated from without, hence its protection is quite passive, it cannot strike back or even get out of the way.

But now we are to consider that living organism which in its typical form has its center within, organized and controlling. With this thought we may pass to the *Animal*, which is next to be considered.

II. ANIMAL LIFE.

If we notice the animal before us, we observe that it has the power to break its immediate connection with the Earth, though it soon resumes that connection. It can cut loose from gravity in a moment of effort, but always comes back again. The dog lifts his foot, yet can put it down on another spot; bringing his act in relation to the physical universe, we may say that he has a limited control over the Earth's attraction, he can degravitate even if he soon re-gravitates. The animal body is thus able to separate from the terrestrial body, its elemental source, and to renew its spatial relation thereto; it can replace itself in space.

Herein the Animal is different from the Plant, and this we may deem their primal difference. The Plant is fixed in its fated spot of Earth, the Animal has relatively spatial freedom. Gravitation is the unitary principle of the total Cosmos; but the Animal can break from it for a moment, and defy it a little. This is his primitive separation, in which he asserts his earliest individuality even against the primal cosmical law. The Plant cannot perform any such act of separation; it remains practically unseparated from its

source, the Earth-mother, even if it grows and strives in the opposite direction, toward its Sun-father. So much is suggested by the locomotion of the Animal: it can reproduce its position in spite of the mechanical determinism of the Cosmos. Or we may say that the position of the Animal in space is mediated by itself, while that of the Plant remains immediate, and keeps its appointed spot, not being able to re-appoint itself to a new position.

Such a power pre-supposes in the Animal an inner organic self-control; the organism has to be self-centered in order to lift itself and move about; all the organs must be directed from within by one organ more or less centralized; in fact, animals are graded by the possession of this power. Plants on the other hand are essentially decentered within; each organ is practically autonomous, and can be, under certain conditions, the entire Plant, both in assimilation and reproduction. In the animal organism then, each organ is properly a member of the whole and cannot take the latter's place, being subordinate and not autonomous — not independent but interdependent. The boundaries between the two sides, however, are not precipitate, but very gradual. Here again we should note the fact of separation in the Animal; it has its

own center as distinct from that of the Earth; its body being material, is heavy and still gravitates; from this point of view it has two centers: one of its Unlife and the other of its Life.

With this organized central principle of the Animal is connected another characteristic: sensation. The typical Animal feels in each part of its organism, because this is organically centralized in the brain and the nerves which radiate to every dot of the bodily periphery (efferent), then turn around and come back on a different line (afferent). The general center is thus specialized into local centers thousandfold, each of which is a little brain with its two sets of nerves united ultimately with the central brain. When one of these special centers is stimulated, this stimulus is at once generalized by the central organ, and the entire organism participates in the stimulus. The process of the one small part is thus elevated into the process of whole, which is the act of sensation. The single member, being pricked with the point of a needle, causes the entire body to feel that it too is pricked; what hurts anywhere hurts all over. The animal organism centralizing and so universalizing each particular organ, however minute, within its own periphery, is sensitive, as it can sense each locality af-

fects on its surface. The Plant, having no such organic center and hence no such power of centralization, cannot make general what affects it, and hence has no general sensation, but only a partial one, in proportion as each vegetal organ may be a partial center. Thus it may be acknowledged that Plants have a limited and local sensation, as we may observe in the Sensitive Plant. To be sure, Animals differ much in this regard, according to the degree in which their organism is centralized. The cycle of sensation always sweeping from circumference to center and back again is what emphatically individualizes the animal organism, rounding it out in a perpetual process within itself and against its environment, which it posits as distinct from itself and separated. Thus the animal body within its sphere is a self-determining unit, yet keeps up a continual clash with external determination, from which it cannot wholly escape, especially as it draws thence its sustenance. Sensation is indeed a kind of consciousness, not yet internalized but on the way thither: its two sides fall asunder into separate organs which, however, return into each other, though externally, through the nerves. The process of the Psyche is at work in sensation, though not yet through itself purely, but incorporate in the body's

members. So, if sensation be a kind of consciousness, it is not yet conscious of it, not yet conscious of its consciousness, but rather of its outer organism—Psyche having not yet won its own form.

The Animal, having through sensation individualized itself as a whole in a continual process, will proceed to individualize in detail everything else that it does. It takes its food by bits, its air by single breaths, its water by mouthfuls. Thus the elements needful for its life do not flow in upon it in natural masses, but are first separated, divided up, individualized by its special organs. Internally the same process is continued till in the chemism of the body the ultimate unit is reached, the atom. But the Plant has not this peculiar trait, or less decidedly; it does not breathe, drink, eat in morsels, but uninterruptedly, or nearly so. Its relation to Nature is more immediate and unbroken, while the Animal breaks Nature to pieces before accepting it, and individualizes it more completely from its first seizure to its last assimilation. The Animal through its decisive individuality tends to make all that it touches individual like itself—that is its primal assimilation. It dares tackle and appropriates in its own way the primordial forms of the Cosmos, individualizing Space (in its locomotion), Time

(in its periodic food-taking and otherwise), Matter (in its various aliments). So too the Cosmos is being broken up into self-active units in the Animal.

The Animal feeds on the Plant and also on the Animal; that is, its food is not immediate and elemental like that of the Plant, but mediated, already organized. On the whole the Plant has to go in advance and prepare a green world for the Animal, which assimilates what has been already assimilated. The Animal is thus a second life which depends on a first life for its complete appropriation of the Earth and Sun, of the Cosmos and Diacosmos. Still the Animal cannot do without the immediate elements, such as air and water, nor dispense with the immediate radiants, as heat, light and electricity; that is, it has also a vegetal character; in fact, the Animal is all three phases of Nature—Matter (as being gravitative) and Plant as well as Animal, which last is the purposive outcome or perchance the aspiration of the other two.

Another distinction lies in the realm of sleep. The Plant is always dormant, even it has stages of dormancy. It cannot fully separate itself from its immediate relation to Nature, especially to the Earth, and become awake. Of course, when the sun withdraws, it may take a period of rest or have

a diversion of activity. The tree cannot lie down like man and go to sleep, for it is already asleep; that is, it is already in immediate communion with the Earth-life. So the Animal mediates its repose—sleep we may call a mediated repose, which alternates with the waking state. The Animal in sleep uncenters itself, gives up that centralized individuality and returns to its primal creative unity with Nature. This is signified in its prostrate position, which no longer resists gravitation but drops back into the original oneness of the Cosmos. It closes its eyes and all the senses, which take a fresh dip into that creative life-stuff, out of which they were originally differentiated. Thus in the waking struggle the Animal becomes exhausted and must return in sleep to the primordial reservoir of vital existence for a new draught. Strange, but every twenty-four hours the Animal must be re-born vitally. It goes back for a spell into the womb of its All-Mother Nature (not into that of its particular mother) where it is individuated afresh, apparently in every cell, which must be the ultimate seat of fatigue. Now the Plant never loosens its hold on the breast of Nature but keeps sucking, with possibly a light nap occasionally; it never gets fully differentiated into waking and sleeping; it never fully breaks its con-

nection with the life-stuff, till the tie is externally broken by death, though day and night make some change in the Plant, since the Earth-life is halved into a continual process of sleeping and waking by terrestrial rotation. The unborn Animal sleeps and feeds plant-like; it is passing through its vegetal stage, a kind of phytozoon on the way to the complete bifurcation of Plant and Animal, which hardly takes place before weaning. Sleep is, therefore, the animal's daily physical regeneration seemingly from Life's protoplasmic sources; the whole course of its evolution it has to re-enact every day, if it is going to live. Man has to lie down and embrace the bosom of his All-mother at full length, becoming an infant again, yea a Plant, till he touches the life-giving sources of the whole vital world, we may suppose. Re-born of the creative Universe daily is his living cycle in each round of the Sun, with whom he in his way sets and rises. Thus the act of the Animal individuating itself for hundreds of millions of years, has to be re-enacted by man with every diurnal whirl of the Earth. His whole line of living evolution he has to re-evolve in bed, or at least recuperate, otherwise he stops and goes back to the elements.

Significant is the fact that the Animal evolves the eye, which has the power of posit-

ing the objective world as distinct and existent, through the mediation of the light-waves. Thus the dualism between subject and object is no longer merely implicit as in the lower animals, but has become explicit, realized through vision, which produces this division. The eye makes the separation between the seen and the seeing, though it reaches not to the self-seeing, the higher act of the Ego. When the eye sees not only the glassy pool but also sees itself mirrored in the same, it is a kind of outer Ego, self-beholding indeed, but altogether on the outside—a forecasting dream of the real Ego thrown upon the external world.

Also the Animal evolves a voice as it advances into its higher stages, and in correspondence with its voice a more fully organized ear. The two organs are in fact counterparts, symmetrical if not in form at least in purpose, and conjoin their separate possessors in a common feeling, however slight. Thus the Animal not only has sensation within the organism but can throw it out, can utter it to another organism which thrills in response to the same sensation, whereby the two become one in a degree and are associated. The self-movement of the living body is concentrated in a single organ, the vocal chords, which vibrate the sensations of pain

and pleasure to other living bodies that participate in them through sympathetic throbs, being thus fused together into a community by means of feeling. The voice, accordingly, is a great instrument of association already far down among the animals; but its destiny is to rise to articulate speech which in so many ways associates human beings, and is itself a wonderfully organized or associated product. Language makes the community of souls possible through communication (or what makes several individuals *common*), and is itself the community which mediates the members of the communal organization, and finally is to make them conscious of the same through its utterance. The thoughtful reader will naturally think back to the beginning of Nature's association in the cell and follow this ever-advancing principle in the organ, in the organism, in the community of organisms both of Plant and Animal, till he reaches man's association in institutions, which have by no means yet reached their final evolution. Indeed man is hardly yet aware of his institutional heritage, but must soon become so, if he is to save it from the anarchic forces now at work. Here, however, the main interest is to see the evolution of the voice in the Animal as the chief medium of Nature's higher association.

The Organism of the Animal becomes sensibly heated even to itself, in distinction from the organism of the Plant, though the latter too has its heat-scale. The normal temperature in man is usually placed at about 99 degrees (F.), from which any considerable deviation is unhealthy. Other mammals vary somewhat from this norm; it is highest in certain birds, reaching 112 degrees (F.). The heat of the animal body is simply a result of chemical combustion; from this point of view our organism is but a chemical laboratory maintained at a certain degree of heat necessary to compose and decompose the various constituents of life; too much or too little heat would destroy the process. This thermal equipoise is maintained within by the higher animals both in the hotter tropics and in the colder arctic regions.

Biologists put stress upon what is called a morphological distinction between the Plant and the Animal: the former has a membrane or coat of cellulose (with some exceptions), the latter has no such coat (with some exceptions). Not much anchorage can be found in that distinction. A common physiological character is that both take food and transform it through chemism into function partly and into waste partly, the latter being thrown off as excretion. This process is often called

metabolism. The humblest unicellular Animal has already some kind of mouth for ingesting food, stomach for digesting it, vacuole for ejecting waste. The Plant has the same general process, but requires different aliment and employs different organs. This vegetal food is mostly liquid and inorganic; still there are not a few Plants which live on decayed organisms (saprophytes); organic life feeds also the parasitic and insect-catching Plants.

Suggestive in this connection is the dual character of the *Euglena*, an infusorian. Its assimilative apparatus is double, both that of the Plant and of the Animal, and it can employ either or seemingly both. It can take carbon dioxide and mineral salts by means of its chlorophyll, like a Plant. But it has also a mouth, gullet, stomach and vacuole, like an Animal. Which is it, Plant or Animal? Naturalists divide on the question. It is to be observed that this true amphibian (which word means double-lived), is not the early phytozoon, in which the Plant and Animal are not yet differentiated, but the bifurcation has taken place and the two lines have developed into pronounced difference. Yet in the present case these two lines, Plant and Animal, unite into a single living thing with a double organism, conjoint twins of Plant and Animal. Such a bi-corporal life seems unique but has its suggestion for what is coming.

The human body has its vegetal assimilation of liquid nutrition in certain organs, which can be used for preserving life when the stomach is incapacitated. Already it has been noted that man's organism has its Plant character, present but subordinate, which it is to transcend in order to be truly itself. The question arises: Can the Animal lapse to the Plant? Whatever science may say to such a metamorphosis, poetry has celebrated it repeatedly. Virgil introduces it in a striking passage of the *Aeneid*, where the human Plant is made to speak and also to bubble blood, though fixed in earth. Dante picks up the same incident and employs such a transformation as a punishment for the sin of suicide in one of the circles of *Inferno*. The *Euglena*, however, stands as the instance of a double-bodied Plant-Animal in the order of Nature.

It is difficult to draw a fixed line between Plant and Animal in form or function, for Nature has drawn no such line. Their difference is sometimes demanded when no differentiation has yet taken place. That is, the difference must first evolve, then it exists and can be given. When Plant and Animal are evolved into their typical forms, their distinction is just what has become manifested. In like manner the definition of Life is refractory till it defines itself or evolves itself

as distinct from Unlife. Still we have to think what Life with its various shapes is as a stage of total Nature, and formulate it just in its evolutionary aspect, which indeed manifests the lurking Psyche in the Physis, whereof much has been already said.

At present, however, we are to set forth the basic process of Animal-life, which process will also be seen to be psychical in its primordial source. This process will have the three stages which we have already noticed as forming the round of every living individual—Formation, Assimilation, Generation. Life has inherently this triple movement, be it vegetal, animal or telluric. As a living thing the individual has Form, and keeps forming itself after one and the same general pattern; but in order to form itself and thus retain its Form, it must also have Assimilation, which appropriates and makes like to itself the external and unlike. But this external world with which it grapples in Assimilation, is far vaster and stronger than it is, and will in time assimilate it the other way to Unlife unless it can reproduce itself in a wholly new individual, yet of its own kind—its offspring. Generation thus rises to reproducing not merely the single individual within its own organism, but a line of successive individuals through time,

manifesting therein a deathless element. Accordingly the Biocosmos must show these three processes of Animal-life in some detail.

I. THE FORMATIVE PROCESS OF ANIMAL LIFE. AS we are here at the start ushered into the presence of Form, we ask whence comes such shaping power? The question carries us back to the primordial individuation of the Life-stuff (Protobioticon), when the earliest living Form must have appeared on our planet. We have often noted how Nature, being the absolutely separated stage of the Absolute, carries out to the last degree of fineness her principle of separation, which is verily her deepest creative character. Such is the ultimate ground of individuation in the widest sense, inorganic as well as organic, and it is this individuation of Nature which gives Form, finally the animal Form, which still further culminates in the human Form.

That which first catches the eye is the Form of the animal, and this is what characterizes it externally, and puts it within certain limits or outlines not to be essentially changed. Every species has its basic Form, into which each individual of it falls, taking possession of it naturally, in his own right. Undoubtedly this Form varies, no two individuals of the same species are alike; then also there are abnormal variations, mon-

strosities in which the mould appears to be broken in places. Still Nature pours every living individual, Plant or Animal, into its fore-ordained matrix, within which it has on the whole very slight freedom of transformation; its external shape is fated. The human Form with all its differences is fixed on a common model, which without question has evolved, from lower animals; indeed scientists are correlating it more and more not only with monkeys but with fishes and even with worms. Such we may deem the primal Fate of Nature: she impresses outer Form upon all animate existence—truly her first act of individualizing Life. Man has to submit and to accept his Form as imposed; but he can ask the question: Will he ever be able to wrest this power from Nature and to build his own outer Form in correspondence with his inner freedom? It is said that this present Form of his is the highest visible manifestation of Nature, incorporating a gleam of the Divine Idea, and thus bringing to appearance the Beautiful. Or we may say that this human framework is the All-Self (Pampsy-chosis), revealed in the supreme shape of Nature. Hence its importance in Art, wherein it is taken to manifest the Godlike.

While in this way the Animal Form is fixed, it is internally very active, always reproduc-

ing itself. As living it must be re-making itself incessantly. Each organ and indeed each cell is ever bringing forth the whole organism which brings it forth. Every part is both means and end, the maker and the made, within its round of existence. So far it may be deemed self-end; still it is not the finality, it too must be subsumed under something higher, being a link in the great evolutionary chain of Nature, for the entire chain must be subsumed.

The Animal Form has also its periods of time stamped upon it indelibly—birth, youth, maturation, decline; thus it has its temporal as well as its spatial limits, both of which it posits through itself. Such we may deem the leading fact in this sphere: Form is imposed on the organism from without by Nature, but must be re-imposed by the organism itself from within—Nature's gift must be continually confirmed anew by the recipient, who has to make over into his own his external determination. The fateful Form must, therefore, be always reformed and renewed, if it is to live; to be sure, man can destroy his life at a stroke and turn his organism back into the elements. He can play suicide and become anarchist to himself. In his universal revolt against all Form transmitted or inherited, he may conclude to direct a blow at

his own Form, which has been thrust upon him by Nature without his consent, and thus to crown his negative career with his own final negation.

In such manner the Form of the Animal is cast in the mould of the species; each individual being nearly, yet not quite, the same. But this slight variation of the individual accumulates with the lapse of many generations, and makes new species; indeed all the diversity of animal Forms is now traced to the one primordial Form out of which have evolved the rest. Thus the individual, if time enough be given, can vary his mould of Form, though he cannot break out of it; he is seen to be a kind of Fate-compeller even within the limits of Nature. Darwinism has therein given a new emphasis to the individual. But to this slow variation of Darwin has now been added the sudden catastropic variation of De Vries (the so-called Mutation), in which the individual may beget not merely another of the same species, but of a wholly new species.

1. *The Animal Organism as a Whole.* We are first to take a glance at the animal Form in its entirety before proceeding to its external parts. Choosing man as the typical Animal toward which all Life has evolved, we observe his erect posture—the result of a long development in which the extremities (leg and

foot, arm and hand), have become differentiated into separate organs. The biologists of today are trying to obliterate the distinction between *Bimana* and *Quadrumana* on anatomical grounds; still the outer Form asserts itself and stands up. That is, it degravitates more and more through its inner force, rising from the earth, and seemingly therein less fated. But the animal body restores the line of gravity (in walking and leaping), it regravitates; thus it shows the power of locomotion, of change of place, in distinction from the Plant, which is rooted to one spot, though it too is often erect, and has a limited power of self-movement. The animal Form moves as a whole and localizes itself, occupying a new space, while the Plant is localized externally, and fixed in the same space.

Thus the animal Form has attained a certain inner supremacy over itself and shows a Will, yes Free-Will, even if incipient. Self-active from within we see the animal begin to be, and thus it has a center from which the total Form is ruled. The Plant is, on the other hand, inclined to be multicentral, without due subordination of its parts; each organ tends to be the whole of which it is but an organ. Here again we may recall Goethe's aphorism: "The subordination of the parts points to a more perfect organism."

To be sure, there is a long line of these organic Forms of the Animal from the microscopic unicellular blob of plasm, up to the diversely associated multicellular Organism. Still each of these Forms has its inner organization, even if at first largely implicit, till at last animal Form seems to have become fully explicit in man, and to have quite exhausted its trans-shaping power (see preceding pp. 39-41). The plastic possibilities of the original Life-stuff have been realized to their highest Form, it would seem, unless man himself can take Nature in hand and give to her a new lease of formative power. Hitherto she has simply evolved for many millions of years her own line of organisms in Plant and Animal, according to her own instinct. Or we may conceive that the sculptor of the long gallery of animals, who is none other than Psyche, finds no longer her plastic material adequate to her needs, and must transform the very Life-stuff furnished by Nature. Whispers concerning something of this sort are already in the air.

It is declared that invisible Life in general is greater quantitatively than visible, and that Forms of the unseen Animal outbulk the seen. Moreover this world of animated Forms is in a perpetual war with itself, the unicellular specially with the multicellular and organized.

Indeed our organism begins and ends with a microbe, and thus the Form of the higher Animal is a vast organization of Forms out of which it is evolved and to which it is resolved.

The universe as Pampsychosis has its counterpart, but still its part, in the multiverse of Nature, whose fundamental trait is this individuation of Forms, which thus reach down to the bottom of creation. But next we shall take one of these typical organic Forms of the Animal and watch it dividing, that is, forming within itself.

2. *The Animal Organism in Its Dual Symmetry.* That the higher animal is halved lengthwise and that these halves are clapped together into the one living organism with its process, has been observed by most people on their own bodies. This is known as bi-lateral symmetry, which is so prominent in the human organism, wherein Nature seems to be pushing her dualism to its extreme embodiment in order to make the completer unity of Form. A perpetual interchange and coalescence are going on between these opposite yet symmetrical parts, ever overcoming their separation, yet positing it again. The fact suggests, indeed adumbrates, the psychical process of division and return, though it is not yet the Ego. The conceived line of demarcation is called the median line, halving

the organism fore and aft into its two symmetrical sides, and therein duplicating wholly or partially many organs of the body. This bi-lateral symmetry becomes less pronounced as we descend in the scale of the animal world; seemingly it evolves with the ascent manward.

The Plant divides otherwise, though it too has its symmetrical counterparts, separating and growing upward and downward, at the ends not at the sides—which we may call bi-terminal symmetry. Moreover it strives outward, in root and branch and also in stem, spreading from its germinal center toward the external elements. But the two halves of the animal organism, even while growing outwardly, turn inwardly to each other and form their organic unity, centripetal rather than centrifugal, determined from within more than from without. Manifestly the Animal is getting self-centered within its own Form, though it as a whole has to obey gravitation. This organic concentration of the Animal culminates in its central organ, the brain, which, however, still shows the bi-lateral division in its two lobes.

In addition to this bi-lateralism the organism of the Animal has its dorsal and ventral sides, very different from each other, indeed not symmetrical. This difference is not pronounced in the lower animals, though it has

begun. The vertebral column determines especially the dorsal part and protects it passively, while the fleshy ventral part has active protection (arms and feet, senses, etc.). Again we see that Life unifies Nature's twofoldness; the outside is dual, but the process is one. We shall find that bi-lateralism reaches some of the bodily organs and not others; the ground of such a distinction is suggestive and will be touched upon later, when we have seen the prime organic differentiation of the Animal Form.

3. *The Animal Organism Differentiated.* From the foregoing dual formation of the Organism we return to the latter as a whole for the purpose of considering its constituent parts—Trunk, Extremities and Head. Now each of these parts has its own bi-lateral symmetry, though they are not symmetrical with one another. The three are constituents of one animal Form which is continually reproducing itself through nutrition. Each has its own character and connection with total Life: the Trunk is in general directed inward and is more vegetal, the Extremities are directed outward with power of self-movement and are more animal, the Head is the rounding out of the organism externally and internally, being directive and self-directive, and so is in itself more mental. Thus the human organism is a

resumption of all former Life, even that of the Plant, on which it largely feeds, a kind of recapitulation of vital forms from the protoplasmic starting-point. What a museum of antiquities is dug out of our body by the evolutionist, far more varied and older than those of Troy and Mycenæ! And still the excavation is going on with new discoveries.

Thus the Formative Process of Animal Life returns to its very beginning and re-enacts its whole evolutionary history in each individual, which physically bears in itself what its race has gone through and transcended. The Form is the storehouse of the archives of its past; so much we can see, even if the record has just begun to be deciphered. The outer differentiation of the animal Organism just cited indicates three great stages of Life's development which are now organically united in the one process of the Animal as a whole.

At present, then, we have to consider this outer differentiation which helps us organize first the animal Form—Trunk, Extremities and Head. Now these, in contrast to bi-lateral symmetry, may be deemed a division cross-wise rather than lengthwise, the threefold instead of the twofold division—the arm being somewhat refractory, having evolved to a member distinct from the leg. Of course we have in mind the typical human organism, to-

ward which all living shapes are advancing and which is their explanation. These parts cannot be called symmetrical, not any two of them, but rather the contrary; their relationship is far more internal than external. It should be added that their order is significant; though the head is on top, it is not first in an evolutionary or psychical succession; the Animal starts with a trunk in the cell, or for example, in the Amœba; the head proper comes last. So we think of this triune sequence of the divisions of the animal Form as Trunk, Extremities and Head. In the present sphere the main correspondence between the Plant and Animal lies between the Trunk of the one and the Stem of the other; both are in the middle, both are one and undivided in form, both show a cylindrical tendency, both separate into limbs downward and upward, out of both evolve the other two parts. The Trunk of the Animal and the Stem of the Plant were originally one and probably undifferentiated in the primal elemental Life-stuff (*Protobioticon*), in which their germinal separation must have taken place into Protozoa and Protophyta (for example, into the Amœba, the unicellular animal and the Bacterion, the unicellular plant, though biologists still differ about these characteristics.) Here we again remind the reader

that this earliest Life-stuff is an hypothesis (like Ether); also its first differentiation into Plant and Animal has never been witnessed, and probably will require other means for its detection than the microscope—perchance a new sort of spectroscope.

These three parts of animal Form have had, accordingly, a very significant evolution, both separately and together. The Trunk even in man remains nearest to the vegetal form and character. Respiration, Digestion, Circulation, which take place in the Trunk of the human organism belong to the Plant also, which has not the Head with its controlling brain, nor the controlled Extremities. In fact it took ages of evolution for the rising Animal to throw off the Plant-form. After the Protozoa there is a long line of living shapes which though animal in function are more or less vegetal externally—sponges, star-fish, echinoderms, even some of the mollusks. These may be well designated as the transitional Plant animals, being animal in essence but plant in appearance. It would seem that animal Form was of far slower evolution than animal Life. The first living thing to develop out of the original Life-stuff was probably a Plant, which differentiated in time self-movement and sensation and became an Animal, though preserving relatively its own shape. The en-

tire lower orders of Animals indicate still such a condition, and there is no reason why the evolution should not be going on now, even if we may not be able to detect it at some points, especially at the beginning.

At each of these parts we may take a separate glance, not forgetting that they belong together physically, yea psychically in one process.

The *Trunk*, then, is to be taken first, being still a kind of enlarged cell both in shape and function, a huge sac containing the organs of Assimilation which have been evolved from the earliest activities of the cell. Bilateral symmetry is stamped upon the Trunk externally, but not to the point of separating the two sides, which still make one concrete form. Internally the twofoldness of the Organism manifests itself in many gradations, even to the doubling of the organs, which, however, co-operate symmetrically (for example, the lungs). Still many of its organs are single. The Trunk is more the vegetal part of the human Organism; like the Plant it has its controlling principle outside of itself; that is, its organs have their final seat of authority in the Head with its brain. Will the human Trunk, having reached its present stage after æons of development, perchance from the original Plant-cell, undergo still fur-

ther development? The remorseless logic of Evolution would seem to demand that all Life be hurled into its seething process; man's body is to continue its transformation in the future as in the past. Some have thought that it is already completed, having risen so far from its first protoplasmic stuff; but who is going to cry halt to Evolution?

The Trunk is, accordingly, the primal most elemental part of the human Form. As the Plant largely sustains the Animal, so the seat of sustenance in the body is its vegetal portion, the Trunk, which is thus the purveyor for the higher activities of the brain, in due obedience to the same. To be sure, the Trunk with its nutritive purpose can get the upper hand of the whole Organism, and subject the Head, the master. But that is sickness, physical or moral, or both.

Next we are to see the implicit and undivided doubleness of the Trunk dividing and becoming twain, indeed two sets of twains in the two kinds of paired Extremities, which shoot off from the Trunk like roots and branches, though directed from a new center, the brain. The Trunk of the Animal is the stem of the tree, whose leaves are now internalized as lungs, and whose roots are also inside as intestines. Even the human Trunk cannot remove itself, so vegetal is it, but has to be

moved by the feet and hands, which have in themselves a stage self-movement and so are distinctly animal, being controlled directly or voluntarily by the central organ.

The Lower and the Upper *Extremities* they are usually called, as they shoot out from the lower and upper sides of the Trunk. Bi-lateral symmetry of the one member now becomes two-membered, doubly so; each side rays forth separately above and below. The bond which held the double Trunk together seems to break, and from each of its four corners it throws a limb. At this point the vegetal nature of the animal Trunk is again suggested, though the root and the branch have undergone a unique evolution into the leg with foot and the arm with hand. Of these the former still steadies and connects the Trunk with the earth, though not fixing the same therein; the latter still extends its flat leaf-like palms, though with the added power of grasping.

The hand was once taken as the distinctive mark of the human species (hence called *Bi-mana*), in contrast with next lower species of animals. The hand and the foot in their separate forms are connected with the erect position of man. From the beginning of the animal Form, it must have had the impulse toward elevating its head and standing upright.

Various reasons of utility may be assigned for the change, but the chief ground is the greater freedom, toward which the Animal and indeed all Nature are ever evolving, by increase in self-controlling and therewith in other-controlling. A second differentiation of the Extremities is into fingers and toes, and in case of the hand specially the third is seen in the thumb and digits, which distinction is slightly indicated also in the foot.

In general the principle of separation and differentiation characterizes the Extremities which have separated from the Trunk and have become external to it, though still attached to it. So they in accord with their principle keep on separating till the two arms unfold into a difference of their own as right and left. Herein we may see that the Plant with root and branch is not only homologous but remotely kindred, possibly ancestral. Thus the Upper Extremities carry differentiation considerably further than the Lower, and are much more versatile in their activity, not having to carry the organism (like the legs), but to mediate it in great detail with the outer world, being relieved of the heavy, burden-bearing work. The arm (especially the right one), is a skilled, light-moving workman, while the leg is a muscular, strong, but plodding day-laborer.

Peculiarly is the Hand the quick and confidential servant of the *Head* even in the matter of gesture, which often tells or emphasizes what the brain is doing. The one indeed is an outer echo of the other and sometimes has to take its place in the language of signs (for instance, in the case of deaf-mutes and of Southern Italians). Thus the Hand becomes a great instrument of association. Indeed automatically the Hand thinks with the orator, the actor, the performer on a musical instrument—a second brain-center. But there must be a first center of the kind, in fact the center of the entire system, to which all these differentiated Extremities return for control, and which returns into itself for self-control. So we come to consider the third part of the Formative Process of the Animal, which can only be the Head.

This is in shape and character the concentration of the human organism, indeed of all organisms from the humblest to the highest. It moves toward rotundity through the Vertebrates, even through the Primates. The body becomes sphered in the Head, centralized and rounded off in one of its parts, which is the seat of control, not merely of its own organism but of all Life. If we conceive the total Plant-world and the total Animal-world as one huge living thing, it would have the hu-

man Head which it has evolved as its ruler. To be sure all Life would be thus a many-headed beast, 1,700,000,000 such heads being on our earth according to statistical estimate.

The Head is, accordingly, the opposite of the Extremities, which are the separated, the decentered element of the animal Form, and which are specially directed from the brain. They have the prolonged cylindrical tendency even to the fingers' ends; their outer shape is thus like the Trunk, only more lengthened and lengthening. But from the drawn-out cylinder we pass to the concentration of the sphere, the Head, which is the embodied center of the total body, containing the central organ of the whole organism. So we conceive the circuit of the animal Form in its triune order—Trunk, Extremities, Head—suggesting outwardly the inner Process of the Organism, and more remotely of the Psyche, which stamps itself even upon the external shape.

The Formative Process of Animal-life, as it unfolds through the individual and organizes itself in him, we have now witnessed in its outer manifestation, which is also the reality and the impress of the inner type or norm. The final shape, the Head, we may well deem not only the topping-out of the animal world but of the entire Biocosmos, in a new kind of

sphere—a form which recalls the total Earth-life and likewise the microscopic beginning, the cell. The Head we may think as clapped on a tree-trunk (vegetal), which throws off self-moving limbs in the Extremities (animal), which, however, are directed from the top (mental). Such is the pyramid of Forms from base to apex which we may see in the human organism, a re-incarnation of the total line of evolution from start to completion.

The Process of the animal Form takes the organism in its immediate appearance, as space-occupying; but in this appearance is to be seen the external manifestation of the inner idea of the Animal. Now this Form is something given, already made; so we ask what makes it or forms it, putting it into this pre-established mould or type? Animal-life which keeps re-forming itself, must be continuously sustained from the outside. This brings us to a new Process of Animal-life, the second.

II. THE ASSIMILATIVE PROCESS OF ANIMAL LIFE. The first fact which strikes us in this new stage is its specialization into a large number of organs. The living organism is now organized in the greatest detail. Life in order to seize and assimilate the outer world employs an enormous variety of implements, which we at present have to classify accord-

ing to some principle of unity. This is, therefore, peculiarly the field of organic separation of the animal body, which may be taken as sort of workshop or laboratory with a vast diversification and refinement of apparatus. Still the unitary principle of the huge establishment must at least be striven for, and perchance we may glimpse the process of the whole and of its leading parts.

Evidently the Form of Life in order to keep itself alive must take and appropriate what is different from itself; it has to tackle the external world, and in its way conquer the same. Here then, enters the stage of difference, of conflict—the separative stage of Animal life, which we call Assimilation in its widest sense.

The Animal assails Nature in her three kingdoms—inorganic, vegetable and animal, making them over into its own self as organism, which thus gets the power of maintaining its ever-flowing circuit of bodily reproduction. The Animal assimilates the elements—air, water and some earth; but its chief food is the Plant, thus assimilating what has been already once assimilated and transformed from the elements into life. Still further, the Animal assimilates the Animal often, thus feeding upon a double previous assimilation, that of both Plant and Animal.

Edible meat has both these characters in it, and when it is eaten, one may suppose that it has the tendency to impart the special powers of Animal-life with increased efficiency, for instance sensation and self-movement, and doubtless volition. Purely Plant-consuming peoples would seem to be more like the Plant, with its single assimilation. The carnivorous animals are fiercer, have more will-power than the herbivorous. Animal evolution moves through flesh-consumers, that is, the consumers of food already doubly assimilated. If the first living thing was a Plant, there must have come the stage when the Plant began already to devour the Plant and thus to turn Animal. Possibly this has something to do with that primal differentiation of Life into Plant and Animal, or the transition from one to the other in the primeval protoplasm.

Accordingly man (unless he be a vegetarian) in his appropriation of the external world for sustenance, takes up the unassimilated element, the once assimilated vegetable, and the twice assimilated animal. All three he transforms into his body in order to live; he cannot now be nourished by the Inorganic alone, as the Plant is, yet with some special exceptions; nor on the Plant alone as some animals are; nor on flesh alone; he has properly to go through the whole process of the

Life-world as to diet in its ascent to himself, with its three assimilations, the last one being his own. Thus man already eats largely pre-digested food; nature for millions of years has been preparing his table, and so to speak cooking his dinner of meat and vegetables. Man's nutriment is, therefore, the result of æons of evolution; seemingly starting from that first push out of the Inorganic to the Organic. Also his organs of Assimilation have been adjusted to his gradually evolving diet, and have evolved in proportion. Each human organ has, accordingly, its evolution, which can often be traced backward through the line of animals to the protozoon, perchance even into the protophyte. In the simple act of eating his meals, man partakes of the total development of the living things of this earth, he appropriates to himself a bit of Life universal.

It may be stated here that Assimilation as now used, means the reproduction of the same organism as already given and existent, not the reproduction of another organism or a new individual. The latter belongs to a different Process, that of Generation. The term *reproduction* is often applied to both Processes, the assimilative and the generative, and must be employed with care to avoid ambiguity. Still the thought of Life's repro-

duction is itself double, being on the one hand the renewal of the body within itself (self-regarding), but also the renewal of the body in a different individual (other-regarding). Thus we see Assimilation and Generation tied together both in word and thought.

The association of cells into the organ has been repeatedly noted in the previous account, and their peculiar power of adjustment. But here the remarkable fact is the association of organs into the highest organism of Nature, correlated and co-operant in one living body which, however, in its turn will show the same associative principle. Animals form societies, not merely those of one species but of different species, till man enters and caps the associative gift of Nature with his social institutions. Beginning with the cell animal life has shown a never-ceasing push for association; and the same has been already noticed in the Plant-world. This inner bent or propensity of all Life—What is it? Whence? Whither? Already we have challenged the work of that unseen Psyche lurking in the seen forms of Physis everywhere and driving it forward step by step toward an end—truly the end of all Nature, which is to transcend Nature.

At present, however, the vast organic variety of animal Assimilation is before us for

some kind of ordering, which may carry a little light through this chaos of particular organs. In the preceding process of animal Form, we specially characterized the Trunk in its outer relations; but now we are to see it as the chief seat of inner Assimilation, vegetal in shape and function. It is the part which ingests and digests and distributes the material brought to it from the outside, working internally and immediately through internal organs. Such is the first stage of what we here designate as the assimilative Process of Animal-life, its most direct, immediate phase, making the outer and different into the inner and similar. But now comes the opposite act of Assimilation; it produces also organs directed outwardly, which have to meet the hostile external world with both defense and offense—warding off its attacks as well as seizing a portion of it for food. But this is not all: the organism, to be directed outwardly for its own end, must be centralized in an organ, the brain, which directs inwardly as well as outwardly, and which thus becomes the center of the Organism as self-directed, which term expresses its supreme attribute in the present field.

We may in brief recapitulate the three stages of the Process of Assimilation: the Organism as inwardly directed (1) as out-

wardly directed (2), as self-directed (3). The work of each of these stages embraces a number of organs which likewise must have their processes larger and smaller. Here only a few of these can be given, since they are specialized almost to infinity. But at present we are to grasp in advance the sweep of Assimilation: from seizing and swallowing the object to sensing it with vision, from a real to an ideal appropriation of it, from assimilating it destructively with mouth and stomach to assimilating it constructively with the eye, which is also an assimilative organ of the higher animal. Such is the middle or mediating process of Animal-life, which we shall now set forth in its more obvious factors.

1. *The Organism Inwardly Directed.*

Taking the human body in the work of Assimilation, we observe that its primary direction is inward from the outside; it turns from the external world to its own fabric with some article of food, which is pre-supposed, is gotten, and is internalized into the living structure. Such is its immediate dominating fact, that of sustenance, which it cannot obtain from itself permanently, but must seize and appropriate as its other, as its opposite. The unicellular organism is practically all stomach, which has a certain ability to make itself into other organs according to its need, being

implicitly the whole of them. The immediate material taken is not entirely used; it is analyzed, separated into the useful and useless, the latter being finally thrown off as waste.

First in order comes the *Digestive System* in its entirety, which embraces a flexible line of organs strung along and connected with the alimentary canal, through which the food passes from stage to stage undergoing many changes, as if in a chemical laboratory. The mouth starts with the first act of division which the teeth continue, till mingled with saliva the first pulp is formed and driven down the œsophagus. In the stomach the chyme is prepared by additional processes, and then follows the chyle, a milky mass which the intestinal absorbents separate, taking up the nutritious part and passing it into the blood, while the non-nutritious part is rejected. Physiologists say that the proteids and sugars (carbo-hydrates) are stored first in the liver whose automatic action turns them over to the blood gradually, as they may be needed; while the food-fats pass by their own line into the blood. At any rate the end of the Digestive System is attained when the product of all its manifold organs is turned into the circulation.

The next fact, accordingly, is the distribution of the digested aliment to the every point

of the organism, which feeds on it. This is done by the *Circulatory System*, whose chief function is to divide up and to apportion what it receives from digestion. Two fluid materials are poured into it: the newly digested chyle and the old venous blood. There seems a tendency to duplicate the organs in this system, in contrast with single organs of the Digestive System.

Circulation starts with the lungs in which aeration of the blood takes place; this gets oxygen and can burn, releasing force like the heat of coal. Then this fire-bearing fluid (temperature normally a little less than 100 degrees) is pumped by the heart to every part of the body through the arterial pipes. Passing into and out of the capillaries quite extinguished, some of it returns to its source for a new oxidation through the air.

The blood is constituted of a watery part (plasma) in which float three kinds of solids: corpuscles, red and white, and the so-called platelets. The white corpuscles, under the name of phagocytes are now regarded as the standing army of the organism, whose duty it is to assail and destroy the intruding foes, especially the bacteria who are always making incursions. Sometimes one side and sometimes the other is defeated with the corresponding result of health or disease. Also

the white corpuscles perform the function of police and remove all disturbing substances. Malarial fever is produced in the blood by a parasite which comes from the bite of a certain kind of mosquito (anopheles). The average man contains about six quarts of blood. Noteworthy is the fact that the organs of circulation, lungs, heart, blood-vessels, have the tendency to be double in correspondence with the bi-lateral symmetry of the whole body. On the other hand the organs of digestion have the tendency to be single (stomach, pancreas, spleen, liver though lobed, and the intestinal canal, though of several sizes and forms). Digestion is a more primitive, vegetal function than circulation of the blood. Also the digestive organs seem on the whole less amenable to the central organ (brain) than the circulatory, in which fact the Plant is again suggested. The word *circulation* implies the circular movement, which is in decided contrast with the digestive movement.

Connected with the round of the blood is the lymphatic circulation, which starts in the capillaries with the watery part of the blood (plasma), and floats in a perpetual bath the cells of various tissues, bringing to them nourishment as well as carrying off their waste. The lymph is always accompanied by some soldiers, the white corpuscles (the aforesaid

phagocytes), for the evident purpose of attacking any foreign trespasser, bacterion or other assailant, who may be met with on the way. The lymphatic vessels, after completing the round of the body are collected into two main ducts which empty into the jugular veins, whence is repeated the cycle through the blood, capillaries and lymph. Thus the Circulatory System as a whole is composed of three parts, arterial, venous, lymphatic. The perfect blood, flowing to the capillaries, does there its work, and is separated into its venous and lymphatic parts, each of which in its way returns to the primal perfect blood by a new distribution through lungs, heart, arteries. Such we may call the process of circulation whose function is to distribute in its round the store of sustenance prepared by digestion. The Circulatory System is thus a kind of middle-man or mediator to the Organism, strictly producing no food, though cooking it over, and then carrying it to the consumer. Compared to the social order, digestion is the farmer, while circulation is the merchant. Indeed the farmer gets his food products from the elements, while digestion gets them from the farmer chiefly.

Finally is the *Excretory System* which has to clean up and carry off what is called the waste of the body, to eject the rejected mate-

rial. This waste is mainly composed of worn-out tissues, ashes from the incessant combustion going on, gases from the chemical laboratory in every part, refractory portions of the original food, various secretions for helping the work of cleansing, and then a flush of water oozing at every pore. Here we see the primal sanitary police established by Nature, but to be sharply looked after by every man who cares for health and working-power. The body has a marvelous instinct of getting rid of its own filth, but needs also intelligent help from the brain. Every organ probably has some ability to excrete its own offal, but the organism has its special officials for this business, chiefly the lungs, kidneys, intestines, skin, all of which have other duties also. It will be noticed that the social Order, especially the City, with its Board of Health and system of sanitation, with its sewers, garbage carts, sprinkling, etc., has simply objectified into an institution the working of the human Organism. Associated man takes his instinctive cue from the association of organs in his own frame-work.

With the Excretory System the Organism directed inwards, which started with internalizing the external world or a part of it, has now turned outwards, and thrown back into that same external world what it has not

wanted. Thus the complete cycle of Digestion, Circulation and Excretion has rounded itself out, having in general come back to its starting-place. The fluids, gases and solids excreted by the body will be again subjected to Earth's process, and transformed to the elements which may once more be wrought over into Plant and Animal. In fact the whole body is destined to be restored to the elements from which it was taken.

Such is the first stage or act of the Assimilative Process of Animal-life, in which the Organism is directed inward, till it finally divides its appropriated material, and throws outward what it cannot use. Thus the inward-turning Process has begun to turn outward, and will demand and create its own set of organs for completing the work of this new direction. Moreover a new character will be developed by this second stage of Assimilation, less internal and self-dependent, more subordinate to an outer central control, and hence more deeply associated with the total Organism, with which it is more directly and completely connected. Less able to live an unseen inner self-contained Plant-life, it will turn more to action, being the direct instrument of a centralized will.

2. *The Organism Outwardly Directed.* Already we have noted the Extremities (arms

and legs) as a division of the external Form of the human body, whose members sprout out of the four corners of the Trunk. The latter is the chief seat of the preceding Process of inner Assimilation, which takes place inside; but now that same Trunk sends forth limbs which are largely employed in the work of outer Assimilation. Such is the present counterpart to what has gone before. Indeed that inner Assimilation is quite helpless against the external world which must be seized and appropriated, and which must be guarded against in its assaults upon the Organism. Thus we come to the continual pitched battle between Life and Unlife, as well as between Life and Life in the grand struggle of individuals for a share of Life.

In this realm of external conflict, the first organ is one of protection, the enveloping wall of the fortress—the skin which is directed outward in a passive defense, yet also directed inward as already noted. Next we place the skeleton with its bones, the upholder of the Organism within and without, for offense and defense. Finally the muscles form the system of ropes which direct the bones and the whole organism in its varied movements within and specially without in locomotion. These three organs or rather systems of organs, while they have also their

internal relations, tend to externalize the internal, to meet the incoming world, in defense, attack and appropriation. These points we may draw out a little.

The outermost part of this external stage of the organism is the *Skin*, or the corporeal integument, close-fitting and protecting the naked tissues underneath. It is in many respects the contrast to the *Bones* in the present division of Assimilation; it does not hold up but holds in; still it has likewise a non-vital element, especially in the nails and hair, and it sloughs off the outermost cover of itself. Thus the *Skin* divides into an inner layer (dermis) vitally organized, and an outer layer less vitally organized and wearing away into the inorganic part (epidermis).

The *Skin* besides its protective character, is both absorbent and excretory, and it is capable of a little round of nutrition in itself with mouth and stomach. But outwardly it is the dividing surface between the organism and the elements; it outlines the individual body in the world, holding and defending all the other organs. Among mankind it is colored variously, and this color of the skin is the chief outer mark of the distinction of races.

Next in this sphere we place the system of the *Bones*—the framework of the Organism

which is the solid basis for all movement of the soft parts outward, and by which they are borne along. Also it contains and protects the inner organs with a surrounding rampart. The human shape it holds upright, and therein suggests the evolution from the lower animals. Moreover the Bones are the earthy portion of the body, though somewhat organized.

The skeleton gives the division already noted in the outer shape—Trunk, Extremities, Head—two hundred and six bones being usually counted in the body. Thus it is chiefly what determines the external Form. But it has evolved, so there is something determining it—evolving it toward an end. The skeleton thus becomes an important criterion of evolution, especially the vertebral system with its skull.

It is the skeleton which must evolve into the upright posture and carry the body as a whole with it, which otherwise would fall to the earth in a mass. The skeleton is what rises up in opposition to gravity; the earthy matter is organized against the earth in a degree, and to this new earth the rest of the body clings. So far then the organism degravitates, obeying its own center, yet as a whole it still gravitates. Significant is it to see the skeleton evolve in the lower orders

into existence, then rise from its horizontalism (or subservience to gravitation), to perpendicularism. But is this last the final form?

The Trunk is on the whole the least protected part, the head is the best protected, the Extremities are the active protectors as well as the assailants. Still the skeleton cannot work of itself, the bony fortress must be manned with a working garrison.

The immediate movers of the Bones are the *Muscles* in which are stored the energy for such purpose. To every bone are attached two or more muscles for directing it back and forth and perchance otherwise. Five hundred and twenty-six skeletal muscles are found in the human body. Now this muscular energy does not start and go of itself ordinarily; it is stored and has to be kindled, like a piece of coal; or it must be oxidized, when it too gives off heat. Blood is the agent.

But the control of this process lies in the nerves which penetrate these numerous muscles everywhere, some of which, especially those of the Extremities, are under the control of the will, while others are involuntary. Thus the Muscles are an intermediate principle, the directive implement of the whole organism, which we may liken to a system of pulley ropes; these must have something to

pull, and also something to pull them in turn—a still higher directive agency.

The Muscles connect the Skin with the Bones locally, and are protected by it from the oxygen of the air which is to reach them through the lungs and blood. The Skin thus prevents the Muscles from taking fire on the outside and then burning up without the order of the central authority, which is brain and nerve. So the skin is the excluding agency, limiting not only to form but to function, turning the organic process inward, shutting off the process outward.

Through the Muscles the Organism has now gotten a directive energy, which is distributed to the organs of the body, but which especially lays hold of the Bones and works them in accord with a purpose. The Muscles are the laborers who indeed perform the task, but who have to receive their commands from a higher authority, with its system of messengers going and returning. Therein the Muscles pre-suppose a new directive center, which must likewise have its seat in an organ.

At this point, then, the Organism directed outwardly in Assimilation comes to its limit, and organically through the nerves of the Muscles passes over into a new field. It is seen to be under direct control of a superior power which must next be sought. Meanwhile

we can look back and observe that Skin, Bones and Muscles form a whole with its process in conflict with the external world. They are the defenders, upholders and providers of the citadel of the individual which must be protected and nourished from the outside realm of Nature. Still such action is not automatic and involuntary like a great part of the Organism inwardly directed. Next we must ascend to the fountain of this new directive energy.

3. *The Organism Self-directed.* We have now reached the control and centralizing activity of the total Organism—the Nervous System, with Brain and Spinal Cord. Hitherto there has appeared a multiplicity of organs which we have sought to co-ordinate in our thought; but now they are to be co-ordinated by one of themselves; that is, all the different organs are to be unified, and this unification is to be the work of an organ. From the center the lines or nerves run out into every minute part, to the corporeal periphery, and then they return to the center; thus a vast number of circuits going and coming are interwoven through the body. The Nervous System is a System of Cycles separating from and returning to a common point which controls them all, and through them the other parts of the Organism.

This is, therefore, the universal organ penetrating everywhere within its sphere, and yet a particular organ too, whose function is to unite all the particular organs, to subordinate their particular separative character, and therewith its own. We may call it the organ of all organs; specializing visibly, it must also visibly universalize all specialized organs, including itself. This double part it has to enact, yea to organize sensibly.

The Nervous System with the Brain directs the outwardly directed and the inwardly directed organs of the body, and directs itself therein. So we see the perpetual round of nervous action whose image is realized in the above-mentioned cycles. As every point of the Organism in its separation must be hunted up by a nerve and joined to the center, there arises the surprisingly large number of nerves in the human body—499,500, some have estimated. But the very object of this enormous differentiation is to overcome differentiation, to bring back all these differences to unity. Still this has to be done outwardly, materially, by an organ; thus the Nervous System with the brain is the highest visible manifestation of the Universal incorporate; or it is the Psychosis materialized, as far as this can be brought about. Noteworthy is the fact that the seat of the psychi-

cal Process indicates or pre-figures in outer form so closely just that Process.

So we have the Directive or Administrative System of the Organism, which directs the directed inwardly and outwardly, and is both along with itself. These three Systems constitute the complete process of Assimilation, which keeps pouring the outer world into its mill and working it over till it be transmuted into the mill itself, which becomes thus self-working and self-active, getting the food which enables it to get such food, assimilating the unassimilated till this assimilates also. The stages of self-direction with the corresponding organ may be summarized as follows:

(a) Self-direction organizing itself in its special organ *The Brain*, which consist of the Cerebrum, Cerebellum, Medulla.

(b) Self-direction, reaching out to the rest of the body and controlling it—Spinal Cord with two lines embracing the inner and outer (peripheral) organs.

(c) Self-direction reaching forth to the world outside the organism and ideally getting control of that (or assimilating it), as in the sense of vision. This is a return to the previous external world, but not to use it as aliment for the body.

(a) The Brain is the organized center of

its own Directive System, and of all the other Systems of bodily organs. But the Brain too is still further organized of System within System, refining itself more and more toward the Psyche, which is the final creative point of Assimilation. Still its bi-lateral symmetry is ever present, the inerasable stamp of Nature—the outwardly separated parts becoming one.

This separation is likewise indicated in the two kinds of matter of which the Brain is composed—the gray and white, or the outer and inner, which, however, coalesce in a kind of medium. The gray matter is made up of nerve cells mostly, while the white matter which underlies the gray is constituted chiefly of nerve fibres, which grow out of the nerve cells.

First in order, the *Cerebrum*, co-ordinates all the manifold lesser co-ordinations with supreme authority, with Will. It directs the rest of the directive organs—it is the direction of direction, and hence ultimately it is the self-directed, and imparts that characteristic to the whole organism. In the *Cerebrum* is the supreme turning-point from the sensory to the motor power, from inwards to outwards, from afferent to efferent nerves. These are composed of two distinct kinds of cells, to which is added the third kind called associa-

tional—connecting cells of the Cerebrum, which alone has been estimated to contain more than nine thousand million cells—the very image of infinite particularity unified through association, or made universal though still in a particular way or organ. The Cerebrum may be deemed the creative prototype of all human association, being itself so completely associated in its minute cellular division.

The *Cerebellum* is supposed to be the seat of the co-ordination of the actions of the muscles and of other organs. Many muscles have to co-operate in walking for instance; then again the muscular System requires respiration for instance, which has its primal automatic control in the Medulla. The *Cerebellum* is composed of white and gray matter, like the Cerebrum, but somewhat differently arranged, having not so much an originative as a regulative power. An animal deprived of its *Cerebellum* cannot make its muscles co-operate to one end, although these may show irregular movements. The many muscles required to give a sudden leap must be subordinated for the single act: this subordination is the work of the *Cerebellum*, which is in its turn subordinated and has to obey the commanded purpose. Thus it is double, governing in one direction, yet being governed in another.

The *Medulla* has chiefly control over the functions of the inward-turning organs of the Trunk (lungs, heart, stomach, etc.). It works automatically from within, not reflexly from without (reflex action properly starts inward from the skin). Also it works continuously, not subject directly to the Will. Still it does not act independently for it too is associated with the rest of the Organism. In general the *Medulla* is in control the vegetal part of the total System, whose action lies inside the thorax and abdomen, and cannot be interfered with by volition. Thus it is generally recognized as the co-ordinating center of all involuntary activity, or of the Organism inwardly directed in Digestion, Circulation, Excretion. It contrasts with the *Cerebellum* which co-ordinates mainly the outward-turning organs which have the battle to fight with the external world for food and defense and so must be under direct control.

Putting these three parts of the Brain into an order, we see a return upon the whole organism, of which the *Medulla* is the co-ordination of the inward-directed part, the *Cerebellum* of the outward-directed part, while the *Cerebrum* is the co-ordination of these co-ordinations, and likewise of its own or of itself. Here then we may see the primal seat of organic self-direction, which has three phases or

cycles; the self-direction of the Cerebrum, of the total Brain, and of the total Organism. Still the latter is not governed directly always from the three brain centers, but has its own center, a sort of second or subordinate Brain situated almost wholly in the Trunk itself.

(b) This secondary System of centralizing and directing the Organism or parts of it, has many ramifications, but may be looked at in three main divisions—the Spinal Cord, the so-called Sympathetic Nerve, and the Nerves proper, or the Neural differentiation, which embraces the peripheral System on the surface of the body. The general character of this secondary System is meditational, lying as it does between the immediate organs of Assimilation and the supreme organs of control. In fact the whole sphere is one of intricate division and specialization; the Nerves are indefinitely specialized for each little part or purpose. Every region of the body's surface has a different degree and kind of sensation for instance, and this is a neural differentiation.

The *Spinal Cord* has the double duty of reflex action and at the same time of transmission of the stimulus to the Brain. It is itself a reflex center of afferent and efferent nerves, yet is also connected with and subordinate to the cerebral center, to which likewise there

must be a going and a returning. The Spinal Cord is cleft lengthwise by a fissure which quite halves it, the two parts being united by a little neck of gray matter, while the white matter lies on the outside of the cord. The motor fibre from the nerve is what makes the muscles contract.

The two lines of the *Ganglionic or Sympathetic System* have to do with the viscera, the inward-turning organs. They branch from the spinal nerves near the spinal column and form a row of ganglia on each side of the body, and the two rows unite in one ganglion at the pelvis. They resemble two knotted ropes suspended on each side of the spine and tied together below—an inner and outer spinal cord controlling inner and outer organs of Assimilation. Hence there is a sort of duplicated Spinal Cord, the outer being protected by its bony walls. These nerves are respectively called the cerebro-spinal and sympathetic Systems. The main ganglionic line divides into subordinate groups of ganglia forming an intricate network known as plexuses (for instance, the solar). Crawfish and insects have chiefly the ganglionic System and thus indicate a starting-point of nerve evolution.

The work of the *Nerves* proper in the Organism has been often compared to that of the Telegraphic System with its thousands

of wires penetrating every portion of the country, and combining it into centers small and large, whereby the minute intercommunication of part with part and of these parts with the whole is brought about. The nerves are accordingly the means of the complete association of all the separated members of the body, even to the cell, interconnecting every point in the Organism with the series of lower centers, till they reach the seat of supreme authority. The cranial nerves go to the Brain directly, as they lie nearest, but the vast multitude of the other nerves show a gradation of control, a kind of hierarchy, which orders, correlates and unifies the corporeal activities, internal and external.

The great fact, then, of the large population of Nerves is Association, which is here realized in its highest organic potence. Taking the cell as the least and final individuation of Nature, billions of units in one Organism, the Nervous System as a whole is what co-ordinates and associates them. The preceding secondary Brain, as we may call it, embracing the three Systems—the Spinal Cord, the Sympathetic Nerve, and the Neural Differentiation ramifying in all directions and individuating as if in correspondence with Nature herself—has now completed its mediation, outer and inner, has connected the outside

or superficial as well as the inside or visceral parts of the Organism with the Brain which, as self-directed, is the seat of all other direction. At this point then comes specially the relation of the Organism to the outside world.

(c) This relation (say of man's body to its environment) varies much, and hence differentiates itself variously in the Organism, whose differences in this regard have long been known as the Five Senses, which have seemingly evolved from the simple primal cell-sense, one as yet and not very pronounced, though certainly manifested. So the nerve-ends of the bodily periphery become specialized in the course of long evolution for adjusting the Organism to external conditions. Again rises the question as to what ultimately works this transformation. In general it would seem that the Nerves are most susceptible to this evolutionary power, being the chief means of vitalizing into the highest forms of Life the lower and even the non-vital forms. It is Psyche again overcoming the vast separation of Physis and restoring the ultimate One.

This field we may call Sensuous Assimilation, in which the outer world is taken up into the central Brain through the Five Senses (sometimes more are given). This furnishes knowledge or ideal Assimilation, not ali-

mentation or bodily Assimilation, which, however, the same center controls. The object now begins to be assimilated to the Psyche directly, not to the Organism—one begins to know. *Touch* is the Sense of immediate contact with the external object, and varies much in different parts of the body. Next we have *Taste* and *Smell*, which sense the object dissolved in liquid or air, but still in contact with special organs of the body. Finally *Hearing* and *Sight* are Senses of the object at a distance, but taken up through waves of air or light. Theoretic, constructive, ideal Senses they have been named from this attribute.

Thus the realm of the Five Senses with their sensations concludes the process of the Organism as self-directed, starting from the Brain and reaching through the Nerves to the outer world and then through the Nerves returning to the Brain. Such is the cycle of organic self-direction which, however, is but a stage of the larger cycle of Assimilation, which cycle, beginning with its immediate act of biting and digesting food, winds up with assimilating the object ideally and at a distance as in sense of sight. Thus we conceive the assimilative Process to extend from swallowing the object to knowing it—from a real to an ideal Assimilation—the latter returning to the world not for physical but mental food, perchance to find the Psyche therein.

At this point is concluded the second stage of Animal-life, the assimilative, which has unfolded itself in three main processes: the Organism inwardly directed then outwardly directed, and finally self-directed. All these processes have the same general object: to transform the outer world into the inner Organism which does the work of transformation. But now the opposite has to show itself: this inner Organism makes itself outer or another; from transforming an object into itself, it proceeds to transform itself into an object. It not merely assimilates but generates. In Assimilation the Organism has reproduced itself within itself; in Generation it has reproduced itself in another. In the one case there is appropriation, in the other there is impartation. We may call the first case self-regarding (individualistic), the second is other-regarding (altruistic).

We may conceive Generation to be Assimilation turned about and rounding itself out to a whole; the Organism assimilates itself to a new entire Organism assimilating. This is the inherent logic of the transition: when the principle of Assimilation is applied to itself, or made universal, it can no longer one-sidedly subsume the object under itself, but must also subsume itself under the object; the Organism, from making the object like to itself,

must pass to making itself like to this object, or generating another like to itself. The thing assimilated is transmuted into the thing assimilating.

Thus we may again see that reproduction is of two kinds: assimilative and generative, and can be regarded as forming a bridge of transition from one to the other. In the first case it overmakes the world into itself, in the second it overmakes itself into the world. Thus in the last instance the Organism gets to be a kind of world-maker within its sphere; it recreates itself creating, and so manifests what is now known in biology as genetic continuity. This fact in its organic manifestation is what must be next set forth.

III. THE GENERATIVE PROCESS OF ANIMAL-LIFE. The present stage, as the third in the movement of Animal-life, reveals itself as a return to the Formative Process already set forth. The Form of the Animal was there (in the first stage) taken up as something given or pre-supposed; but now that given or immediate Form is to be seen bringing forth itself in a kind of self-mediation, reproducing itself through organs. So Generation goes back to Formation, ever re-forming the body of the Animal according to its pre-established norm, of course with some variations. The Generative Process, accordingly is a phase of

that creative individuation, which belongs to all Nature, is indeed the very soul of Nature sprung of her primal separation from and in the All. For we may deem Nature the Multi-universe born of, yet remaining in, the Universe. Each living unit has this universal power (or power of the Universe) of separating itself into many individuals. So far back we trace Generation, to its primal source, which must be the Generation of all Generation, in which the Animal as genetic individual participates, thus showing itself to be an organic member of the supreme original Totality—the Part sharing in the Process of the Whole.

The Animal likewise has its norm or ideal prototype transmitted from individual to individual, which fact is realized in the vast repetition of shapes, each of them being a sort of copy of the originative norm. Every Organism as genetic has an immortal part which is just this animal norm and which it hands down to its offspring. Still every individual has a mortal part; it is pre-formed, limited, fated, transitory; it goes through its fixed period of birth, maturity, decline, decease. Yet it has the power of re-making and projecting this individuality through time indefinitely, and thus has an eternal element.

So the Organism through Generation keeps reproducing the pre-established Form of the

given species, or more remotely the original Animal-form itself. That Form seems superimposed upon every living individual, whence comes it, and what does the act? It is one phase of the total manifestation of Nature as individuated or separative. Yet this individual as Organism insists upon not remaining merely individual but also upon sharing in what created it, that is, in its own creation. So it becomes generative, turning back to its genetic source; what makes it, it must make likewise. Thus it breaks over its individual limits, reaching backward and forward in procreation; it makes itself universal organically (not spiritually). Even our body longs to burst its barrier of Form (in its genetic desire) and to re-make its own Form.

Assimilation, having satisfied one sort of appetite, begets another, its counterpart and complement. The Organism in its assimilative stage has reproduced itself as something already given and existent; but now it seeks to reproduce its own reproduction. In Assimilation the Organism takes for granted in impulse its own origin, but now it pushes to originate just that origin: it can not stay a part of itself, but must be the whole of its process, must instinctively seek to be universal. Though already born, even the animal body is not content therein, but proceeds to

re-bear its own birth. Such is the supreme desire of the body: it feels itself a part and is unhappy till it integrates itself; or it feels itself in prison, till it breaks out and reconstructs its prison; it is a slave in Assimilation, but is free in Generation (or relatively so).

As the relation between the assimilative and reproductive processes of the animal Organism is the most significant of this whole sphere, we may employ still another set of categories to designate it: potential and actual. The Organism in Assimilation renewing its own ready-made tissues, is potentially creative or reproductive; it renews itself as old, as given, as unseparated within itself. But when it renews itself as a new individual it is really new, creation is actual, reproduction is realized in the separated Organism which is no longer merely potential in the first Organism. The Generative Process is thus the true realization of what Life assimilates, completing such Assimilation into a whole. Even the body will totify its own hunger, and altruize its selfish craving.

These expressions suggest a higher sphere, the social order of man. The socio-economic institution springs from the need of nutrition and assimilation in the human organism; yet

it is when taken in itself, an institutional organism, the association of many individuals for the purpose of satisfying their basic organic wants. Civilized man does not gratify his bodily needs immediately, but through the association with his fellow-men. Already we have noticed the association of all the organs into the organism, and of the cells into each organ, so that Nature gives not only the hint, but the instinctive propulsion to human association. In like manner the fundamental concept of Ethics is suggested by the organic action of Assimilation and Generation, though both are to be subordinated in the still higher ethical relation.

The culminating work of Life as organic is the generative Process of the highest animal, whereby this reproduces the Form of itself in a new individual. It is thus self-begetting, propagates itself through duration, and in a way eternizes itself. We may say that the Animal now breaks out of its own fixed and otherwise impassable limits of Space and Time—its bounded shape and its periodic life—and posits itself in new limits of Space and Time. Thus it transcends those primal elemental restraints of Nature (Space and Time) and to a degree determines them to its purpose. We may here conceive the Animal as going back to its first given Form and

re-forming that, and thus re-making its first appearance (see the above Process of Animal Form).

Looking again at the foregoing Process of Assimilation we note that, though it reproduces its own given body, it cannot reproduce its starting-point, it cannot recreate its total self. The outcome of Assimilation is to reproduce all the separate organs of the body; but now the Animal must advance to the reproduction of this reproduction; the individual as a whole (not merely in its organic parts) is to be reproduced and to unfold through its period. The Animal as complete is not only to generate itself as begun but also as beginning—which is the true generation. To assimilate simply is to patch up the old individual with fresh fibres, but to generate is to reproduce just this individual able to assimilate and to generate. Or we may say the organism having assimilated must at last come to re-make itself assimilating and generating.

So there are two reproductions, that of the already given organism and that of the as yet ungiven organism; we might call them the subjective and the objective reproductions—in the latter the Animal reproduces itself completely as object. We can also categorize them as the assimilative and the generative

reproductions of the Animal. With another set of terms already mentioned we can reflect upon them: individualistic and altruistic. Assimilation proper subordinates the outside world to itself—it is Nature's selfishness; Generation subordinates the individual to the other—it is Nature's altruism, which still further develops in the Animal as parent. So the Animal is to remain not merely this living individual, but is to make itself genus, the creative type of its kind—not only individual but universal.

The animal individual, from having been the total Process in itself, which it was in Assimilation, is now to become a part of the Process only, one side of it or one-half of it, which is the case in Generation. The dialectic of Assimilation demands that it be subjected to its own law, that it be assimilated, and also by another individual. But this other individual too has to obey the same law, and be assimilated while it assimilates. From this point of view each animal individual both assimilates and is assimilated by its other, which must be its symmetrical counterpart organically, or of the opposite sex. This mutuality of assimilation is characteristic of the generative Process in its very germ, in the two conjugating cells.

The two sides of bi-lateral symmetry for-

merly united in one body, are now separated into two bodies which are still symmetrical in Generation. The dualism of the organs of the one organism which was so prominent in Assimilation has passed over into two organisms, of two opposite but symmetrical sexes. The animal individual in order to reproduce itself as individual must be taken back to its source, must be dipped afresh as it were into the original fountain of its being, through one of the opposite sex. It has to begin over again from its germinal cell, and evolve as a new individual, assimilated and also assimilating. Thus it shares in both sides, or inherits, as the saying runs, from both parents.

Thus the organic dualism which is so deeply imprinted on the one body, breaks into two bodies, which, however, return to the one body in the offspring. Each individual through the other participates in the total Process, shares in the Generic, the Universal, the self-creative All. Over the individual is the genus which subordinates him in order to re-create him as individual who is, therefore, not in himself generic. The absolute genus (the true *summum genus*) is the Pampsychosis, far above the natural or organic genus; through the latter the individual can only reproduce himself again, not being the genus as such, or as self-creative. The self-dividing and

self-returning One which does not fall asunder into sex is spirit, the Ego. Here the fact may be noted that Darwin's famous book, *Origin of Species*, is really seeking for this one generative Process of living individuals, Plant and Animal, in their vast diversity. To be sure, such is not his conscious purpose; he will show the cause or source of variations of Species, not the source of Species itself, which indeed calls for the primal individuation of Life. Species being given, he investigates how and why it will vary. But this investigation cannot stop till it reaches to the origin not only of Species but of Species-making, in fact of Nature herself. Still the work of Darwin was epoch-turning, since it threw the age upon the thought of Evolution, though not original with him, and led up, of its own inherent logic, to the still deeper problem: Does Evolution itself evolve, or is it done with itself?

But this question, discussed elsewhere yet rising to the surface here and everywhere, must now be set aside for considering the Generative Process of Animal-life in its special ordering. As in the case of Plant-life, we shall look at it in its three main aspects: single Generation (asexual), double Generation (sexual), total Generation (or animal Generation as a whole, in its entire line of

descent from its start and at present existent). Thus the original Animal-norm may be seen manifesting itself in its uncounted shapes of which we are ourselves one, just that one which glances back in time and over in space, and orders the whole by a universal principle which strives to be harmonious with that of the Universe itself:

1. *Single Generation of Animal-life.* When we see the one *Amoeba polypodia* divide within itself and become two individuals, both being alive and the child not distinguishable from the parent, we witness doubtless the simplest form of animal Generation, that by fission. What makes it divide? Such is its nature, we ordinarily say, and therewith let the matter drop, having swallowed a little isolated fact. Still we are not satisfied, and no amount of science, which stops with the separated fact, however small or great this may be, is going to quench our thirst for what lies behind the external phenomenon and causes it to appear. That tiny act of microscopic fission is a phase of the total Universe and must show itself such just in such a work of separation, which in its way is creative, and shares in primal creation. The microbe, self-dividing and thus individuating itself, not only reflects but also re-enacts the All which does the same thing. The exceeding

minuteness as well as the simplicity of the act make it the more impressive, as it seems to interlink and unify in a lightning flash of thought the extremes of the Universe.

The foregoing may be taken as an instance of single Generation in its simplest stage. It is mostly called asexual, as sex is not yet involved, or monogenetic (R. Hertwig calls it monogony as distinct from sexual amphigony). The chief fact is, Generation now takes place through a single organism, which herein has its strong resemblance to the Plant-world, and hints their primal unity, ere Animal and Plant had yet bifurcated. Again we should note that the new animalcule has inherited an undying portion in its framework, though it as distinct individual should live only a few moments; by mere fission it propagates itself, and this generative act is an immortal spark of original creation. The norm or type of Animal-life endures in the deed of Generation, though its manifestation in the body is very finite and transitory. The creative energy is what immortalizes: Forms vanish in Time, but the ultimate Form-maker not only persists through Time, but re-moulds Time itself after his own pattern. So we have to conceive the lowest infusorian, a mere dot or blob of protoplasmic life-stuff, but still self-generative, as participating in the one fundamental energy of creation.

The generative division of the Animal is most commonly crosswise, but it may be lengthwise or even oblique. Still another form of uni-parental Generation is that of budding, which again recalls the Plant. In the lowest animal organism, each part has the tendency to produce the whole body under certain conditions. There is as yet no decided centralization in a head and brain, even if there be a limited self-movement. Still these living sacs or globules often dart out into something like trunk and extremities; they seem to improvise the organs of a higher animal, according to the need, and then take the same back into the common receptacle. Indeed the Amœba would appear to be a potential man, the plastic possibility of the fixed organs, which evolution is to make persistent in the lapse of the ages. Still we have again to ask who is the artist working in this so formable body of the microbe, and shaping it evidently to an end? Already we have noted it struggling in fitful outreaches toward a higher organization—wherein may be felt again Nature's deepest aspiration to advance, even to advance out of itself.

In this field of single Generation or asexual reproduction are many grades in which may be observed the approach toward the complete sexualization of reproduction. Two

cells of an infusorian often seem to couple though they are just alike as far as can be seen. Then dimorphism appears in which two different cells are observed to conjugate for reproduction. The so-called parthenogenesis is single generation (or uni-parental), but some biologists claim that it is a degenerate reproduction from sexual cells, hence a lapse. Undoubtedly single Generation (monogenetic) is most common in the lower animals, such as the worms and cœlenterates, while it is lacking in the higher orders. Moreover, as the animal rises in the scale, there takes place a differentiation between the body-cell and the sex-cell, which act also shows a gradation. The cells of Generation become differenced from those of Assimilation, and are stored up in their own special organ. The animal which is still in a vegetal stage is propagated by budding; its tissues or its cells must possess both kinds of reproduction, assimilative and generative; it is still a plant-animal (phytozoon). Outer bodily growth can turn into a new individual, which fact indicates a low, or vegetal, or purely assimilative stage of the animal organism, not yet evolved to the fully generative stage. When the animal is practically all stomach, procreation is a product of digestion—the generative principle has not yet developed

into its own organs. In the higher animals it is noticeable that bodily growth usually ceases with sexual maturity—the Plant turns into the Animal, and adds no more layers. On the other hand even in the lower Vertebrates, such as the fishes, growth in size continues long after their sexual maturity, probably in many cases to the end of life, wherein the backboned animal still resembles the Plant.

Perhaps the most striking transition between asexual and sexual reproduction is seen in the so-called alternation of generations. For instance the jelly-fish, *Bogainvillia ramosa*, is on the one hand an asexual polyp which produces by budding the sexed medusæ, which in turn produce the asexual polyp; the sexless parent brings forth the sexed offspring, which now bring forth the sexless grandchild, whose offspring are again sexed. Such is the alteration between the asexual and sexual principle in the same animal, which seems to be struggling out of the Plant, yet ever dropping back into it as regards reproduction. Single or uni-parental Generation pushes up for once into double or bi-parental Generation, but cannot maintain it without a dip backward into its previous life-form, where it rises again. Other kinds of alteration between single and double Generation have been observed (for instance in the

Crustaceans). But we shall pass now to the latter.

2. *Double Generation of Animal-life.*

From the foregoing account we may observe a striving of the animal toward a complete dual sexuality, in which the separative tendency of Nature would seem to culminate. The difference of sexes in the higher animals and especially in man shows the physical world evolved to its last chasm, which, however, is to be bridged by the generative deed. It is no wonder, then, that the biology of today has brought forward with so much industrious research and experiment the problem of Double Generation (getting now technically to be named amphigony), and has traced it into the primal genetic cells of male and female. Generation has thus become cellular, in accord with the dominant biological task of the time. The study of the behavior of the sexual cells (spermatozoon and ovum) is pursued in great detail with a singular fascination as if the scientist himself expected the next moment to witness his own genesis. Of course this moment has not yet arrived, and probably will not under the microscope; but in the meantime we have learned many other things. In this connection we may cite an authoritative formula of Professor Hertwig of Munich: "Sexual reproduction is a re-

production by means of sexual cells." But here again we have to ask for the origin of this origin, for the source of this cell-sexing, or of sexuality itself. Can we find any ground why Nature bifurcates itself anew into the two sexes in order to reproduce the individual? We perceive it to be a separation which takes place in both the vegetal and animal organism, and which evolves by many gradations up to the final diremption between the human male and female.

We have often had to turn back to the fact that Nature is inherently separative, and individuates itself by the necessity of its origin. Now this act of double or bi-parental Generation is one method of Nature's individuation, that is, of reproducing the living individual. Thus sexuality is an organic manifestation of Nature's original creative energy; through the sexes man (and indeed all Life) goes back to the primordial fountain of the Universe as self-generative and shares in that—whereby he too becomes self-generative, of course organically. Sex, then, as active is the process of Nature's individuation in one of its phases, that of creating sexed individuals in the offspring. The Universe as universal must be self-creative, whereof the sexual process has to be deemed a manifestation; thus the animal may be said to universalize itself, of

course not spiritually but naturally. Sex, accordingly, taps the genetic reservoir of total creation for its creative energy, though this be only a little drop trickling down into the individual. And it may be here added that the individuation of Nature comes to its most intensely expressed dualism in sex—in the two mutually sexed individuals whose function it is at last to overcome this dualism. For in sex the individual feels his insufficiency as a whole, feels his halfness, so to speak and will integrate himself with his other half. Thus even the organism has the impulse to totalize itself, or within its sphere to make itself universal, especially by going back to its own beginning (say in the cell) and reproducing its origin—transforming itself from the generated into the generator of the generated.

The living individual as animal comes in the course of its development to challenge its own origin as something given, as something imposed upon it externally, in which it took no part. Having had no hand in its own creation, it grows to be reactionary to the coercing law of its own being; it will not passively remain the made, but will be the maker of itself as made; it will ascend to the fountain of its own existence, and there will make itself over, will re-enact the law of its own gene-

sis. Such is this deep-seated impulse of sex: it compels the individual as animal to return upon his forced or fated origin, and to re-originate himself in a new being; thus he rounds himself out to a complete whole and is the genus, taking up into himself his own presupposition, prescribing his own prescription. It is a symmetrical fact with Nature that the youth, having gotten his growth and reached the age of puberty—that is, having passed from his time of Assimilation to that of Generation also—begins to turn against the transmitted order in the Family and even in the State; he kicks against the prescribed limits environing him on every side; he will challenge, if he does not assail, the whole institutional world in which he was born. He will not be satisfied till he have a hand in regulating the regulations which regulate him; he must at least help make the law which he obeys; he must become self-legislative not only morally but also institutionally, if he is to escape from his negative, anarchic condition. The institutions of our country make the youth legally self-governing at his majority, when he has attained the maturity of Nature and is questioning the traditional order imposed upon him, when even his organism is challenging its own origin and seeks to be re-born out of itself in a new birth.

The man is not consulted whether he shall be born or not; life is super-imposed upon the individual without his knowledge or consent, so he aspires for a kind of organic freedom in Generation. The individual alone can assimilate but not generate; in order to reach the creative function of his own individuality, he requires another individual, symmetrical in sex, that each may subsume or assimilate the other, and thus both be present in the third, the offspring. Thus the spacious province of heredity unrolls before us, into which stream ancestral contributions by the million.

The basic character of the sexual Process in animal Generation has been already outlined. The individual man, simply living for himself through assimilation, is not the whole process of himself, but the half, the one side which must find its completing half in the opposite sex. Desire is the manifestation of this halfness, which longs to be the whole. The sexual individual, being inadequate to his own immanent kind of species as self-created, is impelled to his sexual counterpart, needing it to assimilate him to his beginning and to recreate his starting-point as the new individual. He integrates his halfness and is taken up into the total process in which two sexual halves become one, the creative one—the genus above both as individuals. But

the half can rise to be the whole only for a moment in Nature, then it drops back into itself again, into the previous dualism—it cannot universalize itself as persistent and thus be Spirit, but remains Nature. Still it reproduces its own Form, and on this side returns to the given Form, to the type, in the new individual, which is still a half and sexed, and which will show the same natural inadequacy and limitation which has been seen in the parents.

Thus the generative Process of Animal-life winds up in an endless series of transitory individuals, children of Time's succession, in which they begin and cease. But while the individuals rise and vanish, the species or the norm persists and evolves into the multitudinous diversity of shapes present and past. Here we may again add that from this point of view the two sexes as separate are only potential, a possibility, which becomes reality in the genus embracing both or in their generative unity. Parenthood even in the realm of Nature re-unites the separated individuality with its Creator.

The animal as generative we may call a living Universal, not a spiritual; it rises to participation in the creative fountain-head transitorily, then falls back into its own individual separation. The animal satisfies its hunger

and thirst, but therein has not really satisfied itself or its deepest necessity, which is to re-make itself as a whole or to objectify itself as a living individual. In Assimilation the Organism is a vast laboratory, in which the chemist recomposes himself while decomposing himself, so that Chemism here does not fall assunder, as it does in the Diacosmos. Still such chemist has not only to assimilate his Organism, but to generate it as the highest end of Nature. Now the result of Generation on our planet has been a series of individual forms trailing through time down to the present. This series as a whole must also be considered.

3. *Total Generation of Animal-life.* Evolution has brought out into strong relief the whole line of Animal-life; in fact biology in its dominant evolutionary trend has largely dealt with the Animal as a more pronounced living individual than the Plant. Total Generation would include the entire result of the generative Process of Animal-life; it views the creative norm of the animal realizing itself not merely in a single individual, but in the completely ordered kingdom of shapes.

There are three phases or lines of this realm of total Generation. (1) The present existent forms of the animal world from lowest to highest are to be graded into system

with its nomenclature (species, genera, classes, families, tribes, etc.). (2) The past forms of the animal world, as revealed in the geologic ages, are to be set forth in their evolution, which shows the existent fauna arising in time. (3) The present individual organism (say of man), in its genesis from its earliest stage to its last, is seen re-evolving the animal shapes of the past from their start, recapitulating the historic rise of the whole animal world in its own growth as individual.

Now all three of these lines of development have the common movement: they start far back in the pre-cellular life-stuff, rise to the uni-cellular status, and then conclude in some form of cellular association. Such is their unitary principle of evolution which indeed underlies the million-fold grades and shapes of animals and plants—those now being, those having been, and those getting to be. For this reason the science of the cell (Cytology) lies at the basis of Biology and unifies its countless variety of forms. (See the preceding exposition of Cytology, pp. 130-160.)

Accordingly, if we wish to take a total survey of Animal-life as generated, we must go back to the conception of the elemental life-stuff (Protobioticon) both vegetal and animal, to which we assign the primal differentiation into Organic and Inorganic. In this pre-cel-

lular material takes place the bifurcation into Plant and Animal, each of which moves out of this common starting-point on its own line. The biologist is still observing minute organisms which seem to be almost neutrals in this no-man's-land (see account of the *Myxomecetes* on a former page). The potential plant-animal (phytozoon) now splits, or rather unfolds into its two possibilities, one of which we may call the first plant (protophyte), and the other the first animal (protozoon). Samples of each sort may be taken in the Bacterion and in the Amœba.

We have now gotten our first Plant and first Animal, and have reached the epochal forking of all organic life into its two ascending lines of living individual forms, each of which henceforth moves on its own distinct path. The stages of this primordial Earth-life are, first, protoplasmic, and, secondly, phytozoic, which last stage differentiates into Plant and Animal. Already we have traced the evolution of the early Plant (protophyte), through its various gradations to its highest forms. Now the same thing is to be done for the early Animal (protozoon). But just here is the need for a vast new class, the third, embracing all the animal forms after the protozoon. Naturalists often give to this class the name of metazoa, which include all the higher ani-

mals, those which are above the so-called gastrula stage, and have attained the true cell with its associative forms. (A completer designation would be metaprotzoa.) In like manner there should be a corresponding division of Plants, the metaphyta (or better, metaprotophyta), embracing all above the protophyta. But this term, as far as our knowledge goes, has not been used.

But at present our task is to classify the metazoa, which embrace quite all that we immediately see of the animal world, the sphere of its associated cellular life, its varied multiplicity of forms up to man. The problem of classifying and naming these Forms has always been present to the observer, and such attempts have their history, their considerable evolution, say from Aristotle down to our own day. How shall the vast variety be inter-related and by what criterion? Tribe, class, order, family genera species are some of the names by which the ever-widening groups have been designated. Each individual animal is thus co-ordinated with every other animal, from least to largest. We take a common catfish and call it a vertebrate; thus we have conjoined it in a group with all the upper animals, and contrasted it with all the lower. So in the one individual before us we are to see the whole animal crea-

tion. In recent biology two other very significant processes have sprung out of this line of animal Forms, known as ontogeny and phylogeny (already described).

In the creeping lizard we may easily see a prophecy of the human organism with the latter fully developed before us. Indeed the homologies of man's organism have been traced back to the protozoon. But what future development of the animate Form does man's organism prophesy? Or is with it the chapter of organic development closed? Are there in him any glimpses of that ideal Form toward which the entire line of animality seems to be moving? The front fin of a fish may prophesy the foreleg and paw of a cat, which member heralds the toes of the ourang-outang, while these forecast the human fingers—but what do the latter prophesy? Can any scientist point out a hint of what is coming? The question has the implication that man, having become conscious of evolution, may have henceforth to be consciously evolutionary. Is he to take Evolution out of the merely unconscious instinct of Nature, where it has lain hitherto, and to direct it by his self-conscious reason? Some maintain that the human body has reached its limit of complete Evolution; others say that our organism contains many undeveloped organs which

in the future are to attain their completion. Still again we hear that Evolution has passed out of Nature (Physis) and is henceforth to have its chief seat of activity in the Psyche which is to continue in its sphere the work of association already begun in the cell. (See preceding pp. 37-53.)

The ordering of the animal kingdom in the present field (metazoa) is just now passing through a transitional state of confusion, especially as regards the larger divisions. The older classification into Invertebrates and Vertebrates has been undermined, and there is no system to take its place. Still the Vertebrate, though reduced from the first rank to the third rank in scientific gradation, maintains its authority. That is, the Vertebrate is now subsumed under the Chordate, and this again under the Segmentate, and this again under the Metazoa. The difficulty seems to be that the naturalist has not yet come upon the ruling, or perchance the creative principle of classifying the diverse shapes of the animal world. Enormous has been the advance in the special study of individuals, varieties, species; but with this development of specialization, the science of today shows a lack of generalization. Still the reader ought not to be set down wholly in chaos. What we have been able to think out

for ourselves in this field, we shall throw into the following brief summary. Of the Metazoan system we make three divisions.

A. THE PLANT-ANIMALS or Phytoids, which must be carefully distinguished from the previously mentioned Phytozoa, in which there is as yet no differentiation. But the Phytoid is decidedly an animal in function, though in form it is like a plant, and is often named from this resemblance (as the crenoid or sea-lily). These animals we place first and lowest, since they have not yet fully gotten rid of the vegetal formative process, which they have in common with the Plant. Thus they must be considered to stand nearest to the primal bifurcation of the life-stuff into Plant and Animal. Such are the sponges, star-fishes, echinoderms (once known as radiates, now called chiefly coelenterates). We may also observe that Phytoids are in the process of getting rid of their vegetal form, which likewise has or may have a skeleton (as can be seen in the star-fish). Indeed the skeletal criterion of classification may be conceived to run through the whole gamut of Animal-life from the Phytoids to the Vertebrates, though sometimes it is not so easy to find.

B. THE MOLLUSKS may be put next as the intermediate or transitional stage, though

there is a good deal of doubt about their position in the line, the systematists ranking them diversely. Examples are the oyster, snail, cuttle-fish. The vegetal form has disappeared, and a distinct bi-lateralism has arisen; but the Mollusks are not yet segmented into successive rings, like the worm (see next division). The skeletal arrangement is variable: sometimes inside (cephalopods), sometimes outside (bivalves and univalves), sometimes quite non-existent. It would seem that in the mollusks the skeleton is in its uncertain stage, but on its way to its articulated form which culminates in the vertebral animal.

C. THE SEGMENTATES, beginning with the worms and reaching to man who is included. This division is based upon the so-called segmentation of the animal organism, its skeletal arrangement being a series of concentric rings of more or less rigid material. The Invertebrates of this sort Cuvier called Articulates though he excluded the well-articulated vertebral column of the higher animals; possibly he could not think of man's skeleton with that of a worm or insect. Such articulation we may conceive as a return to the Plant-animals (Phytoids or Anthozoa), and as an association of a number of them into a new organism, which still shows their original

more or less circular units. This division we shall subdivide in the following manner.

1. *Worms*, represented by the annelids, or the ringed earth-worm.

2. *Arthropods*, or the joint-footed insects, spiders, myriapods, crustacea.

3. *Chordates*, in whose body the notochord or primal backbone appears (cartilaginous), which begins to connect the articulation. Of this class (or sub-tribe) there are several less important divisions till the highest and most important portion of the animal kingdom is reached in

THE VERTEBRATES.

This is now classified as a division of the Chordates, which in turn come under the Segmentates, which in turn come under the Metazoa, which again form one of the main divisions of the animal world—a position held not very long since by the Vertebrates. This may be taken as a sample of the present tendency to revolutionize former classifications. Still the conception of the Vertebrate and the word also hold their place in science as well as in literature. The term belongs to Lamarck (1797), though the conception existed before him; in fact it has been traced back to Aristotle, who, however, takes the blood

as his criterion and not the bones of the vertebral column, making the division into bloodless (invertebrate) animals and blooded (vertebrates with their four classes—fishes, amphibians with reptiles, birds and mammals). It may be added that there has been a recent attempt to take the blood in its corpuscular constitution as the criterion for a new classification of Animals, which, in its way is a return to the work of ancient Aristotle.

But when it comes to putting into order the four (or five) classes of Vertebrates—the fish, the reptile, the bird, and the mammal—the modern anarchy of science breaks out afresh with illuminating discord. The main point is to arrange these so prominent and well-known animal shapes into new divisions which will not only show their differences (which are plain enough), but their deeper inter-relations. Among the many attempts to re-classify the Vertebrates, we may here set down that of Huxley as probably the best known, beginning with Fishes: (1) *Ichthyopsida* (fish-looking) in which the Fishes and Amphibia are joined. (2) *Sauropsida* (lizard-looking) in which the Reptiles and Birds are brought together by anatomical homologues. This conjunction which seems now so strange, is well-certified by evolution in the

geologic ages. Especially the Archaeopteryx, a fossil reptilian bird of the Mesozoic, appears to furnish the best sample from which the differentiation into Reptile and Bird took start. But there are many other extinct specimens of the same general kind known as pterosauria. (3) Mammalia (udder-bearing). Here the skeletal criterion is dropped and the method of alimentation for the young is taken. The difficulty with the classification of Huxley is that it has no leading principle of ordering the Vertebrates. A desperate attempt to cling to the bones as the standard is seen in the little-known divisions, Lyrifera (Fishes and Selachians), Quadratifera (Reptiles and Birds), Malleifera (Mammals). And in this highest class, the Mammals, there is found no small diversity of ordering from Linneus till the present time. Still there is good ground for dividing the Mammals as follows: Monotremata, oviparous (Ornithorhynchus); Marsupialia, viviparous, with pouch for young; Placentalia, having a placenta with uterus. The last rise through a variety of forms to the simian and finally to man.

The foregoing line of development shows the ascent of the human species through what we have named the total Generation of Animal-life. On the whole the basic principle of

classification is the Form as determined chiefly by the bony structure. The assimilative Process has furnished also a number of criteria for ranking the animal, but they have hardly been pivotal. The question arises, whence is to be taken the ultimate test of ordering all these shapes of Animal-life—from Formation, Assimilation or Generation? Of course Form is the most apparent and striking, but the deepest and most essential fact of animal existence is Generation. Already some phases of it have been seized upon for co-ordinating certain shapes of Animal-life, but it has not been universally applied. In this respect Plant-life seems to be better organized than Animal-life. One may be permitted to think that there will be a gradual approach in systematic zoology toward the generative Process of Animal-life as the true principle of its order. In that case even the division of the Vertebrates will have to be supplemented, or probably supplanted.

But, having fairly grasped the generative Process of the living individual, we find that it reaches back to something more ultimate. Necessarily individual Life pre-supposes universal Life as creative of this Life individualized. The act of Generation taps the vital reservoir which exists already, and which individuates itself into the separated world of

living things. But the individual once being born, has to go back and re-bear himself; he makes himself the medium for the common fountain of Life to pour into the birth of what lives singly. So we are led to inquire after this common fountain, the universal source of the individual Life of Plant and Animal, which lies in the background of all the varied display of living forms on our planet, and is indeed their primal form forming them separately.

Such total Life welling up into the single lives of the whole Earth, we shall distinctively call Earth-life, which embraces in its complete process the sum of terrestrial creatures and their common living substance. In it takes place that as yet hidden transition from the Inorganic to the Organic, from the precellular plasm into the cell, where lies the source of primordial individuation, which is broached by the generative Process, and set to flowing anew into individual existence. That which is known in Biology as germinal continuity has its origin in this universal Life of the Earth, though this too originates still further back. But Earth-life is the collective act of Nature's individuation, the totality of vital units from the microscopic cell (and possibly before) to the largest organism.

We repeat, then, that the supreme postulate and creative pre-requisite of individual Generation, both in Plant and Animal is this Earth-life, which cannot be omitted in any complete view of the Biocosmos whereof it is the full summation and synthesis. Likewise it has its own organization and processes which are next to be considered.

III. EARTH-LIFE.

The two extremes of living things may be taken as the microscopic cell and the Earth-life; the smallest and the largest become therein counterparts, and are the first and last, between which all vital existence is moving. The shapes of life, in so far as they are visible, appear to be set in this framework embracing least and greatest, between beginning and conclusion. It is the grand living stream of existence as a whole which we are now to summon before us; it seems to be bubbling up from unseen depths in the smallest points of life which unite, organize and associate in a vast line of varying forms, till they pour back again to the unseen depths of the Earth-life.

Now is there any connection between the appearance and the disappearance of this living river before us—is it simply emptying back into the invisible underworld of its origin the contents of its visible upper world, to be made over again into life? Some such cycle has long been conceived, and on certain lines rendered probable. The dissolution of organisms into their chemical constituents would seem to be a preparation for their vital

re-constitution. Still something besides chemism is needed for making and re-making life. It is agreed that spontaneous generation from inorganic matter has hardly yet taken place within any limits now perceptible; still many a scientist holds it as necessary postulate of Evolution. For if our planet was once flung off as a fragment of fire-mist from the sun, it must have become alive much later. But how? Whatever else may be affirmed, the Inorganic must have turned to the Organic. Furthermore, is this process still going on? It has not yet been scientifically detected in spite of many adroit attempts. But such a postulate is also necessary; it is absurd to think that just so much life-stuff was evolved from Unlife somewhere and at some time on our planet just once for all, and that then this protoplasmic material was left to its own Evolution, which has been continuing ever since. Surely that original transition from the Inorganic to the Organic is still a necessary part or stage of the life-process of the Earth, even if it yet awaits the sight of the scientific eye.

It would seem that Earth-life alone can individuate the living thing, can start the vital organism on its career even as self-generative. For the aphorism of science, *omne vivum ex vivo*, calls secretly for the

origin of the first living thing which could reproduce itself. The problem is not simply whence came just this single vital shape before us, but whence came it with its power of self-propagation? It was born immediately of a parent who again had a parent; but who or what individuated the first parent with its parenthood, though it be only a cell? Here we reach back to the source of all individual life on our planet, the giver of just this individuation; it must be a kind of universal self-creative life which imparts itself to each tiny bit of living matter. So we rise to the conception of Earth-life, which, however, has to keep on individuating itself as universal and self-generative, in order to be the universal life of the Earth, of which every individual living thing has to partake in order to live. From this each Plant or Animal gets its special vital share, namely from the whole of vitality of our planet, and as far as we know, of the universe. Every day in our food we appropriate a bit for our renewal; then finally our organisms are plunged back into this reservoir of total Earth-life for some sort of re-creation. If we look back at the generative Process, vegetal as well as animal, we find that it reproduces individuals after a given norm. It therefore reveals itself as limited, transmitted, originated; what is its

origin? Now this norm is that which persists through birth, life, death, and passes on from individual to individual. It is the immortal portion in Generation, and manifests the participation in the universal life. The generative Process of the individual living thing, be it Plant or Animal finds its true realization as well its primal source in the creativity of the Earth-life, which is accordingly the Generation of Generation, or Generation as universal, to which all individual Generation returns as to its fountain as well as creative prototype. From this point of view we may behold the previous stage of Animal-life passing over into Earth-life through the generative Process, which must, according to its own principle, be generated.

Here it will be recalled that the three Life-forms we have put together in one process—Plant-life, Animal-life and Earth-life. Though these three stages become outwardly very distinct, still we are to trace, as far as possible, their inner inter-relation, and behold them genetically connected. Thus we have just seen Animal-life through its highest act, that of Generation, connect with its primal originative source, the Earth-life. All special Generation must push forward to the universal reservoir of Generation, which, however, in its turn needs to be accounted for,

and traced back to its origin. But at present we seek to keep before the mind this three-fold process of the Biocosmos in its ultimate Life-forms, of which Earth-life is the third stage returning to the first, the Plant, and embracing the whole round of terrestrial Life. Moreover this differentiation arose and still keeps arising with all its diversity from a common primordial vital protoplasm; that is, Plant-life, Animal-life and Earth-life were originally 'one undifferentenced Life, to which every living shape has to go back for renewal. We may say metaphorically that the sphere of the Earth-life keeps turning on its own axis quite as decidedly as the sphere of the Earth, though the one is biocosmical and the other cosmical; or the one has an inner vital determination while the other has an outer mechanical or gravitative determination.

Here the reflection comes up that the entire physical Universe (the Pancosmos), so far as we know, lives through our Earth-life alone. Ours is the sole living point of the All as Nature, whose creative purpose would seem to be just this living point. The sun and even the stars contribute to life on the Earth; that is, their energy, cosmical and diacosmical, is transmuted into the small dot of vital energy of the globe, in which each liv-

ing thing participates. The conjecture lies near that there are other far-off extra-mundane forces which are passing through the alembic of Earth-life, in which they become at least vitalized, and attain a higher destiny. Still it is possible, yea probable, that there are other Life-points besides ours scattered through the constellated spaces.

We have already indicated that there is an unseen returning current in Earth-life, passing from the cessation of the living individual back to the beginning, where it has to be re-vitalized after dissolution. The preliminary steps of this transition may be summarized as follows: (1) The general change from the Inorganic to the Organic, with which is closely connected (2) the act of vital individuation; (3) the act of bifurcation into Plant and Animal lies also in the dim foreground of Earth-life, which thereafter begins to have a history traceable in its remains, through ages. But, like man, Earth-life had its pre-historic time, which is very difficult to reach directly. Given its starting-point, Geology has been able to point out in a general way the successive periods of Earth-life, organic with inorganic. Thus we seek to embrace in one thought and its term the total life of our globe; this is what we here call Earth-life. It also has its process; as already said, it is

perpetually moving from the Inorganic to the Organic, and from the Organic back to the Organic. The quantity of Life compared to the Unlife of our globe is very small, and there is an incessant fight between them; the original struggle for existence is not merely that between living individuals, but it goes back to the struggle of Earth-life itself against its own inorganic elements, which are always seeking to snuff it out. If we conceive total Earth-life, or all living matter to be a small globe lying in another globe of non-living matter ten million times larger, we have the quantitative relation between the two according to a well-known estimate, which probably is intended not to be precise, but only suggestive.

It should also be noted that Earth-life as organic has its round between two impassable barriers, or as yet unpassed: between non-vital matter and consciousness. The transformation of Unlife into Life without the mediating germ or egg has not yet taken place—spontaneous generation is still disclaimed by science, even if it has to be postulated in Earth-life. On the other hand, the transition from the living body to the conscious Ego has not been scientifically made. So the little globe of Life before mentioned hangs in the air, being isolated from what goes be-

fore and from what comes after, though science is working at bridges on both sides.

Plant and animal, as we have seen them, are individuals; out of what do they individuate? We observe both going back to a form which is common or nearly so and then unfolding into a vast diversity on each line, vegetal and animal; what and whence is this power of individuality which so dominates all Life? It individuates more and more in time, it keeps specifying (or making species). At least we have to say such is the nature of Life, or better, it is Nature herself manifesting her separative character, which indeed carries us up again to her very origin.

Now the scientist deals or has dealt quite exclusively with this living individual, plant or animal, analyzing it into its parts down to cell and even to cellule, and on the other hand synthesizing it in various ways into species, genera, families, etc. His microscope can only see individuals in some form, however small. Now this process of individuation takes place in and through the Earth-life, which has therein its primal function. In what way? This lies beyond scientific proof which, as already said, deals with the living individual as plant or animal. But what if the Earth also with its Life is an individual, source of all other living individuals? The

Earth has been individualized and likewise vitalized, and we have to think it as imparting these traits to its progeny, plant and animal. Earth-life is then the creative source and prototype of all living individuals.

Every plant and every animal have in themselves a vital and a non-vital element; when burnt, for instance, they show the inorganic earth which is in their constitution. Thus each living individual is a reproduction of Earth-life; it recapitulates in small its primordial big parent. And its vital process is the continual reduction of the Inorganic (air, water, soil, etc.) to the Organic, that is, to its own living individuality. Then after a cycle of time it restores these inorganic materials to its source, of which they form a part. Such is the round of individual life with its birth, maturity, decline, cessation, a copy of the Earth-life, from which it as vital sprang.

The Earth with its Life, therefore, we have to grasp as an individual; it, too, has been individuated, like the Plant and the Animal. Science now very generally holds that it separated originally from the Heliosphere, at a certain stage in the evolution of the Sun (see *Cosmos and Diacosmos*, pp. 259-265). The Earth was, accordingly, born an individual, whose father, or we may say, grandfather,

was the Cosmos. So this individuation of the Universe reaches far back, really to the Pampsychosis, which is in itself the primordial separation. But what concerns us now is that this individualized Earth goes on with its process till it generates the spark of Life, somehow passing at a little genetic point from the Inorganic into the Organic. Of course, the When, the Where and the How lie as yet beyond the ken of science—some say they never can be known (DuBois Reymond's famous *ignoramus et ignorabimus*, a very hazardous prophecy by the way, and indeed contradictory). But what we here wish to emphasize is that the Earth becomes a living individual—or becomes individualized and vitalized—even if the vital spot is very minute in a colossal non-vital body. But having grasped this point of view as genetic, we may see Mother Earth reproducing her own fundamental traits in plants and animals, or in the vast multitude of other individuals primarily earth-born.

Naturally the question comes up: Is this Earth-individual with its Life also transitory like Plant and Animal? Science on the whole answers affirmatively. The Earth has also its cycle of Life, even though it lasts millions or hundreds of millions of years. It passes through the round of birth, bloom, decay,

death, like the mere insect or indeed the microscopic cell. Thus a vast life-scale of living things presents itself to the mind, from the duration of a few hours or a few moments even, up to uncounted æons. But each Life, short or long, is individualized, and has the same general cycle of existence—the separation from and return to its elemental source. Earth-life would seem to be no exception.

The further problem arises: If the Earth with its Life be only one individual, are there other similar individuals in the universe which are passing through their vital cycles? These may be as varied as our plants and animals, and Earth-life may be only a kind of amœba in the universal Life. Proof there is none, but imagination winged by science is prompted to take a far-off flight into the void of the cosmos. But for our present sight, the Earth with its Life appears a kind of universal individual, embracing all living things, originating them as well as receiving them back into its bosom.

Though we may not with our senses be able to get back to the primal transitional formation of Earth-life, we can observe that its first function is to transmute the Inorganic into the Organic. This is the step to individuation, and each living individual must draw on the original storehouse of Life, not

only in order to be born but to continue existence. It looks as if there might have been barely one species at the start, which showed no differentiation of Plant and Animal; but the tendency of Nature to separation and individuation has resulted in the present millions of species, constituting as far as we know, the only living speck in the physical universe. Yet to bring forth this speck of Earth-life would seem to be the great purpose of the Cosmos, which is possibly yet to be vitalized from this speck quite invisible (humanly speaking) at a short distance from the surface of our globe.

Earth-life, accordingly, we conceive to contain the elemental start or Life-stuff of the planet, then the sum total of all individuals which are alive on the Earth. Each of the latter passes through its cycle and returns to its origin as inorganic, perpetuating its Life by the generative process. Earth-life, while ever revolving, is also evolving and has long been evolving so that it has its history. But within human ken it has no association with other living individuals of like kind; it is its own species and genus as well as individual.

Many sciences have been unfolded out of Earth-life in its various aspects. Here, however, we shall co-ordinate its general process with that of Plant-life and Animal-life; thus

the three Life-forms of the Biocosmos will show a certain unity of order, revealing a common process which belongs to every living individual, and whose stages have been already often designated as Formation, Assimilation, Generation. But the Earth, as the sole telluric individual alive in the Universe, will have its own peculiar ways of manifesting the basic process of Life just mentioned.

I. THE FORMATIVE PROCESS OF EARTH-LIFE. The Form of the Earth in general includes both the inorganic and the organic elements taken as not yet separated. The external shape or body of Earth-life is its most immediate manifestation and is first to be considered. This is by no means accidental, but has its significance which is to be pondered. The sphericity of the Earth may well be deemed its primal characteristic, it shows matter centered in itself, individualized we may say; with good reason some educators have taken the sphere as the first geometric form, from which all other such forms are to be derived.

The spherical Form would seem to be common to most of the free-moving heavenly bodies, and may be taken as the earliest combination of cosmical Motion and Matter. That is, Matter primordially united with Motion becomes spherical. So the sun, the plan-

ets and probably the stars. Terrestrial Form can be regarded then, as a primeval act of the Cosmos, the first individual of Nature. On the surface of the Earth we may notice the same characteristic in the falling rain-drops, which are rounded. (On Matter and Motion of the Cosmos, see *Cosmos and Diacosmos*, p. 39, etc.) The body of Earth-life differs in shape, accordingly, from Plant-life and Animal-life, which show a cylindrical tendency. All, however, strive toward a certain rotundity of shape.

We have already spoken of the norm of the Plant and the Animal, which is impressed upon all individuals, however varied they may be. Earth-life has also its norm as a whole, the invariable and universal one of Nature; reaching back to the early Cosmos. This norm of Earth-life we may, therefore, deem the cosmical norm.

1. *The Earth-organism as a whole.* Motion is, then, a primal element of the Earth's material Form, shaping it and keeping it shaped. In other words, terrestrial Form must be perpetually reproduced by Motion. In fact, we can discern three main kinds of terrestrial Motion: first is axial, which may be deemed its own specially, as self-revolution; second is orbital, which acknowledges and obeys an outside power, the sun; third

is its Motion along with the whole solar system around some supposed cosmical center. Coupled with these Motions are the changes of day and night (axial) and those of the seasons (orbital). What changes the third Motion (galactal, we can conceive it) has brought or will bring, is of course unknown; but it is not improbable that even this remote influence may have produced some variations of Earth-life in the long periods of the past.

The terrestrial sphere in its spherical motions is in striking contrast with the Plant and Animal. The Plant is fixed to the Earth on the whole, and has mainly an inner movement of growth, a pushing outwards in layers during its round of life. The Animal in general has a limited power of locomotion on the Earth's surface. Both, therefore, manifest broken or finite Motion in comparison with the perpetual or infinite Motion of the Earth, which they seem to have the power of tapping individually for a small portion of moti^ve power.

2. *The Earth-organism in its dual symmetry.* The sphere is naturally symmetrical in its two halves or hemispheres. The equator is the well-known median line of the Earth which is not an exact sphere, but technically an oblate spheroid. Parallel to this median line are drawn the lines of latitude

so important in Geography. A second halving of the Earth into symmetrical parts is made by the ecliptic, whose inclination to the equator is nearly twenty-three and a half degrees. Another symmetrical halving of the Earth is that of day and night produced by axial rotation, and hence is not fixed but continuous, and also self-returning every twenty-four hours. Earth-life as a whole may thus be deemed half asleep and half awake, spatially and temporally, contrasting therein with Plant and Animal whose sleeping and waking involve the whole individual, not the half of him; or he is entirely in the light or entirely in the night, not in both at once.

The symmetry of the Earth is, accordingly, of the two hemispheres, not of the two sides (like the Animal) or of the two ends (like the Plant). Spherical symmetry is the simpler and more immediate, being equally possible in many divisions, as an apple can be halved in numerous ways. Lateral symmetry of animals has but one true median line of separation; terminal symmetry of plants has essentially but one way parting the two symmetrical ends (roots and branches, including leaves). Still in the three forms of Life—Plant, Animal and Earth—we are to note the common principle of dual symmetry.

3. *The Earth - organism differentiated.*

Looking at the Earth's appearance around us, we see it divided into three physical elements—air, water, land—a gas, a liquid and a solid. These we set down in the probable order of their origin. In the great transition of the Earth from its original mass of luminous nebula or fire-mist, the air or atmosphere was doubtless the first to evolve; out of this air must have come as it cooled off the liquid, water, which is composed of the gases oxygen and hydrogen. Still further, of this water sprang land which still often shows, even on the mountain tops, so many signs that it once had its home in the bottom of the sea. In such way science at present conceives the Earth's Organism to have been differentiated into its three main elements in the lapse of geologic ages.

The first fact about the terrestrial air is its continual motion. As it is gaseous, its particles or molecules are expansible, self-repellent, though still subject to gravitation. The next fact about the Earth's atmosphere is that it moves in currents, and that these currents, after detours long and short, come back to their starting point. For instance, there is the universal sweep of the winds towards the equator and then their deflection and return toward the poles, mainly caused through the sun's heat. But in this general

atmospheric ocean there are many other cycles and cyclones, furious and moderate, great and small, down to the petty momentary eddy of the autumnal breeze. Noteworthy, however, is this tendency of mobile air to run into circuits, in part determined thereto by the rotary motion of the round Earth. The science of Meteorology deals with this great variety of wind currents which are also the bearers of heat and cold.

If air be the universal element surrounding the whole earth, water is a partial element covering about three-fourths of the terrestrial surface. The characteristic of water in contrast to air is its non-elasticity, its unyielding nature, being almost incompressible. It has a hard molecular individuality, though so easily separative and penetrable; it is the digger, tearer of continents and leveler of mountains; also the chief transporter of Earth's burdens, not merely on its surface but in its currents. There is little doubt that land was born of water; also the earliest life arose in the sea, man still bears traces that he was once an aqueous monster. Water in doing its work goes in a circle, running down hill in the rivers, then rising through evaporation into the air and returning to the fluvial sources in order to make the same round over again. So we see a perpetual process of these

three elements together, while each has its own process.

There is a question about a change in the character of the air, as well as about the diminution of its quantity. Some scientists maintain that the atmosphere is losing its oxygen and its carbon dioxide, the one being taken up by animals chiefly and the other by plants, whereby both pass into the solid earth. How these losses have been made good in the past geologic ages, since the advent of organic life has been the subject of no little speculation, and the question is still unsettled. In both cases supplies have been supposed to come to our globe from the outside, and possibly from the heated inside also. The mass of air seems to have been constant and its chemical constituents have not varied in proportion since life began on our planet, say a hundred million years ago. A small increase in the proportions of oxygen and carbon dioxide has been shown by experiment to be fatal to both Plant and Animal.

On the other hand, it is stated that the land of the globe is increasing. Not only is the area extending at the expense of the water, but certain chemical constituents held in solution are continually deposited as solids, especially by marine organisms, like the coral insect. Possibly in this case also there may

be a cosmic supply. But here the question will arise: Is our globe always receiving and not giving off anything? And are comets, meteorites, cosmic dust and such interplanetary bodies simply feeders of our hungry Earth? If so, then it must be increasing in size for the future.

On the other hand, danger has been feared from these outside wanderers. The comet may be dismissed in spite of its threatening aspect, but not so easy is the meteorite to be put aside, which may drop upon us without much warning. Meteoric masses weighing some tons are known; but if such a body were a mile in thickness, and were to fall on a city, this would be suddenly destroyed. A scientist of eminence has declared that a meteorite with a diameter of twenty miles, "would pretty surely be fatal to all the land-life of the earth." A possible collision with an asteroid has been broached, especially with one whose very eccentric, if not uncertain, orbit, runs between the Earth and Mars.

This differentiation of the Earth's Organism is what furnishes food to all Life, vegetal and animal. Also to the Earth's own Life air, water, and land are necessary. Thus considered as a whole the Earth is self-feeding, unless it receives some aliment continuously from the Cosmos outside. On the other hand,

the diacosmical energies—heat, light, electricity—have to be furnished to it unceasingly, though it has stores of its own. Thus Earth-life assimilates external elements to its own Organism.

II. THE ASSIMILATIVE PROCESS OF EARTH-LIFE. So we may call the present stage of Earth-life, keeping the nomenclature in correspondence with Plant-life and Animal-life as already set forth. To be sure the Assimilation is now different; we grasp the total organic world as assimilating the inorganic; in fact this is just what the Plant does, and also the Animal in part. Still this inorganic element we here conceive to be an integral part of the Earth-organism as a whole, while the Plant-organism is distinct from its inorganic food, and assimilates the same from the outside. So to the Earth-body belongs a non-vital as well as a vital portion—the former being far the larger—and between these two portions its assimilative Process takes place. In this way Earth-life may be looked at as a return upon Plant-life, making itself a kind of universal vegetable, as far as this is possible under the conditions. for after all is said the Earth too is a limited individual as well as the Plant.

Earth-life employs Assimilation in its most immediate stage, even before the Plant is

distinctly formed. The cell is built into a life, from something not alive; what does it? Here lies that act of living individuation which is the primordial fact of the Biocosmos, in which Psyche begins to get inside the smallest division of Nature, the atom or perchance the etherion. In general it is Earth-life which has to assimilate Unlife to Life, and start the living individual, imparting to the latter the same power. But on the other hand Life individual returns to Unlife in the same process of Earth-life, which controls all its children in their total round of existence.

1. *Unlife to Life.* Here meets us again that oft-mentioned transition from the Inorganic to the Organic, which dominates all Biology, being ever-present and hanging over it like a cloud which the scientist has been totally unable as yet to disperse. To make the passage across the grand chasm between Unlife and Life is the supreme object and pursuit of biological science; meantime it brings up to the surface in this desperate burrowing an enormous amount of valuable facts, experiments and observations, which constitute its present content. Thus it has its end as yet ideal which many say is unattainable; still the search is not lessened but rather intensified. Some form of the much-defamed spontaneous generation lies always in the

background of our Biocosmos as a so-called postulate, somewhat like ether in the Diacosmos (as already noted). The formation of that primal life-stuff, speculative on one side yet very real on the other side, out of which stream all living things, down to the minutest cell, has to be pre-conceived as the starting-point of biological science. On this subject we have dwelt sufficiently in other parts of this book (see p. 139, *et passim*).

Even the quantity of this elemental pre-cellular life-stuff has been estimated. And we may conjecture how much of it arose at the start, and whether it is being exhausted; where and when it began may be conceived but cannot yet be proved. Now into this original protoplasm of Life, Evolution enters and differentiates it in many ways.

2. *Earth-life as Separative.* Here again we shall have to repeat the pervasive fact of individuation, which springs out of the primordial life-stuff of the Earth, and enters into every living individual—the first separative act of the Biocosmos. Earth-life individuates itself into the millions of separate plants and animals, the Earth itself being the prototypal creative individual of them all, their universal individual we may think it (if we can). Now it is this individuated plant or

animal with which science concerns itself in one way or other.

Then there is the separation of Earth-life into its two lines of development, vegetal and animal, so that every region of Earth has its double life known as Flora and Fauna. Moreover Earth-life has its peculiar circulation; there is a continual movement of these vegetal and animal forms called their geographic distribution over the terrestrial surface, and this movement is traceable through the past geologic ages.

Equally certain is the final separation, in which Life separates from its separated individualized condition. It is the logic of Life as particular that it ends in death, for it is not universal. Each living individual as Plant or Animal goes its round of birth, maturity, cessation, when it returns its elements to the Earth-life. It may propagate itself and thus show its persistent or immortal portion; but as mere individual it is mortal.

3. *Life to Unlife.* There is the return of all living things to their inorganic constituents, which thus are ready for a new vitalization. Such is the round of Earth-life, which incessantly ejects into its Unlife vast masses of its Life, a kind of general excretion of the huge terrestrial individual, which therein resembles the small organisms of Plant and Ani-

mal, though these in Earth-life are thrown off as wholes. Death of the living individual is thus a stage of the process of Earth-life, a restoration of the borrowed elements—air, water, earth—a return of the Biocosmos to the Cosmos, which, however, may be again transformed into Life.

The end and aim of living Nature is to undo itself as Life. On the other hand the struggle of the living individual is to preserve its Life as its special boon. Earth-life lives through the death of individual Life, which forms a part of its process. That is, the total Life of the Earth is always moving from the Organic to the Inorganic. Thus it comes that every living thing is in conflict with external Nature, which it has to subsume in order to live, but which subsumes it in the end. We may conceive two quantities of Life, one vast and one little, or rather one all and one small, in a struggle which winds up in the cessation of the individual who is the small one. This is, indeed, the primordial struggle of the living individual for existence—the struggle not with other individuals but with Earth-life itself.

Such is the seal of fate set upon all individuality that lives. The very fact of individuation marks the limit, and stamps death upon the living object. To be sure such indi-

viduation springs of Earth-life, which as Nature must produce this separation in order to exist as process. Why take the trouble to be born that you may die! That is just your penalty for getting alive; you as so much Life are a part of the total Earth-life, which after having separated or individuated you, demands you back as its own. Your final malady, verily the malady of all maladies, is your living individuality, which, however is not yours, and which you must give back to the owner.

Meanwhile who are you? Perchance a Self or an Ego which has transcended Life, even Earth-life, by getting its separation (or individuation) inside itself, not imposed from the outside, and which can divide within itself and be its other, while still remaining itself. Thus rises a new kind of individuality, not that of Life, but of Spirit. Not till the individual can put this outer separation of the Earth-life inside himself, can he persist, having his own individuation within himself, and thus mastering his own limit of life. Or we may say that the Universal of himself is no longer external, but internal, and indeed has become his very process. Or to use a still different expression, the individual has now mastered his own negative in Life and made the same his servant. For the living individual is one-sided and hence perishable

through his other, which is Earth-life having the external power of individuation. But when the individual can individuate himself, he can be no more the victim of Life even of Earth-life.

To die is on the one hand to yield to Nature, to be subject to her separation, her individuation, her negation. But on the other hand it is also to transcend Nature, to separate from her separation, to serve up her deepest character to herself. Thus she is at last self-undoing. Ego, or Spirit, is this perpetual dialectic of Nature, making her final act not death, but the death of death—the negation of her negative. The ultimate principle of Nature is separation, universal separation, hence in the end separation from itself as Nature, or as the externally separated; thus it becomes the internally separated, or the self-separated. In other words, Nature of its own inherent character rises to Spirit, as that which lay implicitly in it from the beginning, and will not stay in its dualism, but is always overcoming the same, even if positing it. So we reach a new Nature, which becomes one with itself in and through its separation.

Many are the special ways in which the Earth-life attacks and undoes the individual Life; these are the particular diseases which can often be met and cured. But the one uni-

versal disease of individuality itself is incurable, or has been so far. The supreme fact here is that the living individual is always capable of death; the special form of it, however, varies in time, place and kind of malady. The physician can only put off the moment, delaying the fate of Life but not mastering it; he may slow its pace and assuage its pain, his best gift being that of *euthanasia* conferred upon the poor mortal. But the original ailment of individuality itself he cannot touch with his medicine till he be able to confer upon us the boon of *athanasia*, by curing mortality itself and reversing Nature's course of individuation. Some scientists have indeed intimated that the death-bearing microbe of old age is to be isolated and then exterminated through the antidote of all antidotes, whereby the cycle of Life will return to its youth without having to pass through the underworld of Unlife. The problem is whether the living individual will ever be able to re-bear himself completely, and start over again, without the mortal dip back into the elements belonging to the process of Earth-life which still must individuate Life.

Such is the round of Earth-life, as it moves from Unlife to Life in all the latter's varieties, and then turns back out of Life to Unlife. Assimilation we call this process, since

each side is perpetually assimilating the other to itself, that is the Inorganic to the Organic, and then the Organic to the Inorganic. In Earth-life we observe the twofoldness: the non-vital element is not outside, but a part of the process as well as the vital; the two are mutually assimilative. But in the Plant and Animal assimilation was essentially to vitalize the non-vital and showed only one side of the process; while Earth-life shows both sides, not only vitalizing the non-vital, but also devitalizing the vital. And we may also say that it keeps individuating, de-individuating, and re-individuating Life.

But now we have to ask: whence comes this Earth-life? It too has an origin and a generation for itself, even if it be a source of generation on our globe for the individual Life in Plant and Animal. This is what we may look at next.

III. THE GENERATIVE PROCESS OF EARTH-LIFE. Again we should first note that this is the third stage of the total Process of Earth-life, and is primarily the reproduction of the Form of the Earth. For this Form has to be continually generated by rotary motion, not too swift nor too slow. Thus Generation in the present case is a return to Formation which we see perpetually re-enacted; for our globe, even as to shape, was not made once

for all, but has to keep re-making itself every day and that too with no little speed.

Moreover the Generation of Earth-life has both its inorganic and organic phases. Inorganically it is generated from the outside, or determined by the Cosmos from which it sprang; but organically we may deem it essentially self-generated, though it depends still for Life upon the diacosmical radiants—heat, light, electricity.

Still further the generative Process of Earth-life is different from that of Plant and Animal; it produces no young individual Earths; reproduction is turned upon itself, and brings forth itself perpetually renewed after a season of aging or of Unlife. The dual relation of the sexes does not belong to the Earth as a whole, but to its constitutive members in Plant-life and Animal-life. It is the many millions of sexual individuals, vegetal and animal, which keep Earth-life always self-begetting within itself. We may say that the Moon is in a sense the child of the Earth, having issued from it; but that separation took place long before the birth of Earth-life, or the transition from its inorganic state to its organic. The Moon is supposed to be wholly inorganic; but as it separated from the Earth so the Earth long before separated

from the Heliosphere, which act we may consider its first or inorganic birth.

In this generative Process of Earth-life we can behold three stages, as in Plant-life and Animal-life, though the former be quite different and unique in its way. Still they all are homologous, and we shall call them by the same names. So we have at present Single Generation, which is not only asexual but inorganic and hence external; Double Generation, in which is the movement from the Inorganic to the Organic, with the appearance of life and sex; finally Total Generation will go back to the past and take up the whole line of Earth-life in its evolution through the geologic ages. In this common nomenclature we may note a common principle of Generation running through all three Life-forms—Plant, Animal, Earth.

1. *Single Generation of Earth-life.* Let it be remembered that this deals with the inorganic act of the Earth's Generation through the primal rotation of Matter, which results in separation, or in a kind fissiparism, which is of course non-vital, yet in a sense monogenetic. Now this externally generative process which belongs to the whole Cosmos, is to become internally generative in each separated part, when the latter gets to be alive. But the long evolution from

outer to inner Generation is specially the work of the Earth-Life in its totality, whose first form is that of inorganic or cosmical evolution. So we bring before us the begetting of the Earth (sometimes called Geogony).

The general sweep of the Earth's genesis has been elsewhere given. We may start with that shred of fire-mist or nebulous matter, in its first apparent, more or less chaotic form (of which the great nebula in Orion may be taken as an example); then the shred becomes a part of the nebulous spiral (say like that in Canes Venatici); then it passes into the evolution of solar systems, to which our Heliosphere belongs; the latter then throws off the planets of which our Earth is one; this in turn throws off its moon, and begins to cool and to solidify, till air, water and land differentiate themselves, and the inorganic process of our globe begins which finally unfolds into the organic (for the cosmogonic evolution of the Earth see *Cosmos and Diacosmos*, pp. 251-256).

Such is the general view of science today, largely speculative; but it does not stop here. It is supposed that we have reached about the middle period of Earth-life at present—one-half gone, one-half still to come—each half representing perhaps a hundred million

of years, a kind of euphemism for a very long time. Earth-life is, then, to cease; and our globe as a dead cadaver is to pass through a new unseen unilluminated stage, perchance the meteoritic, buried in the graveyard of the skies, till the æon of resurrection arrives. So the transition has been conceived, with some show of facts though very inadequate. But the initial point is again reached, namely that shred of fire-mist in some Orion nebula which is just emerging once more into light out of its dark cosmical cemetery—whence our Earth is again to evolve, and to go through its round of existence.

Earth-life is, therefore, but a small segment in the vast cycle of terrestrial evolution; of that vital segment we here and now have the satisfaction of standing on the central point perchance. But it is significant to note that the Earth as individual must die too, like the rest of us animals and plants, must be resolved into its original cosmical elements, must be dipped into the Pancosmos whence it was born, thence passing to resurrection and new life.

So we picture to ourselves the total cycle of the Earth's existence, the geogonic evolution as a whole, of which terrestrial life is but a part. This part has also its past history, its long evolution down to the present.

Thus the Earth's development began at a certain time to bifurcate and to run double.

2. *Double Generation of Earth-life.* There is a generation of the inorganic element of Earth-life going on all the time; there is likewise a generation of the organic element of Earth-life going on all the time; such is what we here conceive as the double generation of Earth-life which is now existent and has long existed. The one embraces the rocks of the Earth, stratified and unstratified, with soil, air, water; the other embraces all Life from lowest to highest. The rocks are always being displaced and replaced by erosion, upheaval, subsidence and other causes; that is, the Earth is continually generated anew inorganically; in like manner there is a perpetual displacing and replacing of living individuals, vegetal and animal; that is, the Earth is continually generated anew organically. These parallel movements, however, are deeply interwoven with each other; the inorganic world sustains directly or indirectly the organic, while the latter helps reproduce the inorganic (for instance, the limestone of the Earth is mostly if not wholly the deposit of organisms). Still we hold apart these two separate lines of Generation of Earth-life, especially in the science of Geology, in order to scan their interaction. Here it may be

added that the preceding process of Assimilation, in which each side assimilates the other, depends upon the present process of Generation, as the inorganic and organic forms have to be generated before they can be assimilated. Earth-life therefore has these two strands, ever active and inter-active.

The process of inorganic Generation results from two kinds of rocks—in geologic language the primary and secondary rocks. The former are the original constituents of the Earth cooled and crystallized, hence designated as igneous, unstratified, without fossil or organic remains. The secondary rocks are the derived, resulting from the destruction of the original rocks and their reconstruction through water (aqueous rocks), or through the atmospheric agencies (sub-aerial rocks), or through organisms, vegetal and animal. The last give the fossiliferous rocks, which being also stratified in succession of time, reveal the past history of Earth-life along three lines—plant, animal, mineral. Herewith we are enabled to reach back and take up the entire sweep of Earth-life in its generative movement.

3. *Total Generation of Earth-life.* Thus the organic stage of Earth-life has its distinct history divided into numerous epochs and sub-epochs, in triple record, from the be-

ginning of life on our planet till the present. Stratification of the inorganic material has preserved the contemporaneous organic remains in various degrees of completeness, from a mere trace or footprint, or bone, up to the entire skeleton, whose flesh and hair have continued undecayed in some instances through being encased in ice.

The science which deals with fossils is called Paleontology, and has reached large proportions. Fossils in the different successive strata of the same region indicate which rocks are older and which younger since the order of ascent in the organic world is known, and thus becomes the key for unlocking the relative age of the inorganic formations. Still further, the same kinds of fossils appear in strata very far apart, on a different continent perhaps; all such rocks are supposed to have been formed in the same geologic period, however distant they lie asunder. A geologist has recently estimated that the total stratified order of the Earth's crust has a thickness of fifty miles; but the strata are much broken and interrupted through various causes, and have to be put together from diverse localities. Fossils have been called the medals of creation, as they bear the stamp of the historic order of the Earth's evolution. Still not the whole of this evolution can they

give, but only the organic part, and not all of that. The earliest organisms have hardly left their trace.

It was an epoch-making scientific act when this idea of ordering the Earth's successive layers through their fossils first began to dawn upon a human brain, and to be applied even to a limited territory. The English claim in the present case the right of priority for William Smith (1769-1839), a surveyor, who, in pursuit of his calling was led to observe the recurring kinds of fossils in strata at different places. Such strata he accordingly sychronized, making them products of the same geologic epoch. What he did for a part of England is now being done for the whole Earth. He also applied the basic principle of the Earth's evolution that in a succession of strata the oldest is found at the bottom. Thus the Earth is conceived to grow by adding layer to layer, like a Plant, round an unstratified kernel which is without fossils (azoic). From this point of view Earth-life may be compared to a gigantic tree with its manifold concentric layers, which are continually added on the outside, if not year by year, at least epoch by epoch. How many such layers this Earth-tree (the real Yggdrasil) will deposit belongs of course to the future; but we

can seek to count the layers of the past, as we do those of the Sequoia. And by such a count we may approximately determine the age of this Earth-life in its multitudinous sequences. The co-odination of all the fossils along with their strata around the globe is now a main task of Geology, which has to give at last a telluric chronology, both inorganic and organic up to date.

The bare outlines of such a chronology we may here set down in the nomenclature usually given:

(I). *Azoic*, the era of Unlife, which in the widest sense would embrace the Earth's earliest appearance in a nebulous form, perchance first in the Cosmosphere, then in the Heliosphere, then in the Geosphere thrown off from the Sun. This azoic era would include the evolution of the chemical elements, starting possibly with proto-hydrogen, which finally evolve into chemical compounds, some of which we have with us still in the form of azoic rocks, unstratified, upon which the earliest strata rest and begin the concentric fossiliferous layers of Earth-life already mentioned. Herewith we have come to the next.

(II). *Zoic*, the era of Life on our globe, to which Life has occurred the transition from Unlife. In this era are found many divisions and sub-divisions, of which the following may

be briefly noted: (1) *Palaeozoic* or old-life, in which are several periods, such as Silurian, Devonian, Carboniferous. (2) *Mesozoic*, or middle-life, which has also several periods. (3) *Caenozoic*, new-life, which is also subdivided. As already indicated, each of these eras, and indeed each of their subordinate epochs, had its own peculiar species which can be identified over the Globe. Then again each of these important stages had its special forms of Life; thus the Silurian is called the age of mollusks, and the Carboniferous the age of coal-plants. It would seem that the total life-stuff of the Earth was expended in a colossal effort to produce one kind of living thing, animal or vegetal, at a time. We may conceive the Earth-life as a whole to be a huge animal which has had to go through various stages of evolution, at first a fish, later a reptile, and finally a mammal, which it is now, though once it turned plant mainly, back in the coal measures. Of course it has kept in general the living shapes which it once evolved, still its stress seems to have been upon one great typical form during a given time. In this trait Earth-life appears like an individual undergoing a series of metamorphoses through the geologic ages, each of which is characterized by such a metamorphosis. While the Earth-life may be deemed

mainly an animal, it is also a plant and was primarily so. In vegetation through many flowerless forms, it finally infloresced in the flowering plants, seemingly along with the rise of the mammals.

So far Earth-life has remained mammalian, culminating in man. But with his advent comes a great new transition—the sweep from Life to the conscious self. This still takes place upon our Earth, and is a part of its process. So we may set it down in the present connection.

(III). *PSYCHIC*. The individual has now reached the completed act of Generation in a continual self-genesis, which is Soul, Ego, Self. That is, he can separate and become his own other within himself, thus returning to himself and becoming the whole genetic process. The total Generation of Earth-life has here gotten inside the living individual, who now individuates himself when he chooses, or generates himself anew in each act of consciousness, and thus persists through and beyond Life.

Earth-life has, accordingly, shown in its generative sweep three great stages—inorganic (azoic), organic (zoic), and psychic. Between each of these stages yawns a wide abyss which science finds it impossible to

bridge. To pass from the pre-inorganic to the inorganic, and then from the inorganic to the vital and finally from the vital to the psychic are great flights which thought alone as yet dares attempt. Such a fact would seem to indicate that thought is itself primordial, antecedent to Nature which springs from it as universal, or as the Universe.

But we have now reached the conclusion of the ordering of the three Life-forms as particularized separately and as united in their one process—Plant-life, Animal-life, and Earth-life. This portion of our entire theme we have designated as the Particularized Biocosmos, which has wound up in evolving the inner movement of the psychic individual, who now has won the power of turning back not only upon himself but also upon all his past history, being in his evolution the total generation of Earth-life, which he is next to re-generate. That is, we are to see that the Ego has evolved to the point of re-evolving its own evolution, of which it is to become conscious. But this transition carries us over into a new stage of the whole Biocosmos, which now is able to look back at itself, and trace its own past history.

Part Third.

HISTORICAL BIOCOSMOS.

We have to include in the science of Life not merely Biology, but the biologist himself biologising, or evolving his Biology. Thus we rise to the conception of a completed Order of Life or Biocosmos, which attains not simply the Ego as evolved, which stage was reached long ago, but as going back and evolving all living Nature up to itself as evolver, which stage belongs emphatically to the present time. The hero of this Biocosmos is unquestionably Charles Darwin, whom we have to grasp as an evolved Ego returning upon Nature and evolving Evolution.

It is worth while to consider the fact that Biology has its connection with Biography,

which is indicated by the common Greek word *Bios*, Life. Both, too, stand in relation to the Biocosmos, of which we are treating. It is true that Biology deals more with the physical processes of Nature, while Biography records rather the mental or psychical side of the individual as shown in the occurrences of his career. In a sense we can say that the plant or animal has a Biography which gives an account of its birth, development and cessation. It would be interesting to have the Biography of a tree like the gigantic Sequoia. Pedigrees of famous steeds have a biographical value to the horse-breeder. But it is the life of the biologist which specially concerns us here, and is intimately intertwined with his science, each reacting upon the other, so that they become mutually interpretative. The mind or consciousness of the biologist turns biological, being trained by what it works in, and it gets to looking at the universe biologically, that is, after the method and within the limits of Biology. Such an Ego accordingly belongs to the full sweep of the Biocosmos; indeed, a line of such Egos appears, unfolding in historic succession, and setting forth the various stages of their evolving science. Thus we catch the outlines of the historical Biocosmos, which will arise only after a considerable evolution on which we can look back.

Here then the pivotal thought comes up that we have reached not merely Evolution, but the Evolution of Evolution, as it turns round upon itself and applies itself to itself. The biologist evolves his science, but now we are to evolve the biologist evolving his science, and behold him subject to his principle, illustrating in his own individual life his evolution of life in Nature. Nor is this all: there are many individual lives of biologists successive in time, who show the Evolution of their science as a whole from its beginning till the present time.

Evidently we have before us three phases of the evolutionary principle: First is the Evolution of biology (the science), then is the Evolution of the single biologist (the biography), third is the Evolution of the many biologists with their doctrines (the history). The great scientist thinks with Nature, or by means of Nature, to whom he has to give a human voice, which she strictly has not, yet longs for. But Nature is large, has many compartments, each with its own character, or soul or Psyche. The scientist usually specializes, confining himself to one of these compartments, with whose Psyche he affiliates on the most intimate terms, seeking by many sorts of interviews to get acquainted with it and to express it. Newton was a cosmical genius, who

showed the deepest intimacy with the mechanical element of Nature; his mind was born in some deep unity with gravitation, whose law was his own as well as that of the Cosmos. But this realm's limit seemed also his spirit's boundary, his diacosmical genius was by no means so transcendent, and in the Biocosmos he has hardly left a trace. On the other hand Darwin's very soul was biocosmical, and hence evolutionary; he hardly felt the inner psychological throb of the Cosmos or Diacosmos as great divisions of Nature, or in one of their lesser compartments; he was the supreme biologist who lived on intimate terms with life whose soul he caught and voiced in his doctrine of Evolution.

Suggestive in a number of points is the comparison between Newton and Darwin, the two supreme scientists of the English-speaking race, if not of all Europe. Each in his own way sought and formulated the unity of Nature in one of her largest phases. Newton placed all the material bodies of the physical Universe under one law, that of gravitation, which the sun and stars obey as well as a bit of earth-dust. Thus the separated Cosmos he unified under an universal principle, and made it truly a part of the science of inorganic Nature. Darwin likewise performed a mighty act of unification through his law of organic evo-

lution, by which the living universe was seen to be governed by a single principle. The two English lawmakers of science have, accordingly, ordered their respective territories of Nature, having done this not merely for their own people, but for the rest of mankind. In like manner, we may be permitted to think, England has elaborated a constitution with form of government which seems to have some attribute of universality for Europe, since nearly all European nations have adopted it more or less closely, as the one fundamental law of the State. The two English scientists we may, therefore, connect on one interior line, with the dominant institutional consciousness of their people.

The seventeenth century, that of Newton, had to put under law all the diverse and recalcitrant pieces of matter in the physical universe—the first subjection, we may deem it, of Nature's individuality, which had been let loose along with man's, from the clerical sway, in the Renaissance. The free movements of natural bodies must be shown to be not capricious or accidental, but obedient to legal control. This was peculiarly the work of Newton who may be well called the Lawgiver of the Cosmos. (See our *Cosmos and Diacosmos*, pp. 170, 178, etc.)

On the other hand the nineteenth century,

that of Darwin, felt imperiously the need of putting under law all the variations of life, all the changes in living things. Not only the external movements of lifeless bodies, but the internal movements of vital bodies must be seen to be no play of chance or caprice, but duly subordinated to control. Species, for instance, are not arbitrarily created from the outside, but evolve freely from within; yet this freedom obeys its own law. This must be regarded as a new stage in the progressive emancipation of Nature, when she is declared by science to be in a manner self-governed. Life has undoubtedly its anarchic, negative, revolutionary aspect, but this will be seen as a transitory phase when we grasp its evolutionary character. Darwin is essentially the Lawgiver of Evolution, and thus has borne science out of its seemingly destructive attitude, which it manifests so decidedly in the Diacosmos. Rightly does our time feel grateful to Darwin, for he has revealed the supreme positive act of Nature in the Biocosmos, and has shown the rescue from negation through his law of Evolution, which, at present chiefly biological, is yet to be made universal, being applied in its way to the inorganic world, yea to Evolution itself.

Very significant, therefore, is this return of nineteenth century to the seventeenth, in

the endeavor to express a new and more internal unity of Nature. In a sense we can say that Darwin goes back to Newton, takes up the latter's far-reaching thought and applies it to a fresh domain of the physical world. Evolution, the pivotal category of the Biocosmos, reaches back to Gravitation, the pivotal category of the Cosmos, and connects with it in the one great process of total Nature. Cosmically the individual body has its center outside itself, to which it strives perpetually to be restored; biocosmically the individual body has its center inside itself, out of which it unfolds into its genetic act, whereby it reproduces itself and thus returns to its starting-point. Such is the simple round of Life, which, however, is but a stage of the larger round of Nature as a whole, as already often stated. The interest here is to see the stages of this process taking place in stretches of time, in centuries, generally speaking; also it concentrates itself in the mind and character of great scientists, who thus become the stages of Nature embodied, or rather personalized. So we conceive Newton and Darwin, whose lives are a manifestation of Natural Science, and thus must be integrated with it.

At this point it may be noted that Biography as such has never been ordered through any universal principle. The career of the

individual, it seems to be taken for granted, is not amenable to any law of development which applies to all careers, whatever be the department of activity. But every person who enacts a life is an Ego, and must ultimately manifest the process of the Ego, which is verily universal. Hence Psychology is the only discipline which can reveal the all-dominating principle common to every human life. Philosophy as a world-discipline never did and indeed never could give a philosophy of Biography, which must refuse to have a system foreign to itself clapped upon its free movement. The science of Psychology, that is, of the Psyche or Self, can alone penetrate and order the Self in all its diversity. Accordingly, Biography, which is the favorite kind of literature for a majority of people, is sometime to reach a new stage of its evolution, advancing out of its present separative, chaotic, distracted condition. All lives must show the common underlying principle or law of all life, which they in one form or other embody. Newton and Darwin in the circuit of their terrestrial existence, had the one common process of the Ego; but with the former this took a cosmical turn (or mechanical), while with the latter it took a biocosmical turn (or vital). The Biographies of both would give their unitary process, but would portray it unfolding

their separate characteristics. And some day we may have a science of Biography, as we have long had a science (or philosophy) of History, which in a number of ways is the counterpart and complement of Biography.

Accordingly we have to think that biological Evolution is not complete till it embraces the corresponding biographical Evolution which evolved it as a science. Both are forms or stages of that larger Life which we name the Biocosmos. Biological Evolution is to set forth not merely the Descent of Man (or his Ascent, as it is sometimes put), but it is also to bring before us the descended Man, the biologist himself, looking back and telling us of his Descent from the beginning (perchance the *monera* or *amoeba*). His act is truly the last outcome of Evolution which thus turns about and takes up itself as a whole. It is true that in such a case Evolution proper has evolved out of itself and gone beyond into a psychical sphere. The end of Evolution is to free the Psyche from its immediate bond with Nature, till it attains the power of self-return within itself or self-consciousness, and through this to become aware of how it gradually won such a power. Thus the Psyche is to evolve into being conscious not only of its own immediate self, but also of the genesis of that self in its long training with Nature (or Physis). Dar-

win indeed is inclined to limit Evolution to his own organism, hardly reaching his self-re-turned Ego, which therefore works quite unconscious of its true end, and in the deeper sense does not know what it has done—namely evolved out of Evolution. Still the evolutionary biologist must not omit himself from his own process; just he is the greatest fact of it, as he wheels about and recreates in thought his entire Evolution perchance from a microscopic cell. And when he has evolved himself evolving Evolution, it is plain that he has evolved its master. His Biology thus winds up in his Biography, therein rounding itself out to completion.

There can be no doubt that his age, and especially his nation were ready for Darwin, in fact were calling for him, and hence rose the mighty response to his book. This was a fact which Darwin himself did not always see; he is inclined to deny that “the subject was in the air, or that men’s minds were prepared for it.” He says (in his Autobiography) that he “sounded not a few naturalists, and never happened to come across a single one who seemed to doubt about the permanence of the species.” Even his closest friends held back. Lyell the geologist and Hooker the botanist, “though they would listen with interest to me, never seemed to agree.” How could they

take such a big leap at once, with their transmitted inheritance of old doctrines? But Lyell and Hooker will also evolve, though they too must have time, like the rest of animated existence.

Now it is a curious fact that his foregoing statement runs directly counter to what he says in the Introduction to his *Origin of Species*, where he recognizes a goodly number of his predecessors in the matter of the gradual modification of the species. His object there is to show that his theme was in the air and had been so for a good while. He adds a suggestive note in the same place: "It is rather a singular instance of the manner in which similar views arise at about the same time, that Goethe in Germany and Dr. Darwin in England, and Geoffroy Saint-Hilare in France, came to the same conclusion on the origin of species in the years 1794-5." The mentioned Dr. Darwin was Charles Darwin's grandfather, Dr. Erasmus Darwin, poet-naturalist as well as physician, from whom the grandson may have derived a fair half of his talent, to the exclusion of his ancestor's other poetic half. But the fact above indicates that distinguished men in Germany, France and England, each independent of the other, more than fifty years before the appearance of the *Origin of Species*, had at least suggested its

fundamental subject. This surely shows that the idea was fermenting deeply in the time, and was getting ready to be born.

It may be here remarked that these opposing statements of Darwin illustrate a strain of his psychologic character: he was gifted with a considerable power of unconscious self-contradiction. He had small logical, or rather, dialectical aptitude; he specially disclaims any success with metaphysics or mathematics, they both lay outside of his mental domain. Argumentation indeed he possessed, his great book is cast throughout in the form of an argument. On the whole Darwin in his life was an unfallen, paradisaical spirit, despite his reaction; little of the negative lay in him consciously, all his friends have celebrated his angelic character. He was one with Nature and responded instinctively to her heart-beat; such was his congenial sphere as well as his limit. Still he also heard the call of his time and answered famously in his way. This was through Nature, who also gave expression to the spirit of the age in Darwin's voice, which really could speak no other tongue but Nature's.

The foregoing facts of the age's preparation may be elaborated a little further, to show more fully the place of Darwin as the pivotal biologist of the Biocosmos, who biolo-

gically evolves himself evolving Evolution as the time's basic thought expressed in a category. Moreover Darwin has his peculiar method of Evolution: it takes place through Natural Selection, or the Survival of Fittest, which involves the elimination of the unselected or the unfit. Thus the method has a deeply negative, indeed a tragic counterstroke, which may be applied to nature and to man also, the latter becoming in the talk of the day the submerged half, more or less. Now Darwin lived and wrought in the very heyday of England's Political Economy with its doctrine of ever-decreasing means of human subsistence. Thus death through starvation continually looked the English people in the face; they beheld fate stealthily creeping upon them in the lack of the supply of food. Some would survive, the strong, the rich, the capable, in general the fittest; the rest would sink beneath the wave. Human Society in England was one colossal example of Natural Selection, which surged before and around Darwin everywhere who, bearing in his soul the strong impress of the fact, took it and applied it to all Nature. Undoubtedly the air which he breathed was full of it, he heard the echo of it on all sides from the statesman and theorist to the bitter shout of anguish always rising out of the hearts of the poor. The social

order of his time and nation, therefore, gave to Darwin the push to his task, and suggested to him his epochal thought.

A few indications may be pointed out. Ricardo's Theory of Rent made a great stir in England during Darwin's earlier days, and was generally accepted. This showed a selection of the land, the best being taken first, then the next best, till the poorest soil was reached which would simply furnish food enough to keep those alive who tilled it. But the people needing bread would still increase; what was to become of them? At least they would have to engage in the bitter struggle for existence, which Darwin saw raging around him on every side, and which became a part of his consciousness. Then Britain was an island whose territorial limits could not only be seen but decidedly felt, so that they have entered into the very character of the Englishman who has so often been designated as insular. Thus Nature had drawn a sea-line around the supply of food though the mouths to be fed kept increasing. Necessarily the impressive social phenomenon in the British Isles was the struggle for existence. But the most significant of all books to Darwin in his mood was the Essay on Population by Malthus. This brings out that while sustenance increases only in arithmetical ratio, population increases at the

same time in geometrical ratio. Again looms up portentous that Natural Selection among men in a social condition, with the survival of the fittest and subsidence of the less fit. This book seems to have dropped down upon Darwin's table at the pivotal psychological moment. Listen to his own record of the matter in his Autobiography:

“In October, 1838, that is, fifteen months after I had begun my systematic inquiry, I happened to read for amusement *Malthus on Population*, and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of plants and animals, it struck me that under these circumstances favorable variations would tend to be preserved, and unfavorable ones to be destroyed. The result of this would be the formation of new species. Here then at last I had got a theory by which to work.”

So Darwin traces his first glimpse of the theory of Evolution through Natural Selection, and acknowledges that he derives his idea from Malthus; only he transfers the struggle from social man to the vaster population of plants and animals. The British Islanders had become profoundly conscious of this struggle in their midst, for it had received emphatic expression not only in Ricardo and

Malthus, but also had been organized into an extensive science by John Stuart Mill's work on Political Economy, a gloomy book full of the modern social tragedy. It is still Natural Selection with its remorseless submergence of the weak. From this fateful impression Political Economy in England has been named the Dismal Science. The same doctrine was carried over into Philosophy by Herbert Spencer who first formulated the famous phrase, "the survival of the fittest." It should be added that in continental America such an insular theory could not arise; the circumstances, social and physical, were wanting. There was still an abundance of land, no limitation of the food supply was visible, and hence no social struggle for existence as in England. It was in place, therefore, that the strongest contradiction of the doctrines of Ricardo, Malthus and Mill, should be the work of an American economist, Henry C. Carey. Darwin with his theory of Natural Selection could not have originated in the United States, where his social presupposition was wanting; he had to be born not only a European but an English Islander of the nineteenth century, in order to see and perform his task for Nature. Darwin must be seen as an offshoot of the same economic world which produced Robert Owen with his early socialism as the panacea for

the ills of society, and which developed Karl Marx with his later socialism, whose edifice he sought to erect in a monumental book (*Das Kapital*). Darwin's Natural Selection should be regarded, therefore, as the outgrowth of the time and nation in their most coercive problem, and not simply as an isolated burst of individual genius. Shortly before the publication of his great book he witnessed the exciting repeal of the long-standing corn-laws, which act threw down the last bar to the unrestrained might of Natural Selection among the British people.

Here we may recall that the nineteenth century, which was spiritually defined and formulated by Darwin more than by any other man must be deemed the evolutionary century. We have elsewhere noted that Hegel, the chief philosopher of the century, applies Evolution to his Absolute Idea, and thus his entire system of thought is evolutionary, though kept wholly in the realm of abstract thought. That was too remote for the average mind, which must see the principle working in the realm of sense, which proof was just that furnished by Darwin. Accordingly the biologist and not the philosopher took possession of his age and voiced its inmost spirit in a way intelligible to all, elevating at the same time Natural Science into the utterance of the

universal Self (Pampsychosis) and quite supplanting its former royal herald, Philosophy. Hence resulted the great philosophic subsidence, especially in the last half of the nineteenth century, which subsidence carried down with it a good deal of the old theology. Then began to be felt the need of a new formulation of the Universe in all its three constitutive stages—God, World and Man. For the two old formulations in all their various phases were no longer sufficient; Religion and Philosophy, the two ancient world-disciplines of man and the greatest trainers of his spirit, had been partially at least outgrown. Not that they were to be thrown away and wholly eliminated from the great school of humanity, but they must be supplemented by a third construction of thought of the All, different indeed but co-operant and reconciling, for Religion and Philosophy from the time of old Greece had never been very good friends and needed a mediator. At any rate the aspiration rose in the soul of the age for the new third world-discipline—an aspiration indicated by the deep-seated unrest of the best spirits.

So it happened that Natural Science with its fresh triumph laid claim to being the great new dispensation. Through it the old order had been assailed and partly undermined; its negative might had indeed been prodigious.

But did that make it competent to be the supreme positive doctrine? Many fervent disciples said so, and thus arose the Gospel of Natural Science, very ably and often beautifully set forth by an army of literary missionaries. But now, as the smoke of battle begins to clear away, we can see that Natural Science cannot take the place of Religion and Philosophy, which it sought to do in the height of its victory; nor can it be that third newest world-discipline called for by the aspiration of the time. Still it is going to remain, yet remain in its place; Nature is not the Universe, but at most the second compartment of it; and Natural Science cannot, therefore, be the science of the All, but of a part, a phase, a stage. There must be a greater over it, the Universal Science or the Science of the Universe, which determines it, and gives to it its final organization. We hear in certain quarters a deep disappointment with Natural Science, it has not fulfilled what was expected of it some years ago, especially in education. In fact it has shown a decided tendency to separation, distraction, pessimism, in general to uneducation. Such a result comes from trying to make it do what it cannot and ought not; Natural Science does not reveal the ultimate unitary process of the Universe, and hence it is unable to furnish the universal method; yea it cannot

finally furnish its own method, for Nature has to be ordered at last by something higher than itself. Still it has asserted its place and function in the grand Totality, chiefly through the work of Darwin, and is no longer to be contemptuously cast out by Religion and Philosophy.

Natural Science with its supreme category of Evolution is not, therefore, the new-born world-discipline, though it be the chief force which is propelling such an idea toward realisation. It drives us to forecast what will be the dominant thought of the twentieth century. Already has the question been asked: After Darwin, what? Evolution has shown itself to be one side or part of a greater Whole, which would seem to be next in order.

If we seek to grasp fully the place of Darwin or of any epochal genius, we are to see him as the mediator between what may be deemed two extremes: the universal spirit of the Ages which is now to reveal itself in the stage of Evolution, and the popular mind which must be ready to receive such a revelation; this, however, has to be formulated and imparted by the mediating Great Man of the time. To use the psychological phraseology already employed: it is the function of the genius of a given domain and time to mediate the Pampsychosis in its special manifestation

with the People or the Folk-soul of the period. It may be said that in the nineteenth century the World's Spirit had become evolutionary, and that on the other hand the People's Spirit was ready for the impress which was also its own. Darwin was the one who had the gift of uttering the timely message from God to Man (to employ the religious phrasing of this matter). Still Darwin is not the whole of Evolution, nor is Evolution the whole of the Universe.

It has been already remarked that there was something insular in the theory of Natural Selection, and that England alone through its social and mental condition could have called forth such a doctrine. The fittest and the unfit seem engirdled in a ring of sea, and the struggle for existence takes place. Natural Selection implies the sinking of the unselected under the waves of being, while the selected species rises and floats on the surface like an island, like England. Civilisation is indeed saved by the survival of the fittest, yet its triumph is ever accompanied by the awful tragedy of the unfit. Now Darwin, an Englishman and so an islander, catches up this keynote of his time and people and of his peculiar locality, and starts to applying it to the whole life of Nature. But why just he, this individual? What experience does he pass

through whereby he is selected among millions of the same human species to unfold Natural Selection?

Now this experience as told by himself, is emphatically insular, as he proceeds in his voyage on the *Beagle* from one group of islands to another. He starts of course with the British Isles which were doubtless at one time connected with the continent, but have been long separated from it, and have developed their own peculiar species and varieties among living things, notably, the man and his institutions. The first group of islands to which the vessel came was the Cape de Verde, lying off the coast of Africa, and closely related to it, though differing from it enough to suggest a little bit of evolution, if the thought was ready. But the great insular experience of Darwin on his voyage, which lasted five years altogether, was at the Galapagos Islands, in the Pacific, some hundreds of miles west of South America, under the Equator. They were of volcanic origin, their geology as well as their fauna and flora indicated their original connection with the South American mainland.

It may be said that Darwin at the Galapagos Islands saw his theory rise bodily before his eyes out of the ocean. In the territory itself he beheld variation and descent from an ances-

tor. This ancestor was the continent of South America from which these different islands had been originally separated, and been made to constitute an entirety together (the archipelago); then the archipelago was divided up into a number of large and small islands, and even some smallest ones. Says Darwin in his *Journal*: "This archipelago consists of ten principle islands of which five exceed the others in size." It is evident that the earth itself presented variations which might be classified after the model of Natural History as family (the original continent), as genus (the archipelago as a whole), and as species (the several sorts of islands), each of which finally had its individuals. But the striking fact was that all these gradations were separated from one another, insulated we may say; and they all—family, genus, species, individuals—had their real counterparts before the eye. Thus the territory itself furnished the framework and suggested externally the order and evolution of living things there found.

Again we shall cite Darwin's *Journal*: "By far the most remarkable feature in the natural history of this archipelago is that the different islands to a considerable extent are inhabited by a different set of beings," that is, the life upon them varies. For instance, the tortoises of the same species on different is-

lands showed so great differences that an experienced eye could tell from which island a given specimen was brought. Darwin goes on: "I never dreamed that islands about fifty or sixty miles apart, and most of them in sight of each other, formed of precisely the same rocks, placed under a quite similar climate, rising to a nearly equal height, would have been differently tenanted." The physical environment was quite similar in all, but the organic variation seemed to go on. Birds of the same species in the separate islands varied, so did the flowers. Here then was variation with the consequent evolution into distinct species, mapped out by localities and set directly under the eye. Insular species of plants, animals and insects fenced off by the sea and confined to limited territory in the separate islands, always show differences in their individuals. Here is the clew to Darwin's chapter on *Variation Under Nature* (in *Origin of Species*). Seeing this phenomenon oft repeated in a little enclosed spot, Darwin carries it home and applies it to the whole earth; he has found the typical fact of his work, and at once proceeds to make the same universal. But first he is driven to find the source of such variation.

Darwin fully recognized the foregoing original suggestion of his idea. Says he in his

Origin of Species (Chap. II.): “Many years ago, when comparing and seeing others compare, the birds from the closely neighboring islands of the Galapagos Archipelago, one with another, and with those from the American mainland, I was much struck how entirely vague and arbitrary is the distinction between species and varieties,” and he might have added genera. In fact there was no fixed boundary line between these classes; every individual, plant and animal, varied from its parents and from its brothers and sisters. Variability of all living organisms thus became his germinal starting-point, seen plain in the Galapagos Islands; but when he went home to his own British Island and saw the intense insular struggle for existence, he found his second great category, Natural Selection, as the chief, though not the only, ground of this condition in which the fittest persist and propagate. Says he: “As more individuals are produced than can possibly survive, there must in every case be a struggle for existence.” But who will survive? Those individuals “which have favorable differences and variations” are preserved, while the injurious variations will cause destruction. He also states (*Origin*, II), whence he derived his view: “It is the doctrine of Malthus applied with manifold force to the whole animal and

vegetable kingdoms." Thus also he applied the Galapagos Islands as a kind of measuring-rod to the whole earth, dividing it up into so many insular units of the migration of flora and fauna, and hence of geographical distribution, as well as of variation.

The individual Darwin is, accordingly, a product of his environment working with his inherited gifts. As stated some pages back there was an insular element in his character and career, otherwise he would never have evolved Evolution by Natural Selection. An insular Evolution had evolved him the evolver of insular Evolution. The sight of the Galapagos Islands, and their living inhabitants, brought him to a consciousness of his own deepest self and of his life's task; they were Nature's outer manifestation of what lay in him, and so he beheld himself in them as in a mirror. He as naturalist had found his true counterpart in Nature, and began at once to unfold and describe what he saw. He had discovered the world (or quite a fragment thereof), and then he sets about discovering himself in the world everywhere.

This brings us to a new stage of his development or personal evolution; and we are led to ask what are all these stages. Darwin's individual evolution to the point where he saw and evolved organic evolution, making the

universal life of Nature the content of his own life as conscious, cannot be left out of a complete survey of the Biocosmos, which thus not simply evolves as a natural object, but beholds itself evolving through the ages—the evolver standing not outside but inside of Evolution, not merely a spectator but a participant active, yea necessary. Evolution would not be complete without having evolved Darwin—its culminating act in some respects. Still we are not to forget that before and after Darwin runs a line of biological Egos engaged in the work of evolving Evolution, and themselves a part thereof also. This fact brings to the surface the historical side of the Biocosmos, and shows that the doctrine of Evolution had long been evolving and is still at its task. But the all-dominating personality in this field is Darwin whose individual evolution we wish to see as an illustration, yea as an integral part of universal Evolution. So next we have to unfold the biographical Darwin to his place in the Biocosmos.

I. DARWIN'S BIOGRAPHY.

The Biography of the biologist, the Evolution of the evolver of Evolution, the life of the man who unfolds Life—such we wish to grasp in its main outlines, as an essential stage of the Biocosmos, which seeks to order the totality of Life. As Darwin turned back and showed the development of his own organism physically, so we are to see him developing this development mentally (born 1809, died 1882).

Evidently here are woven together two strands, two kinds of life which we may call organic and psychic. Darwin evolved organic Evolution through its various forms, but his act therein was psychical or mental. Now to perform such a mental act, he had to have his preliminary training, or his Spirit's Evolution into seeing Nature's Evolution.

This is to be unfolded in his Biography. But after he had written his great evolutionary work (*Origin of Species*) he lived many years, making new application of his principle. Accordingly we may observe three leading stages in his career:

First is his period of education, which we may call his Apprenticeship, till he found

himself and his vocation, through his voyage as naturalist on the *Beagle*.

Second is the period of elaboration from his germinal point of view, which view he brings back with him as his instinctive yet creative idea; this is what is now to clothe itself with facts of organic life.

Third is the period in which he seeks to make his principle universal, applying it generally to animate existence. Thus he passes from the implicit time of acquisition to the explicit discovery of his principle, which he finally applies in many ways.

Here it may be noted that Darwin's individual career can well be regarded as a typical life; it has in it the idea and the movement of universal Biography, though following its particular lines and character. We may deem him a special manifestation of the universal man in a very unique and exalted way: in a way which becomes an exemplar of all completed lives, like those of Lincoln and Goethe for instance. Not a broken imperfect life consisting of scattered fragments is Darwin's; it has a unity and a process which connect it with the All-Life, yea with the All-Self, of which it is an incarnation and a reflection.

In this sense it will be worth while to study Darwin's biographical stages with some attention.

I. APPRENTICESHIP. We are struck with the difficulty which Darwin had in finding his true bent, in discovering what he had to do in the world. If we look into his immediate ancestral inheritance, we observe a line of science coming down to him through his forefathers. He has celebrated the mental capacity of his father, who was a physician and specially gifted with keen power of observation, which the son also shows. But the most interesting as well as famous of these ancestors was Dr. Erasmus Darwin (1731-1802) who was a poet and put Nature into brilliant Poppian verse in his *Botanic Garden*, and seems to have kept up his poetizing to the end of his days. This trait he did not transmit to his grandson, who says (in his Autobiography) that in earlier life he read poetry with pleasure, and then continues: "But now for many years I cannot endure to read a line of poetry; I have tried lately to read Shakespeare, and I found it so intolerably dull that it nauseated me. I have also lost my taste for pictures and music. My mind seems to have become a kind of machine for grinding general laws out of large collections of facts." So he confesses to "the atrophy of the higher aesthetic tastes" during his later years. Very different in this regard was his grandfather, who, however, on another line reveals a men-

tal turn very similar to that of his grandson. For Dr. Erasmus Darwin wrote a work called *Zoonomia*, which seeks to find the law of the animal world, and in one passage (cited in the Introduction to the *Origin of Species*) partially anticipates Charles Darwin's doctrine in regard to the transmutation of the species. The grandfather also wrote a work called *Phytologia*, which has to do with plants. Organic life was therefore the main theme and delight of this ancestor, wherein he is like his famous descendent, who, however, did not poetize it, though certainly gifted with imagination subordinate to science. It has been noticed that children often skip their fathers, and inherit from their grandfathers (a point dwelt on by Goethe, by the way); some such fact we may see in the case of Darwin.

The first decided bent which Darwin notes in himself as a boy was "my taste for Natural History" and also the passion for collecting specimens of various objects, "which was very strong in me and was clearly innate, as none of my sisters or brother had this taste."

When nine years old he was sent to a "Dr. Butler's great school in Shrewsbury," where he stayed seven years. Here is the result in his own language: "Nothing could have been worse for the development of my mind than

Dr. Butler's school, as it was strictly classical, nothing else being taught but a little ancient geography and history. The school as a means of education was to me simply a blank. During my whole life I have been singularly incapable of mastering any language. Especial attention was paid to verse-making, and this I never could do well." Here is one of the first guns of the great battle between Natural Science and the Classics, about which recent pedagogy has heard so much. The school had no study of Nature for developing the boy's innate bent which showed itself in the fact that "I continued collecting minerals with much zeal but quite unscientifically. I must have gathered insects with some little care," even before the age of ten years. Also he observed birds, and dabbled in chemistry. Evidently the boy Darwin is making his own curriculum of education in strong reaction against the transmitted training through the Classics. Once he was publicly rebuked by the headmaster "for thus wasting time on such useless subjects."

What is to be done with the trifling lad, for so he seems. His father took him away from the classical school, where he "was doing no good," and sent him to Edinburgh University to study medicine, evidently that he might succeed the father in practice. But here again

the youth kicked out of the transmitted traces and pursued his own course in some irregular studies of Natural History. He loved to hunt and to sport with animals. His father in desperation once hurled at him a little thunderbolt: "You care for nothing but shooting, dogs and rat-catching, and you will be a disgrace to yourself and all the family." Evidently he will not fit into any paternal model; he quits Edinburgh with its medicine after two years, he will not become a doctor and follow in the footsteps of his sire. What to do with the inadjustable boy must have been the chief problem of the Darwin household. Fortunately he pays a visit to his uncle, Mr. Josiah Wedgwood, who at once discerned the bent of the youth, and what was still better, became sympathetic with it. Mark this uncle, for he speaks the pivotal word at the right moment, and thereby renders possible the future career of Charles Darwin.

The well-intentioned father, striving still to keep his son in the ready-cut groove of a transmitted vocation, proposes to mould him into a clergyman of the Anglican Church. So the young man betakes him to the University of Cambridge to study for a degree, where he remains three years (1828-31). But it is the same old story. He had to brush up his classics which he had forgotten with delight, and

to study Mathematics which he abominated; still by dint of a good memory he succeeded in passing the examination. Listen again to his damnatory judgment: "During the three years which I spent at Cambridge my time was wasted, as far as the academical studies were concerned, as completely as at Edinburgh and as at school." But there was the same strong undercurrent of his true bent which he succeeded in gratifying. He heard the lectures on botany from the professor (Henslow), "though I did not study it," and he went with the class on botanical excursions, "which were delightful." Moreover he gave rein to his passion for collecting beetles. Says Darwin of himself: "I am surprised what an indelible impression many of the beetles which I caught at Cambridge have left on my mind. I can remember the exact appearance of certain posts, old trees and banks where I made a good capture." But while he remembered beetles, he totally forgot Homer and Virgil. What was the whole beautiful classic world compared with an insect! Here is a sample of the love of Nature which is hard to parallel: "One day, on tearing off some old bark, I saw two rare beetles and seized one in each hand; then I saw a third and new kind which I could not bear to lose, so that I popped the one which I held in my right hand into my mouth." An

heroic act surely of its kind; what seasoned entomologist would dare it? But the prisoned bug shed an acrid juice "which burnt my tongue so that I was forced to spit it out," and so it was lost, says Darwin regretfully. This certainly shows the bent of the youth, as well as his observing power. Through the advice of Henslow he studied geology and went with its professor, Sedgwick, on a geological expedition to North Wales. Such was his real education at Cambridge; he was in training to be the High-Priest of Nature and not a clergyman of the Church of England; nor could he be brought to fit into any of the prescribed vocations. It may be noted that already his heart is set upon communing with organic life, and that he has in a desultory way tapped its three main divisions: Plant-life (botany), Animal-life (zoology), Earth-life (geology).

It is manifest that Darwin's education up to this point has had two lines in it—the open, regular, authorized, and the secret, irregular, unauthorized. He has been training himself, in defiance of the prescriptive disciplines; though he has not rebelled, he has quietly let them run into him and then run out. Classics, Medicine, Theology had all tried to educate Charles Darwin and could not; they were unable to call out of its germ his true self, his

deepest nature, which, however, in a somewhat clandestine and unordered way persisted in asserting itself. Now the peculiar scientific character of the man, at present acquired, remained with him to the end of his days. He was always a kind of amateur in science; he had not the professional touch, or routine, or knowledge, though in his way he showed that he knew more than any professor of Natural Science in the world. But he was no trained biologist, like his friend Huxley; no trained botanist like his friend Hooker; no trained geologist like his friend Lyell. Still he drew from these friends, in the most amiable way, what he needed of theirs, and supplemented his own deficiencies; he tapped them when he wanted them, without having to go through their professional tread-mill, with its crushing formalism and useless lumber, from which he had re-acted so strongly in the education of his youth. For Science also has its ritual, its ceremonies, and especially its dogmas, and can become even more dogmatic than Theology.

Darwin then had no established training for his scientific work such as we see everywhere at present in the schools. He was not put through the prescribed curriculum by the learned professor of biology; doubtless he would have turned against that too, in his

younger days. Very glaring are some of his deficiencies of education in his own department. To the last he never learned to draw and he could not dissect with any skill; drawing and dissecting would now seem the most elementary and indispensable branches to the scientist. He even doubted his mastery over the mother-tongue, and hired an adept to correct the English of his great book (*Origin of Species*). Now we hazard the opinion that it was just this unconventional education which gave free scope to his genius; he was never case-hardened by the University Professor of Science in transmitted dogmas. It is true that at Cambridge he was deeply influenced by two teachers (Henslow and Sedgwick), yet he did not study regularly with either of them, but went irregularly botanizing and geologizing. To the end he was a free ranger in Nature, whose secret he must catch at first hand in her own untrammelled life, and not in the lecture-room of the Professor, who, however, was a very useful purveyor of knowledge to him. It is an oft-repeated phenomenon: the great discoveries are usually not made by the trained scientist at the University, but by the outsider, the amateur, who possesses the inborn love of his theme with the genius to catch its deepest spirit.

But, returning to the parental household,

we may still hear the old problem even after the Cambridge examination: What is to be done with this wayward young man who evidently has little taste for the clerical profession? Meanwhile Professor Henslow, though a cleric himself, has fathomed the bent of his botanical friend, and has quickly gone to work to get him appointed as naturalist to the *Beagle*, which was going to make a long scientific voyage, in fact round the world. Papa Darwin put his foot down against such a wild, career-upsetting scheme; but Uncle Josiah Wedgwood intercedes, and the paternal consent is granted. Speaking briefly of this pivotal act, Charles Darwin says: "My uncle sent for me and offered to drive me over to Shrewsbury (the father's residence) and talk with my father, as my uncle thought it would be wise in me to accept the offer." So the mediator appears at the right moment for determining the career of the great scientist. Old Homer would picture it a divine interference, perchance of Pallas Athena, at a nodal turn of destiny, appearing to young Telemachus. This mediatorial uncle is already famous in the family for his mind and word. Darwin goes on in his account: "My father always maintained that he (the uncle) was one of the most sensible men in the world, and he (the father) at once consented in the kindest

manner.” The uncle has distinctly glimpsed the bent and possibly the genius of his nephew, and moreover shows strong sympathy with it, being eager to see it unfold according to its own law. Remove the lad from his father who does not understand him; get him out of England with its oppressive formality and traditionalism; send him off to sea where he will be turned loose upon the vast realm of Nature in which he can revel to the full of his spirit’s debauchery: so must have felt and thought Uncle Josh, who thus makes himself the turning-point in the career of the greatest modern Englishman. Henslow, the warm friend, did much, very much for that budding talent, and finally secured the offer of just the right position for its further development; still all this had been in vain but for the mediation of the uncle, or in the words of Darwin: “It all depended on so small a circumstance as my uncle offering to drive me thirty miles to Shrewsbury,” in order to win to the scheme the old doctor. A very brief and mild memorandum has been preserved of Wedgwood’s opinion in the case which is worth citing: “If I saw Charles now absorbed in professional duties (as clergyman), I should probably think it would not be advisable to interrupt them; but this is not, and I think, will not be, the case with him. His

present pursuit of knowledge is in the same track as he would have to follow in the expedition (*Life and Letters of Darwin*, by his son, Vol. 1, p. 173). So speaks Uncle Josiah the words of wisdom to the father, which bear of themselves a deep educational import for all parents and children, at the critical conjunction of choosing a vocation. Thus Charles Darwin, after many an obstruction, turns down the open road toward his true destiny. He remarks in his Autobiography: "The voyage of the *Beagle* has been by far the most important event of my life, and has determined my whole career." He was a volunteer naturalist, receiving no salary and paying his own way besides. But he was now for the first time a free man, and could evolve in his own way on his own lines; no wonder that in his emancipation he evolved Evolution itself.

The voyage lasted five years (1831-6), starting when he was twenty-two years old, and thus embracing a very acquisitive portion of human life. Vast were the stores which he brought back, but they were in a separated, more or less chaotic state. Always observing and writing down in his note-book we find him, as if determined to swallow all Nature in his quinquennial banquet. Amateur indeed with many shortcomings, but a true lover, he

feels at one with Mother Earth in all her forms, and harmonizes with her spirit. His letters throb with happiness, for he has found his vocation, which is always in tune with his talent, and also with his ambition. No more Greek and Latin, no more medical lectures, no more Theology, no more Papa on this free Ocean! Still Darwin has expressed the strongest affection for his father, who continued to think of him as a possible curate after he had come back a new man, from his regenerating voyage. The old Doctor was a good obstetrician for infants, but totally unfit for an adolescent, especially a genius. These five years have also their culminating point when Darwin saw the outlines of his theory stamped upon the huge sphinx-face of Nature. This vision embodied he beheld at the Galapagos Islands, as already indicated.

II. THEORY ELABORATED (1837-59). We have now reached the period in which Darwin makes explicit that evolutionary germ hitherto implicit and potential. He has gradually to formulate that which he has lived inwardly and outwardly—has lived in his own internal struggles to get educated and in his external experience with free Nature during his oceanic voyage. Evolution as yet unborn but struggling for birth in his Apprenticeship, is next to pass into Evolution realized, evolved and

expressed in speech. This period lasts from the time of his return, when he starts to elaborate his acquisition, till the publication of the *Origin of Species* when Evolution leaps forth into the light of Heaven fully evolved and categorized, ready to undergo still new Evolutions.

We are first to keep in mind that here in particular run the following streams of Evolution, one alongside the other, or perchance one beneath the other. First is the objective or physical Evolution, that of Nature, which is properly the theme. Then there is the personal Evolution, very important, but kept underneath, though it is really the working principle which drives the whole machinery. For it is Darwin's Ego which is re-creating the creative principle of Nature and giving adequate utterance to the same; the evolver he is, who while evolving Nature is himself evolved. None of these sides can be left out in a complete statement of the Darwinian process; all belong to the Biocosmos which has to present the psychical Evolution of the individual evolver as he evolves physical and perchance universal Evolution.

From the foregoing account it is evident that the reader must keep before himself no less than three Evolutions: (1) the original elemental Evolution of Nature herself which

brings forth a Darwin, the evolver; (2) the re-created Evolution generating in thought and formulating in speech Nature's Evolution through the evolved evolver; (3) the evolver's own Evolution, while evolving Nature's Evolution; he must be self-evolving in doing his evolutionary task. Perhaps the reader may seek to include his own Ego as the fourth stream of Evolution intermingling with the three other streams and re-producing them in himself.

For more than twenty years after his return Darwin was elaborating the vast quantity of materials which he had collected. These pertained especially to Biology and Geology. One of the works was his *Journal of Researches* during the voyage of the *Beagle*, printed first in 1839 (second edition corrected and enlarged 1845). This is still a popular book, being written in a familiar style and always manifesting the straightforward interest of the lover of Nature. It shows Darwin eagerly picking up every particular fact without much reflection or endeavor to put in order what he saw. It is a kind of diary of his voyage. Yet growth can be traced in it, the evolution of the Naturalist who is finally to evolve Evolution. As already stated, the culmination of the book is reached in the visit to the Galapagos Islands, which took place toward the

close of the fourth year of the voyage. Having there received the impress of his idea from Nature herself, he could go home and elaborate it into reality from his collected stores. This, however, was no small or brief task.

Two years and more after his return he was married. It is not out of place to remark that he in his marriage makes himself a new center of Evolution, as does every man in such a relation. Darwin took advantage of his position, as we may observe from allusions in his writings. He watched the unfolding of his children, and did not fail to note down what he saw. Says his biographer: "At the end of 1839 his eldest child was born, and it was then that he began his observations ultimately published in the *Expression of the Emotions*. His book on this subject and the short paper published in *Mind*, show how closely he observed his child." Eight children were born to him—surely a great opportunity for the study of biological Evolution, as well as for the exercise of parental love and anxiety, both of which Darwin showed in full measure. Moreover he quit smoky denatured London, and moved to the country where he lived the rest of his life in free, open contact with Nature. Here he could experiment with plants and animals, wild and domestic; the environing coun-

try became his laboratory in which he made Life reproduce and reveal its processes, confirming his views. Still he did not wholly abjure the society of his scientific friends whom he could meet in his little trips to London, and who often went to his rural residence, named Down, to see the great naturalist.

But the chief fact of this second period of Darwin's career is suggested in the following statement: "In July, 1837, I opened my first note-book for facts in relation to the *Origin of Species*, about which I had long reflected and never ceased working for the next twenty years." Darwin himself thus marks off the foregoing period through which was spun the one thread uniting all his diversified activities: his theory of Evolution. To be sure, he says he had been thinking about it for a long time, especially during his voyage; but it probably lurked as a hidden impulse farther back in his youthful love of Nature which dominated him from childhood. But now he becomes conscious of his life's chief pursuit; he must uncover the origin of species. Moreover when he read Malthus fifteen months later (1838) he came upon his basic principle, Natural Selection.

At last in November, 1859, his pivotal book, yea the pivotal book of the century perhaps more than any other, was published with nu-

merous accompanying circumstances of interest, all of which cannot here be recounted. It was an abstract of a much larger work, in fact the abstract of an abstract. This bigger book never came out, though much of its contents probably went over into the author's later works. The first edition was taken in a day (1250 copies); and so it has gone on selling all over the world in many languages from that time to this. The Age took it at once as the most adequate expression of its very soul; everybody had to read it who wished to hear the voice of the nineteenth century in its clearest and most concentrated utterance. Another indication of its striking adjustment to the time is the fact that a contemporary scientist, Mr. Alfred R. Wallace, had elaborated the same doctrine of the transmutation of the species, written it out in an essay which he sent in the summer of 1858 to Darwin, who says of it: "This essay contained exactly the same theory as mine." Still Darwin himself denied that "the subject was in the air," or that the world was ready for it. But not only ready, the Soul of the Age was calling for it, being instinctively evolutionary and striving for some utterance. Darwin spake the right word at the right moment; he possessed the genius to make himself the voice of the universal Spirit to the eager people—a truly mediato-

rial function of the Great Man, as already indicated.

In this way concludes the second period of his Biography, with a prodigious blare of the triumphal trumpet over the whole civilized world. He has now made explicit his thought so long implicit, has realized his Idea, brooded over for more than twenty years, in one colossal manifestation. What next?

III. EVOLUTION MADE UNIVERSAL. That is, Darwin proceeds during the rest of his life—the concluding period—to apply his theory to all Nature, not leaving out wholly the psychical side (1859-82). This period is about as long as the second. Having made explicit his one central principle, he goes forward to universalize it, showing its validity as well as its extent in a number of departments of science.

We can see that the implicit germ of his first period had now come to complete fruitage, and his life is rounded out. The vast disorganized, scattered experiences of his voyage round the world he orders after a single fundamental thought which he has evolved out of the mass, which is to be ordered. A world of facts he gathers one by one in his world-trip, and crams them into his brain, belaboring them till he finds the principle by which they are to be organized, and then he proceeds in his last period to organize them after this

principle. To Darwin the outer, separate universe of Nature becomes an inner harmonious unified universe through Evolution by Natural Selection, which is the central mediating principle. And just that is also the unity of his life evolving through its three periods. He mediated himself in his own crude immediate state with his universal Self; and so completely did he live this process that he was the mediator in the sphere of Nature for his age.

Thus he goes back to his voyage externally, and makes the inner circumnavigation of Nature, avoiding Classics, Medicine and Theology to the last. We may observe him branching from his central principle in his next extensive work, *Variation of Animals and Plants Under Domestication*. This contains his theory of Pangenesis, which "implies that every separate part of the whole organization reproduces itself" through the so-called gemmules. Next we may place *The Descent of Man* (1871), in which the transmutation of the species is applied to the human being—which application the author had avoided in the *Origin of Species*. This is, of course, the most important application and has given to Darwinism its greatest fame, as it affirms that man had come through "a pithecoïd ancestor." But we shall have to forego any special designation of the rest of his works.

Noteworthy is the fact that in the last years of his life he devoted his books chiefly to plants. His was primarily a flower-soul, he was a botanist more than geologist or zoologist. This was an original bent lying in his character, but doubtless unfolded by Professor Henslow, his dearest friend, educator and then helper. Indeed Nature herself was first of all a plant, and Darwin followed her. His earliest love was for flowers, and later he went to the country from flowerless London, living in his Paradise or floral world, which was his garden at Down with its insects and birds. And on his voyage he seems to show the greater inclination for Plant-life, though he keeps also in view Animal-life as well as Earth-life.

Such, as we look at it, is the movement of the personal biography of Darwin, which is in itself psychical, and unfolds after its own law, though its content is the evolution of organic existence. A remarkably integral life was his, fully rounded out, representing the finished human career, whose process is indeed a manifestation of the process of the All-Self, or of the Great Entirety. Typical we may deem Darwin's individual Biography, reflecting the universal Biography of all men at their best and its process, though each man has and must have his own special sphere of

activity, which has also its special events. We may again emphasize that written Biography must be elevated out of its present chaos by bringing to light this universal process in each human career, as well as its particular occurrences.

Darwin lies beside Newton in Westminster Abbey; thus the mighty Dioscuri of Nature's Revelation are twinned in their mortality as in their immortality.

II. BEFORE DARWIN AND AFTER.

Having evolved the one central man who has practically evolved Evolution, we may trace briefly the line of predecessors into him, and the line of successors out of him. The Hero of the Biocosmos, in so far as this has yet unfolded, is Darwin, who possessed the power of conquering his age with his thought, and stamping upon it his fundamental category. His was the regnant biological Ego—that designates his supremacy as well as his limit. For he was not the universal genius, even in the realm of Nature; biocosmical was his field, rather confinedly fenced off from every other domain of knowledge. He has himself marked down his own spiritual bounds with candor and modesty. But within his kingdom he is the monarch.

Still the science which he stands for, that of Evolution, is itself an Evolution, and has a number of ascending stages each of which is usually represented by an important person, who has his own biography or individual Evolution. All of these taken together in succession will show the history of the science aforesaid. That is, we are to see Evolution itself evolving up to the point at which it becomes aware of itself and formulates itself as a

part of its own total science. And we may add that Evolution does not stop with Darwin but takes a fresh start. If his own principle be applied to himself, he too must evolve still further. And this is what has happened.

The considerable details of biological history we cannot here enter upon; only the mountain peaks of the science we shall attempt to bring into one view, that our reader may catch a glimpse of the complete Biocosmos, as we see it.

I. ARISTOTLE. We shall begin with an Ego which was not merely biological but was universal, elaborating not the science of Life alone, but all science, yea the science of the All. Doubtless of the great men who have ever lived, Aristotle best deserves the title of Genius Universal. In his works is grasped and formulated the universe with its triune process of God, Nature, and Man. This he did of course in his way, which is that of the Thinker, the Philosopher. Upon his thought is stamped every phase or part of the great All with equal fullness and favor. In him the ideal and the real are equally at home and harmonious; his mind conjoins and mediates in one process the Particular and the Universal. But that which we may especially celebrate here is that he united the metaphysician and the scientist in one complete per-

sonality with both sides present and co-operant in mutual sympathy and appreciation. After him these two sides separated and flowed down time in diverse and often antagonistic streams. During the last hundred years (say the nineteenth century) Philosophy and Science have been at daggers' points for the most part. At first Philosophy seemed to hold its own (in Schelling, Hegel, and we should add, Oken, the much belabored at present). Then Science flung its foe to the ground, yea down into Inferno itself, as was thought. Still Science has found itself unable to do without its counterpart, and is becoming more speculative than Philosophy (a fact which has been repeatedly noted in the preceding exposition). The two are really approaching each other, even through mutual execration.

It would seem, then, that the time is marching toward a new Aristotle who will again be metaphysician and physicist in harmonious proportion, who will reunite in himself the two halves of the universe in a new symmetrical construction. It may well be questioned if Philosophy, in its present form, can accomplish this great coming act of reconciliation; apparently it has evolved to its limit, and is impotent to proceed further with the evolution of thought. A new discipline must

take its place, preserving all its treasures won, which are many, including just this Aristotle. But let it be also emphasized that Science is not the new discipline, for Science too has shown its limitation, and indeed is calling for something more universal than itself. Such a dawning discipline of thought which can mediate the fierce dualism between Science and Philosophy (and we may include Religion) is the new Psychology.

It is evident, however, that Aristotle, who is placed here at the beginning, may also be regarded as a kind of ideal end toward which both Science and Philosophy are striving. Thus he is himself an illustration of his own doctrine, that the end lies in the beginning, is what essentially determines the same, especially in the sphere of Nature, and often returns to the same, as may be noted in Generation.

The first fact regarding Aristotle in the present connection is that he had already the general conception of Evolution. Again and again he speaks of the ascent of Nature through various stages from lowest to highest. To be sure, this conception was not wrought out by him to completion; it was a germinal idea for whose realization thousands of years were required. Still he gave utterance to the idea.

His scientific activity embraced the whole field of Biology, though his work on Plants has been lost. A good deal of his Zoology survives, though in a fragmentary way. He paid much attention to embryology which is usually deemed a very modern science; day by day he observed the evolving chick in the hen's egg, and had his eye generally on the development of animal-life. Thus he pre-enacted an important phase of the modern movement toward Evolution, for the embryological researches of Von Baer (first part published in 1828) are decidedly evolutionary before Darwin. But Aristotle had already opened the same field.

He also paid especial attention to the structure and functions of animals, and he sought to classify them in larger and smaller divisions according to their kinship. An extensive and close observation of animals he shows, and some of his statements of fact have been verified quite recently by science. Thus on many sides he radiates germinal thoughts which require ages to unfold and ripen.

It is evident that he sees the pivotal fact of organic Life to be Generation, a conception which the botany and the zoology of today are beginning to develop fully. Says he: "First study the facts or appearances of animals; then reach down to their causes; but finally

consider their Generation." The last has indeed the stress; it treats of the organic individual in its highest function, that of reproducing its own separate individuation, and thus of continuing itself beyond its own limited existence. This touches the doctrine of germinal continuity upon which modern biology is laboring with so much zeal and industry. Aristotle glimpsed the deep significance of the generative process of Life, and makes upon it many subtle observations scattered through his scattered treatises.

But we recur to the thought that Aristotle was not confined to biology or to any single department of Nature or of Mind. He was not the modern specialist in one branch of science; he knew all its branches, and would not only co-ordinate them with one another but also with the universe itself. From him could spring the true university, based upon an universal world-view which ordered all the variety of special knowledge. His school continued his work for hundreds of years under its so-called scholarchs. So with the coming of the new Aristotle we may also think of the coming of the new University which will be truly universal and be organized and unified by the science universal.

Another point in Aristotle's conception of Nature should not be omitted. In all organic

Life, plant as well as animal, he sees the working of the Soul (Psyche). The psychical element exists in conjunction with the physical. The result is that he regards all Life, and indeed all Nature as having within it an End to which it is moving, and which it seeks to realize. Nature is, accordingly, teleological in Aristotle, the realm of an inner propulsion toward an end—it is not complete in itself, but ultimately a part of a greater Whole. Herein the universal thinker again appears with his thought of the Universe, in which Nature has its place and character.

II. FROM ARISTOTLE TO DARWIN. We put together in this caption the greatest ancient and the greatest modern biologist for the purpose of comparing and contrasting them. As regards their individual lives, both show that common psychical process which is manifested in every complete career. Each has his time of Apprenticeship, of Elaboration of materials gained, and finally of Realization of his idea, with its application to special domains of knowledge. (For a brief account of Aristotle's Life from this point of view, see our *Ancient European Philosophy*, p. 348, etc.. For Darwin's Life, see preceding section of this book.)

The first fact here to be emphasized about Aristotle is his encyclopedic faculty of acqui-

sition; every sort of knowledge he seems to have appropriated with an equal relish; he swallowed all creation in his mind, omnivorous to know. On the other hand we have to note how limited, how dainty was Darwin's appetite for intellectual acquisition; Classics, Mathematics, Medicine, Theology, Art and Poetry would not stay on his mental stomach. Nature was his domain, yet only one nook of it he passionately loved, the biological. The Englishman was a specialist by birth, and therein again belonged to his age, which is so devoted to specialization. But the Greek was all-embracing, all-ordering, all-knowing in aspiration; he was born universal and an universalizer. Individual he indeed was and finite, yet he more than any other recorded mortal bore this impress of the Universe itself in its highest process. The Pampsy-chosis would seem to have stamped him with its own image.

The result was that Darwin became an agnostic in reference to all spheres of knowledge lying outside of his relatively limited horizon. Still he spoke the epoch-making word of Evolution within his province, where it was picked up by others and borne far and wide, and is still in the process of dissemination. Nor should we forget that Aristotle was a chief factor for centuries in molding both the Euro-

pean and Oriental mind, and still today he is potent in influence. The man of the present, seeking universality as a counterpoise and corrective of the desperate particularism of the time, cannot do better than take some lessons from old Greek Aristotle, the first true organizer of the thought of all things and of the All itself.

In the long interval between Aristotle and Darwin are many noteworthy biologists with important contributions. A history of them shows a continuous undercurrent of evolution toward Evolution as a formulated doctrine. Perhaps the most important and typical of the discoveries in the present field was the circulation of the blood by Harvey. In the sphere of Natural History the name of Linnæus stands first as the supreme orderer of plants and animals. He is the author of the so-called binomial nomenclature which gives a name to every natural object in two words, usually Latin, expressing the genus by a noun and the species by an adjective term. For instance, the common dog is called *Canis familiaris*, while the wolf, which is also a dog, is called *Canis lupus*. Minerals were likewise designated in this way as well as plants and animals. Thus the vast diversity of Nature gets labeled and classified. This must be deemed a great act which endowed science

with a definite speech for the first time, whereby scientists were enabled to talk to one another intelligently through distance and duration. The result is that the whole scientific world employs the binomial nomenclature for inter-communication; one hears it in Japan and in the Orient,—a sort of universal language of science. A great trainer it is also for organizing thought; it does not leave the individual object isolated, but puts the same under its species which again is subsumed under the genus. The implication is that the process is to continue till all Nature is ordered through its various stages; indeed even Nature must at last be subsumed under what is higher, under the *summum genus*. So the binomial nomenclature of the great Swedish botanist we may well deem a genetic thought, which is still productive in science.

The microscope is the source of the most important discoveries in biological science. There is a dispute about the time and the inventor of this instrument. But the application of it belongs to the seventeenth century almost coterminously in England, Italy and Holland. Perhaps of these early microscopists the most credit is due to Leeuwenhoek, who first observed the connection between the veins and arteries in the capillaries, though this had been conjectured before him by Har-

vey. But the triumph of the microscope came two centuries later in the revelation of the cell as the organic unit of Life. It is true that the cell had been recognized, described and even pictured by the observers of the seventeenth century. In fact the ancients had supposed some such structural unit in both plants and animals; the same statement had been repeatedly made as a conjecture. But the ocular proof of the cell-theory as well as the formulation of it are assigned to the year 1838 in the work of two German co-laborers, Schleiden and Schwann, the one a botanist, the other an anatomist. The latter declares that "there exists one principle for the formation of organisms and that principle is the cell," supporting the proposition by direct observation. Then came the discovery of protoplasm (by Dujardin) as the common ultimate material in plants and animals. The leading statement here is that of Schulze (1861) that a cell is a globule of protoplasm surrounding a nucleus. It should be noted that Darwin's pivotal book, *Origin of the Species*, had appeared two years before, yet it hardly participates in this great movement of microscopic biology.

But no sooner has the cell concentrated the attention of biologists than the question opens concerning its function, its physiological character. If it contains the unitary process of all

Life, vegetal and animal, it must be the seat of health and disease. The *Cellular Pathology* (1858) of Virchow was in this field epoch-making. But when it began to be conceived that hereditary qualities were transmitted from generation to generation through the cell, biology took a new turn, and entered upon the investigations in which it is at present chiefly engaged. The transmission of physical qualities from ancestors is the theme about which our time is most anxious; the implication is that with physical are transmitted psychical qualities. Evolution being granted, we wish to catch it in the very act, to find its secret process. This work has been going on since the Darwinian deed, and it we must scan briefly.

III. AFTER DARWIN.—If we inspect the two terms which compose the title to the *Origin of Species*, we shall find that *origin* has a deeper and stronger stress than *species*. Really Darwin's book is a discussion of organic generation, and turns upon the genesis of the individual organism. This is what is brought decidedly into the foreground in the trend of biology after Darwin. What is the method of the propagation of Life? Such a question goes back in its farthest reach to the fundamental act of Nature, namely its individuation. For Nature does its work through cre-

ating individuals, organically and inorganically; this must be deemed its primordial trait. Darwin, of course, does not call up such remote outlooks, he rather shuns them, while Aristotle for instance, as philosopher, seeks them as indicating Nature's universal relation, that is, its relation to the Universe.

The Darwinian round may be briefly conceived as follows: (1) The given variation of organisms; this on the whole is taken for granted by Darwin as his starting point. To be sure there is implied even here that such variation takes place through birth; every born individual is different from all others. (2) The struggle for existence between these varying individuals of the same species; the fittest survive in the battle for food primarily. (3) The propagation of the fittest organism after getting rid of the unfit. But the progeny of this fittest organism is again composed of the fit and the unfit, and so the struggle begins over again, or rather it never stops. Evidently the generative act of the individual which keeps reproducing variation with its two main classes, the fit and the unfit, is the pivotal act of the whole process, upon which many problems turn. Can generation be so controlled that it will lessen or eliminate the unfit? In the lower organisms, the plant and animal, this has long been done by the im-

provement of the breed, through a remorseless weeding-out of the unfit. But when we rise to man, the problem becomes complicated with other considerations. Still the new science (Eugenics) is grappling bravely with the human or social side of the question.

The scientist after Darwin who has most directly pushed into the heart of the subject is the German, Weismann. He illustrated and enforced the distinction between the germ-cell and the body-cell, the former is transmitted, the latter is not. Accordingly all heredity comes down through the germ-cell or germ-plasma; necessarily this means that there has been a continuous cellular stream through all organic existence from the original fountain of Life, which is tapped and flows forth into these germ-cells, eternal, immortal, till the Life of the planet ceases. On the other hand the body-cells are purely individual, are not inherited. As an inference from this proposition, Weismann declares that there is no inheritance of acquired characters. Against him on this point rose a good deal of opposition headed by Herbert Spencer, who stoutly maintained that traits won by the individual for the first time have been often transmitted to his posterity. The discussion revived the work of the almost forgotten Lamarck who had also propounded a theory of Evolution at

the beginning of the century, in which theory the transmutation of the species was upheld. He sought to account for variation by the use and disuse of organs followed up by heredity in the offspring. Thus Lamarck reached back of Darwin in trying to account for variation, which the latter assumed. Hence after Darwin arose the new school of biologists called the neo-Lamarckian, which has representatives in Europe and America.

Another significant addition to post-Darwinian Evolution is the doctrine of De Vries, that new species often appear suddenly, and not merely through "slight, successive, favorable variations," as Darwin held. This doctrine showed by experiment that generation of the individual can make a leap at once into a new species, not merely repeating the parent with a little difference. Thus the germ-cell has in it untold possibilities, seemingly all the past of the organic world from the beginning; it embraces potentially the totality of all Life, plant and animal. That primordial germ-cell, issuing from the first living stuff (Protobioticon) and individuating itself, perchance as the primal plant-animal (phytozoon), contains implicitly all the organic forms to be evolved in the ages to come, and is still preserved and transmitted in the generative process of the organism. The chief in-

terest of the doctrine of De Vries is that the original germ-cell can break out of its fixed mold transmitted from parent to child, and become a member of a new order; it can develop of a sudden the potentialities that have been suppressed hitherto by the regular norm of the organism for uncounted ages. De Vries has shown that even the plant can turn revolutionist and defy its traditional limits (see preceding p. 199), following some hereditary instinct of vegetal freedom. The question rises: Will man ever be able to reach and control this tendency to mutation or sudden transformation which lurks in every organism, seemingly in the very act of its generation? This would indeed be the new metamorphosis of living Nature, when we can tap the original fountain of Life, and make it develop what organic shapes we choose, instead of leaving them to blind impulse.

The doctrine of germinal continuity set forth by Weismann is a great and fruitful thought at which biology is still working. To it we would conjoin the doctrine of De Vries which makes the germ-cell the arena of sudden catastrophie changes which appear to be the bursting forth into reality of long-inherited ancestral tendencies previously submerged. Every plant and animal, yea every living genetic cell contains the possibilities of the total Biocosmos.

The third considerable name in the post-Darwinian evolution of Biology is that of Gregor Mendel (1822-1884), an Austrian monk of Brünn. His chief experiment was to take two pure breeds of peas, of different colors and shapes and lengths, and by cross-fertilization to produce a hybrid pea. Now this hybrid would have the characteristic of one parent present, while that of the other parent was absent. Here Mendel had the insight to give names to these two derived characteristics, one of which he called dominant, the other recessive. But what has become of that characteristic which has disappeared? Is it destroyed? Not by any means; to show this fact was the next step in the experiment of Mendel. He took the hybrid and raised from it alone a new crop of peas, which was divided between the two ancestors in a certain proportion. Thus the suppressed (or recessive) characteristics of the hybrid again appear in its progeny, part of which follow one grandparent, part the other. That is, after the recession of parental traits, there is the recurrence of them in the new generation, a return and restoration to the original sources. This stage we cannot find named specially by Mendel, though fully described by him; we may call it the recurrent. Thus the hybrid reproduced itself doubly in its offspring, alternat-

ing between the two ancestors (the so-called alternative inheritance); also there is the separation or dissociation of characters in the germ-cell, each of which can be transmitted (sometimes named unit-characters). In this case there is a new approach to that primal act of Life, namely, living individuation; each characteristic of the pea is individuated in the genetic cell and asserts itself sooner or later. What constitutes or causes these unit-characters is not known; some say they spring from a chemical, others from a mechanical change at the source. But what we are to grasp first is the Mendelian round of heredity: dominance, recession, recurrence. The last term involves the persistence of the unit-character; though it may be for a time only potential, it can become real, doubtless suddenly so (as in the examples of mutation given by De Vries).

Mendel continued his experimentation on this double offspring of the hybrid; he found that each side afterward bred its own kind, yet with some exceptions. Moreover, not a little depends on what characteristic is selected for trial—color, shape, stalk, seed, etc. All qualities are not always transmitted alike. It is a significant fact that though Mendel's results were first communicated to the Brünn Academy of Science in 1865 and published the following year, they were without the least

response from the scientific world, which was then digesting Darwin's book. Mendel, a contemporary of Darwin, enunciated a doctrine, which was to find its place not only after Darwin, but after the two chief post-Darwinians, Weismann and De Vries. It was mainly the latter who about the year 1900 re-discovered and resurrected Mendel's work, which is in general complementary to his own. At the present time the Mendelian movement would seem to be uppermost in biology, and has called forth or at least confirmed a new department of it, or a new science perchance, which now goes under the name of Genetics. So it comes that an Austrian monk, a celibate, has given to science the epoch-making idea of generation, to which by his vow he might be supposed to be unfriendly. Also he was ahead of his time which had to evolve up to him before he could be appreciated.

Accordingly in the succession after Darwin we put together three leading names—Weismann, De Vries, Mendel. They all contributed to explain the genesis of the living individual. Each of them in his own way dealt with that persistent germ-cell which has the power of continuing itself in a line of transitory individual shapes through time. Thus in the organism there is suggested an immortal and a mortal part. Germinal continuity, in its full

acceptation, is to be regarded as having the duration of Earth-life, with which it begins and ends. It is a kind of string on which has been strung and will be strung all living forms from the first terrestrial Life to the last. Moreover, each individuated germ-cell is a very complex thing, bearing in itself thousands of transmitted characters, each of which is declared to be a unit in itself and may rise to the surface in heredity.

Using terms already employed (180) we observe that the organism manifests all three kinds of genesis, Homogenesis (like produces like), Heterogenesis (like produces unlike—De Vries); to these we may add the Darwinian doctrine of Homoiogenesis (like produces similar). These doctrines often held separately, are seen to be united in the Mendelian experiments. That is, an organism may produce all three kinds—likes, unlikes, and similars. (See a very striking colored illustration of this fact in Prof. Bateson's work on *Mendel's Principles of Heredity*, in the flower *Primula Sinensis*, which by crossing is made to show vividly the Mendelian process—dominance, recession, and recurrence—and also indicates by unique coloration of various shades the three kinds of genesis—like, unlike, and similar. (pp. 294-5.)

The chief interest here is to observe the

many possibilities lurking in the transmitted germ-cell, which under right conditions spring into reality. In Mendelism a submerged world of inheritance is uncovered and made to appear. The individual is shown to have a varied power of procreation transmitted from the ancestors. Variation is not merely continuous, but discontinuous, to use a term of the Mendelians. Doubtless every sexed individual is a hybrid more or less composite and is made up of inherited unit-characters thousandfold, and so may beget individuals specifically different from itself. The more complete and higher the evolution, the more complex and diversified is the product; hence we have to think that the most developed organism has in it the potentialities of the widest variation. Man, even if he does not produce the greatest diversity of shape and color, produces the greatest inner diversity of character in a single natural species. No telling what may break up from that underworld of generations. Still behind all this varied play of individuals we have to keep asking whence comes this power of individuation, and what is its place in the All. Ultimately the germ-cell, however small, is the potential universe in its creative process.

III. RETROSPECT AND PROSPECT.

The attempt to see Nature in her totality and to probe for her central principle, is an old one; but such a search has fluctuated with the ages. It may be said that Philosophy began with the Philosophy of Nature in the old Greek philosophers (hence they were called *physiologoi*). The genius of Darwin has been designated as biocosmical, being confined to the province of Life; Newton on the other hand was cosmical in his greatest work. One of the noteworthy modern attempts to present Nature as a whole was that of Humboldt in his so-called *Cosmos*. Hegel in his Philosophy of Nature took a still bolder flight, seeking to synthesize the natural and the spiritual world, wherein he connects with ancient Aristotle. Hegel in spite of his heavy and often forced formalism has many excellent thoughts about Nature; his book has been lashed by modern German scientists with bitter vituperation, still we dare confess that we find in it a deeper view of Nature than in Humboldt's work. Particularly the part on Organic Life, though in many details it is far behind the science of today, has in it thoughts and distinctions which are truly universal and hence valid for all time. Still we shall agree that

the new Aristotle is the great synthetic genius who is wanted, who will unify the present deeply specialized and divided Natural Science and then correlate it with the Universe of which Nature is but a stage or part. Till such an universal organizer appears, we shall have to swash about at random in the ocean of particulars, with which the experimental scientist is deluging us from every direction.

We have now briefly set forth not only Evolution but the evolver of Evolution, yea a line of such evolvers, which line is itself an Evolution, or a history. That is, Evolution to be true to its own principle, must also evolve. Biology has to be studied, but with it the biologist biologizing. In him we behold the mind evolving in itself and also as evolutionary in doctrine. The reader is thus to appropriate the Biocosmos as a whole, which embraces not only the science of Life, but also the scientist, who certainly ought not to be left out of his own work. To be sure we here come upon the Ego which itself has evolved up to the point of turning back and grasping Evolution which is really its own Evolution, whereof it becomes conscious.

Mind, Consciousness, Ego—such is the new world which has now come into view, and which has been more or less implicit in the

living thing from the beginning. But when it becomes fully explicit and works in its own right, active in itself and self-creative, we have not only transcended the Biocosmos, but the entire realm of Nature. The soul now has its own body, not that of matter—nay, it can in its way reproduce its own body, and does so in every conscious act.

Still the chasm between Life and Consciousness remains impassable by science; no microscope can see and describe the conscious act, which must see and describe itself. A self-seeing microscope has not yet been invented; in fact it is just that which invents microscopes. In previous chapters we have often noted the gap between Unlife and Life, that transition from the Inorganic to the Organic. But having taken Life and observed its various evolutionary stages, we have reached the second scientifically impassable limit, which lies between vital and mental action. The Biocosmos is, accordingly, bounded definitely at beginning and end by science-defying barriers. As Chemism would not go over into Life, so Life refuses to turn into Mind. Still, if looking at the evolution of our planet, we have to postulate the transition from Unlife to Life, so likewise we have to postulate the transition from Life to Consciousness. Where and how man first broke through into his self-

knowing Self, is a matter of conjecture; but we observe that every human infant has to go through the same process. (See preceding p. 47.)

If we consider more closely the foregoing transition, we shall take Generation as the highest process of Nature, and regard it in its relation to Consciousness. The halfness of the sexed individual rises to be the wholeness of the Ego; every human being is an entire self within himself, we may say, an image of the All-Self; but only a moiety he is as male or female, both of which are Nature's sides of a higher totality in which both are to participate together. Germinal continuity of the race, which may be said to be the leading theme of present biology, is not through one but through both; the dualism of Nature, manifested at its highest point in the sexes, must be overcome, even momentarily, that it continue; the two sexed individuals are to become one that they may persist as two through generation. The dialectic of Nature can be heard in the statement that sex must transcend sex in order to exist as sex; or the supreme dualism of Nature has to be unified that it be dual. Now Consciousness has this dualism, present also, but perpetually overcoming and overcome; the two sides we designate with new names, subject and object,

which are always dualizing, yet also always unifying in one process (the Psychosis). Thus the individual as Ego is eternally self-propagating, making and remaking himself in ceaseless process; this self-generation does not fall outside of himself into another Ego, but is within himself, is indeed his own self-creativity and source of all other creativity of the self. Creation of the body and creation of the mind have long been felt as intimately related; in fact they bear the same name in human speech. The genetic process of the Ego (as we may call it in this connection) produces the internal individual, while the genetic process of the organism throws out the external individual through indefinite repetition without self-return—wherein is seen the outer individuation of Nature. Now this outer individuation of Nature is what will become internal in the Ego which is such self-division within itself, and also the self-unification. Looked at from this point of view, Consciousness may be deemed the self-sexing of the individual and the overcoming of the same in the one process; but such an individual is no longer merely natural, but an Ego, which has the power of individuating itself eternally, whose self-begetting is just its being.

On the other hand the Ego has risen to be the very image and personation of the cre-

ative principle of the Universe which we have often called the All-Ego. The individual now re-enacts and indeed recreates the universal Self; so far has that primal individuation of Nature unfolded till this has individuated the very All in its primordial process. That is, the natural individual has evolved to the point where it is the bearer of the Universal, or of the essential movement of the Universe. To use our technical terms, through the long travail of Nature the Psychosis has risen till it has become the pure reflection of the self-creative Pampsychosis as the supreme genetic act of the All. Such is the high origin of Consciousness on the one hand, and such is its low origin on the other. Consciousness results from and in fact embraces the vast experience of Evolution from the beginning of Nature, till it can evolve Evolution out of itself. Consciousness is given from above, yet it has had to win this gift of itself by the toil of æons. So it is its own, yet also the Universe's; on one side it is the created, but it must forever recreate its creation; if it be truly God-made, it must itself make God, or rather re-make Him; else He could not have being for it. The Ego has gained its autonomy through a long service to Nature, yet it had to be endowed with this capacity to serve for its autonomy, which service has been just its disci-

pline unto perfection. To be a self-conscious being is, therefore, a very high attainment, the steps toward which we can see all the way down the ladder of Nature from the start. The Ego is created by the Creator to create itself, and so it is like to the Creator. It passes through the stages of determined existence in order to reach the self-determined. Its God-given gift of freedom it must earn through a long training of unfreedom in order to possess such a gift. That training we may follow through all the steps of Evolution. The experience of all Nature's unfreedom the Ego must get in order to surmount the same and to attain its freedom, or its own inner self-active consciousness.

Using another set of terms, we may recur to the conception of *Physis* and *Psyche*, as expressing the pervasive dualism of Nature. But when *Psyche* becomes self-dividing and self-returning in one, or self-individuating within itself, it declares its independence of *Physis*, even if it recognizes its former dependence, and finally accepts and even formulates its previous evolution in, with, and out of *Physis*. In its new freedom *Psyche* can return not only upon its free self, but also upon its unfree self and observe its process toward its (psychic) freedom. Thus it becomes a perpetual self-reproduction as the essence of its own self-

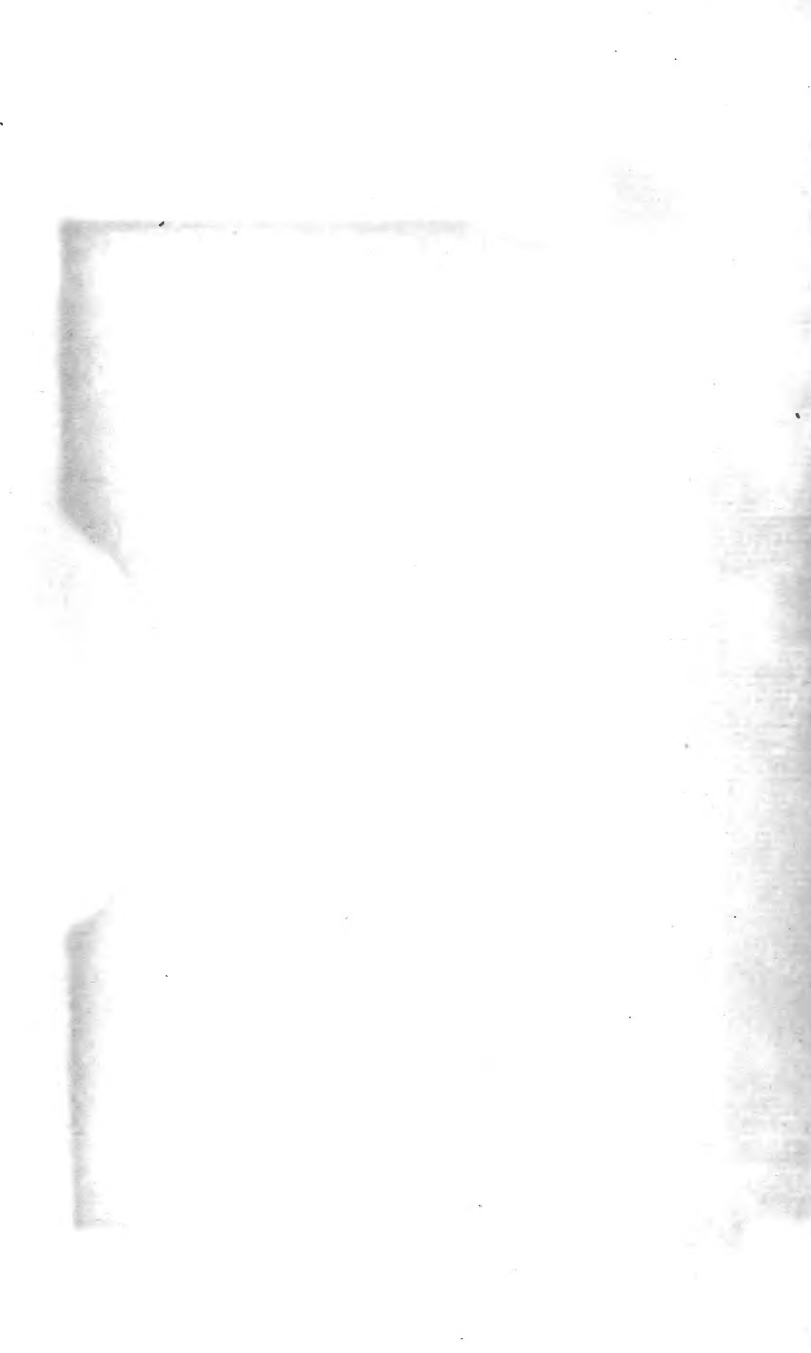
hood; it is indeed self-generative, still not as particular like Nature, but as universal; it must create itself universally along with every special activity, and so be Consciousness.

With this evolution of Consciousness we have moved out of Nature into a new world having a new order. Therewith we have also moved into a new science, that of the Ego, or of Psychology proper. The Ego as conscious has the ever-present process of the Universe in each of its special activities; surely its deepest character is to universalize what it particularizes, or to hold in one supreme unity that which it grasps separately. Thus we may see that the true science of Psychology is the universal science, being the science which organizes itself and all other knowledge—self-ordering and all-ordering in one. (For an account of Consciousness see our work on *Feeling*, pp. CV-CX, of the Prolegomena; also in the body of the work, p. 132, etc.)

We have now completed this survey of Nature and its science. Its three leading stages or divisions of which we took a brief forecast at the start have been unfolded under the designations of Cosmos, Diacosmos, and Biocosmos. And Nature also has been treated as a stage in the process of the Universe, reaching its culmination and conclusion in Generation, from which we have to make in thought the

leap, non-scientific as yet, to the conscious Ego, which not only knows itself, but has come to know itself as evolutionary. This impress is what it stamps at present upon all knowledge, making science along with itself evolutionary. Such is not only the individual consciousness of today but also the associated or public consciousness.

So we are to make, in our thinking at least, the transition from Nature's Evolution to the Ego's Evolution—from an outer physical to an inner conscious Evolution. And we may add that each Ego, as a self-evolving individual within himself, is to associate with other Egos, in that new kind of body, called the Institution, which may at last include total humanity. For the outlook now is that the race must be institutionalized to secure the ultimate freedom of the individual. To be sure, the universal Institution of Man, be it political, religious, social, or all combined or something else, is at present a dream; still the persistent Evolution of human association into ever-enlarging forms would seem to have some such outlook (see preceding pp. 50-53).



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