TO CHRIST THROUGH EVOLUTION

LOUIS MATTHEWS SWEET, S.T.D., PH.D.

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BY

LOUIS MATTHEWS SWEET, S.T.D., PH.D. 1869-

PROFESSOR IN THE BIBLICAL SEMINARY IN NEW YORK

Author of "The Birth and Infancy of Jesus Christ," "Study of the English Bible," "Roman Emperor Worship," "The Verification of Christianity," etc.

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TO THE MEMORY

OF

MY MOTHER

1848-1924

FOREWORD

This volume is offered as a contribution to a controversial subject, but in no controversial spirit. It is investigation, not propaganda. The author's position is frankly theistic, no less frankly Christian, no less frankly evangelical, but the whole purpose of his writing is to show that one may be all these and maintain the open mind and, what is quite as necessary, the balanced judgment. This hope, and this hope alone, has made possible the work which this book has involved. The deepest conviction which has come out of this long and interesting study was once voiced nobly by a great and famous theologian in these words—which should be a motto for all of us:

"All knowledge is knowledge of God."

L. M. S.

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TO CHRIST THROUGH EVOLUTION

CHAPTER I

INTRODUCTORY: THE BIBLE, SCIENCE AND MAN

When I was a youth in college I followed with intense interest the debate between Thomas Henry Huxley and William Ewart Gladstone on the creation narrative in Genesis. I thought then, and I think still, that, with all his consummate ability, and though in a general way he was on what I should call my side, Gladstone had the worst of it, because he occupied and defended an untenable position; namely, that the detailed order of events in Genesis anticipated the judgments of modern science, and was, therefore, divinely inspired. Huxley seemed to have no difficulty in showing that the order of events in Genesis and the order of events as interpreted by contemporary science were in conflict in several important particulars. He argued, therefore, on the basis of Gladstone's logic, that Genesis could not be inspired. To me, the whole debate, while intensely interesting as a battle of the giants, was entirely irrelevant.

My faith in the divine inspiration of Genesis, in spite of the fact that as I viewed the conflict, the Bible champion was defeated, was not the least bit shaken, because as I have said, the discussion itself seemed beside the mark, and the outcome of it a matter of indifference. I did not start out with Gladstone's premise, and, therefore, I did not land in

Huxley's negative conclusion. Is it not quite conceivable that the Bible and Modern Science might differ as to the succession of events in creation in certain details and yet both be right, consideration being given to the difference in point of view? For example, it is generally admitted by interpreters of Genesis that it is written consistently from the viewpoint of an observer on the earth's surface. All the events which take place are descriptively conditioned by this fact of situation and viewpoint. It has often been pointed out that for purposes of description the Ptolemaic scheme is accurate when the earth is assumed as the center, while the Copernican is necessary if the sun is taken as the center. If a description is intended simply to represent what is given in observation, the earth-center is accurate enough for all practical purposes. If one wishes to reach not apparent but real motion—the sun must be taken as the center. This would be called the "scientific view." But if the search is for the real motion of *all* the heavenly bodies one could not stop with the sun, which is itself in motion through interstellar space. So far as I know the absolute or pivotal center of the universe is unknown. It is evident that in this matter of an assumed fixed center, the Genesis narrative and modern science occupy different viewpoints and, therefore, get different results. Any attempt to bring them either into harmony or into conflict on this point is—so far as the Scripture is concerned—eisegesis not exegesis.

To read science into this account is quite as inadmissible as to read contradiction of science into it. There is another quite relevant consideration. The *order* of biological events may be differently conceived according to one's purpose in describing it. For example, one may use the *logical* instead of the *chronological* method,—that is, group things together which are related either in thought or in vital coöperation rather than those which succeed each other in the order of time. Whether or not the Biblical order is of this sort, such a method is intelligible and would at once suggest and resolve a conflict between the Bible and Science. An order might be (and this time I am sure that the Bible order is of this sort) selective and typical rather than exhaustive and chronological. In any case there would be no real but only apparent conflict.

In other words, I venture the suggestion that the Bible account of creation and its attitude to nature in general is non-scientific; not unscientific, but deliberately and scientifically non-scientific. Let us follow out this suggestion and see where it leads.

I should like to approach the matter in quite a different way from that ordinarily employed. Any careful reader of the creation narrative should notice, first of all, what many interpreters seem to have missed altogether—its extraordinary condensation. It deals with the universe in verse 1; it passes from the universe to the earth in verse 2 (whatever our interpretation of verse 2 may be): it moves through all the stages in the moulding and preparing of the earth for its inhabitants to its culmination in man at verse 26. From the origination of man, in 1:26, the story reaches Abraham, about 2000 B.C., in eleven short chapters, of which less than one (including the opening verses of Chapter 2) are given to the physical universe. The conclusion is inevitable from this condensation alone—altogether apart from the literary form, which is poetical and parallel; the lack of close definition and classification in the scientific manner; and the mixture of literal and symbolic expressions which are clear enough from the point of view of religion but meaningless from the point of view of science—that what *we* mean by science is impossible within such limits. It is interpretation, not classification nor description.

And what is true of this narrative is true of the Bible as a whole. It does not teach falsehood, nor does it teach science. This is a false antithesis. Scientific truth is not the only truth in the world. The Bible teaches truth about nature, not science, which is quite possible. If we bring together every reference to nature in the entire Bible, direct and indirect, as I have done or tried to do more than once, we shall find that the nature-matter is always interpretative and appreciative; it is never looked at by itself, never given for its own sake, and never accompanied with the descriptive fulness which is of the essence of science.

The most significant portion of the evidence on the whole subject is discovered when we come to the matter with which we are particularly interested, the nature of Man. Let me state the leading facts in outline.

First, there is no formal acknowledgment or actual definition, except in ethical terms, in the cosmological section at the beginning or elsewhere in the Bible, of the distinction between mind and body. That is to say, the modern separation between physical or physiological and psychic phenomena—between physiology and psychology, if you choose—is nowhere in view. The organs of the body exercise mental functions, and the mind is the subject of bodily passions, which is, of course, true so far as experience goes. The brain is not mentioned in Scripture, nor the nervous system, nor the circulation of the blood, which are the key facts for all modern investigations of the relationship of the mind to its bodily organ. Thinking, feeling, and willing, all psychic functions, are performed by the man himself in indivisible psycho-physical unity, acting through internal and external organs, here or there, heart, liver, kidneys, intestines, eyes, ears, hands, indifferently.

Second, there is no scientific interest manifested in Scripture in the discrimination, analysis or explanation of the various functions of man, whether on the side of mind or of body. There is no attempt, for example, to find a unifying center for consciousness (it takes such unity for granted) or for the coördination of the various organs or activities of the body. How we think and with what instrument, why we love, or by what means we act, seems never to have interested the Biblical writers at all; and yet these questions form the very subject-matter of all the modern sciences which concern man, and without these there would be no such sciences. The deeper problems of our physical being, from the viewpoint of science, such as generation, conception, gestation, birth, and growth, are either ignored altogether, or else accepted as unfathomable mysteries, to be wondered at, admired, and referred to the wonder-working God.

Third, the Bible is, as has already been stated, earth-centered and therefore, popularly descriptive, and in its description of world events as frankly homocentric. Its viewpoint is religious truth not scientific naturalism. Its interest is primarily in man and in the world as man's home; in man and in the creation as coming from God and sharing in some sense in the same destiny. There is much interpretation of nature in all this, but no naturalism.

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The reader does not need to be told that this is not the viewpoint of the natural sciences. It is not a question of accuracy in details at all, but of viewpoint, of method, and of emphasis. The Bible is headed quite in the opposite direction from physical science. Professor Ritter's bluntness helps us here. He says: "Any scientist who insists that the causal explanation of a sensible object lies deeper than observation can go, is at heart an apostate to observational science, whether the 'invisible,' 'deeper' cause, supposed to be final, be conceived of as pure matter, pure energy or a Divinity."

Undoubtedly, the acceptance of this canon would put a great deal of scientific speculation out of business very promptly. As a matter of fact, Professor Ritter occasionally violates his own rule.

But we should understand and appreciate his position. His polemic is addressed, not to theologians as one might suppose, but to scientific elementalists who attempt to interpret the organism in terms of the invisible constitutive factors hidden in the cell. The whole meaning of his statement however is conditioned by the phrase "observational science," by which he means "the science of physical observation." From the viewpoint of *observational science* thus defined, whatever is beyond *observation* is also beyond *science.*

Whether observational science can take in the whole of reality is quite another question, but the limitation of its field and of its method is evident and perfectly legitimate. Would that all scientists observed it!

On the other hand, we do well to take heed to this distinction, and not attempt to mix categories. Jeannie Welsh Carlyle once said: "It is the mixing up of things which is the Great Bad." The mind of inspiration is perfectly clear in this matter. The realm of secondary causation; the close, minute observation of phenomena; the analysis of physical events in terms of their physical constituents and antecedents, which is of the essence of science, is never infringed upon. Faith is, therefore, free and science is also free. The Bible never confuses issues.

Let me return now for a few moments to the Bible outlook upon man and Nature. There is abundant reason, I hold, why the Bible should occupy, as it does from beginning to end, the unassailable position of viewing the world according to ordinary observation, phenomenally and not scientifically.

First, this method of viewing the universe detaches the religious interpretations of the Bible from the changing world-views and cosmic theories of science. Science is always digging into the world which we see, with microscope, telescope, and all the paraphernalia of experiment and precision—for what? In order to lay bare its inner structure. Its aim is to uncover the *physical* mystery by insight into the physical structure, to explicate the mechanism of Nature in all its operations.

Francis Thomson rather satirizes the work of scientists when he says:

> "Science, old noser, in its prideful straw
> That with anatomizing scalpel tents
> Its three inch of thy skin and brags 'All's Bare'!"

It doesn't brag as much as it did—for its greatest discovery brings humility in its train. The vastness and complexity of the universe has progressively been disclosed, reaching upward toward the infinitely great and downward toward the infinitely small;—into

> "The multitudinous diminutive
> Recessed in virtual night
> Below the surface seas of sight;
> Him whose enchanted windows give
> Upon the populated ways
> Where the shy universes live
> Ambushed beyond the unapprehending gaze,
> The dusted anther's globe of spiky stars;
> The beetle flashing in his minute mail,
> And every water-drop a-sting with writhing war."

While the stellar universe has been multiplied many thousandfold, the inorganic atom and the microscopic cell have become "inconceivably complex." In both directions the outreach is toward the infinite. The task of science is thus seen to be endless and its viewpoint and interpretations necessarily subject to constant change.

A book of permanent spiritual value for all generations of men can escape from entanglement in this changing process of thought in only two possible ways: It must either give us final, absolute, and complete science; that is, must explicate in terms of natural processes the sum total of phenomena, or else abandon the scientific platform altogether and lay hold upon those truths and principles which do not change as science changes. God

The former alternative would be impossible for several reasons, the first being that it could not possibly be under- Super stood. In the second place, it would be unending. Scientific treatises are often and necessarily of prodigious length. For example, Professor Wilson's monograph on the Cell, confessedly not a general or exhaustive treatise on cytology, contains, with book-lists and indexes, four hundred and eighty-three closely printed pages.

Wheeler's monograph on Ants contains six hundred and sixty-three immense pages. My Bible, the *vade mecum* of my study life, consists of three hundred pages, in part more closely printed than Wilson's but only three-fourths as large, and not more than one-third or one-half as large as Wheeler's.

In this connection, may I call attention to an instructive illustration, in detail and by way of contrast, of the way in which the Bible deals with nature? There are two references to ants in the entire Bible; one is attributed to Solomon, who says (Proverbs 6:6): "Go to the ant, thou sluggard; consider her ways and be wise; which having no chief, overseer or ruler, provideth her meat in the summer, and gathereth her food in the harvest." The other (Proverbs 30:25) comes from Agar, the son of Jakeh: "The ants are a people not strong, yet they provide their food in the summer."

One of the most fascinating pages of scientific history hangs on these little verses. In the first place, in both of them the ant is used to point a moral; the interest is not primarily but only incidentally scientific. In the second place, a very accurate observation is made, namely, that while the ants have no king, nor overseer, they work together. It is also said that they provide their meat in the summer time and lay up food in harvest. The ancient writers on ants followed Proverbs absolutely in regard to this harvest idea until the modern Northern myrmecologists began to study. To a man, they denied the correctness of Solomon's observation. On the basis of *their* observation there seemed to be a real conflict between Scripture and science. The scientists said that the ants never lay up any food at all; they live from hand to mouth. So it went until an Englishman, by the name of Moggridge, about the middle of the nineteenth century, discovered an *agricultural* ant which gathered seeds and laid them up for winter. Several species of ants discovered in Palestine and elsewhere, known as Harvest ants, exactly fulfill the Biblical requirements. Undoubtedly, the proverb-makers had actually seen the Harvester ants take grain into their underground houses. But while accurate this is evidently not a scientific treatment of ants. It is quite correct. It is an acute observation. But over against three or four verses in all Scripture on ants, are Wheeler's six hundred pages and more. Scripture gives quite enough space to the ant for religious purposes. Besides, the Scripture references are centered around a scientifically irrelevant moral exhortation. Science does *its* work, however, not according to the importance of the subject, in the general scheme of things, but according to the facts to be known.

For more than a hundred years, scientists have been carefully studying ants, tiny creatures though they are. Many learned men have given their entire lives to this study and literally hundreds of books and papers have been written upon them.

Of the making of many books, therefore, particularly of scientific books, there is and should be no end, for life is infinite and men are always learning. There is but one Bible, and we need no other. It holds its place of unchallenged preëminence—it is still the greatest selling book in the world—by virtue of its doing one thing and doing it supremely well,—by leaving out of account all ancillary and secondary matters (and I am frank to say that all scientific matters are in this sense ancillary and secondary), and dealing with essential and unchanging verities.

In the second place, a scientific Bible (that is, one that anticipated the discoveries of science) would have doomed the human mind to perpetual paralysis of astonishment on the one hand, and to unprogressive stagnation on the other.

In that same book of Proverbs it is said: "It is the glory of God to conceal a thing; but the glory of Kings is to search out a matter."

One of the most discriminating remarks on the creation narrative of Genesis ever made was penned by the Duke of Argyll: "It neither prevents discovery nor anticipates it, but runs around the outermost rim of all possible discovery."

Many of the finest chapters of human life have been concerned with the investigation and discovery of these hidden things of Nature.

I have one more thing to say on this subject of the non-scientific character of the Bible and its justification, and this is the most important, I think, of anything I have said. This characteristic has enabled the Bible to become a forerunner and pathfinder of science. The Bible is not scientific in the modern sense, but it has performed an introductory task of vital importance, on behalf of science. It has helped to drive magic, mythology, and deification of things out of man's thought of nature. It has reduced nature-gods like those of Egypt and Babylon to the normal level of thinghood. It has provided a unified, rational, law-abiding world in which men could be free from the tyranny of jealous personified world-powers, in order to study the works of God in nature.

I doubt if we who devotedly love the Bible begin to appreciate the magnitude and the beneficence of the service which the Bible has performed on behalf of science, in emancipating the human mind from the superstitious dread of nature as the abode of darkly ominous powers, and stimulating it to the study of God's workmanship in the world.

Third, this non-scientific attitude has further enabled the Bible to contribute to the awakening of the sense of personal worth and ability in man. Scientists frequently object that the Bible unduly magnifies man and disproportionately minifies nature. The very first reasoned attack upon Christianity took this ground,—that in Christianity man has been absurdly magnified, made central in the universe and brought into an impossible comradeship with God. Celsus said that it was as absurd as for a group of bullfrogs, on the margin of a pond, to think that the stars had been lighted for their benefit, for man to think that God could or would care enough for him and for his salvation to visit the earth. Spencer has said much the same thing, while Haeckel affirms dogmatically that man "has no more value for the universe at large than the ant, the fly of a summer's day, the microscopic infusorium, or the smallest bacillus" ("Riddle, E. T.," p. 87).

My answer to this screed of depreciation is that had such a view of man prevailed from the beginning, science never would have been born. The Bible taught man to hold up his head and look the universe in the face, and, outside the range of its historic influence, there have been, in modern times, no sciences. The Bible has furnished a ladder by which man could climb out of his mythologies and his cramping creeds of fear to a platform of confidence and self-respect where scientific thought and observation are possible. It has done this, not by being scientific but by the entirely non-scientific but truly pedagogical method of subordinating nature to personality and putting into the human hand a key to its ultimate meaning, on the level of his own conscious life. By revealing the essential kinship of man and nature through their common dependence upon God, the Bible, ignoring Science, has helped to create Science. Nature depersonalized, in the long run, would be fatal to science because it would destroy the value of life and cut the nerve of interest,—this would be as bad as that nature should be personified in such a way that interest is lost in terror.

Fourth, the non-scientific character of the Bible has enabled it to place adequate emphasis upon the idea of God. There is apparently an inherent tendency in the human mind to substitute the symbol for that which is symbolized and the case of nature is no exception. Love of nature is a wonderful and uplifting emotion—idolatry of nature has always tended to become both blinding and degrading. An undue emphasis in the Bible upon the details of cosmic procedure might easily have defeated its purpose to open the eyes to the reality and greatness of God. Scientific preoccupation with natural processes and secondary causalities has its own peculiar dangers as the history of modern intellectuals abundantly shows. What is it Schiller says?

> "The Great Creator
> We see not—He conceals Himself with
> His own eternal laws. The skeptic sees
> Their operation, but beholds not Him,
> 'Wherefore a God?' he cries. 'The world itself
> Suffices for itself!' and Christian prayer
> Ne'er praised him more than does this blasphemy."

Is it not pathetic, to be made skeptic by the perfection of God's work and His gracious self-concealment—to be blinded by the sun to the light which is above that of the sun? And so the Bible makes of the universe, majestic as it is, a small matter by comparison with the greatness of that eternal Being who made it. It is glory enough for the heavens to declare the glory of God. They need no light of their own.

If, in the main, what I have been saying is true, we ought to be ready for a working program in dealing with this question of man, who is both a science and a scientist, a maker and a would-be solver of problems.

The answer in one way is simple. So far as the Bible is concerned we must be careful to draw and maintain the boundary line between the interests of religion and those of science. But, I am asked: Just where do you draw the line between the theological, say, and the scientific rights and interests? We need a map of the no-man's land between science and religion, the scene of countless raids and forays back and forth. We need a sharper definition of boundaries.

I think that for careful and discriminating thought this task ought not to be so difficult. Let me tentatively define this boundary as marked by the distinction between matters of fact in nature and questions of meaning; or, in other words, between processes and causes—or to escape the ambiguity involved in the term *causes*—between process and Cause. From the theological side this involves the distinction between *the divine act* itself, taken in the absolute sense, and the divine mode of acting as exhibited in the natural order. From the viewpoint of philosophy, Professor Lindsay ("The Fundamental Problems of Metaphysics," p. 50 f.), himself an ardent theist, states the case clearly, though somewhat abstractly, thus: "All science is based on the belief in invariable and orderly sequence. Real causes are unknown to science, which really deals only with occasions; causations are to science only transformations. It is, however, no impeachment of the causal principle that it has thus no place in the scientific realm, for efficiency preserves its validity and worth in its own proper, non-phenomenal sphere. In the phenomenal sphere, a First Cause would be inconceivable, no interruption of the sequence of equivalent changes being admissible. Scientific method, then excludes all notion of a First Cause. If the intuition of causation seems to demand the postulation of a First Cause, the exigencies of science can meet this demand only by breaking away from its own method, which is confined to changes caused by forms of energy previously existent."

Moving out upon the facts of nature through Scripture I should say at the outset and in the broadest possible way that it is impossible to interpret its terminology—for example, as to human origins, in terms of physical realism. The words of Scripture convey no physical image and involve no definitive details of process. That man and nature alike came from God and depend upon God the Bible is never weary of asserting—but it gives us no blue-print of the process. The *how* of it is almost literally untouched. The whole creation narrative in both sections is dominated by three words which are translated respectively *create, make* and *form* and the three are used to cover all details which are given of the things done and all the phases which are even suggested of the way in which they are done. It is perfectly clear that an account so constructed is synoptic in the extreme. It has no verbal apparatus for detailed description of process, even if there were interest in it, which apparently there is not. Let us follow out this suggestion somewhat carefully as it applies to man.

In the first section, the creative act is related directly and without steps to the imparting of the divine image to man (vs. 26—here the word *make* is used), which is defined in terms of creaturely supremacy and social organization as realized in sex (vs. 27).

In this statement there is no reference to any sort of method of action or physical details, not even separate reference to man's body except as implied in vs. 27, or to his mind. Man's creation is defined in terms of *idea* and *result* and *creative power* through which the idea passes into the result.

What are the things to be insisted upon as constituting the doctrine of this statement? They are evidently these:

A. Man owes his being to God.
B. He is a specific logos or thought of God.
C. He bears an imparted likeness to His Maker.
D. He is the intended crown and head of the creation.

If there is any significance in the words used man is both *created* and *made*. There is nothing here said or implied of the actual method of man's creation, whether instant or gradual, direct or mediate. It cannot be used either for or against evolution. It therefore contains no scientific data.

A specially interesting item in this connection is the use of the expression, "after its kind," which, though not used in connection with man, is six times repeated in connection with other living beings in the first creation section. This phrase has often been used as Biblical authority against development—as if the initial form is to be looked upon as fixed and final and the creation idea attached just there.

This cannot be done, for the reason that any evolutionist would admit that the likeness between parent and offspring is an *observational truth* of great significance—an open, evident, observable fact in nature. Living beings do bring forth after their kind—in spite of variability—otherwise, as I have elsewhere emphasized, there could be no order or classification. Moreover there is no reason to believe that this orderliness has not been a characteristic of nature from the beginning. On the other hand, if it is affirmed that the phrase excludes variation, it is brought into violent conflict with perfectly evident facts of every day observation. Finally if it is said that variability contradicts this Biblical statement—there is also equally violent collision in the manifest facts. But, of course, there can be no real collision between heredity and variability because both are evidently facts of nature.

In the second section, the case is very much the same. The order is reversed, man (the male individual) precedes animals and woman. If one insists upon scientific realism in the order of events it is hopeless to try to reconcile this with the first section. The two instantly step apart and stiffen into antagonism. But if we recognize the truth that the intention is not at all realistic, in this mechanical sense, but that the description is intended to portray man in his self-development and in adaptation to his broadening environment under divine care, it is beautifully harmonious not only with the preceding section but with the whole Bible. It seems to me that every detail in the description resists a realistic interpretation in the sense of science, and that, furthermore, the result of such treatment is especially unfavorable to the uniqueness and supremacy of man for which we should be particularly solicitous. Man is *formed,* thus associating with him the third word in the trio of creative terms, "from the dust of the earth." This gives us a new idea, that of preëxistent physical material, an idea absent from the first section for a reason which I will point out later. It supplies, no hint, however, as to how the dust is worked up or transformed for vital use. We are left in the dark on this point. The narrative also carries man into rather intimate relationship with the lower animals. They also are formed "out of ground." In addition, the result of this formative process in the case of man is exactly the same as in the case of the animals. He became *nephesh,* living soul—so also do they. This leaves but one expression, "and breathed into his nostrils the breath of life," peculiar to man. This expression is usually stressed as indicating a unique creative process in the case of man. But unfortunately for this interpretation the meaning of the word "breathed" is limited by nephesh. By this *inbreathing,* or as the result of it, man took *his* place among living creatures.

The term nephesh does not mean soul in our sense, but refers to a quality of livingness which man shares with every other living being. It is, clearly, in no sense distinctive. Then what of the inbreathing? If the result is not distinctive can the process be? Under literalistic handling this passage involves a most uncomfortable leveling of man with the beasts that perish and might be used with telling effect—as indeed it has—against the creation idea of the first chapter and against the notion of man's uniqueness and supremacy in general. But this is surely an impossible result. Man is as great in this passage as in the former and the reversal of the order of his appearance, rightly understood, only serves to enhance this spiritual emphasis. The movement of the first section begins with the universe and—glorious paradox—ends with man as the climax of creation. From the cosmos to man is an upward climactic movement. The second section begins with man at the center and shows him, under the fostering providence of God, reaching out through thought and language, work and love, in correspondence with an ever-widening environment. I somehow cannot help thinking that the *inbreathing* mentioned here is not so much *creative* or *originative* as it is *inspirational*. It is not so much a mode of making as a method of treatment. The distinctive thing about man is not in his creaturehood so much as in his privilege. God inspires, illumines, teaches him. "There is a Spirit in man, and the *inbreathing* of an Almighty One maketh him to understand." If one rejects this idea and substitutes a quasi-scientific interpretation, I do not see how it is possible to save the creation narrative in its two movements from mutilation into contradictory fragments. One or the other must go, and with it the unity and authority of that portion of the Bible. This to me is an intolerable and entirely gratuitous and unnecessary result.

We come now to the crux of the whole situation so far as this first chapter is concerned—the relationship between creation as set forth in the Biblical narrative and the theory of Evolution. How are these two ideas related to each other and particularly to man? My answer to this question is—it all depends—upon two things, chiefly;—the meaning given to *creation*, on the one hand; and the interpretation placed upon evolution, on the other.

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Beginning at the creation end, let me say that for adherents of the Bible this is a purely exegetical question. The Bible must be allowed to define its own terms. No Biblical term can legitimately be taken out of its Biblical setting, excised from its historical usage and grafted into a context of one's own philosophic notions. Certainly, we cannot claim Biblical authority for the inharmonious and incongruous combination. This caveat has a definite application just here. What does the Bible mean by creation? There is a certain difference of emphasis, at any rate, between the words *create*, *make* and *form*, but as all three are applied to man we neglect the difference here and confine our attention to *bara*—the word which is translated "create."

This word is used some thirty times in the Old Testament with such a variety of significations that it is difficult to bring them to a synthesis—and yet, the general outcome seems to me clear and unmistakable. The word is used in the Old Testament for all kinds of events in nature, in history, in individual experience, which exhibit clearly and unmistakably the agency of God. These meanings run all the way from origins, absolute and secondary, to regular habitual processes in nature; to providential happenings in human history through to the great Messianic consummation; and to the workings of Divine Grace in the human heart. In every instance the word stresses the *Divine Agency.* In every instance, method, secondary causes, intermediate processes, even where manifestly present, are ignored. The wind that blows to-day, the new growth of shrubs and trees that come forth to clothe denuded wastes in wilderness and desert, the historic providence that delivers Israel and the establishment of the covenant relationship, the preparation of the earth for man's habitation, the birth of men as individuals, the rise of nations—all are brought under the word *create,* as is also the fiat which evoked Nature at the beginning.

The Biblical idea of creation, therefore, for all its variety of applications, is exact and definitive. It is concerned only with God and divine action. It contemplates process solely as divine action. It includes within itself all natural processes considered as divine action. Any conceivable process which reveals God is creative for that reason and for that reason alone. Development, history, salvation, at any point in the world process, is creative, quite as much as origination in the absolute sense—provided it is looked upon as the activity of God. Hence, it is quite clear that the developmental idea, *as such,* can be brought into harmony with the Bible idea of creation. The Duke of Argyll ("Unity of Nature," p. 272) makes a statement quoted and endorsed by Dr. Orr ("Sin as a Modern Problem," p. 167) which is full of significance for us: "Creation and Evolution, therefore, when these terms have been cleared from intellectual confusion, are not antagonistic conceptions, mutually exclusive. They are harmonious and complementary." And James Martineau puts the same truth in another way: "In Evolution the creative fiat opens up and spreads itself along the furrow of perpetuity."

This gives us our desired boundary line. Science as such is not concerned with God nor with divine action—it is concerned with process, in and of itself. Its technique is altogether of the observational world. Its sphere is the interrelated system of secondary causation. Any theory, whether evolutionary or not (and nature speculation was sometimes atheistic long before it was evolutionary) which professes to interpret *process* as absolute, final and complete; which affirms that man came *by* process and not *through* process; which denies purpose, which excludes divine action and reduces reality to a self-running and self-explanatory mechanism, is, of course, atheistic. It denies creation and contradicts the Bible. But it is not only atheistic, it is also, and in exactly the same proportion, unscientific. As Professor Conklin beautifully says: "If man is the result of unintelligent forces and processes; if, as one biologist has said, 'The evolution of consciousness is the greatest blunder in the universe'; if men are born by millions only to be swept away by flood, fire, famine, pestilence and war; if they live and die like the beasts and leave only their bones and implements behind; if suffering and struggle are purposeless and lead to nothing, then certainly it would be true that evolution debases man and destroys the hopes of mankind. But this is not true, and it is not the teaching of evolution, but rather of pessimism and atheism" ("The Direction of Human Evolution," p. 231).

With a type of evolutionary theory which it cannot relate to God and harmonize with divine purpose and translate into divine action, which dethrones God and degrades man, theology is necessarily at war. On the other hand, it is no more than fair to say that with a theology which ignores facts, confuses means with ends and dictates terms to investigation, Science is rightly and necessarily at war. But the fault lies not with the Bible nor with Science, but with faulty human nature with its ignorance, its prejudice and its misunderstood partial viewpoints.

In view of its nature and method there are three items in particular of the Genesis story which seem to me to verge upon the miraculous. The first is, that without psychology and without physiology and even without any discrimination between the two disciplines as we know them, the Bible, following Genesis, has reached unerringly the central and supreme ideas without which all psychology becomes a meaningless listing of shadowy states of consciousness, the unity and spirituality of man, his likeness to God and his ability to know God. The second is, that without scientific method, apparatus or even terminology, it has given us an orderly, progressive, law-abiding and divinely significant world in which true science may have a home. The third is, that the Bible, antecedent to science and apart from man's experience in studying and controlling nature, placed man at the head of the natural order in a position of deputed sovereignty over the lower creation. Could anything make the fact of divine inspiration in the Bible clearer? Could inspiration do any nobler work?[1]

[1] The most successful attempt to relate Genesis and science known to me is in a little book by Morris Morris, Sc.M., published by Marshall Bros., London, 1924. I received it too recently to make use of it in the text. It should be read in connection with this chapter and Chapter X.

CHAPTER II

THE MEANING OF EVOLUTION—ADAPTATION AND PROGRESS

EVEN a cursory survey of the wide field of discussion covered in general by the term evolution is sufficient to disclose a peculiar and pressing need not only for definition but for analytical discrimination, which goes far deeper into meanings than is ordinarily involved in the task of definition. The word evolution is not merely ambiguous, it is also vague—vague not from lack but from excess of meaning. It is the broadest kind of a generic term. It comprises a bewildering complex of primary and secondary applications; of unresolved tangles of facts, inferences and explanations; of theories within theories, of speculations resting upon speculations and supporting other speculations; together with sober interpretations of obvious facts. It needs, therefore, not only definition in the dictionary sense, but even more explication and analysis.

Professor T. H. Morgan, for example, says: "We use the word evolution in many ways, to include many kinds of changes. There is hardly any other scientific term that is used so carelessly, to imply so much, to mean so little" ("Critique of the Theory of Evolution," p. 1). George A. Gordon of Boston says: "No close thinker can define his position by a word which has been so overworked. We may call ourselves evolutionists and speak popularly of the evolution of anything under the sun; the real question would remain: 'What kind of evolutionists are we?'" ("Through Man to God," p. 4).

W. L. Walker of England says of one type of evolutionary theory: "It is the great magic-worker of Monistic-Agnostic and antitheistic philosophy. By its means the most apparently incredible feats can be accomplished. Given only matter and energy to start with, by this potent agency we are led directly onwards till we reach mind in man with all its achievements. We seem to see our spiritual selves being born or made out of nothingness. If there are difficulties, evolution is the universal solvent. If it seems to sober sense impossible to derive the rational from the nonrational, we are assured that evolution can accomplish it" ("Christian Theism and a Spiritual Monism," pp. 88, 89). And yet the same author who speaks thus with fitting scorn of one kind of evolutionary theory, says of evolution interpreted in another way: "In addition to the large amount of evidence that exists for it, the theory gives such unity to our thought in respect to the world, explains so much that is otherwise obscure, and is in such harmony with our experience that we feel instinctively that, in some form, the evolution doctrine must be true" (*ibid.,* p. 91). No better illustration of the Protean slipperiness of the whole conception and the vagueness of the term used to describe it could be presented than this instance where a clear and consistent thinker unqualifiedly condemns evolution in one form and as cordially endorses it in another.

There is in this very obscurity a certain amount of significance. It is quite clear, for instance, that evolution is not a clear-cut, self-contained and articulated system of ideas which stands apart, like a building, with a definite outline and contour and an appraisable set of fixed intellectual values.

It is not like Positivism, for example. Every man who thinks *knows* whether he is a Positivist or not (unless, as Frederick Harrison insists we must except the Agnostic), but many an intelligent man does not know whether he is an Evolutionist or not. As things are now, a judicious man would refuse to accept the term unless allowed to define it for himself.

There is another helpful inference to be drawn from the otherwise rather forbidding uncertainty of the term we are studying.

The word evolution is itself in process of evolution. It is undergoing change. It is, thus far, in a fluid state and running into molds of thought themselves unfixed. It has, therefore, received no final or authoritative expression. Accepted with enthusiasm or rejected with dislike, few seem to have any clear idea of what is being accepted or rejected and a particularly vague apprehension as to whether the dissidents are accepting or rejecting the same thing. When one man, presumably honest and possessed of at least a modicum of intelligence, asserts that "not one fact in the universe tends to prove the truth of evolution," while his opponent asserts with equal confidence that "every fact thus far discovered harmonizes with the theory of evolution," it is clear that in some way or other these two are facing in different directions and looking at different objects. To think otherwise, in the presence of such contradiction as this, would be to blaspheme human reason and cast discredit upon the intelligibility of God's work in Nature.

Professor Patten of Dartmouth, author of "The Grand Strategy of Evolution," begins his first chapter with these words: "The theory of evolution is now accepted by all classes of intellectual leaders" (p. 20). Well, so be it, but in what sense? I am not exaggerating one iota when I say that if Professor Patten's interpretation of evolution is accepted as final and authoritative, a majority of the books now extant, dealing with the theoretical aspects of evolution, have no longer any but a purely historical interest. They are obsolete. Let the following suffice as an example of Professor Patten's handling of his colleagues and predecessors: "The field naturalists and the modern biologists survey a particular mental facet, and each school has evolved a more or less rigid formula for the things it most clearly sees. The Lamarckians chiefly see the inheritance of acquired characters, the molding influence of habit and of the external environment. The Darwinians see little else than 'natural selection' and 'the survival of the fittest.' The Weismannians see an omnipotent 'germ-plasma,' the creator, mute and unquestionable of all things living. The morphologists see their own cubist diagrams more clearly than living, growing organisms. The cytologists, breeders, and experimentalists see little more than their own thumb-nail sketches of the minute machinery of life and heredity, of Mendelism, chromosomes, and eugenics."

Professor Patten pays cordial enough tribute to the accuracy of the work of these men within their respective limits, but says of them comprehensively: "They lack perspective"; and maintains that the more comprehensive sciences must be called to the assistance of these workers in order to interpret the world of Nature in any adequate way. As I shall show later, Professor Patten's whole method of procedure, involving the factors which he emphasizes as creative and those which he puts on one side as secondary and unimportant, results in a picture of the evolutionary process absolutely different from anything the most experienced among us has been taught to identify as such.

This is no reflection upon Professor Patten or his predecessors. A revolutionary and superannuating interpretation of this sort is bound to come some time. That Professor Patten has achieved this is at least open to question.

I instance this simply to support the statement that the term evolution is vague partly because the task of formulating it is still unfinished; and that the attempt to make an established system from any present form of the theory is out of the question.

Another inference which we are entitled to draw from our present confusion about the meaning of evolution. In all its more ambitious forms, from the least to the greatest, it is an attempt to formulate an interpretation of Nature, both comprehensively and in detail. Since Nature is so great, so complex and, in her deeper aspects, so unfathomably mysterious, any such scheme of interpretation which attempts to comprise details of operation is bound to be obscure and to let many facts slip out of its grasp. As Professor Patten says: "Nature, indeed, is so vast, so intricate and in many respects so inaccessible that science can see but a very small part of her; and since no one science can long preserve its images undimmed, nor adequately utilize the vision of other sciences, man's mental picture of Nature is a mosaic patchwork of flickering images, a changing composite caricature which exaggerates her most conspicuous features, her most dramatic and recently discovered features" (p. 22).

This inherent circumscription and uncertainty of vision are bound to show themselves in all our attempts on a large scale to theorize about Nature. The baffling obscurity which hangs about this matter of evolution may, perhaps, be looked upon partly as the result of a vaulting ambition which has, in some respects, "o'erleaped itself."

Leaving all such general considerations, for a time, on one side, let us address ourselves to the task of getting at the meaning or meanings of evolution.

All experts are aware, or should be aware, of the fact of which few laymen have ever dreamed, that what popularly passes for the theory of evolution is a somewhat inchoate mixture of four distinct theories, no one of which necessarily involves all the others.

The first is the pre-Darwinian theory of the interrelationship and ascent of life, by and large, throughout cosmic history. This theory does not at all necessarily involve descent or the notion of natural selection or the survival of the fittest. In fact the idea of evolution—that is, of a regular and continuous sequence in the appearance of living forms—was accepted before the Darwinian terms were heard of and by scientists who never accepted the hypothesis in its Darwinian form. For example, Louis Agassiz (see "Life and Letters," vol. i, p. 203), who was an uncompromising anti-Darwinian to the end of his days, says: "Having completed the comparison of the fossil species (of fishes) in Paris, I wanted, for the sake of any easy revision of the same, to make a list according to their succession in geological formation, with a view of determining their characteristics more exactly and bringing them by their enumeration into bolder relief. What was my joy and surprise to find that the simplest enumeration of the fossil fishes according to their geological succession was also a complete statement of the natural relations of the families among themselves; that one might, therefore, read the genetic development of the whole class in the history of creation, the representation of the genera and species in the several families being therein determined; in one word, that the genetic succession of the fishes corresponds perfectly with their zoölogical classification, and with just that classification proposed by me. The question in characterizing formations, therefore, is no longer the numerical preponderance of certain genera and species, but of distinct structural relations carried through all these formations according to a definite direction, following each other in an appointed order, and recognizable in the organisms as they are brought forth."

The second theory, which Agassiz consistently refused to accept, though it seemed an almost inevitable corollary of his own views, is the theory of descent; that is, that the succession of living forms from the earliest to the latest has been connected through physical filiation, involving both heredity and variation,—that is, that all living forms are more or less closely related by blood.

The third theory is that this ascent and transformation of living forms has been brought about by the accumulation through long periods of time of slight increments of vital change.

The fourth theory is that this entire result has been brought about by the action of natural selection working upon chance variation and weeding out forms which fail to adapt themselves to the environment and are, therefore, unfit. There are, as we shall see, differences of opinion as to what is essential Darwinism, but, to me, it is just this combination of four theories, evolution through descent by gradual change, controlled by natural selection.

This fourfold combination of separate theories is so closely knit as to present the appearance of being one fourfold theory, but inwardly it discloses a significant lack of real unity. The moment we subject the combination to analysis, it becomes clear that each one of the four theories must stand on its own base and depend upon its own separate and non-transferable body of evidence. It also becomes evident that these theories, thus separated, differ among themselves in the bulk and quality of the evidence offered in support of them.

It is quite inadmissible, therefore, to argue for natural selection on the basis of evidence for descent alone, or for gradual modification by descent through slow increments of gradual change on the same basis. Moreover, it is not wise to allow ourselves in antagonizing one or more aspects of this composite theory to be maneuvered into antagonism to the idea of development in general. Two important results have followed from the composite nature of Darwinism. The adherents of the theory of evolution have broken up into schools, subschools, and eclectic groups which have multiplied in bewildering confusion. Otto says: "Darwinism, which was originally a technical theory of the biological schools, has long since become a veritable tangle of the most diverse problems and opinions. Darwinism, even in its technical biological form, never was quite and is to-day not at all a unified and consistent system. It has been modified in too many ways and presented in such different colors that we must either refrain altogether from attempting to get into close quarters with it, or we must make ourselves acquainted to some extent with the phases of the theory as it has gradually developed up to the present day" ("Naturalism and Religion," English trans., pp. 85, 86). This process of division and subdivision has resulted in part from the original compositeness of the scheme as formulated by Darwin himself.

The second result of this generally accepted combination has been to blind one's eyes to the deep-seated differences of opinion among scientists as to what evolution really means. The apparent unanimity among scientists in all departments of investigation and of all schools of thought as to the *fact* of evolution is most striking.

But, when we turn from the basic fact of an evolution of some sort to the consideration of what it really involves, and of the factors which have brought it about, the unanimity ceases abruptly. We are transported at once from a symphony concert where all is harmony to a *shivaree* of utter and apparently hopeless dissonance. There is difference of opinion as to descent itself, and as to whether descent has been in one or more lines; as to the meaning and influence of the struggle for existence; as to the relative efficacy of natural selection. Even more deep-seated and far-reaching are the differences between mechanists and vitalists, elementalists and organismalists; geneticists and paleontologists, physicists and biochemists. And we get chaos itself when we attempt to assay the various opinions and shades of opinions as to the causes of variation, the influence of environment, the mechanism of heredity; the nature and operation of the germ-plasm; the functions and performances of the chromatin, nucleus and cytoplasm; the acquisition and transmission of modified characters; the interrelationship and natural activities of physical, chemical and other known, unknown and perhaps unknowable factors in the process.

The situation is admirably summed up by Professor Bateson: "The many converging lines of evidence point so clearly to the central fact of the origin of the forms of life by an evolutionary process that we are compelled to accept this deduction, but as to almost all the essential features, whether of cause or mode, by which specific diversity has come to be what we perceive it to be, we have to confess an ignorance nearly total ("Problems of Genetics," p. 248).

All this is intensely interesting in itself, but it is more than interesting, it is of vital import to one who has set himself the task of coming to an understanding with evolution.

We do not propose to erect our house of faith on the shifting sands of biological controversy, but, surely, we may venture to inquire as to the meaning of these chaotic differences of opinion in a science where exactness of method and certainty of result form the very materials of success.

We are struck at once by the contrast between problems of organization, structure, function, and process which have been solved in whole or in part, or may reasonably be expected, in view of the progress already made, to yield to investigation, and another entirely different group of problems in the solution of which we have made no progress whatever. These later problems we do not need at present to define further than to say that they are ultimate and run back into the great mystery of nature itself. For this mystery, empirical science offers no solution.

But, before we reach this ultimate point of thought, it may be that the difference of opinion among scientists and their various views may, upon analysis, yield something of value in our search for assured truth.

There is certainly nothing in which they differ more significantly than in the scope of the field of observation to which they apply their theory.

For a beginning, let us take Huxley's famous definition of evolution found in "The Life of Darwin" (Vol. II, p. 210): "The whole world, living and not living, is the result of the mutual attraction according to definite laws of the powers possessed by the molecules of which the primitive nebulosity of the Universe was composed."

There can be no reasonable doubt, I suppose, that Huxley believed in the truth of this account of the Universe; but certainly no one could possibly have known better than its author that this comprehensive formula was not only unproved but was, by any possible or conceivable application of the inductive method, unprovable. We are thus at the outset confronted by a theory of evolution which is in large measure pure speculation. I am, therefore, not concerned even to discuss the truthfulness of this formulation but merely to point out its speculative character and lack of anything like an adequate empirical basis.

Scarcely less ambitious than Huxley's scheme is Osborn's. According to this scientist, "evolution is a universal law of which gravitation is one of many agents" (see "Nature and Evolution of Life," Preface, p. viii).

Evolution is, therefore, the developing Universe or the developing of the Universe. Evolution is the entire cosmic process interpreted as a progressive movement according to the key-principle of continuity. Everything is evolution—gravitation, molar physics, chemical affinity as well as the operation and history of life.

This universalized idea of evolution infuses a deeply speculative element into the investigation at the very beginning, because it takes universal physical continuity for granted even where evidence is lacking or positively against it. Professor Osborn, for example, affirms that "life is continuous creation or creative evolution," but also that "life may arise through combinations of preëxisting energies." "This creative power is something new derived from the old." He calls this process evolution rather than creation, because life appears to arise out of new combinations of preëxisting matter.

Now the empirical element here is undoubtedly the appearance under observation of something new—the activities of which are altogether distinctive, by comparison with what has gone before (as Osborn admits). The speculative element is the affirmation of a real, physical continuity underneath or rather within apparent discontinuity. In other words, the formula of evolution is applied to the facts *contra speciem* rather than drawn by logical inference from the facts. Taken at their face value the observed facts point to a certain break of continuity in the stream of physical events, an inflow or release of new creative energies.

This unmistakable leap in Osborn's logic is noted by the keen-eyed Ritter, who says that Osborn's purpose (of working toward an energy conception of life) "permits him to pass over rather lightly the morphology of the hypothetical first life" ("Unity of the Organism," Vol. I, p. 320).

The highly speculative character of Osborn's work in general has not escaped Ritter's observation. He says: "We may call attention to the unmistakable indications scattered throughout the theoretical part of the 'Origin and Evolution of Life,' that so far as chromatin enters into his theory the author is faced toward metaphysics and metaphysics of a distinctly mystical cast." Ritter also calls attention to what he terms Professor Osborn's *"emotional attitude"* (italics his) and pokes fun in his sardonic fashion at the latter because "the focal point of this attitude should be chromatin, whether hereditary chromatin or any other—especially when the author is a paleontologist"! All this apparently, Professor Osborn speaks of "germ evolution" as "the most incomprehensible phenomenon which has yet been discovered in the Universe." The significance of this by-play for our purpose lies in the fact that a fellow scientist recognizes the speculative character of Osborn's theory of evolution. His scheme extends beyond any empirical basis.[1]

Professor Kellogg ("Darwinism To-day," 1912) keeps his feet on the ground far more firmly than either Huxley or Osborn.[2] He confines himself within the limits of biology.

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[1] Professor More says ("Dogma of Evolution," p. 27) that Professor Osborn's theory of variation is "based on mechanical energy of a type unknown to physicists."

[2] This statement applies still more closely to Professor Kellogg's new book ("Evolution," 1924). See below, p. 98.

For him evolution is equivalent to the doctrine of descent, for he deals only with organic evolution.

Here is his own statement (*op. cit.,* p. 11): "The theory of descent (with which phrase organic evolution may be practically held as a synonym) is, then, simply the declaration that the various living, as well as the now extinct, species of organisms are descended from one another and from common ancestors. It is the explanation of the origin of species accepted in the science of biology." He excludes the origin of life from this explanation and says: "The theory of descent explains the origin of kinds of life; not the origin of life." It is clear from this statement that Professor Kellogg dismisses the question of the origin of life, a topic which forms one half of the title of Professor Osborn's book, as beyond the range of science. The only evolution he treats is organic evolution, which is narrowed down to an explanation of organic variety, and that explanation is not carried to the point of including the problem of problems, the whence and how and what of organic beginnings. This is a tremendous simplification. From the cosmic speculation of Huxley and Osborn which sweep from the original nebulosity to the day-before-yesterday, we have come in upon a territory which at least looks a little as if we might traverse it in a lifetime. And, as a simplification, it is a definite advance toward clarity of thought and the establishment of really worth-while and intelligent convictions. The trouble with schemes like those we have just been considering is that they are too vast to mean anything to us. No man can chin himself on the belt of Orion. Cosmic theories of this sort fail, usually, to convince us, not because they are false, but because they are so manifestly incomplete. For example, Huxley avoids all the difficulties inherent in his definition by so framing the definition that the consideration of them is really excluded. Evolution in his sense cannot be proved—by the same token it can hardly be disproved. Such philosophies are not refuted—men rather get tired of them. It is, therefore, a tremendous relief to find that Professor Kellogg, instead of trying to explain the Universe, "living and not living," is content to deal with a single problem in a relatively restricted field.

By so doing, Professor Kellogg gives us a coherent view both of the problem itself and of the theory which has been constructed to solve it. Instead of being asked to look at the universe and bring every operation in it under a single formulation, which is thereby so broadened that it loses both grip and definition, we are asked to view the world of life as science sees it now, under contemporary conditions, and then to follow science as it attempts to reconstruct the process through which that world of life has come to its present status.

In the second place, Professor Kellogg very carefully distinguishes this general idea of evolution from Darwinism, which according to his definition is a "mechanical explanation of the accepted fact of descent" (*ibid.*, p. 2). In another passage Darwinism *per se* is described as the theory of descent plus the theory of natural selection. "This is Darwin's causo-mechanical theory to explain the transformation of species and the infinite variety of adaptive modifications. A rigorous, automatic natural selection is the essential idea in Darwinism, at least, in Darwinism as it is held by present-day followers of Darwin" (p. 15). This last qualification is well chosen. I find no such elaborate scheme as is here defined in Darwin's own writing. For example, he says ("Animals and Plants Under Domestication," pp. 6, 7): "For brevity's sake, I sometimes speak of natural selection as an intelligent power; in the same way as astronomers speak of the attraction of gravitation as ruling the movements of the planets, or as agriculturists speak of man making domestic races by his power of selection. In the one case, as in the other, selection does nothing without variability, and this depends in some manner on the action of the surrounding circumstances on the organism. I have also often personified the word Nature; for I have found it difficult to avoid this ambiguity; but I mean by nature only the aggregate action and product of many natural laws,—and by laws only the ascertained sequence of events." This paragraph was, of course, written by Darwin, but it is far from being Darwinism as interpreted by Professor Kellogg, or the neo-Darwinians. I cannot see that Darwin, here or elsewhere, advocates anything so ambitious as a "rigorous, automatic, causo-mechanical" scheme of any sort.

The distinction which he thus draws between evolution and Darwinism enables Professor Kellogg to argue that evolution understood as identical with the theory of descent is independent of the Darwinian idea of natural selection. While natural selection is under attack, "evolution is looked upon by biologists to be as proved a part of their science as gravitation is in the science of physics or chemical affinity in that of chemistry" (*ibid.*, p. 3). This statement should be carefully noted and pondered. Descent is looked upon not as a theory but as proved fact. Natural selection is in no such case. It is not only separable from "Evolution" as such, but it rests, as has already been suggested, on an entirely different basis in evidence. "Doubts of Darwinism are not, then, doubts of evolution. Darwinism might indeed be on its deathbed without shaking in any considerable degree the confidence of biologists and natural philosophers in the theory of descent" (p. 3). Theoretically, we are quite ready to grant that descent and natural selection are separable. One question, however, we should reserve the right to ask: whether Evolution without natural selection *means* the same as with it—whether or not the dissolution of connection between these two theories does not force an entirely new valuation of descent? It will be remembered that natural selection is offered as a "causo-mechanical explanation of descent." If it breaks down, we are left without a causo-mechanical explanation of descent, until another has been found. If descent remains intact, while natural selection goes by the board, then descent remains a fact in the air, so to speak, without a causo-mechanical explanation. But, in turn, descent is offered as an explanation of organic variety. If it is a fact without a causo-mechanical explanation, then organic variety is a fact without a causo-mechanical explanation, until a substitute for natural selection is found.

It is, moreover, quite clear that descent, in and of itself, does not afford a causo-mechanical explanation of organic variety—which is a very important consideration, indeed.

Professor Kellogg makes another careful distinction to which attention should be given. He distinguishes Darwinism (natural selection) as "the natural selection of the fit, the final arbiter in descent control," which, he says, "stands unscathed, clear and high above the obscuring cloud of battle," from "Darwinism, as the all-sufficient or even most important causo-mechanical factor in species-forming, and hence as the sufficient explanation of descent," which he admits, "is discredited and cast down" (p. 374). The trouble with natural selection evidently is that while it is true and does its work efficiently it *does not work in the right place.* It stands too near the end of the process, instead of taking its place at the beginning. It cannot *explain* descent, or the way in which descent works because descent is in operation before natural selection can take hold. As Darwin says: "Selection does nothing without variability, or as Smyth puts it: "Tendency precedes selection." All that natural selection can do is to control results, and that negatively, by killing off misfits. There are other limitations in it, but these are obvious and generally admitted. John Burroughs in the posthumous volume of essays entitled, "The Last Harvest," states tersely the verdict of naturalists in this matter. He says: "It (n. s.) is a name for a process of elimination which is constantly going on in animate nature all around us. It is in no sense creative, it originates nothing, but clinches and toughens existing forms."

We are, therefore, entitled to affirm that the fourth member of the quadrilateral of theories with which we started is no longer tenable in the sense in which it was originally proposed as a creative factor in evolution.

The question which we have already suggested now pushes to the front. What difference does this deposition of natural selection from its premier position make with the doctrine of descent or with evolution in general?

The first thing to note is that we are in quest of a substitute for natural selection. A large part of Professor Kellogg's book is taken up with a review of the various theories which have been constructed to account for the tendency to vary which precedes and conditions selection. What is it that is wanted? Professor Kellogg describes the "Great Desideratum" (capitals his) thus: "The much sought for, often postulated, all-necessary modifying principle antedating and preceding selection which must effect change, determinate though not purposeful" (p. 347). It is evident that we have reached the point where a philosophical interpretation of the whole process becomes almost inevitable. The actual performance in Nature which precedes and conditions selection is the tendency on the part of organisms to vary, and to vary determinately and cumulatively. To say that this tendency is automatic or mechanical is to go beyond description into interpretation. This is clear from Professor Kellogg's antithesis of *determinate* and *purposeful*. It is still clearer when he says, after refusing assent to various theories: "Nor can any Nägelian automatic perfecting principle hold our suffrage for a moment unless we stand with theologists on the insecure basis of teleology" (p. 377), or, as he states the issue in another place: "Nägeli's automatic perfecting principle is an impossibility to the thoroughgoing evolutionist seeking for a causo-mechanical explanation of change" (p. 387). The basis of Professor Kellogg's objection to Nägeli's theory of orthogenesis is to be found in two particulars: (1) that Nägeli conceives of "the organism itself as a force or factor making towards specialization, adaptation, that is towards progressive evolution," in relative independence of the environment, (2) that this inner driving force of the organism is conceived of as a "mystic, essentially teleologic, force dominating the physical and chemical factors involved" (p. 278). Such an idea of an "unknown, unproved, mystic vital force," Professor Kellogg considers opposed to science.

There are three features involved in these statements which particularly interest us. The first one is that the extreme emphasis upon the influence of the environment which is involved in the original theory of natural selection, in the general breakdown of that theory has brought about an inevitable recoil to the opposite extreme of putting practically the whole responsibility for variation upon the organism, which, consequently, is endowed with a driving force of its own.

It is interesting to note, in the second place, that the question of teleology lies so close to the surface in this matter of variation that a scientific theory or, if Professor Kellogg's objection to Nägeli's scheme is allowed to stand, a theory proposed by a scientist is found to be so full of teleology and mystical implications that one who holds it might as well go the whole way and be a "theologist." We can understand and appreciate with full sympathy Professor Kellogg's irritation at being confronted with a "mystical driving-force" at a moment when he wants to deal with matters of biochemistry which pertain to his science and "which we are beginning to recognize and understand with some clearness and fullness" (p. 278). On the other hand, I am not particularly concerned to make a drive for teleology just at this point, nor do I feel that Nägeli's driving-force is very much better suited to the "theologist" than Professor Kellogg's own "automatic" modifier. What I consider really important to point out is that it is imperative that we find our way through the rather narrow pass between natural selection and "vitalism."

In the first place, we take it that Professor Kellogg's real objection to Nägeli's "driving-force" is not that it is "unknown" and "unproved," but rather that it is "mystical" and "teleologic." We infer this partly from what he says about types of orthogenesis which are not objectionable to science, such as Eimer's (p. 278, bottom). These theories are in harmony with scientific methods, because "they rest on the *assumption* (italics mine) that (1) physico-chemical factors produce direct effects on the plastic organism" and (2) that "such effects, repeated and intensified, result in a certain degree of modification or control of variation and evolution" (p. 279). This supposition is in itself in the highest degree reasonable—but note that it rests upon assumption, not upon observation. It is an interpretation of variation, based upon an unproved theory: (1) that physico-chemical factors are adequate to produce variation [1] and (2) that they work in such alignment as to produce variations in the amount and direction necessary. Nägeli's scheme is also an interpretation based upon the assumption that physico-chemical factors are *not* adequate to produce variations to the extent and in the direction necessary. Both Nägeli's scheme and the rival types of theory are unproved. Nägeli's theory is at a disadvantage with a scientist, if for no other reason, because it substitutes a (presumably) non-physical force for physico-chemical factors of change and thus presents a barrier to the advance of empirical science in that direction—but to one who looks to the significance of the whole, to whom the limits of science are not the limits of reality, it is simply a question of whether Nägeli's assumption is more or less probable. It assuredly is not irrational, moreover it cannot be definitely discredited as a hypothesis, except from a limited dogmatic viewpoint, until

[1] Note that the core of the whole question *so far* is the meaning and cause, or causes, of variation. For this reason Morris's book, mentioned in the preceding chapter, is important. He practically confines himself to the question of variation, its origin and significance.

the necessary physico-chemical factors of change are produced.

We are thus presented with a deadlock of rival theories which awaits further evidence. Our position in this issue is not controlled by any personal feeling in the matter for, as a matter of fact, we have been inclined to agree with Kellogg rather than with Nägeli. The latter, perhaps, has put up the barrier too soon. That Professor Kellogg's objection, however, is rather to the teleologic implications of Nägeli's driving-force than to its being unknown or unproved, we infer, further, from his own suggestions as to the cause of variability. He says: "What is needed, then, is a satisfactory explanation of the pre-useful and pre-hurtful stages in the modification of organisms." Whether we have such an explanation in our hands "may be left for the moment undebated," but "with it once in our hands, we may depend with confidence on natural selection to do the rest of the work called for by the great theory of descent. Among all the divergent lines of development and change, instituted by this agent of beginnings, natural selection will choose those to persist by saying no to those that may not. And the result is organic evolution" (p. 377).

Now, the question is: What, according to Professor Kellogg, is this "agent of beginnings" or "the causes of variation," for this must be conceived of as a complex of causes rather than a single factor.

He first asks a question: "Why cannot the simple fluctuating or Darwinian variations be chiefly the result of the inevitable variation in the epigenetic factors, which, when not intruded on by exceptional disturbances, would themselves follow the 'law of error' and hence produce 'law of error' variability?" This means, that in the process of development from the ovum, the internal structure of the unfolding organism would never be twice exactly the same, nor would the influences of the environment (epigenetic factors) tend to repeat themselves exactly, hence variations of greater or less extent would normally be sure to occur. The causes of variation then would be (1) the internal structure of organisms never twice exactly alike, (2) the environmental factors also constantly changing—hence, "hit and miss" variation of greater or less extent according to the range and character of the epigenetic factors involved. On this basis of supposition he concludes: "If variation is thus simply the wholly natural and unavoidable effect of this inevitable nonidentity of vital process and environmental condition, why does not evolution possess in this state of affairs the much-sought-for automatic modifying principle" (pp. 386-387). He asks further if this "automatic modifying principle which results in determinate and purposive change—that is, in the change needed as the indispensable basis for the upbuilding of the great fabric of species, diversity and descent—is not that the very thing provided by the simple physical or mechanical impossibility of perfect identity between process and environment in the case of one individual and process and environment in the case of any other"? Then he concludes: "It seems so to me" (p. 387).

Criticism of this scheme should be addressed not so much to its intrinsic correctness as matter of fact as to its sufficiency for the work which is imposed upon it; that is, as an explanation on mechanical principles of variability, hence of descent, hence of organic variety. Of course this "agent of beginnings" is "unknown" and "unproved" Professor Kellogg says: "It seems so to me." And then adds: "I do not know. Nor in the present state of our knowledge does any one know, nor will any one know until (as Brooks says of another problem) we find out" (p. 387).

This, however, is not a part of the criticism. It simply justifies the statement: that Nägeli's scheme is objected to because of its mystical cast, rather than because it supposes an unknown factor. If Professor Kellogg's scheme seemed satisfactory as a hypothesis, we should be prepared to accept it until something better offers itself. But this scheme is not altogether satisfactory *as* a hypothesis.

In the first place, it is anything but simple, in spite of the author's repeated use of the word. Of course, the proposition which states the impossibility of "perfect identity between process and environment" in any two cases, is simple enough. It is as Herbert Spencer would say, "verbally understandable," but the thing it represents is neither simple nor easy to understand. For, note, that the word 'organism' here really stands for all the myriads of organisms which have been and are in the world, from the lowest to the highest, with all their complex differing structures, with their variant methods of metabolism and reproduction, with their different kinds and degrees of response to stimulation, and most significant of all, with their orderly arrangement into classes up and down the vast organic scale. By hypothesis, this whole intricate world of orderly variety has been developed from some sort of primitive simplicity by a hit-and-miss oscillation due to the inevitable instability of adjustment between organic process and environmental condition. On the other hand, the word environment stands, not for something unitary and simple, but for another complex, inconceivably vast and intricate, of innumerable substances, simple and compound forces, and methods of operation, known and unknown. This hypothesis, therefore, while it may be true is certainly not simple. In fact, when the bare outlines of the statement are filled out, it shows itself at once to be just a new formulation of the problem.

Again, it seems that the explanation really begs the question—for it assumes the organism with its ability to react to outward stimulus, the environment with its ability to provide the appropriate stimulus, the adjustment between the two which conditions the entire process. To be sure this adjustment is not uniform in any two cases, but it is regular, and, by hypothesis, it ought to be mechanically exact. It is, observationally, exact enough to produce a world of order.

But waiving that point for the time, the question here is, how did this original adjustment, involving action and reaction on the part of organism and environment come into existence? Until we get some sort of an answer to this question, we are still without an explanation of descent. Professor Kellogg's objection to orthogenesis on the ground that it is teleological may be put aside for the time. His objection, that Nägeli's type of orthogenesis involves an overemphasis upon the autonomy of the organism and severs the latter too much from the environment, is valid. For example, he is correct when he says that "no orthogenetic line of descent can persist in a direction not adaptive" (p. 375). In the same connection he says further: "Modification and development may have been proved to occur along determinate lines without the aid of natural selection. I believe they have. But such development cannot have an aim; it cannot be assumed to be directed toward advance; there is no independent progress upward, i.e., toward higher specialization. At least, there is no scientific proof of such capacity in organisms. Natural selection remains the one causo-mechanical explanation of the large and general progress toward fitness; the movement toward specialization; that is, descent as we know it" (p. 376).

This last is a tremendously pregnant paragraph and demands the closest scrutiny. There is a determinate process of development antecedent to the operation of natural selection which makes possible the work of natural selection, but it cannot be credited to the organism alone. That is, the organism cannot be conceived of as driving ahead under its own power, like a motorboat, indifferent to wind and tide in the environment. There can be no unaided inward thrust toward specialization which disregards fitness. Therefore, natural selection, which eliminates the unfit, no matter how specialized, must be admitted as a controlling factor in the building up of the ultimate fitness which is arrived at.

Beyond this, however, it seems to have no place or function. It is related solely to fitness. It has only an incidental and negative relationship to specialization, in fact none at all except to see to it that unfit specializations do not survive. It has nothing to do with producing specialization. Therefore, any explanation of development which is based upon natural selection alone, or even mainly, inevitably leaves specialization in the lurch. It falls outside of the explanation. But, to do this is to betray evolution in the largest sense. If evolution does not mean general progress along the line of increased specialization, that is, along the line of advance from lower to higher in the organic scale, it means, simply variations on one general level. It tends to become a colorless term for meaningless variations—a shifting to and fro of things that never really go forward—or at most speciation without progress.[1] Beside this objection, gradation in specialization, up and down the gamut of organic fulness is a fact in nature which demands explanation. We have now arrived at a distinct conclusion. It is a mistake to mix together, as Professor Kellogg appears to do in the paragraph we are studying, the process toward fitness or adaptation and the process toward broadly increased specialization, which is what we mean when we apply the term progress to evolution, as if they were the same or involved the same problem. On the contrary, it seems perfectly clear that they are quite distinct—so much so that the apparatus of explanation which will apply to the one may not even touch the other.

Let us consider, for a moment, the situation. Under the pressure of the struggle for existence, oscillatory variations of the "trial and error" sort may be provisionally accepted as sufficient for incidental variations and for survival purposes. We may also concede that natural selection will keep the oscillations in check and eliminate the forms which are unfit through excess of variation in one direction or another. But how does this hypothesis touch upon the other and higher

1 See next chapter for discussion of this point.

problem—the origin and control of the movement toward increased specialization? In other words this survival scheme does not aid us a particle to find a vehicle for the upward trend of development through the various orders of nature. There is nowhere any satisfactory evidence of a *direct* and creative correlation between fitness or adaptation and increased specialization. There is no reason to suppose that the accomplishment of the one aim, to realize fitness in order to survival will involve the other and more significant end, of an ascent to higher and higher levels. How could any apparatus, the result of which is to give us an adapted world, at the same time guarantee us a graded world of variety such as we actually have?

Professor Kellogg sees that there is a double problem here for the very next words after the paragraph we are now discussing are these: "But what Darwinism does not do is to explain the beginnings of change, the modifications in indifferent characters and indifferent directions" (p. 376). What Darwinism fails to do and has always failed to do, it seems to us, even in the hands of so able an interpreter as Professor Kellogg, is to see the real nature of the problem. For, while Professor Kellogg recognizes the importance of these so-called "indifferent changes" from a natural history point of view—"All this is tremendously important," he says, "for there are, among animals and plants, hosts of existent indifferent characters and many apparently indifferent directions of specialization"—he loses sight of the real importance of these facts from the theoretical standpoint because he really sees nothing but the question of utility. The problem of advance has not been separately visualized. Even with the modified Darwinian survival through adaptation seems to be the only essential matter. These changes mentioned are indifferent—because they are "pre-useful" or "pre-hurtful"—that is, while they often are and must be, many times, related *directly* to specialization, and hence to organic advance, they are not so related to survival. For that reason they constitute not only an unsolved problem but a source of embarrassment to Darwinism. But, just the moment we realize that progress is itself the important thing in nature, that specialization has a value, not merely as related to survival, but in and of itself—then these changes cease to be "indifferent" and become for the purposes of our interpretation what they are in nature, "tremendously important." As I see it, no fact can be more plainly or broadly blazoned on the very forefront of nature than that variety is cherished for its contributory value. Variety appears everywhere redundantly. I have myself noted with intense admiration two plants of the same genus, favorites of mine, standing side by side in the fields, differing so slightly that the casual passer-by would never notice it, the difference having no conceivable relationship to survival (since both survive equally well), but always maintained from seed to flower through countless generations. Either one of these forms would have survived alone, neither has any advantage over the other and there seems to be no competition between them. And there are thousands of such cases throughout organic nature. To hitch variety, which is the condition of advanced *specialization*, to the chariot-wheels of utility, making it merely a sort of by-product of nature's insurance of survival, seems very nearly to invert the scale of natural values.

And this conclusion, which we shall expand in the next chapter, is a partial answer to the question which I raised many pages back: "If natural selection is deposed from its premier place among the factors of evolution, can the theory itself remain unchanged? That the changes which lead to graduated specialization throughout the natural orders cannot be hinged upon natural selection is a certainty. That it cannot be explained on the basis of a general theory which is grounded chiefly on the idea of survival, which is really the conditioning idea in the background of the whole Darwinian conception, is also certain. The theory seems utterly inadequate to the rich variety of nature. Professor Kellogg quotes a long passage from DeVries, in which the latter recognizes with great clearness the two major problems of evolution. "Darwin discovered the great principle which *rules* (italics mine) the evolution of organisms. It is the principle of natural selection. It is the sifting out of all organisms of minor worth (this phrase must be interpreted as referring to all organisms below the death line) through the struggle for life. It is only a sieve, and not a force of nature, no direct cause of improvement, as many of Darwin's adversaries, and unfortunately many of his followers also, have so often asserted. It is only a sieve, which decides which is to live, and what is to die. But evolutionary lines are of great length, and the evolution of a flower or of an insectivorous plant is a way with many side paths. It is the sieve that keeps evolution on the main line, killing all or nearly all that try to go in other directions. By this means natural selection is the one directing cause of the broad lines of evolution. Of course, with the single steps of evolution it has nothing to do. Only after the step has been taken, the sieve acts, eliminating the unfit. The problem, as to how the individual steps are brought about, is quite another side of the question" (p. 239).

The question of survival is undoubtedly of immense importance at any given level of natural development; but survival, as the result of a happy passage through the sieve of natural selection, does not account for nature's previous ascent to that level nor does it provide anything more than the raw materials for a fresh ascent in the future. Nor, seemingly, will "trial and error" oscillatory variations account for these ascents any more than the side-to-side or up-and-down vibrations of an automobile will explain its climbing the last hill or bearing around to the right at the next turn.

CHAPTER III

DESCENT AND PROGRESS

The outcome of the last chapter was the discovery that survival through successful adaptation and that aspect of organic variety which involves the process of advance through increased complexity and specialization of structure, are two distinct though related problems not solvable by the same apparatus of interpretation. That is to say, that while heterogeneous (or miscellaneous) variability, in response to environmental changes under the negative control of a natural selection which eliminates the unadapted, might very well account for a *distributive* or *horizontal* variety such as we have, for example, in the varieties composing a compact species, or the species composing a well-defined genus, or even in related genera, would utterly fail to give a reasonable account of the whole trend and sweep of organic development from lower to higher forms which the theory of organic evolution imperatively demands. Professor Conklin makes a threefold division in place of our twofold analysis. He says ("The Rate of Evolution," 1920, p. 594): "The results of evolution as contrasted with its causes may be considered from three different aspects, which may be characterized as diversity, adaptation, and progress. The first concerns increasing diversification as shown in the appearance of varieties, species, and genera, which are no more complex in organization than the forms from which they have descended and which may be less complex; such changes, which do not lead to more highly organized forms, may be known as variation, speciation, or diversification. A second aspect of evolution deals with increasing adaptation to conditions of life;

this may or may not be associated with progressive organization or with speciation, and may be called progress in adaptation. A third aspect, and most important as measured by its results, concerns the advance in organization from the simplest to the most complex organisms; this may be called progressive evolution, or more briefly, progress. No doubt progressive organization, by which is meant increasing differentiation and integration, has come about through diversification or speciation, but on the other hand, the latter has only rarely led to the former."

This threefold analysis may be considered more accurate than the twofold distinction at which we arrived independently in the preceding chapter; but it will be noted that the idea of progress is introduced into the second aspect of evolution, which is defined as "progressive adaptation." We have assumed that speciation was the outcome of adaptation, which, whether "progressive" or not in the strict sense, is on the move; but concluded at the same time that progress in the sense of increasing specialization is not necessarily involved in it. This, entirely without intent to do so, agrees fairly well with Professor Conklin's statement that progressive adaptation may or may not be associated with progressive organization. It might be said that if adaptation itself becomes progressive, it might naturally be expected to carry progressive organization with it. Under these circumstances we should wish to inquire: When and how does adaptation become progressive? The key-sentence in this admirable analysis is the last one, which amounts to this. Progressive evolution, in the sense of increasingly complex organization, is the outcome of speciation or diversification. We should not have higher forms without first having diversified forms. Progress is the outcome of variation, but not always, nor often, *"only rarely."* That is to say, while organic progress is through descent, it is not a necessary or even usual result of descent. It is a rare and exceptional thing. Now, before we discuss the causes of this exceptional phenomenon, namely, progressive evolution through descent, let us turn again to Professor Kellogg's scheme.

According to Professor Kellogg and those who agree with him, the key to organic variety *in all its phases* is Descent. He states his case in the following sentences: "Descent is the explanation of the origin of species accepted in the science of biology." Connected with that definitive statement is this: "Descent is looked on by biologists to be as proved a part of their science as gravitation is in the science of physics, or chemical affinity in that of chemistry" (p. 3). Of organic variety in general he says: "Now all these millions of kinds of animals and plants (living and extinct species) can have had an origin in some one of three ways: they have come into existence spontaneously, they have been specially created by some supernatural power, or they have descended one from the other in many branching series by gradual transformation. There is absolutely no scientific evidence for either of the first two ways; there is much scientific evidence for the last way. There is left for the scientific man then solely the last, that is, the method of descent" (pp. 10, 11). The general trend of the argument may be gathered from the following: "The homologies or structural correspondence in gross and detail, which the study of animal and plant comparative anatomy reveals to exist in varying degrees among living and extinct kinds of organisms, have but one possible scientific explanation, an explanation which serves at once to account for the existence of this correspondence and its varying degrees. This explanation is community of ancestry, the blood relationship of organisms, the theory of descent" (p. 17). He says further: "The descent hypothesis explains completely all the phenomena of homology, of paleontological succession, of ontogeny, and of geographical distribution, that is, it explains all the observed facts touching the appearance in time and place on this earth, of organisms, and the fact of their likeness and unlikeness to each other, and this no other theory

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does" (p. 19). That is to say, in simplest possible terms, all organisms now existent on the earth, and all organisms of the past of which we know anything, from lowest to highest, from simplest to most complex, from "ameba to man" if you choose, are sufficiently alike to indicate a common ancestry, more or less direct, more or less remote.

It is evident that before we can discuss Professor Kellogg's scheme intelligently we must purge his statement of all possible ambiguity or obscurity, so that we may know exactly the issues involved in the discussion. To that end, we must call attention to one possible source of misunderstanding in Professor Kellogg's most important statement (pp. 10, 11). He enforces the conclusion that the theory of descent is the *only scientific explanation* of organic variety by contrasting it with two other possible theories, namely, (1) that these varieties have originated "spontaneously," or (2) that they have been "specially created by some supernatural power." There is, he concludes, no scientific evidence for either (1) or (2), which fact logically shuts up the scientific man to the acceptance of the theory of descent.

Before we can decide to accept or to reject this argument, we must be clearly informed as to the exact organisms to which the argument is applied. And when we do this it becomes clear at once that the three possibilities which are presented as rivals do not at all compete on equal terms. The theory of supernatural creation, for example, *per se*, without any consideration of secondary or derivative processes, should not be applied except to the first or original form of life. It is not claimed, for example, that any contemporary organisms were specially created. The only question concerns the number and character of the forms *first* introduced by the Creator. Darwin's original idea of a few simple forms into which the Creator breathed the breath of life, is quite compatible with all that the Creation-idea really demands. The notion of *abiogenesis*, or the spontaneous origin of living from non-living matter, is also, in modern times, applied only to the first and *ex hypothesi* simplest forms which appeared. Most scientists who hold to this idea (and Professor Kellogg does not seem to have all the faculty with him on this point) seem to be of the opinion that this genetic transition from non-living to living matter must have been made, but only under exceptional circumstances, and perhaps but *once* in the history of the globe. "It seems unphilosophical to look for an origin of life at any other period than the precise phase of planetary development under which it first arose" (Simpson: "Man and the Attainment of Immortality," p. 18). In itself, the idea of abiogenesis should not be repugnant to the theistic mind, in spite of the fact that it has often been a moot point in debate between theists and non-theists. The derivation of life from the non-living *as a fact* would not at all settle the question as to the origin of nature or of matter with all its marvelous potentialities, including that of initiating life; nor has it any real bearing upon the origin of species.

On the other hand, the introduction of life by creation, would appear to a human observer, on the phenomenal side, indistinguishable from spontaneous origination. The scientific, as contrasted with the speculative argument for abiogenesis, would, so far, exactly correspond to a scientific argument for creation. But, this is not the point:—which is, that the theory of descent is no real competitor of these two just discussed theories of origins. The doctrine of descent applies not to original forms, however introduced, but to derivative forms. It applies only to descendants. In using the term "descent," Professor Kellogg need not say that it is not an explanation of "the origin of life," but only of "the origin of the kinds of life"—the very word used determines this. Therefore, if we identify evolution with descent, as Professor Kellogg does, with whatever ancillary apparatus of variation and selection one may join with it, we have no theory of origins. The source of organic variety in the first organic forms, which became parents though they were not offspring, lies beyond the reach of our explanation. All variety which has been achieved through descent is ultimately derived from an organic variability which descent did not produce.

In addition, it seems to be true that a certain amount of variety attaches to all organisms known back to the dawn of life. As a matter of fact there seems to be quite as *much* variety, quantitively speaking, then as now. Variety of one sort and another, belongs to all known periods of organic history as it belongs to all known grades of contemporary life. Hence, it seems an inevitable conclusion that organic variety is due *in part* to an aboriginal variety belonging to the first living forms. At any rate, the obliteration of all primitive differentiation among primordial living forms is entirely unjustifiable. Here again we are forbidden to set up a universalized scheme of descent as an explanatory theory.

Our ignorance of the earliest living forms really cuts two ways. If the most rigid creationist is asked: "How many different kinds of plants and animals did the Creator originate outright?"—he is unable to answer. If he does attempt to answer by stating that there were as many as now, and of the same kinds, he makes a statement for which he has no adequate ground of any sort. Not only so, but he states what is contrary to all the physical evidence we have. So far the evolutionist is on secure ground, and there can be no intelligent debate. On the other hand, when the evolutionist is asked what and of what sorts the *original* ancestors of past and present forms were, he too is inclined to be very reticent. He has much information on the past, some of it running a long way back,—he thus has a basis for inference. But as to the first forms, he has no real knowledge. We do not even know whether the first forms were animal or vegetable, or neither the one nor the other. (See Minchin: "Enc. Brit.," 11th ed., p. 488.) Hence, we do not have the materials for an historical solution of the problem of variety.

Such a solution must be found somewhere in a balance between the original constitution of the first living beings and the modifying influences within and without through which their descendants have been changed into the forms which we know. How far such changes have taken place, we can be *sure* only as we are able to trace out, on an empirical basis, relationships between past and present living beings. This is the slowly advancing task of inductive science, which cannot be hastened overmuch by speculative theory.

And this last suggestion leads us to the consideration of this question: How far is the theory outlined by Professor Kellogg justified by known facts? And at this point Professor Kellogg himself introduces some rather striking evidence. He not only admits, but strongly emphasizes, what he terms the "curiously, nearly completely subjective character of the evidence for both descent and natural selection" (p. 19). Instead of being based upon objective evidence, positive, observed or experimentally proved instances, the fact is "that no indubitable cases of species-forming or transforming—that is, of descent—have been observed, and that no recognized case of natural selection really selecting has been observed." After citing instances apparently negating this statement, he affirms still more forcibly: "Such a list, even if it could be extended to a score or to a hundred of cases, is ludicrous as objective proof of that descent and selection under whose domination the forming of millions of species is supposed to have occurred." Taking these sentences superficially, the anti-evolutionist would be tempted to quote Professor Kellogg as having logically surrendered his theory. Such a judgment would be hasty and ill-advised. Scientific candor in the statement or understatement of actual concrete evidence for a given interpretation must not be confused with scientific tenacity in holding that interpretation in lieu of something better. Dr. James Orr (*apropos* of a remark by Professor J. A. Thomson) has said: "If one took scientific writers strictly on their word, one would have to admit that, up to the present, evolution had not been proved at all. But, this is overmodest. The proof for some form of evolution, within limits, is peculiarly cogent."

Eleven years after the date of the book I have been quoting (1912-1923) we find Professor Kellogg saying as follows: "Every year the old proofs of evolution are reconfirmed and new ones found. Evolution is proved by all the evidences of comparative anatomy, embryology, paleontology, and geographical distribution, evidences which increase in amount every year. The evidence from any one of these fields of science alone is sufficient to prove evolution; from them all together it is overwhelming" (*The New Republic,* April 11, 1923).

Nevertheless, what Professor Kellogg said in 1912 is still true and still significant. For what is at issue is not evolution *as a fact,* but the descent theory, and not descent merely, but descent as an explanation of organic variety in the entire scope of that term. That evolution (in Professor Kellogg's sense) has occurred on a wide scale—that many far-separated lines of living forms have a convergent genealogy, which in the far background of organic history, merge and become united, we cannot possibly doubt. But, that all organic lines can be brought to a common center and made to merge in a single line of descent, or a group of lines in which ultimately organic variety is lost, is a question in regard to which Professor Kellogg's caveat as to the quantity and quality of evidence is both true and pertinent. Moreover, by the conclusions previously reached, we cannot admit that the problem of organic advance or progress can be tacitly tied up in the same bundle with the problem of organic variety. For the question here is, can descent explain ascent? Now, Professor Kellogg says in the same connection: "The argument for descent is of satisfying but purely logical character." This logical argument, as we have seen, is drawn partly from the comparison of theories noted above in which descent is held to be the only possible *scientific* explanation of variety.

The limitation of this argument we have already seen. It leaves out of account any variety which may have belonged to the primordial forms of life. Historically, variety emerges from variety and thus harks back ultimately to the hypothetical beginning, however relatively simple we may imagine it to be. Be it noted here, that the question which really interests us is, on the one hand, to get a grasp of the scientific value of beginnings, together with an adequate scientific explanation of progress. And these two things hang together. When Professor Kellogg says that the theory of descent is an explanation of the origin of the different kinds of life and not of the origin of life, how far does that which he assumes, namely, life, which means living beings plus an environment, plus some relationship between them, etc., enter into and condition his explanation. We cannot really assume life and explain it at the same time. Moreover, since the destiny of any living being and of all living beings descended from that living being, depends somewhat upon its original constitution, the whole scheme of evolutionary explanation must rest back upon an *unexplained origination.* And this need not necessarily be at the point where living forms emerge, for there is a preparation for the organic in the inorganic which also presents a problem of origination upon which all explanations must rest. If evolutionary theory is willing to admit that it is compelled to assume organic nature, which it cannot explain, then we are prepared to accept any formulation of the process between the unknown beginning and now, which seems reasonable and directly or inferentially justifiable. And this point we can see, at least as a possibility, that no scientific explanation of variety can reach back to the beginning, in which case some other suggestion is in order.

Professor Kellogg's argument, on the positive side, must also be considered. He develops his logical statement (given in outline) thus:

1. The *observed* fact of overproduction.
2. The *logical* conclusion of a struggle for existence.
3. The *observed* fact of miscellaneous variation.
4. The *logical* conclusion that those individuals most fortunate in their variations will win in the struggle.
5. The *observed* fact of heredity.
6. The *logical* conclusion that winners will transmit their favorable variations to their posterity.
7. The *logical* conclusion that these interactions "will be repeated over and over again, with the result of slow but constant modification of organic types, that is, formation of new species."

There are some jumps in the logic here and some conclusions drawn from observed facts which might easily be disputed, and in fact have been, and still are, disputed,—but let that pass. We may accept Professor Kellogg's conclusion that new species have been formed in this way, without accepting the theory which is erected upon it. The argument becomes inadequate and unsatisfactory only when the attempt is made to include the whole of organic variety within the range of any such process. It involves a dangerously extended analogy, particularly when we attempt to bring within its scope the major fact of organic progress. It involves a gigantic assumption both of fact and of interpretation. Otto says ("Naturalism and Religion," p. 91): "Of course the assumption necessary to his (Darwin's) idea is that the forms of life are capable of variation and of continually offering in ceaseless flux new properties and characters to the sieve of selection, and of being raised thereby from the simple to the complex, from the lower to the higher."

It will be seen at once that the first two Darwinian assumptions stated by Otto may be entirely true without at all carrying with them the truth of the third. It will also be seen that even if every one of Professor Kellogg's logical conclusions should inevitably follow from his observed facts, the fact of organic progress would not necessarily be included in the explanation. For this would be to carry the argument for *species-forming* clear across the boundary lines of species, genera, orders, and families without limit from one end of the organic scale to the other. This is not the place to deny that such an ascent has taken place, nor do I see any particular reason for such denial,—but, the point is that a formula for what Professor Conklin calls "speciation" or "diversification" must not be extended to take in "organic progression" without objective evidence. It is not merely that there is not enough evidence, but that it is not of the right sort. Besides, there are positive difficulties involved in any attempt to interpret progress in terms of ordinary variation and the known operation of heredity as set forth in Professor Kellogg's scheme.

In the first place, organic change in the way of speciation has not been universal. Professor Morgan (*op. cit.*, p. 2) says: "The biologist, in picturing evolution, thinks of series of animals that have lived in the past, whose bones and shells are preserved in the rocks. He thinks of these animals as having in the past given birth through an unbroken succession of individuals to the living inhabitants of the earth to-day. He thinks that the old, simpler types of the past have in part changed over into the more complex forms of to-day."

The first consideration, and a very important one, here is that Professor Morgan has used the qualifying phrase *in part*. The paleontological records, on the face of them, seem to demand this qualification. Transformation has been by no means universal. Some forms have remained *unchanged* throughout the whole of organic history, so far as we are aware. We are, therefore, a double problem,—why some forms have remained unchanged in a relatively static adapta-

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tion to environment, while others have shown themselves plastic and responsive to modifying influences either from within or without. This fact of permanent adaptations, at various levels, which is so widespread throughout organic nature, is the more remarkable when we recall that these fixed or arrested forms frequently occupy the same environment and presumably have been subject to the same stimuli as those which have advanced. This is significant in more ways than one. It indicates a certain limitation upon the operation of the environment, which should throw light upon the process of evolution itself.

Environmental influence which is so partial in its results, though supposedly quite indiscriminate in its action, which allows, so to say, so much of autonomy to the individual organism, can hardly be said to be rigidly mechanistic. It is in some sense elastic, allowing for the play of individuality. There seems to be a selection here for *variation*, which precedes the selection which tests for adaptation or eliminates for unfitness. If the whole environment operates upon the whole organism, how is the selection accomplished which causes the organism to vary from its relatives who share the same general constitution and are subject to the same stimuli? Or does the environment focus upon the organism certain selected and specific stimuli which elicit the variation, or does the organism select certain specific stimuli to which it responds with variation? In either case there is a little too much discrimination to fit easily into the mechanistic formula. It will be said, I presume, that the whole environment changes,—some of the organisms respond with variations, and those whose variations are favorable, survive, but that does not tell us why some vary and others do not, or why some vary favorably and others do not, since all share the same general constitution. There is another aspect of this matter. At least a modicum of organic variety is left outside the modifying process as we know it. Some of the "older, simpler forms" do not change over. They stay as they were, adapted, successful, and primitive. Do they necessarily trace back to the same ancestry as those forms which have shown themselves plastic? Plastic and adaptable are evidently not the same. Why should not organic life have said at the first level of adaptation which it gained? Professor Conklin's answer to this question is interesting and suggestive. He rejects the old teleological idea that the protozoa stayed such in order "to occupy a place in nature which would otherwise be unoccupied," and says: "The true explanation is more probably that they are incapable of further progressive evolution; they have branched off from the main stem of progress and cannot now return. The case is like that of the differentiation of cells in development; the only cells which remain capable of indefinite development are the germ-cells; muscle cells and nerve cells cannot again become germ cells, and in a similar way the only cells which remain capable of progressive evolution are certain kinds of germ cells in certain groups of organisms. Certain species, like certain cells, have become so highly differentiated in particular lines that they cannot progress much beyond the limits already reached; they are too highly specialized to give origin to new lines of progress" ("Rate of Evolution," 1920, p. 597).

The fundamental idea here is that progressive evolution is made possible by the favorable conjunction of many concurrent circumstances which could have occurred very rarely. Professor Conklin points out (*ibid.*, p. 595) that the difference between lower and higher forms is not in the completeness of adaptation, but in the complexity and perfection of it in the higher forms. This increasing complexity and perfection of adaptation "from lower to higher" is a part of the problem of progress (p. 596), which problem cannot be solved as if adaptation alone were involved. Now, we are told (*ibid.*, p. 596) that thousands of species appear which do not involve increased complexity of organization nor lead to progress. Almost all mutations thus far studied involve (*per contra*) "simplification of germ-plasm if not of adult structure." Some represent phases in species-making, while few if any involve any progress. Progressive evolution has apparently halted almost everywhere, "usually neither mutations nor real Linnæan species lead anywhere except to mere diversity. There are probably more than a million known species of animals and plants both living and extinct, and yet there have been relatively few lines of progress" (*ibid.,* p. 596). How have these lines of progress —which, though few focus in themselves, so far as we are concerned, the vital issues in this discussion—how have these lines of progress been initiated and carried forward? In the first place, the possibility either of diversification or of progress "depends upon the nature of the germ-plasm,"—no external or bodily changes which do not involve the organization or structure of the germ-plasm have any evolutionary value. That rules out of the progressive series every change which does not enter into and affect the germ-plasm. Again, "increasing complexity in evolutionary series must have depended upon rare and fortunate mutations which were not only viable but contained the possibilities of much further evolution and which were peculiarly suited to a favorable place in nature" (*ibid*).

There are four important items in this sentence. First, progress is conditioned upon rare and "fortunate" mutations. What are mutations? Let Professor Conklin tell us. He says ("The Evolution of Man," "Yale Lectures," 1922, p. 154): "Inherited variations are caused by changes in the germ-plasm itself. These changes may be of two kinds, (1) those which are due to new combinations or recombinations of old inheritance factors or what is known as 'Mendelism,' and (2) those which are caused by sudden alterations in the individual factors or genes, such transformations being known as 'mutations.'" The word "fortunate" in the statement we are now studying (note, "Rate of Evolution," p. 596) must be taken to include two things,—first, these mutations are fortunate in being favorable to survival so that the mutants can survive, and fortunate also in that the mutation is in the direction of increased complexity. This fact, that these mutations must be upward, involving higher complexity, accounts in a measure for their rarity, along with the fact that the change itself must take place in the germ-plasm. We shall return to this point later. Second, these mutations must also be "viable," that is, capable of transmission and inheritance and so made permanent. A gain which is acquired through sudden organic change must be maintained through the operation of a relatively stable mechanism of transmission. This is a very important consideration. The principle of heredity must be flexible enough to allow for mutations but rigid enough to hold in its grip for permanent transmission through an established reproductive habit changes which involve the structure of the transmissive apparatus itself.

Third, these mutations "must have contained the possibilities of much further evolution,"—that is, of giving rise to other mutations still more complex and advanced. The process, therefore, is cumulative; advance is made through a series of mutations, each one of which is "rare," "fortunate," "viable," and increasingly "complex," while the whole series inaugurates and carries forward an unbroken, creative ascent.

Fourth, these mutations must have been "peculiarly suited to a favorable place in nature" in order to account for their extensive diffusion as well as for their success in the struggle for existence. In addition to these four points, another should be added, drawn from the first statement of Professor Conklin's which we quoted in this connection. That is, his explanation of the failure of contemporary protozoa or their ancestors, to evolve. According to this statement, there is a *line* of progress from which our protozoa have branched off through specialization in some particular direction. That is, progress is possible only to organisms which have not exhausted their evolutionary possibilities by specializing in some particular direction. Professor Conklin uses the illustration or analogy of the germ cells. So long as a germ cell remains a germ cell with its development fund unexpended, it can, by going through the appropriate divisions and changes, develop into any kind of body cell, but having once developed into a muscle or nerve cell it cannot reverse the process and become a germ cell again. There is, then, according to this statement, "a tide" in the affairs of organisms as of men, a plastic period of funded possibilities in development, or of plastic individuals in a group of organisms, for which alone progress is possible. "The only cells which remain capable of progressive evolution are certain kinds of germ cells in certain groups of organisms." As to the rest, they have expended their fund of possibilities by becoming "too highly specialized to give origin to new lines of progress." In other words, in order to inaugurate new lines of progress we must have potential and relatively unspecialized forms. Collateral lines of types differentiated in "particular lines" do not give rise to "new lines of progress." Perhaps a concrete illustration may serve to make Professor Conklin's point clearer.

Professor Minchin, in speaking of the *Flagellata* which combine the three modes of nutrition exemplified respectively by plants, animals, and fungi, says: "Such instances show clearly that in the simplest forms of life the difference between plant and animal is but a difference of habit and of mode of nutrition, to which the organism is not at first irrevocably committed, and which are not at first accompanied by distinctive morphological characteristics. Only when the organism becomes specialized for one or the other mode of life exclusively, does it acquire such definite morphological characters that the difference between plant and animal can be used for the purpose of a natural classification, as in the higher forms of life ("Enc. Brit.," 11th ed., Art. Protozoa). Speaking loosely, we may say that the new line of progress involving the distinction between animal and vegetable could be inaugurated, according to Professor Conklin's idea, by an organism not yet specialized for either mode of nutrition. When once the pathway of adaptive specialization in some particular direction is really entered upon, there is no turning back. This principle applies generally to the problem of progress. Therefore, since "progressive evolution invariably and inevitably means increasing differentiation and integration" (Conklin: "Has Progressive Evolution Come to An End?" 1919) it follows that progress is along a line of *general, balanced,* differentiation which avoids any *cul-de-sac* of excessive or one-sided specialization where progress must end.

Another point is to be noted here. While we do not know very much about the factors involved in the production of mutations, certain conclusions which are both probable and general seem to be within our reach. Professor Conklin says (*ibid.*): "It is highly probably that mutations take place in response to changes in environment, but it is necessary to remember that the environment of the germ-plasm is not merely the outer world but also the inner environment of the body organs and fluids and cells, and the innermost environment of the cytoplasmic and nuclear substance which surrounds the inheritance factors or genes." The significance of this statement will be considered a little later.

Let us now make a specific application of this scheme of progress, after which we can indicate one or two conclusions.

The greatest single step in the history of living forms must have been the transition from unicellular to multicellular structure. Professor Conklin says: "Millions of years ago, unicellular organisms reached the utmost limits of a single cell." The only pathway of progress lay in the direction of multicellularity. Professor Patten (*op. cit.,* p. 205) says: "One of the great innovations in the methods of animal life was the union, or the cohesion, of the offspring of parent cells to form social aggregates, or multicellular organisms. This simple innovation opened up a new world of possibilities, produced a larger unit of life, and gave rise to a new order of animal life on a much higher level of organization than before." How was this *simple* innovation accomplished? Professor Patten tells us *what* happened but not *how*. "The very act of union took away something from the old freedom of the cell, restricted its power of individual action, and conferred upon it new powers and a new freedom common to all. The groups of cells thus formed had common interests, common dangers, and a common external environment. A new stability was acquired through action and reaction in unison; new powers were gained through subdivision of labor, and by greater economy in the performance of vital processes." All of which is very true and very wonderful. Now, be it noted, this great transition was brought about in *descent-linked* organisms. By a twofold process of surrender and acquisition, an organism consisting of many federated cells was derived by birth from an organism consisting of a single autonomous cell. Were it not for the fact that we have this derivative process illustrated by the development of each metazoan from a single germ-cell, the theory would be really incredible. And yet there is evidently a vast difference between the derivation of a multicellular form from its own racial germ-cell and the derivation of a multicellular order from unicellular parents. Professor Conklin has gone quite deeply into the matter of this great change, and his interpretation of the process is full of interest. What follows is partly quotation and partly summary.

Multicellular forms did not arise by the coming together of separate cells, as is sometimes assumed (see below, Chap. VI), but rather by the failure of cells to divide completely (the word "failure" here does not of course mean lack of accomplishment or failure in any negative or pathological sense, but just "did not"); when the original cell divided, the products no longer moved apart as separate and complete individuals, but remained attached to one another, and instead of restoring all missing parts, as each cell did when it became a separate and complete individual, the initial differences between cell products were preserved and increased at successive divisions. In this way entire cells became new units of differentiation, and at the same time, all the cells remained bound together into a unit of a higher order. Now, be it noted, first, that we have here an exact and accurate description of the difference in the respective methods of unicellular and multicellular reproduction so far as the process and results of cell division are concerned. Professor Conklin goes on to describe this difference thus (his order slightly changed): "When a complex protozoan divides, the two daughter cells revert to a simpler type of organization than that of the parent, and then, from that stage these simplified cells start to differentiate all over again and advance to a complexity like that of the parent, so that "successive generations of protozoans make little or no advance in organization." They are limited by the one-cell type of structure. When the cell formation of a metazoan developing from the egg is arrested, differentiations never go beyond a stage comparable with those of the unicellular organisms, and *if the different cells* (produced by division) *fail to stick together, they generally lose many of their differentiations and revert to the simpler organization of the egg* (italics mine). That is, development in the metazoan *thus arrested* keeps to the habit of the protozoan. But, "when the cells of a multicellular animal or plant divide (under normal conditions) the daughter cells do not go back to the simpler state of the egg, but preserve the differentiations which they have already attained (in the initial cell divisions) and continue to augment these during the further process of development." The question at once arises here, how is this increasing differentiation of the cell in development made possible? Professor Conklin promptly explains: "In multicellular organisms this increasing differentiation of the cells is made possible by the close union and interdependence of the cells, whereas in the unicellular forms, the very independence of the cells prevents increasing differentiation. That is to say, what is quite evident is that a single cell can increase in size and in complexity only *so much*. Its development is limited by what Professor Patten calls its "architectural plan" which involves definite structural limitations.

Now, according to Professor Conklin, how has this barrier been passed? The multicellular organism has a different reproductive habit. In its development it holds on to the differentiations gained in the initial stages of cell-division, and augments them (that is, the cells in successive divisions become more unlike) as it goes on, thus passing the barrier of unicellularity and attaining a multiple cell life. This is clear enough but there is a difficulty when we come to use it as an explanation. On the face of it, this new reproductive habit, or method of ontogeny, seems to be controlled by its own results. It is itself a secondary matter, hinged upon an inseparable condition found in its consequents. This increasing differentiation of the cells which result from cell-division, issues in "a failure completely to divide," or a federated relationship of the cells; while on the other hand, this increasing differentiation is made possible by "the close union and interdependence of the cells." This indicates not a mere logical contradiction, but the important fact that something has been left out of the analysis. Is there an intracellular as well as a cellular structure in the metazoan? This is an important question, for a multicellular organism is something more than a mere aggregate of cells. These cells are *federated,* mutually related, acting and reacting in close union and interdependence. There must be, or at any rate seemingly should be, something in the *structure* which corresponds to this union of cells. It is difficult to see how particles of highly organized and specifically constituted matter can be held together by a relationship. But it is a fact that intracellular structure has never been fully established. This mysterious and unlighted hinterland of intercellularity is the stronghold of the vitalistic theory. In reply to the question: what arrests the process of cell-division at the critical point in the development of the metazoan?—the answer from the mechanistic side now is, "Probably hormones, but *nobody knows.*" And the very supposition raises the question: where do hormones come from?

But we may now return to our particular theme—the relationship of this great transition to the theory of descent. If the theory of mutations is correct, then this whole fundamental change from one type to the other was brought about by a sudden alteration in the germ-plasm of some protozoan, manifested first in the mode of cell-division in ontogeny, and subsequently in the fundamental architecture of the resulting body. It must be remembered that a transition like this through descent must be from a definite protozoan to an equally definite *allied* metazoan. In addition, we must not forget that the process of internal, constructive differentiation in the metazoa runs along determinate lines fixed (1) by the architecture of the metazoa in general and of the germ-plasm in particular, (2) by the architecture of the genus, species, variety, etc., of the individual and its germ-plasm. Now, the pathway of this change may, in a measure, be indicated. When we place a complex protozoan like certain of the Infusoria alongside a simple metazoan like Volvox, we find that the internal differentiations of the former are in line with the external differentiations of the latter. So far there is no solution of continuity, and the evolutionary process is easy to understand. But, we are reminded at the same time that between the antecedent protozoan and the consequent metazoan there intervenes a revolutionary difference in the mode of cell-division which must be traced back into the parental germ-plasm. Of the factors which brought about this change, or of the nature and details of the process which inaugurated it, or of the method by which it was incorporated into the constitution of the parent cell, we have by common consent no knowledge whatever. So far as observed facts are concerned, this change remains an inscrutable mystery. But since all the subsequent "lifts" in the evolutionary process turn upon this initial transition, the transition from unicellular to multicellular structure is in the most literal sense a "crisis"—every higher aspect of organic history turns upon it as upon a hinge. Without a factorial explanation of this first and mightiest change, the greatest single achievement of living matter since its appearance, evolution itself remains a mystery throughout. Can a process ever become self-explanatory which originates in a wholly unaccountable way?

And this question arises not only in regard to the origin of life (which we might agree to leave out of consideration) and in connection with the change from unicellularity to multicellularity, but at every crucial point in the whole process. Professor Conklin says ("Yale Lectures," p. 154): "We now know that fluctuations have no evolutionary value; Mendelian combinations probably play a secondary part in supplying the materials of evolution, though this part is not negligible; mutations, on the other hand, are the fundamental and initial steps in evolution."

It is not necessary to review at length these fundamental and initial steps in evolution as they are outlined for us by scientists. It is only necessary to note that the characteristics which we have noted in connection with the origin of the metazoa, reappear and confront us at every turn. There is the same periodicity and advance, the same ripeness of occasion, the same gradual approach to the border-line of change, the same continuity in constituent elements, the same narrow gateway of escape, the same fundamental and radical change of organic method, the same suddenness of transition, the same overflowing redundancy in results, the same mysteriousness as to the participating causal factors. The final point to be insisted upon, as forming a basis for future discussion, is that progress through descent is a thing apart from the ordinary procedure which has produced species and varieties. If we insist that the organic series is descent-linked, we must make room for the fact that at certain points, and those the points which are crucial, descent has been the vehicle for vital and structural changes, unexampled both in quantity and quality, upon the causes of which our studies in the mechanism of hereditary transmission have cast no revealing light.

CHAPTER IV

MECHANISM AND PROGRESS

In the two preceding chapters, we arrived at a distinction which seems to be a genuine clue to some, at least, of the mazes through which we are anxious to find our way. This clue is the distinction between adaptation and progress. These present themselves as two separate problems, requiring a very different apparatus of understanding and interpretation. In the second chapter we arrived at the distinction. In the third chapter we applied it to the theory of descent. In the present chapter we shall consider the relationship of the idea of progress to the mechanistic theory. Professor Keller in his contribution to the "Yale Lectures" of 1921-22 (*op. cit.*, pp. 126 f.) has made several suggestive general remarks about evolution which we wish to consider. He says: "The essence of evolution is the development of form out of form, in a connected series, with a survival of the fitter forms in adjustment to environment. The outcome of evolution is adjustment to life conditions."

"It is one of the common misconceptions about evolution, and one into which Adams fell [he refers to the famous *Education* which has no pertinence here] that it means progress. It means adjustment only." He then goes on to say what is perfectly true and vitally important also as we shall see, that the very idea of progress, in any large sense, is relative to the judgment of the observer who is viewing the direction in which things are moving. It is a human value judgment. Such judgments are bound to vary greatly, particularly when we come to the affairs and institutions of mankind. All this difference of opinion will be avoided, says Professor Keller, "in the case of evolution, if we consent to view the process as it is, and do not in our straining after the assessment of things as progressive or retrogressive, hug to ourselves the misconception that evolution and progress are synonymous. If we simply ask, concerning any organic or social form, whether it is an adjustment, past, present, or pending, we shall all find ourselves in a substantial agreement that will permit of our going along farther together." Undoubtedly, if evolution is defined in this manner, we shall all agree upon it, as the diplomats say "in principle," if for no other reason than that the term is so completely emptied of meaning that no one cares about what is thought or said concerning it. Whatever is, is evolution. Just start out with the assumption that evolution is adjustment, and that survival is due to adjustment, with the resulting inevitable conclusion that whatever lives is *prima facie* adjusted, and what have we done? We have destroyed controversy by evacuating the controverted question of all real meaning. I cannot see how any evolutionist can accept this as a true account of the matter, at least of the whole matter, for this reason: evolutionary theory has started out with the intention of explaining organic variety on a *scientific basis,* and particularly of the development of the higher forms of living beings, including man, by descent from lower forms. This much then of progress the idea the evolution must inevitably contain if it is to keep in touch with its own history and not be metamorphosed into something totally different.

One thing about the theory which has to be watched continually is its hospitality to contradictory notions and its rather omnivorous tendency to take into its capacious maw that which changes it almost beyond recognition. This is a case in point. It is perfectly true that the theory must include more than progress; but in reducing itself simply to adjustment and making progress merely an accidental and occasional by-product when things are going our way, it rules itself out of the family of significant interpretations.

We must not allow ourselves to forget that it was framed in contradistinction from the idea of special creation, to account for that extensive variety which *includes* the gradation of organic forms from lower to higher as an acquired characteristic of the cosmos, not stamped into its original constitution by creative fiat. And, since the grades of organic beings represent at present stable and classifiable distinctions, they must have arisen in some orderly manner by a process which represents some controlling agency in the cosmic scheme. If, again, this orderly scheme has been the outcome of evolution, or if evolution is in any great measure to be credited with such an achievement it is surely distinctive enough to be called at the very least "evolution *par excellence.*"

At any rate, this is the element in evolutionary teaching most strongly urged, and the only element of sufficient importance to be controverted or even discussed except by specialists. Professor Vines in his great article on the morphology of plants ("Enc. Brit.," 11th ed., *sub voc.*) says: "Evolution means the gradual development of 'highly organized' from 'lowly organized' forms, that is, of forms in which the 'physiological division of labor' is more complete, from those in which it is less complete; of forms possessing a variety of organs from forms possessing but few." Just before making this statement he says: "A survey of the vegetable kingdom indicates that evolution has proceeded, on the whole, from the simple to the complex; at the same time, as has been already mentioned, evidences of reduction or degeneration are common. Thus in the series Bryophyta, Pteridophyta, Phanerogamia, while the sporophyte presents progressive development, the gametophyte presents continuous reduction" (Vol. 21, p. 775 b.).

It is evident, not only here, but elsewhere, that in tracing out a phyletic or racial connection it is not uniformly safe to put the simpler form first and infer progress. But, we must insist that if the theory is to hold its place and make good its original contention as to the derivative origin of organic variety, the direction *at the outset* must have been not "on the whole" but "wholly" in the direction of increased complexity. That is how we arrived at complexity, and complexity of organization, we may say in passing, is one criterion of progress about which there need be no difference of opinion. In the last chapter, we learned from Professor Conklin that progress has been unusual, indeed exceptional and creative, but, it is inevitable by every implication of the theory, that this is how the life process began—for it certainly did not begin with the complex as we know it *now,* and this [progress] has been the distinctive and creative element throughout. It is only in this form that the theory of evolution has grasp and penetration enough to deal with the life problem. Let us look first at the old theory which evolution is supposed to have superseded.

According to this scheme, rigidly interpreted, living forms originated, or made their appearance, about as they are now. The difference between any given organism to-day and its remotest ancestor is negligible. Bodily constitution, at any rate beyond the comparatively narrow range of varietal modification, is persistent and practically unchangeable. The consequences of this type of thought are obvious. On the terms of this theory, the significance of organic history, except as a mere record of transmitted uniformities, is expunged and merged, completely and at once, in the question of origins. This makes a transcendental doctrine of creation immediately inevitable. Hence the idea is easily manageable from the theological side and has been, and still is, very tenaciously held.

On the other hand, this account of organic variety evidently empties paleontology of all explanatory value. The beginning and the end of the historic life process are brought together. The history of living beings since the dawn of life is, *ætiologically,* a blank page. The content of organic variety, during the entire life-period, is pushed back into its beginnings, and a single transcendental explanation is made to cover it all. It should be evident to any thoughtful mind that this theory of organic fixity, in the extreme and rigid form in which it has just been stated, is untenable. It is not merely non-scientific, or even unscientific, but explicitly anti-scientific. No such position as this can be justified by an appeal to the facts. Moreover, it is theologically fatal, for it reduces the doctrine of creation to the phantom-like proportion of a purely formal notion without historical content and without contact with the actual world of living beings. Happily this disadvantageous position does not belong to theology by virtue of any true logical implication of its own principles. It is the consequence of a mistaken idea that one can deduce a specific nature-doctrine from a theological premise. This is always an error. As J. Arthur Thomson has truly said: "It is quite certain that there is no manner of use in pitting a scientific formula against a transcendental one; that always means a false antithesis and intellectual fog. They are incommensurables" ("Darwin and Human Life," p. 20).

It is no part of the doctrine of creation, reasonably interpreted, that the first ancestors of present-day living forms should be like their successors in any such sense as this theory demands. All that theology can possibly ask is that ancestors should be capable of producing descendants, and that the process of descent should be so interpreted as to harmonize with the law-and-order world with which we are acquainted. Science is, of course, pledged to give us such an account of variation, heredity and descent.

At the opposite theoretical extreme from the theory which we have just considered, that of "immutable species" is the original Darwinian scheme of what might be termed unlimited and miscellaneous variability. Organisms tend to vary in response to impulses from within and stimulation from without. These variations in every direction are checked by the primary necessity of adaptation. Natural selection eliminates the unfit, by which is meant the unadapted. The result of this process in the aggregate is organic variety in all its forms. The essential difference between the older theory and the new is quite evident at a glance. In the theory of immutable species, practically the entire responsibility for organic variety is thrown back upon the original constitution of organisms. They were different to begin with, and have simply remained different throughout organic history. Darwin's theory allows a *minimum* of variety to organic beginnings, which are conceived of as "simple" to the very limit of the admissibility of such a term as applied to living beings.

Now, while we freely admit that the idea of immutable species is untenable in the form in which it has sometimes been held, there are several considerations which make us hesitate to accept the Darwinian position. In thus holding somewhat aloof from the Darwinian position, on this specific point, we must be careful not to do it injustice. When a Darwinian postulates unlimited variability and speaks of "fortuitous" or "accidental" variations, he does intend to exclude teleology from consideration; that is, he is looking at the process as physical *result* rather than *purpose;* but he does not intend to enthrone "caprice" or "chance" in the place of teleology. These two are not antinomies. Accidental variations are not uncaused, but events, the causes of which are so many or so complex that we cannot reach them. Every variation in the entire history of living beings has been caused, and is to be interpreted under the heading of *order.* We are all agreed on this point. Our questions arise in connection with our interpretation of the term "cause," which we take leave to postpone for a few pages.

Meanwhile, note this point. The very fact that science has hit upon the term "accidental" (which to the popular mind connotes the very opposite of fixed causality) to describe an event conceived of as rigidly controlled by its antecedents, seems to indicate that we have come to the core of a great mystery—as indeed we have. We are dissatisfied with the Darwinian interpretation for several reasons, the first and most pertinent one being that its view of the origin of variety includes not only general variability of the hit-and-miss kind, but specifically, variability in the direction of increased complexity of structure as an inherent power of the organism, the existence of which can be taken for granted. It is evident that this assumption cannot be allowed to pass as if it were unimportant. On the contrary, it is really the core of the whole question of organic evolution. We have seen previously how, under the handling of Professor Conklin, the way of organic progress has been narrowed down. It is restricted to "fortunate" mutations, possible only under favorable circumstances during a limited plastic period in the life of organisms. In other words, progress must be classified under the heading of "exceptional" in our catalogue of cosmic events. These progressive mutations are exceptional in two senses. In the first place, they are only a selection from the whole number of variations which are known to occur. Two out of the three classes into which variations are divided by scientists are altogether excluded from consideration. In the second place, the power to "complexify" is exceptional *in kind.*

It is quite different from the ability to vary in other ways. It means that certain organisms have the power to add something which, by hypothesis, they did not previously possess, namely, complexity of external structure. Variation, in the ordinary sense, means a structural change in one direction or another, specialization by increase or by diminution in some one particular or limited combination of particulars. It involves a change in size, or color, or proportion of organs, which is brought about by the modification of characters already possessed. Increased complexity, however, involves a total reconstruction—a coördinated movement of advance "all along the line," which involves among other things the fundamental organific principle of development. We are not denying that such a change may take place. We are merely insisting, as heretofore, that such a power cannot be taken for granted as an ordinary matter requiring no further explanation. And the difficulty lies in the very conception of the simple becoming complex as a response to stimulus, as a superinduced modification. For evidently this modification must not be considered as a gift from the outside. On evolutionary principles it must come by way of response from within. It must then be latent in the organism, contained in some sense within its simplicity. A simple organism must have the power to respond to the environment by becoming complex. That means that it is already inwardly and potentially complex. The response—*any* response which an organism is able to make to external stimulus—according to scientific teaching must rest upon an inward structural basis in the organism. If then, a simple organism is able to respond to stimulation by becoming complex, this response too, like every other response, must rest upon a structural basis within the organism responding, which, in this case, can be nothing else than inward differentiations or complexities of structure. That is to say, inward complexities must condition outward complexities. In other words, for that which is *really* simple to become complex is inconceivable.

Lest this reasoning may be attributed to the perverse subtleties of a metaphysician, let us permit a scientist to discuss this question for us. Professor Vines, in the article referred to above, has this to say about the evolution of plants: "Evolution in the race involves progressive differentiation in the individual; hence the causes of evolution and of differentiation must be the same. The evolution of a higher from a lower plant, it is generally assumed, has proceeded by variation." He then quotes a famous paragraph from Darwin to the effect that, of the two factors in variation, the "nature of the organism" and the "nature of the conditions," the former is more important. Professor Vines goes on: "In spite of the statement that the 'nature of the organism' is the most important factor in variation, the tendency amongst evolutionists has been to take much more account of the influence of external conditions. Exceptions to this attitude are Lamarck, who speaks with regard to animals (but not to plants!) of *'la composition croissante de l'organisation'* (*Philosophie Zoologique,* t.i.) and Nägeli, who attributes variation to causes inherent in the 'idioplasm,' and has elaborately worked out the view in his *Abstammungslehre.*" Professor Vines takes his position with Lamarck and Nägeli and gives his reason for it thus: "All but the lowest plants visibly tend towards or actually achieve in various degrees the differentiation of the body, whether sporophyte or gametophyte, into stem, leaf, root, etc., that is, the differentiation of parts not previously present. It is inconceivable that external conditions can impart to an organism the capacity for something that it does not already possess; can impart to it, that is, the capacity for variation in the direction of higher complexity. The alternative which is here accepted is that differentiation is essentially the expression of a developmental tendency inherent in the protoplasm of plants. Professor Vines goes on to qualify his statement by saying that it does not exclude the influence of the environment—a part of the discussion which does not concern us here.

The essence of the situation is that we are thrown back upon the capacity of the organisms which are classified as simple to develop in the direction of complexity, which in turn is referred back to a "developmental tendency inherent in the protoplasm." Of course, the principle involved here applies to animals as well as to plants, and also to the ancestors which plants and animals are supposed to have in common. The point to which we have now come is this: In the evolutionary scheme which confronts the old creationism with its fixed species, we have not thrown off the burden of origins a particle. According to the creation idea, variety, including the range from lower to higher, is *explicit* from the beginning onwards. Progress is not involved in organic history except as steps or phases of the original creative activity. According to the evolutionary idea, variety is implicit in the earliest and simplest forms which respond to the action of the environment with increasing complexity. According to Professor Vines, the capacity to complexify, which is an extension of the capacity inwardly to differentiate, is an inherent and original power of protoplasm comparable with the inherent tendency of inorganic substances to crystallize in a given way. It would seem also that there must be a structural basis for this capacity, however one may describe its latency, which means specificity and internal organization.

All this leaves the problem of origins just where it was. We are rid of the notion of a static world of life with unchanging species, but we are faced with what is at least as wonderful—with an original protoplasm which has the capacity to differentiate itself externally into the manifold forms of varying complexity which make up the world of life. Is one of these theories, so far as the actual facts are concerned, more "creationist" than the other? We may assume protoplasm, and refer it back to the original properties of atoms or their constituents, which is merely a postponement of the inevitable issue—which is that we must *assume* life with its capacity to advance, or assume matter with its power to advance to life with its subsequent history, and stop there, or come forward with some sort of a philosophy of origins. Up to this point, as we have seen, evolutionary theory is no rival to the doctrine of creation. It takes for granted what a doctrine of creation attempts to interpret, and its assumed protoplasm is quite as mysterious and wonderful as the world of variety which has issued from it. Moreover it is extremely doubtful whether we can assume any such thing as "protoplasm" at all. As an indication of what is really involved in the assumption of protoplasm as the material basis of a theory of evolution, read carefully the following statement on the nature of protoplasm

(Minchin: "Enc. Br.," 11th ed., art. Protoplasm, end; see whole article):

"The question may be raised how far it is probable that there is one universal living substance which could conceivably be isolated or prepared in a pure state, and which would then exhibit the phenomena characteristic of vital activity. It is sufficiently obvious in the first place, that protoplasm, as we know it, exhibits infinite diversity of character, and that no two samples of protoplasm are absolutely similar in all respects. Chemical differences must be assumed to exist, not only between the vital fabrics of allied species of organisms, but even between those of individuals of the same species. Kassowitz regards this variability as compatible with the assumption of a gigantic protoplasmic molecule in which endless variations arise by changes in the combinations of a vast number of atoms and atom complexes. It is difficult to conceive, however, of any single substance, however complex in its chemical constitution, which could perform all the functions of life. To postulate a universal living substance is to proceed along a path which leads inevitably to the assumption of biophores, plastidules, or other similar units, since the ultimate living particles must then be imagined as endowed at the outset with many, if not all, of the fundamental properties and characteristic actions of living bodies. Such a conception has as its logical result a vitalistic standpoint, which may or may not embody the correct mental attitude with regard to the study of life, but which at any rate tends to check any further advance towards an explanation or analysis of elementary vital phenomena. We may rather, with Kölliker, Verworn, and others, ascribe the activities of protoplasm to the mutual interaction of many substances, no single one of which can be considered as living in itself, but only in so far as it forms an indispensable constituent of a living body. From this point of view, life is to be regarded not as the property of a single definite substance, but as the expression of the ever-changing relations existing between the many substances which make up the complex and variable congeries known to us as protoplasm."

This summary is particularly pertinent to our present inquiry because it deals with the relationship of manifoldness and unity. There are a half dozen significant statements in this paragraph, all of which we should do well to ponder. But the essential point is that organic variety stoutly resists derivative or phyletic unification except along the line of vitalism. Protoplasm is not a simple or uniform basis variously made up, but as infinitely diverse in its constitution as the forms of life based upon it. There is no way to trace back our present diverse protoplasms to a common source or antecedent except on the analogy of the germ-plasm. In this case, the original antecedent or parent protoplasm must have contained, in some sense which involves structural organization, the whole subsequent development. To conceive of such an original structure as "simple" in any known sense is impossible. The alternative to this is that the ancestors of living forms were, while conceivably quite different, as diverse as their descendants. This supposition leaves evolution quite intact as far as the fact of change and real history are concerned, but does away with it as an explanation of variety—which result follows from the unexplained assumption of protoplasm in the first place.

But there is another consideration which we must take up at this point. According to what amounts to practical unanimity among contemporary scientists, living bodies are not directly affected by the environment in a way which has any bearing on the problem of evolution. This attitude is summed up in the statement: "Acquired characteristics are not transmitted." All influences from the environment which have evolutionary value must first affect the germ-plasm before they can appear in veritable bodily changes. As I write this chapter, the reviews of Paul Kammerer's book ("The Inheritance of Acquired Characteristics") are beginning to appear. In this book, which has been characterized as "Reaction Against Reaction in Biology" (see N. Y. *Times,* Dec. 21, 1924), is a definite challenge to this accepted denial of what Darwin himself undoubtedly believed—a challenge backed by observation and argument. Into this discussion, which so far is strictly "an internecine war among scientists," we shall not enter.

In this connection it is merely necessary to remark that whether Kammerer is right or his critics, makes little difference to the discussion we are now conducting. As usual, the truth probably lies somewhere midway of the two extremes, but it is not for us to hold the scales between them. According to the dominant opinion, every organism to-day, however somatically different from its ancestors near or remote, is one with them in that it partakes of the same germinal constitution. This seems to be true whether Kammerer is right or wrong. Any organism is different from its ancestors by virtue of partaking in a different degree of the germinal material which is the common possession of the entire genetic line. At the outset, then, this germinal material, in potentia, contains all its derivatives. Difference as well as likeness comes somehow within the operation of an original, and, in the transmissive sense, permanent creative complex. While, therefore, evolution presents us with the idea of a world-process which moves forward unceasingly under the control of a mysterious, propulsive, and expansive energy locked up within it, from level to level of increasing complexity and significance, the instrument of that movement through all its phases, so far as life is concerned, is a marvelously complex and intricate structure called the "germ-plasm." This germ-plasm, biologically speaking, is the creative center of our universe. Whatever may be said of the inauguration of this life movement, the carrying of it forward, so far as we are able to see, is conditioned upon the existence and successful operation of this structure which is so wonderful in itself and in its far-reaching and delicate correlation with the vast intricacy of its external environment, that we scarcely know how to express its meaning in words.

We should suppose, from all that is said about it by those who know best, that it is no exaggeration to say that the *germ-plasm* literally makes our universe *bio-centric,* and packs into its microscopic and infra-microscopic fineness of structure the urgency and mystery of our familiar cosmogenic questions in such fashion as to make its origin, nature, and function the central question of philosophic biology. The fact is, the germ-cell involves the whole system of nature, animate and inanimate, with its universal suggestiveness, in all that appears, of more than appears, concentrated upon a microscopic miracle of creative power. J. Arthur Thomson says: "It must be remembered that the germ-cell is not an ordinary cell, but a condensed implicit individuality, rich in the gains of the past, rich in the possibilities for the future,—a psycho-physical being telescoped down" ("System of Animate Nature," I., p. 326). The same author in another place says of the germ-plasm: "Its essence is creative power." If all this is true, the germ-plasm seems to possess many of the characteristics of a metaphysical absolute! Professor Conklin has said ("Heredity and Environment," p. 194): "Germ-cells, and probably all other kinds of cells, are almost incredibly complex. We know that former students of the cell greatly underestimated this complexity, and there is no reason to suppose that we have fully comprehended it. What Darwin said of the entire organism may now be said of every cell: 'An organic being is a microcosm—a little universe, formed by a host of self-propagating organisms inconceivably minute and numerous as the stars of heaven.' "

Professor Morgan has tentatively estimated that there are 7,500 different kinds of genes or heredity factors in the germ-plasm of Drosophila Ampelophila (the Pomace or fruit-fly), while the gross number of genes is twice as great, since the chromosomes which carry them are double. This will give us a concrete illustration of the almost incredible complexity of the germ-plasm.

The germ-plasm is of course a product of protoplasm. The germ-cells which carry the germ-plasm are a result of the division of labor among the cells of the living body. The germ-cells are set apart for the purpose of reproduction and are looked upon as having an unbroken continuity in the genetic succession.

Now, let us take note of the point to which we have come. In the background of organic history, as its necessary basis and pre-condition, is protoplasm, or as we have come to see, protoplasms, infinitely complex and infinitely diverse, a coördinated and definitely coöperating system of practically innumerable and unanalyzable constituent elements. This material, in its typical entirety, is necessary for every living being, however minute or humble. While no two protoplasms are exactly alike, in the proportion of elements which make them up, they are alike in the matter of complexity. The function of reproduction, throughout this world of living beings, so constituted, which function involves the transmission of parental qualities, including the ability to vary, to complexify, to advance in the scale of being, is carried on by means of this microscopic and infra-microscopic molecular aggregation called the germ-plasm. What we are eager to inquire is how these related substances which maintain and transmit life are related to their own past, especially as regards origin. Another question which is equally pertinent is this: since all that we can possibly call "progress" is conditioned first upon protoplasm, and second upon the reproductive function which belongs peculiarly to germ-plasm, how are we to interpret or define "progress"? The problem is that, since all that occurs throughout organic history is derivative from that which is its necessary prius, how can we apply the term "progress" to the process at all?

These are searching questions and not to be answered offhand. We will take the second one first, as it is really preliminary to the deeper question which precedes it. We at once find that there are, or have been, striking differences of opinion on this matter among scientists. Dr. C. B. Davenport has said: "As the egg develops into the complex individual with multitudes of differentiated cells, so primitive protoplasm has developed into all present and past organisms." Professor Conklin comments on this statement thus: "This does not mean that everything which appears in the course of ontogeny or phylogeny was actually or factorially present in the egg or in the primitive germ-plasm. Development is not merely a 'sorting-out' process, it is also a creative one. Everything which comes out of an egg or out of primitive germ-plasm, was potentially in it or it could never have come out of it; but such an explanation of ontogeny or of phylogeny does not explain anything. In a similar manner it might be affirmed that the entire world, living and non-living, was potential in the material from which the world was made, without leaving us any the wiser." This is a very meaningful utterance and opens up several important lines of inquiry. First, however, let us get the whole case before us. Dr. Davenport says again: "The foundation of the organic world was laid when a tremendously complex molecule, capable of being split up into a vast number of simpler vital molecules, was evolved."

Professor Conklin couples this statement with Professor Bateson's idea that "evolution consists merely in the unpacking of an original complex so that it is a process of devolution or simplification." This view Professor Conklin characterizes rather severely as "bizarre" and says of it: "Such an extreme position is not unlike the 'palingenesis' of Bonnet and might be called 'natural creation' rather than evolution, for as Caullery says: 'There is no considerable difference between such views and creationism.'" That is to say, to interpret either development in the individual or evolution in the broader sense as merely the unfolding of an original complex contained in the germ-cell or in the primordial germ-plasm, is practically equivalent to "creationism." It should be understood that the objection of scientists to this idea of creationism is not in the majority of cases due to anti-religious bias, nor has it any connection with religion one way or the other. Evolution emphasizes *process,* and any theory which minimizes the historical process, throws its results back into primordial conditions and interprets it as a mere unrolling of the originally "given," is objected to as interjecting metaphysical ideas into a physical inquiry. Any type of preformationism is so considered. Science recognizes that ultimately it must hand over its unsolved problems to philosophy and religious inquiry, but up to that point it insists upon conducting investigation in its own way. As Professor Kellogg ("Evolution," 1924, p. 4) says: "Evolution can only be a more or less immediate or detailed explanation of how, granted life, granted matter, granted energy, granted any existence of anything at all, and granted an ultimate cause or causes, the form and behavior of living things can be and are as they are." With that out of the way, let us turn to our subject here.

The theory suggested by Davenport and Bateson seems to be the same in principle as that originated by Roux and developed by Weismann—the so-called "idioplasm" theory. According to this theory, ontogeny is a gradual process of disintegration in the very complex germ-plasm by which its original constituents split up and are distributed to the growing individual organism until finally one kind of determinant (factorial unit) from the hereditary material of the germ-plasm remains in each cell of the new body, to give that cell its specific character.

Of this theory Professor Wilson ("The Cell," p. 406) says: "Development is, therefore, essentially *evolutionary* and not epigenetic; its point of departure is a substance in which all of the adult characters are represented by preformed, prearranged germs; its course is the result of a predetermined harmony in the succession of the qualitative divisions by which the hereditary substance is progressively disintegrated." Professor Wilson says further (p. 407): "Its fundamental weakness is its quasi-metaphysical character, which, indeed, almost places it outside the sphere of legitimate scientific hypothesis." Here again we are in the neighborhood of the "quasi-metaphysical," that is to say, creationism is looming up once more. The key to this criticism lies in the use of the word "evolutionary" as antithetic to the word "epigenetic." It is used in Bonnet's sense of "preformational." In this sense a process cannot be at once "evolutionary" and "epigenetic." It cannot be the simple unfolding of a predelineated organization and at the same time epigenetic or creative in the sense of making increment in process—which is the meaning of evolution in the modern sense of the term. And this is the core of the difference between "creationism" and "evolutionism."

In creationism, the responsibility for all subsequent history is thrown back upon the original constitution of that whose history is written. The creationism which we criticized earlier in this chapter holds that the earliest forms were like their latest descendants, like producing like from generation to generation on and on. The idea of Bateson is also akin to *creationism* in that it falls back upon the constitution of the original germ-plasm as the explanation of all that occurs subsequently through division and distribution. But how is Professor Conklin, on a purely scientific basis, going to work out an evolutionary process of derivation without falling back on an original complex from which all subsequent forms are derived by a sorting-out process? What is he going to give us in place of the "bizarre" theory of Davenport and Bateson, which seems to involve a negation of the idea of progress? In a word, Professor Conklin holds that new forms may come through synthesis as well as through analysis, from new combinations as well as from a sorting-out process. Most non-scientific thinkers seem to feel that new combinations of old factors are simply the same things in a new form. This is evidently not correct inasmuch as the new combinations produce new qualities. For example, H and O in one combination produce H_2O with qualities obviously different from either H or O. In another combination, H and O produce H_2O_2 (which is hydrogen peroxide), having quite different qualities from water. There are many isomeres (combinations of atoms) in the molecule in $C_6H_{12}O_6$ (which is sugar) and each isomere has its own peculiar qualities. This is what the scientists call "creative synthesis." And, comprehensively, since there are, so far as we know, ultimately less than a hundred (92 to be exact) elements, it is certain that the whole natural system, including the world of living beings, in so far as they are material systems, have been built up of these constituent elements. And since these elements are complex, it seems also clear that the differences between "things" as we know them have been brought about by synthesis. So far, at any rate, we can follow, and indeed must follow, Professor Conklin. If it is true, and we have every reason to believe that it is true, that there are no constitutive physical elements in the universe other than these, then the conclusion that the inner differentiations of the universe have come about through synthesis or through successive syntheses, is inevitable. Moreover, according to the current theory of matter, our so-called elements are themselves synthetic and reducible to combinations of various kinds, the difference between elements which behave very differently being due simply to the arrangement of electrons which are electrical in nature and identical with each other. Whether this process of analytical simplification can be carried any further or not remains to be seen.

What an impressive view of the world this gives us! I who am thinking here and now, the hand that holds the pen, the pen with which I write, the paper upon which the writing is done, the table upon which the paper lies, the floor upon which the table stands, the building of which the floor is a part, the earth upon which the building rests, the solar system of which the earth is a member, the stellar universe to which the solar system belongs,—are all constructively related to this same fundamental association of congeries of ultimately identical systems. Then why not cut all knots, solve all problems, answer all questions at once, without further ado, by interpreting the universe and all it contains as a mechanical combination of systems of ascending syntheses based finally upon the atom, which is "composed of a massive positively charged nucleus of minute dimensions, surrounded at a distance by a compensating distribution of negative electricity in the form of negative electrons"? We may meet this summary question with an answer equally summary. This final and central synthesis (to name it in terms of the process) issues in something which has every appearance of being different in kind from everything that precedes, accompanies, or conditions it; namely, a creative and unifying self-consciousness which takes up into itself and ideally resumes all that has contributed to its own appearance in the universe, even to the ultimate constituents of that universe. This difference between the self and the not-self, even the most intimate and contiguous portions of that not-self, is a fact, however it is to be explained. As Bergson says ("Mind Energy," p. 38): "The I is something which appears, rightly or wrongly, to overflow every part of the body which is joined to it, passing beyond it in space as well as in time."

It may be that we shall be compelled by reasoning to identify the man with pen and paper, desk and floor, as only a higher or more complex atomic constellation; but it will take cogent reasoning to enforce and maintain such a position. It is no obvious conclusion. No one has shown more clearly than Lord Balfour the essential difficulty, to put it bluntly—the evident absurdity of this position. He says ("Theism and Thought," p. 192): "According to materialism, neurons blindly make mind, while mind, thus unintelligently created, may, and sometimes does, investigate neurons.

Surely a very singular example of the division of labor!" Extend this to electrons and make the man a physicist investigating electrons, and the incongruity is not appreciably mitigated. To this issue we shall return later, but meanwhile, we are way ahead of our story. We are engaged in considering the relationship of organisms to the germ-plasm from which they develop, and specifically Professor Conklin's theory of that relationship. How does he develop his idea of synthetic production of new forms, which we have outlined above? At the outset he presents a different conception from that of Professor Bateson and others as to *the relationship between antecedent and consequent in the derivative process.* Instead of being "actually" or "factorially" present, that which emerges from the germ-cell or germ-plasm is to be considered "potentially" present in the combination of that from which it is derived. This substitution of the term "potentially" for "actually" or "factorially" involves a question which is at once fundamental and crucial. What is the difference between the two expressions?

In order to deal with this question with adequate thoroughness, it is necessary to look at Professor Conklin's general interpretative scheme of evolution. In his lectures on the Mechanism of Evolution,[1] the distinguished Princeton biologist defines the aim of evolution thus: "The general theory of organic evolution undertakes to explain by natural processes the origin of the existing world of living things, and in particular it seeks to account for three classes of phenomena, namely, (1) the diversities (varieties, species, genera, etc.) of the living world; (2) progressive organization (increasing complexity of structure and function) from the lowest to the highest organisms; and (3) the fitnesses (adaptations, etc.) of living beings. Its aim is nothing less than a mechanistic explanation of the origin, development, and present state of the entire world of life." Dr. Conklin recognizes that this

[1] "Wm. Ellery Hale Lectures for 1917," reprinted as a pamphlet from the *Scientific Monthly*, Dec., 1919–May, 1920.

is an ambitious program not yet fulfilled. He admits also "the probability that it may never be fully attained." Thus far "the problems of organic evolution are in process of being more clearly defined and some promising beginnings have been made toward their solution"—on this account it is not reasonable to insist that evolution (as a scientific explanation) has failed because it has not gone further, in view of the magnitude of the undertaking, while "to reject evolution as others have done, because the problems are too great to be solved by the scientific method, is to renounce the slow and sure progress of science in favor of pure speculation and mysticism in which no progress at all is possible." (This last remark is, of course, a passing glance at Vitalism.)

This being the general program of evolutionary theory as he interprets it, Dr. Conklin devotes himself to the discussion of "experimental and analytical studies of inheritance and development in their bearings on evolution." The conclusion of the discussion thus planned and carried forward is this: "The mystery of mysteries in evolution is how germ-plasm ever became so complex as it is, so well adapted to give rise to viable organisms, so filled with the marvelous potencies of development. The greatest problem which confronts us is no longer the mechanism of evolution, but the evolution of this mechanism. The problem has been shifted from the developed organism to the germ-plasm, but it has not been solved."

In the presence of a generalization like this, the danger is that we shall not adequately realize the magnitude of the problem thus left on our hands. To ask: how came the germ-plasm to be so complex and generally marvelous? is like asking: how came the universe to be what it is? The one question really involves the other. Professor Conklin's "greatest problem" which involves the "mystery of mysteries" is an epitome of cosmogony.

From the practical point of view, however, it is a great advantage to have our problems telescoped into one "mystery of mysteries," provided we do not lose sight of the fact that our telescoped problem is complex and likely to be opened up at any moment. It is, moreover, of value to note that this chief problem concerns the origin rather than the operation of the mechanism which controls evolution. It is as if Professor Conklin said: "We now know fairly well what the mechanism is and how it works—the mystery of mysteries now is, how this mechanism came to be." The fact that he uses the term "evolution" to describe this coming to be does not conceal the fact that we are now dealing directly with a question of origin.

Again, it is important to note that in dealing with this condensed key-problem, we are in a position to handle to advantage the significance of the process as a whole, in detachment from minor details. And the first step is to take up the meaning of the terms mechanism and mechanistic. In what sense then are these terms applicable to living beings? It is evident that the meaning which is given to these terms determines our interpretation of all the processes, whether of development or of evolution, to which they are applied. Are we to consider, for example, that all the processes of life are to be explained in mechanical terms, of stress, tension, flexure, and pressure, etc., on the physical level; or of combinations, divisions, attractions and repulsions, on the chemical level, literally and absolutely? Are we to consider that organisms are mechanisms in the same literal sense that other known mechanisms are mechanisms? If so, what can we do with the term "living" as applied to such mechanisms? In what sense can a mechanism be alive? Professor Conklin reminds us that organisms are "living beings" and Professor Jennings that a living organism reacts "not as a substance but as an individual." How then can we speak of living mechanisms without using each of the two words in an utterly unintelligible sense? Professor Conklin introduces a paper on "Mechanism and Vitalism" with these words: "The most fundamental postulate of science is the principle of causality, or the law of cause and effect, according to which (1) all phenomena in the universe are the results of antecedent causes, (2) identical causes invariably produce identical results, and consequently (3) all phenomena are bound together in a determinate or mechanistic way. In contrasting Vitalism and Mechanism, it should be understood that the term Mechanism is not used in the sense of philosophical materialism nor of 'mechanics' in its narrower physical meaning, but rather to connote the regular and invariable sequence of cause and effect" (ms.). In this connection he affirms that the task of science is to classify, not to render ultimate explanations of phenomena.

Later in the same paper Professor Conklin says: "The distinctive characteristics of living things are generally said to be: (1) protoplasmic and cellular organization, (2) metabolism, (3) reproduction, (4) sensitivity, (5) adaptability. Are these properties explicable in terms of physics and chemistry? Does the law of cause and effect apply here as elsewhere in Nature? Theoretical mechanism would answer each of these questions in the affirmative, vitalism in the negative."

In view of all that Professor Conklin says here, we are to understand that he is dealing with the phenomena of life which the theoretical mechanist would "explain" in "terms of physics and chemistry": (1) within the limits prescribed for science in general, which deals only with proximate causes, and (2) within the limits of his definition of "mechanism" which is not used in the sense of "philosophical materialism" or in the narrow sense of mechanics in the purely physical sense. It is therefore permitted the philosopher or theologian to bring the mechanistic scheme under whatever theory of ultimate causality he may choose to adopt. For example, we are permitted, so far as Professor Conklin is concerned, to introduce behind or underneath this whole determinate or mechanistic system of regular sequences, the ultimate causal agency of God, because, within the limits prescribed, "scientific evolution in itself alone does not undertake to settle the question as to whether matter was created or is eternal, nor whether the uniform laws of nature are original and ultimate forces or are themselves the modes according to which some intelligent, personal Being accomplishes his purposes in and with and through Nature" (Tillett: "The Paths That Lead to God," p. 155). If then, these limits are respected, then, the discussion of the mechanistic theory, which according to Professor Conklin's statement does not exclude teleology, becomes a purely scientific matter. The only question which is pertinent to theology is whether or not Professor Conklin's proviso can be accepted. There are some, both among scientists and among theologians, who deny that this determination can be allowed to stand, who insist that a mechanist cannot be strictly such without making mechanism and causality co-existent and co-extensive. Undoubtedly this term needs to be carefully watched, for it has an evident tendency to claim the center of the stage and to push into the background both personality and teleology, even when both are admitted. As an indication of this tendency, note the following sentence from Professor Conklin. After admitting the sharp line of demarkation between the living and the non-living as at present understood, he says: "Nevertheless, many vital phenomena are caused by well-known chemical and physical processes, and this has led to the view that sooner or later all vital phenomena will be explicable in terms of chemistry and physics. Specifically, this is what is meant by the 'mechanistic view of life'" (ms., p. 2). Here again the statement is to be interpreted within the hereinbefore established boundaries to all scientific inquiry. The above sentence is quoted simply to illustrate a tendency which will bear watching, for no one can possibly be unaware of the fact that what starts out to be a purely scientific and modal description has often developed unhallowed ambitions and tried to become a philosophy with disastrous consequences.

At this point, it is only necessary to remark that if the question as to whether the mechanistic theory can remain descriptive is raised at all, the discussion of it cannot be confined to science in the strict sense, for the issue thus joined involves the meaning of causality and the reality and nature of the external world—a subject which is essentially philosophical. In the discussion thus broadened, physical science must submit its premises as well as its conclusions to the criticism of reflective thought. In this eventuality the identification of mechanism, stated in terms of physics and chemistry, with causality, would involve deeper questions than Science as such could possibly handle.

Another question which theology might be disposed to ask is whether this mechanistic scheme, conceived of as universal physical causality, is to be thought of as consistent with the immanent activity of God, continuously realizing itself in the evolutionary movement, or as excluding it. Here again, the problem of causality, both in its secondary or proximate and in its ultimate sense, would be raised, and in its train, the baffling question as to the real nature of physical reality would inevitably appear. In this case, as before, Science without the countenance and assistance of philosophy would not undertake to frame an answer. Science is content to assume that nature is real and will yield us truth as the fruitage of our processes of investigation. We are satisfied to have it so, provided Science does not override its uncriticized assumption and propose conclusions which imply that it has fathomed and established its postulates. In such a case, Science dons the philosopher's gown, to which it has no right, and teaches bad metaphysics.

At this point it will be wise for us to get behind the word "mechanism" and try to visualize what is meant by it. Professor J. Arthur Thomson flatly asserts that the use of the word "mechanism" as equivalent to "causality" is improper. "The word mechanical is sometimes applied illegitimately to a systematic or connected account which displays a series of events in causal coherence without the intervention of mentality" ("The System of Animate Nature," I, p. 131). He states his reason for this judgment in these words: "Given certain properties of organisms in general, of nerve cells and muscle fibers in particular, we may give a more or less connected and complete account of a reflex action without dragging in any psychical agency. But this should not be called a mechanical description. It is simply what it pretends to be, a physiological or biological description, and it implies various non-mechanical concepts" (*ibid.*). This criticism of the mechanistic scheme is more searching than merely a question of terminology,—it defines for us just the point we wish to discuss. To apply the term to causality in the ultimate sense is impossible. Is it a correct term to apply to the type of causation which we find in the world of life? Professor Conklin offers us the alternative of "mechanism" or "non-causality" in his discussion of "Mechanism" and "Vitalism." Here again the term "causality" must be watched. The Vitalists do not maintain that vital phenomena are uncaused in the absolute sense, but uncaused in the mechanical sense. The essence of the Vitalistic hypothesis is expressed by one who is no friend to mechanism, in the following terms, that in vital phenomena "a mysterious agency is at work, the nature of which is beyond physical and chemical investigation" (Haldane: "Mechanism, Life and Personality," p. 21). Vital phenomena are, therefore, not uncaused. An "agency is at work"—*a cause operates*, but that cause is not within the reach of physical and chemical investigation.

The objections to this theory, from the side of physical science, are quite obvious. It places immediately and causally behind all vital phenomena, which must be in some sense physical in so far as they are phenomena at all, a mysterious, *unidentified* agency which operates physically, but is not physical, which produces chemical reactions but is not itself chemical. At whatever point such a concept intervenes, it puts an end to further scientific investigation. It has all the arresting effect upon science that a premature interposition of the theistic idea has without the latter's compensatory advantages. If, when asked, how did this come about? we answer, God did it, we state what is perfectly true, but irrelevant from the point of view of Science. If we answer to the same question: "Entelechy did it," are we in any better case? Not a bit. Besides, Entelechy has no real meaning. Vitalism looks like a theism not quite aware of itself, and interposed in the wrong place, hindering science and not helping religion, a half-way notion that is of no real or lasting value.

On the other hand, Vitalism describes an aspect of reality which Mechanism altogether fails to convey. It bases itself upon a real thing—the autonomy, the originality and the creativeness of life. As Haldane says: "Somehow or other a living organism never *seems* to be a mechanism, however often it may be called one. The closer the examination, the more confirmed does this impression become, always provided that we are studying living organisms themselves, and not merely their dead bodies, or material which has been removed from their bodies" (*op. cit.*, p. 31). Not only so, but the application of the mechanistic hypothesis, *as an interpretation of what actually occurs,* to specific problems, involves us in such difficulties and contradictions as to make its rejection almost inevitable.

Haldane, after analyzing carefully the physical implications of the mechanistic theory as related to the problem of heredity, thus sums up the result: "The real difficulty for the mechanistic theory is that we are forced, on the one hand, to postulate that the germ-plasm is a mechanism of enormous complexity and definiteness, and, on the other, that this mechanism, in spite of its absolute definiteness and complexity, can divide and combine with other similar mechanisms, and can do so to an absolutely indefinite extent without alteration of its structure. On the one hand we have to postulate absolute definiteness of structure, and on the other absolute indefiniteness." He concludes: "The mechanistic theory of heredity is not merely unproved, it is impossible. It involves such absurdities that no intelligent person who has thoroughly realized its meaning and implications can continue to hold it" (*ibid.*, p. 58).

When it comes to applying the theory to mental facts, such as memory, as worked out by Bergson ("Mind Energy," Lecture II) and vision as worked out by Leighton on the basis of Berkeley ("Field of Philosophy," p. 178) these difficulties pile up in ever-increasing weight and mass. What is the trouble here? There must be some deep-seated reason why, in the history of scientific theory, Mechanism and Vitalism have followed each other in recurrent cycles, each as a reaction from the other. Is it not possible that both Mechanism and Vitalism have gone too far in the assertion of "causality" and have therefore slipped more or less unconsciously into ultra-scientific metaphysics? Is it not clear that both have gone beyond our knowledge and that each by placing an overemphasis, the one upon the known and the other upon the unknown elements in our physical experience, has in the long run bred its antithetic counterpart? If the reader will turn back to the quotation from Minchin's article on Protoplasm (see above, p. 92) and re-read it, he will get a hint of the very thing mentioned here; namely, that the mechanistic analysis of the constituents of living protoplasm leads by reaction ultimately to Vitalism. Lest they be overlooked, his exact words are these: "To postulate a universal living substance (on the assumption of a fixed molecular structure) is to proceed along a path which leads inevitably to the assumption of biophores, plastidules, or other similar units, since the ultimate living particles must then be imagined as endowed at the outset with many, if not all, of the fundamental properties and characteristic actions of living bodies. Such a conception has as its logical outcome a vitalistic standpoint." . . . Thus, the attempt to explain the characteristics and actions of living beings in terms of physics and chemistry ends in a sort of biological atomism which deals with problems piecemeal, and is fitted by the problems and difficulties which it piles up, to bring about a reaction to the opposite standpoint. It is also true that it is very difficult to keep metaphysics out of the scientific affirmation of invariable sequence, and that a very slight admixture of the metaphysics of causality in scientific description logically involves theoretical materialism. Finally, theoretical materialism, or, as Professor Leighton calls it "mechanistic metaphysics," is incompatible with a true evolution. "For," says Professor Leighton (*op. cit.,* p. 290), "a purely mechanical process means only the external interaction of parts juxtaposed in space, a system of interchangeable parts, whereas the evolutionary conception of the world implies an organized and organizing unity of process by which the different phases and stages of the world-history constitute a living whole."

Materialism seems to involve all the vices of "creationism" at its very worst; for everything is involved in the original distribution of material particles. The whole development is pushed back into the ultimate antecedents. Professor Conklin's "creative syntheses" are simply the unfolding of hidden latencies. All that emerges in process is "factorially" present from the beginning, that is, the packed complex idea is pushed back to the ultimate cosmic constituents.

To such a scheme, Professor Conklin is definitely opposed. To him it means nothing, for, "it leaves us none the wiser." According to his interpretation, the heredity factors which enter into the germ-plasm complex do not remain unchanged. His mechanism is one which changes *creatively* with a changing environment, which *produces* as well as *educes,* which brings into being that which is contained, not "factorially" but "potentially" within itself. He, therefore, conceives of the operation of the germ-plasm in a very different way from the other group. The germ-plasm is somehow dynamically related to the environment. It acts upon the environment and reciprocally is acted upon by the environment in a way which changes its innermost constitution. It is not, therefore, exclusively a mechanism which controls its environment and produces results from within according to its unchanging constitution. On the contrary, it is in part controlled by the environment, creatively modified in the process of give and take which is its history. Its complexity, therefore, is not a fixed "constellation" of parts which controls evolution with the rigidity of a predetermined constitution; it is a fluent complexity which is a part of the general evolutionary flow. The same thing is true of the primordial germ-plasm, or whatever is conceived of as inaugurating the life process.

The essential feature of Professor Conklin's system, therefore, is that the first life-forms were unfinished, mobile, plastic, the development of which is determined in part by the working out of history, not absolutely predetermined by their original fixed constitution. This marks the essential difference between the evolutionary idea of beginnings (*not origins*) and any type of creationism, naturalistic, or otherwise. It is quite clear that Professor Conklin's system is antithetic to a rigid and literal mechanism, and is much more akin to the ideas of Brooks who held that "mechanistic" simply means "orderly," than it is to the ideas of Loeb, to whom organisms are, literally and in fact, machines. According to Conklin, the consequents in any vital descent-connected series are contained in their antecedents "potentially" not "factorially"—which would not be possible in a series of machines. Every natural agency in the life process is, and remains, irreducibly complex.

On the other hand, it is equally clear that Professor Conklin's system is not in antagonism to any doctrine of creation which does not involve "creationism," that is to say, which does not insist that the whole life series is predetermined by its first members.

And it may be said, finally, Dr. Conklin's scheme makes progress conceivable as an integral part of the evolutionary process. The "problem of problems," however, is still of course unsolved.

CHAPTER V

MECHANISM AND PROGRESS (*Continued*)

We were discussing, in the preceding chapter, Professor Conklin's theory of the relationship of the organism to the germ-plasm from which it issues. We were not able within the limits of the chapter to finish the analysis nor to draw out all its implications. Professor Conklin challenges us to careful discrimination when he antagonizes the theory of the "packed complex" and declares, in expressing his contrary opinion, that the organism is "potentially," not "actually" or "factorially" present in the germ-cell. We are now compelled to seek an answer to the question already asked: What is meant by the term "potential" as used here? This question is the more important because Professor Conklin makes himself amenable to the challenge of exact definition in making use of such a distinction.

It is of course quite clear that the words "actual" and "potential" convey a real antithesis and cannot mean the same thing. To accept one of them is, so far forth, to reject the other. This point is insisted upon in order to make it clear that we have come upon no mere formal nor verbal distinction. Moreover, the issue is not a secondary or minor one. It involves the significance of the genetic process in its most essential and vital aspects. We must, therefore, seek an explanation of Dr. Conklin's expression which shall bring out clearly its point of application in defining his antagonism to the view which he rejects. We have already done this in part, but some of the ground must be traversed again with more minute attention.

Again the word "potential" must be given a meaning which is stable and generally intelligible. And this brings us to the question, which may be stated thus: In what sort of a system can "potentiality" be conceived of as having a real meaning? A satisfactory answer to this question can be reached only at the cost of a somewhat lengthy and roundabout journey, but it should be found altogether worth while.

The simplest explanation of the difference between Dr. Conklin and his opponents is that according to Dr. Conklin, the action of the germ-plasm is not merely distributive in the unpacking sense, but creative in that it traffics (as Thomson says) with *time* and its *environment,* and produces continually new and higher results along an ascending and expanding pathway of efficiency. This must be true if evolution is to include organic progress.

Let us attempt to illustrate the issue as here defined. A woman goes to a hotel with several trunks filled with clothes. She takes a suite of rooms and with the help of a maid takes her clothes from her trunks and hangs them in various presses. In so doing, she adds nothing to what she originally had. No new dresses appear in the process, which is literally and solely distributive. If evolution is this sort of a process, it is quite clear that organic progress cannot be brought within its scope except as the becoming explicit of that which has been implicit from the beginning. The totality of organic variety which we see at the end of the process was factorially present in the seeming simplicity with which it began. The germ-plasm which appears as a single cell is competent, on the basis of its primary structure, to produce all the results in the way of variation and advance, which follow in its train.

Among others this question at once arises: can this explanation be applied to such a process, say, as that which is involved in the development of the oak from the acorn? No one will contend, of course, that an oak weighing several tons literally *came out of* an acorn weighing a fraction of an ounce. As a matter of fact, the case is much more striking than this because the oak is really derived from the microscopic germ-cell within the acorn. The oak can be actually or factorially present in the acorn only in the sense that in the inner structure of the germ-cell there are *factorial units* corresponding in greater or less detail to the features of the mature oak. But even so, there is something more than distribution here. The germ-cell is something more than a complex which is broken down and taken apart and rebuilt on a larger scale. The germ-cell in the course of its development has dealt with the environment, and from the environment has received elements which have been worked into its own structure. We may say that the acorn is potentially an oak, but not in a bureau drawer nor in a sealed bottle—only in the open where there is free and living correspondence between the germ-cell and the environment. As the case has been otherwise stated, the oak owes *something* to history. According to Professor Conklin's idea, the process is creative in that something appears at the end which was not actually there in the beginning. The implicitness of the acorn and the explicitness of the oak are different in kind. The acorn is something more than a telescoped oak—it is a dynamic agent which assimilates, transforms, and creates.

What is true in the ontogeny of the individual organism is true of evolution as a whole. The primordial germ-plasm is potential of the whole unfolding and advancing process, but as before, only in the open, through assimilation, transformation, and creation. The process then is dynamic and synthetic. But this is not all that must be considered. There is one tremendous difference between development and evolution.

Behind the acorn is the parent oak. The mystery here is how the oak becomes a parent by means of the germ-cell contained in the acorn, which is just another way of asking how the germ-cell is able to reproduce the organism from which it is derived. This is a mystery of mysteries, even when we consider only the succession of like organisms. But in evolution we have at least two additional elements of mystery,—one is the mystery of variation which includes organic advance; the other is the mystery of origin. Taking up the latter, we have to deal with this problem: It is evident that the germ-plasm, inasmuch as it is almost inconceivably complex, must have been the outcome of a synthetic process. It must have *become complex* (Conklin's phrase)—that is, it must have been *put together,* somehow. But the only natural process which precedes the appearance of the *primordial* germ-plasm[1] is inorganic evolution. If, then, germ-plasm is the mechanism of evolution in its organic phase, what is the mechanism of inorganic evolution? Or, to return to Professor Conklin's problem, how is inorganic evolution related to the appearance of the organic mechanism? This question must be answered in full view of the fact that whatever may be true of the organism and its germ-plasm, inorganic evolution is analytic rather than synthetic. Bertrand Russell states the case succinctly thus: "All the most complex atoms known are breaking down into simpler ones by radioactivity, so that one may guess that still more complex atoms could not be stable enough to exist in discoverable quantities" ("ABC of Atoms," p. 7). Professor Soddy gives us a vivid picture of the whole process as it now unfolds before the eye of science. First he shows us that "uranium, uranium X, ionium, radium, and the emanation, represent respectively the starting-point and the four successive stopping stations in the long journey of continuous devolution from the heaviest and most complex atom known into less heavy and complex atoms which is going on around us" ("The Interpretation of Radium," p. 134).

It is interesting to note that the familiar evolutionary formulas are applied to the elements which we find in the contemporary world of inorganic matter. He says: "At first glance only, the material universe gives the impression of a permanent and finished creation. In reality the now familiar

[1] We are not taking up here the question as to the origin of germ-plasm or protoplasm.

remorseless operation of slow continuous change, molds even the 'foundation-stones' (Clerk Maxwell's term for the atoms) themselves. By this last step the doctrine of evolution has become universal, embracing alike the animate and inanimate worlds" (*op. cit.,* p. 163). Even the idea of natural selection is applied to the inorganic elements. "We regard them (the elements) as existing because they have survived. All other forms less stable than those we recognize as elements have been weeded out" (*ibid.*).

But, as we have seen, "evolution" here means "devolution"—literally and absolutely "the unpacking of an original complex." Survival of the fittest is survival of the simplest —the final phase being elements which are simple enough to resist the flow toward disintegration which is universal and inevitable, though the "controlling factors" of it "still remain absolutely unknown" (Soddy, see p. 162).

If organic evolution begins with relative simplicity in the organism or germ-plasm and moves forward and upward to increasing complexity, then, on the face of it, the life-process reverses the general trend observable in the sphere of the inorganic.

From the viewpoint of teleology there is no difficulty whatever here, for, as Wallace and Henderson have shown, this breaking up of the more complex elements is a necessary phase of cosmic procedure, for the end-products only of inorganic change are fitted to support life as we know it. Hence, devolution becomes a phase of progress, coördinate with organic evolution. None the less, there is a real and serious problem here unless we admit a teleological element and are willing to look upon life as, in some sense, a new beginning—"continuous with but not a continuation of the inorganic," to use J. Arthur Thomson's phrase.

But, the facts so far stated form a mere introduction to the problems involved in the life-process. We begin, not with germ-plasm, but with protoplasm of which germ-plasm is but one product through the germ-cells.

According to Wilson ("The Cell," p. 23), "the fundamental activities of protoplasm are everywhere the same. The natural conclusion is that there is a corresponding fundamental morphological organization common to all forms of protoplasm and underlying all of its special modifications;" but, so far there is "no consensus of opinion as to whether such a common organization exists." There are or have been three chief theories as to protoplasmic structure. We need not enter into details here—it is only needful to note that Wilson refuses to choose among the three and holds that each expresses a form-phase exhibited by protoplasm at one time or another in its changes. The present idea (p. 27) is that no universal formula for protoplasmic structure can be found, and that the various types may be connected and transformed into each other in cell changes. The source of all these changes is the "ultra-microscopical organization" of protoplasm, for "apparently homogeneous protoplasm is a complex mixture of substances which may assume various forms of visible structure according to its modes of activity" (p. 29). It possesses the unique power of "synthetic metabolism," which makes *"living"* "a group of coöperating activities more complex than those manifested by any one substance or structural element" (p. 29). Hence, "life is a property of the cell-system as a whole." Here enters a consideration of vast importance. If it were true that protoplasm can properly be generalized as "the physical basis of life" so that the world of organisms could be typically considered as "the organism," the origin of life and its connection with the inorganic would still present a staggering problem. Protoplasm involves chemical synthesis on so tremendous a scale as to involve, at least *in method,* a break with all that is known of process in the inorganic. Organic evolution starts out, therefore, on any view of it, with an almost inconceivably complex mechanism and whatever advance in structural and functional complexity may appear during its course, allowing all that can reasonably be asked for epigenetic and historical trading with the environment, goes back to that original complex and is conditioned by it.

But, as it is, we have to deal with the additional fact of specificity. On this common basis of protoplasm is erected the structural and morphological distinctiveness of organisms. Protoplasm may be the same in all organisms, but all organisms are not the same. Even among the simplest organisms there is distinction of form, habit and morphological history. Diagrammatic generalization and classification into like groups do not dispose of the fact that organisms are specific and possess individual characteristics. Life may have a common denominator through all its manifestations, but it assuredly has different numerators and we can neglect this manifoldness only at the cost of losing contact with reality. For purposes of analysis, we may use the concept "organism"—in the world of living beings there are only "organisms." This means that we must face the fact that in protoplasm there is a directive activity which must not be confounded with its known physical or chemical qualities, something above and beyond these qualities as they are known apart from life.[1] Wallace says of Verworn (author of the great work on "General Physiology" which he uses): "In this highly elaborate volume of 600 closely printed pages, dealing with every aspect of cell structure and physiology in all kinds of organisms, he gives no clew whatever to the existence of any directive and organizing powers such as are absolutely essential to preserve even the unicellular organism alive, and which become more and more necessary as we pass to the higher animals and plants, with their vast complexity of organs, reproducing in every successive generation from single cells, which go through their almost infinitely elaborate process of cell-divi-

[1] Minchin, quoted in the preceding chapter, speaks of this as "relations" between the many substances entering into the composition of protoplasm. It is, then, a quality of organization.

sion and recomposition, till the whole vast complex of the organic machinery—the whole body, limbs, sense and reproductive organs—are built up in all their perfection of structure and coördination of parts, such as characterizes every living thing" (*op. cit.,* p. 317). He says also, with something of fine scorn: "But still there is no vital force—to postulate that would be unscientific."

Without entering into the question raised by these final words it would seem to be clear that something in the nature of a "directive and organizing power," some intercellular structure, some quality or complex of powers, as distinct in operation as radio or chemical activity, belongs to the living organism.

Here also the evidence seems clearly to imply a transcendent element in life as compared with the operations known to us in the inorganic sphere. Life utilizes and controls the inorganic to ends which are distinctive and unique.

The next point of intense interest and significance in connection with living matter, is the exceeding minuteness of its constituent units, the living cells, together with the almost inconceivable complexity of its organization. The cells, varying in size from four to eight hundred to the inch, form the active basis of all living beings. Each one is to a certain extent autonomous and individually endowed with the properties of life. This emphasizes the tremendous concentrated dynamism of life and adds force and meaning to the accompanying fact of complexity. Wallace ("The World of Life," pp. 315 f.) says: "Protoplasm is chemically the most complex substance known,[1] for while it consists mainly of four elements—carbon, hydrogen, nitrogen and oxygen—it is now ascertained that eight other elements are always present in cells composed of it—sulphur, phosphorus, chlorine, potassium, sodium, magnesium, calcium, and iron. Beside these, six others are occasionally found, but are not

[1] It seems now to be certain that germ-plasm is even more complex than protoplasm. See Enc. Br. *sub voc.*

essential constituents of protoplasm. These are silicon, fluorine, bromine, iodine, aluminum, and manganese. Protoplasm is so complex a substance, not only in the elements it contains, but also in the mode of their chemical combination, that it is quite beyond the reach of chemical analysis. It has been divided into three groups of chemical substances—proteids, carbohydrates, and fats. These two other groups of organic bodies, carbohydrates and fats, consist of three elements only—carbon, hydrogen and oxygen, the carbohydrates forming a large proportion of vegetable products, the fats those of animals. These are also highly complex in their chemical structure, but being products rather than the essential substance of living things, they are more amenable to chemical research, and large numbers of them, including the vegetable and animal acids, glycerin, grape sugar, indigo, caffeine, and many others, have been produced in the laboratory, but always by the use of other organic products, not from the simple elements used by nature. The atomic structure of the proteids is, however, so wonderfully complex as to be almost impossible of determination. As examples of recent results, hemoglobin, the red coloring matter of blood, was found by Prayer to be as follows—C_{600}, H_{960}, N_{154}, Fe_1, S_3, O_{179}, showing a total of 1894 atoms, while Zinoffsky in 1855 found the same substance from horse's blood to be C_{712}, H_{1130}, N_{214}, O_{245}, Fe_1, S_2, showing a total of 2304 atoms. Considering the very small number of atoms in inorganic compounds, and in the simpler vegetable and animal products, caffeine containing only 23 ($C_7H_7[CH_3]N_{402}$), the complexity of the proteins will be more appreciated." The chemical composition of chlorophyll (the green coloring matter of leaves) without which no carbohydrates could be produced, making animal life impossible, has never been successfully determined. "Attempts to analyze it result in so complex a series of decomposition products, that it is difficult to draw any certain conclusions" ("Enc. Bro." Art.). This substance, which is of course one of the products of protoplasm, is somehow related to hemoglobin, but seems to be even more complex. The significance of the whole matter may be summed up in the statement of Hertwig that "protoplasm is so complex that it is not a chemical but a morphological conception."

In this immediate connection, the cycle of change in plants and animals through which protoplasm does its work, is worthy of most careful consideration.

The plant takes carbon dioxide, mostly from the air in which it exists in minute quantities but accurately co-ordinated in pressure to the structure of the plant, water, and some other simple elements, and by means of chlorophyll itself a product of protoplasm, under the influence of sunlight, transforms these into oxygen, which renews the air, sugar, starch and fat, which become food for the animal. The animal in turn takes these food products, oxidizes (or burns) them and produces carbonic acid and water, which become food for the plant. The details of the process in which the protoplasm of plants and animals is concerned, are almost entirely hidden from us, but the general significance of it is plain. The contrast between matter and energy—*as seen by us*—is clear. The energy-changes (as Professor Henderson points out—see "Fitness of the Environment," pp. 26 f.) which accompany the process are quite different from the chemical. The starch, sugar, etc., formed in the plant from carbonic-acid, water and sunshine (solar energy) are transformed into carbohydrates and transmitted to the animal. In the animal body, solar energy is set free as muscular force and heat, and then dissipated. While the matter involved goes round and round in an endless circuit from plant to animal and back again, the energy is degraded and lost. Matter is cyclic while energy continuously moves on to loss. Hence, there must always be a fresh store of solar energy from which the plant may draw. Now it is evident that this capture, use, storage, and dissipation of solar energy accompanying the manufacture of chemical products is a function of protoplasm by means of its very complex and specialized product, chlorophyll. This is the central link in the whole circuit of the life process. The distinction between vegetable and animal, however arrived at, is vital. The ability directly to transform into food products the inorganic elements, the vegetable organism has either kept or gained—a power which has either been lost or not gained by the animal—and upon this power the whole world of living beings depends. Thus, we have the creative round—the inorganic, vegetable protoplasm with its derivative agency chlorophyll, proteins and carbohydrate foods, and animal protoplasm.

The key-fact here is the comparative simplicity of the inorganic materials used, over against the almost inconceivable complexity of the mechanism of change, the change itself which involves a long and complex series of chemical transformations, and the products of the change. Another item of scarcely less importance is that the general trend of the inorganic to energy dissipation (the "second law of thermodynamics" goes on through this circuit except so far as it is arrested in the operations of living bodies. The operation itself is understandable enough in its general outline if only we could see how such a process is possible. There is no component element in the organism which is not familiar to us elsewhere, and there are no elements with which it deals in its laboratory of transformations which are unknown to us in the scientific sense. Moreover, its methods are not so recondite as to be beyond the reach of analysis. It may be true, as has been suggested (see *Atlantic Monthly,* May, 1923) that the organism works on a percentage basis, like an hydraulic ram. It seizes upon the sun's energy, flowing like a stream to the level of potential equilibrium, takes toll of it to the extent of perhaps one per cent for vital uses and transformations, and permits the remainder to move on to its resting-place. One can see that a "creative synthesis" has taken place here, but to refer the origin of a mechanism which, to say the least of it, introduces a serious complication into the processes of the inorganic, to the continuation of any process going on previously, stuns the spirit of credulity itself. For, while the correlation of solar energy to protoplasm is perfect and wonderful, solar energy can hardly be the cause of its own correlative. While this correlation is for the advancement of the system regarded as a whole and is one of the most strikingly progressive movements in the whole cosmic process—it is yet the outcome of antagonism and strain. The sunlight is on other errands bent when it is held up and mulcted by the living organism for the latter's own ends. At any rate, it is impossible to think that solar energy directly produced the structure of the organism because by the organism it is turned to ends not self-contained; nor is it easier to see how the sun's energy could produce the organism as a response from the inorganic, for the response itself is organic. When we ask, "Response from what to what?" we imply that which is capable of making organic response to that which is fitted to elicit such a response. This involves the existence of the organic.

There is no reason whatever to suppose that at any time in the history of its interplay with other inorganic elements, the energy of the sun, acting in accordance with any known law, could bring about such a synthesis of inorganic elements on the earth as would be involved in the production of living matter with its unique properties and powers. Moreover, even if this hypothesis were within the limits of the possible, such an event would imply not only an adjustment between sun and earth, including the elements and activities of each, of the utmost exactness and nicety, but also an adjustment of truly cosmic range, involving the constituent parts of the stellar universe. However infinitesimal the portion of space occupied by living beings, it is yet inconceivable that life should appear until the universe as a whole were ready for it. For, whatever else it may be, the universe is one. It would require no great effort to imagine that the inorganic world would be on tip-toe with breathless expectancy waiting for the creative moment to come. And, withal, the introduction of life, however brought about, would seem to involve a solution of continuity so far as the accustomed methods of cosmic procedure are concerned. Some people appear to think of the introduction of life as if, while important, it did not involve any breach with the past, or any general change in the cosmic process. This cannot possibly be true. When life is introduced everything henceforward is different. While living beings obey inorganic laws—for life is not simply an island washed by the seas of the inorganic, but separate from it—yet they behave differently. The humblest organism that lives does things which no non-living thing can do. And this means that the coming of life involved a re-dressing of the cosmic balance.

Again, from all that we can judge, in view of the known facts about protoplasm, the advent of life must have been sudden, the outcome of a spasmodic or saltatory movement. This seems to be involved in its uniformity, or, more correctly, conformity to pattern throughout all ranges of living beings. Protoplasm appears to be in essential structure the same wherever we find it. At any rate, its complexity is a part of its nature. Its metabolic function is necessary to its existence, and complexity is essential to its metabolism, which is simply the tearing down and building up of its complex molecules. Whenever and however, life appeared, and at its appearance, therefore, it would seem to involve a fulness of being and an immediacy of operation. There has been, strictly speaking, *no evolution of life,* the continuity, structure, and complexity of protoplasm preclude this. Evolution is a category which applies to the *forms* in which life has been manifested. During the entire history of living beings, so far as we are able to discover, the ceaseless play upon them of changing conditions in the environment has made no impression upon the essential nature of life itself. Professor Arrhenius says ("Worlds in the Making," Preface): "My guiding principle in this exposition of cosmogenic problems has been the conviction that the universe in its essence has always been what it is now. Matter, energy, and life have only varied as to shape, and position in space." Apparently Professor Arrhenius asserts this principle as being equivalent to the affirmation of an eternal and mindless universe—which it by no means is. It is quite as compatible with the idea of designed origination. And, unless we are prepared to affirm that life and matter originated coincidently or are eternal, the statement cannot be taken quite literally. But, we note, that this interpretation falls back upon the original constitution of the universe, the unchanging nature of matter, energy and life. Evolution must always take cognizance of that which is beyond its power either to originate or to modify. Our interest at the moment, however, is with the fact, incidentally involved in the statement of Professor Arrhenius just quoted, that *matter, energy,* and *life* cannot be identified. We need the three categories to describe the facts of experience. In some sense, life is absolute. Its appearance, therefore, involves discontinuity—a change of direction, method, and, logically, of *causality* in the cosmic process. And we must remember that the stages of a process may be *continuous* in principle and *discontinuous* in method, as, for example, in metabolism, gestation, and growth. Even if life is reducible to molecular motion, it is motion *sui generis,* and therefore a departure from other motions. (See McKendrick, quoted by Wallace: "Man's Place in the Universe," p. 201.) And if it is motion *sui generis,* why may it not be something beside motion—is not the existence of any operation *sui generis* and therefore outside previous classifications really the rub? But we are not yet ready for conclusions for we are not yet through with protoplasm.

We turn next to the problem of metabolism. In this process, we have in a very acute form the age-long problem of permanence and change. Every living being throughout its entire lifetime is the subject of incessant material change due to the "inflow and outflow of matter and energy and their intermediary transformations within the organism" (Henderson: "Fitness of the Environment," p. 24). On the other hand, the organism holds this incessant flux in its grip, maintains its identity, refusing to be merged in the current or carried away with it. "Living things preserve or tend to preserve an ideal form, while through them flows a steady stream of energy and matter which is ever changing, yet momentarily molded by life; organized, in short" (*ibid.*). The organism not only maintains itself in the stream of change—which is not merely flowing about it, but through it, and actually making it—but also molds it in accordance with an ideal form maintained from within and *individuates* its particular share of the common materials furnished from the stores of the inorganic. "It is through this structure, in the process of metabolism, that matter and energy flow. Entering in various forms and quantities, they are temporarily shaped exactly to the form and condition of the organism; they conform to the characteristics of the kingdom, class, order, genus, species, and variety to which it belongs, and they assume even the characteristics of the individual itself. Then they depart through the various channels of excretion" (*ibid.,* p. 33). Professor Henderson pertinently remarks that "Science is, of course, still at a loss for an adequate general explanation of such processes" (*ibid.,* p. 33, note).

One might go further and say that science might despair of even framing a naturalistic explanation of a fact so anomalous. What is it that constitutes the unity and *permanence* of that whose constituent elements are never twice the same? Where *is* the *ideal form* which is maintained in the midst of this incessant flux of constituent elements? Describing as carefully as we know how what is known to us of metabolism, the essential matter comes to this. The constituent molecules of any organism are formed, taken down, and re-formed, individually and in groups, according to a fixed configuration which embodies the type to which the individual belongs. But just how that configuration exists or is contained in these constituent molecules, which are chemically not at all unique, and how it imparts itself to their motions, is a mystery, no less. For, by hypothesis, this ideal and individual differentiation is built upon the basis of a never ceasing flow of constituent elements. Professor Henderson says that the problems of metabolism demand a "physico-chemical description of protoplasm as a necessary basis for their solution," which makes life a "physico-chemical mechanism." This hypothesis is assumed to be necessary for the reason that life reactions are so accurate and apparently so inevitable. On the other hand, Professor Henderson makes emphatic and clear his convictions as to the limitations of such mechanistic description. These will receive consideration a little later.

Meanwhile, there are two further important steps to take in our survey of the meaning of protoplasm. The most important self-differentiation of living substance is the production of germ-plasm. This, as we have seen, is evidently a modification or extension of the function of bodily metabolism, and cell-division and an outgrowth and special adaptation for purposes of reproduction of the division of labor which is characteristic of the higher organisms. It presents special problems of its own. In every instance, the multicellular organism is built up from a single cell. This means that the "ideal form" which is preserved in metabolism is *created* or re-created in development. It means further that this "ideal form" which is created in development, is somehow predetermined in the germ-cell. This, of course, is our problem again, and the issue between Professor Conklin and others is whether this predetermination in the germ-cell is "factorial" or "potential." Whatever may be our decision on this point, it is quite evident, since any strict application of the mechanistic principle in the narrow sense excludes the existence of the whole before the parts are assembled, that the consequence of applying it here is, as Otto (*op. cit.,* p. 210) says: "Purely as a consequence of the chemico-physical nature of the germ, of the properties of the substances included in it on the one hand, and of the implicit structure and configuration of its parts, down to the intrinsic specific undulatory rhythm of its molecules, it must follow that its mass grows exactly as it does, and not otherwise, duplicating itself by division after division, and by intricate changes arranging and rearranging the results of division until the embryo or larva, and finally the complete organism, is formed." Roux's "germinal struggle," and the "genes" and "heredity factors" of the contemporary geneticists, serve to indicate the extreme difficulty of the subject. But the fact remains, explain it as we may, that this property of re-creation in one form or another belongs by nature to all living substance until lost by specialization.

What is the significance of all this with respect to the world-process as a whole? How are we to interpret it so as to include the idea of progress and to make of it something more than the "unrolling of the eternally given"?

Any strictly naturalistic system of evolution is self-contained,—that is, the beginning and the end, every intermediate point and every constituent element, from cell to constellation, from ameba to man, are coördinate parts, and relative to the process, of equal significance and value. Haeckel's universe is of this sort—so also is Herbert Spencer's and Huxley's. This is what is meant by Sill's "Positivistic Monad" when he says:

> "There is no world beyond this certain drop.
> Prove me another. Let the dreamers dream
> Of their faint dreams and noises from without,
> Of higher and lower; life is life enough."

From the strictly biological point of view, this is exactly true. "Life is life enough." Each substance, each force, each process, each organism, is absolutely an end in itself, in relationship to the whole. Each item is a cog in the universal mechanism, held in the linkage of a system which begins, continues, and ends within itself. In what sense can we speak of "progress" in a system so constructed or so interpreted? Who shall pronounce upon the relative value of cogs and links? What has nature to say about any of the standards of comparison and valuation which are implied when we use the word "progress"?

As Professor Hocking ("The Meaning of God in Human Experience," p. 540) says: "Nothing is so admirable in its categorical indifference to the concerns of the spirit as is physical nature. It has no member either in the psychical movement or influenced by it. It is a seamless garment of interweaving threads, it is what the mathematician calls in a word, a closed group, and the physicist, a conservative system." "Science is interested," says Otto, "in inviolable causality." If then, Professor Conklin really differs from Professor Bateson, it is because his interpretation substitutes a *dynamic* for a *mechanistic* conception of development and evolution. Bateson's "devolution," corresponding to Weismann's distributive process, is logically the only strictly mechanistic process which is even conceivable. We must somehow get behind or above and beyond mechanism in order to reach or include the idea of progress.

Progress involves the appearance of that which is new and higher—of that which is in some intelligible sense *specifically different* in kind. The advance from atom to living molecule, from ameba to man, is not merely from relative simplicity to relative complexity, it is from one type of life to another, on a higher plane. The fact that man's body contains in the neighborhood of thirty trillion ameboid units is not the full measure of his difference from the one-celled ameba. There is no real higher and lower in a world composed entirely of more or less intricate mechanisms.

Herein lies the significance of Professor Henderson's careful limitation of the proper range of mechanistic description. He emphasizes very properly the progress of organic chemistry, the purpose of which is "to describe the molecular constitution of all the compounds of carbon, including nearly all the individual substances which make up animals and plants" ("Fitness of the Environment," p. 28). This undertaking has been successfully carried out so that we have "very complete descriptions" of atomic groupings within the molecules of fats, carbohydrates, proteins, and most other biologically important substances, all of which give us clear ideas as to the chemical composition of protoplasm. The result is that "the characteristics of life have become less obscure and their aspects more simple" (p. 29). As a consequence, "the physico-chemical basis of life is firmly established in the world of our senses." On the whole (1) the composition of living matter, (2) its physical structure, (3) the changes of matter and energy which constitute the metabolic process, (4) the fundamental economic process of that community which is composed of all living beings, are fairly well known to us. Life as we know it is "a physico-chemical mechanism and it is probably inconceivable that it should be otherwise" (p. 31). This statement is guarded carefully by a note (*ibid.*) to this effect: "I mean, of course, for purposes of physical and chemical study." He then says: "It (life) possesses and ever must possess a high degree of complexity, physically, chemically, and physiologically; that is to say, structurally and functionally."

To summarize his extended argument, somewhat drastically, life, to the biologist, involves *complexity, regulation, food.* In this summary we confessedly are given rather meager materials from which to frame a philosophy of life and must be content with very modest generalizations. The problem of biology (see Henderson, p. 33) which is to relate adaptation to environment on the part of the organism to fitness on the part of the environment to the organism, can be solved only by the use of exact ideas. In order to avoid fallacy we must narrow our conclusions to the area within which we have such exact ideas (see reference to Wallace, p. 34 n.). According to Henderson, such self-limitation means that we must leave outside of our speculations (1) inheritance, (2) variation, (3) evolution, (4) consciousness—because for the present these are beyond the scope of description in terms of matter and energy (p. 30). The importance of Henderson's conclusion will be seen, at once, when we bring it into connection with the general purpose and method of science. As Henderson remarks, the general trend of scientific description is to change from once "quite mysterious order and purpose into the plainest of necessary results" (*op. cit.*, p. 2). This is quite true of scientific description, but in order to turn this descriptive formula into a tolerable philosophy, the category of necessity *must be extended to the system as a whole.* For example, *given* the chemico-physical qualities of the iron atom, all the performances of iron throughout cosmic history may be accounted for as following necessarily from its constitution—as we say: "It is the nature of iron to behave so and so." But why should there be an iron atom at all? Iron is necessary for a system like ours which is adapted to iron and requires it, but is a system like ours a necessity? When Henderson says: "In fundamental characteristics the actual environment is the fittest possible abode of life;" J. Arthur Thomson replies (in "The Wonder of Life," p. 581): "It may be so, but the assertion outstrips the evidence. That we cannot suggest another plan of evolution, another kind of make-up for the physical basis of life, does not by any means prove that there could be no other, no better." This statement brings to light the fundamental fallacy involved in all necessitarian ideas.

There is no inherent necessity why the system of things should be as it is or its component parts exactly as they are. Any given event in a given system may be what it is by necessity in view of its antecedents, but in another type of system the antecedents and the causal linkage might be quite different. Our world-system in that sense is contingent, not necessary. Moreover, within our system as constituted it is a question whether the catgeory of mechanical necessity can be rigidly applied and at the same time yield us the idea of progress. The reader will have noticed that according to Henderson's scheme with its clearly assigned limits, little more than metabolism within the individual organism is made susceptible to mechanistic description. *Every factor which has to do with organic advance or progress is left outside the formula.* Henderson was originally led to make his investigation by the discovery that the adaptation of the environment which involved the fundamental constitution of the inorganic factors, could not be brought under natural selection, or, as he puts it more specifically ("Fitness of Environment," Preface): "Natural selection can have nothing to do with the fact that of all known substances, phosphoric acid and carbonic acid possess the greatest power of automatic regulation of neutrality"—which is the elementary inorganic condition of the life process. That is, the regulation of the environment for the living being antedates the appearance of the being for which the adaptation is made. No process of *natural selection,* operating in the organic sphere, could bring about an adaptation which *precedes* the organic and conditions its appearance. If we make use of the formula of natural selection in the inorganic sphere, as Soddy does, we are bound to use it as involving progressive simplification to the point of stability, whereas, evolution in the living sphere begins with complex protoplasm and involves progressive integration as evolution proceeds from level to level. We have two problems at once here, either one of which is difficult enough to involve a practical impasse to thought. The first one is: How did so complex a substance as protoplasm originate in the midst of a devolution process, the goal of which is stable simplicity? The second: How are we to correlate natural selection with increasing complexity of structure and increasing specialization in organ and function—which is essentially the meaning of evolution?

If natural selection is a rigid, automatic sifting process from the beginning, how did the first *living* forms escape extinction in view of the stability of the inorganic and its advantages in a struggle for survival—particularly in view of the fact that with the advent of life, analysis gives way to synthesis? If natural selection is such a principle, how can we account for the survival of the first multicellular forms in view of the equal or superior adaptation of the unicellular forms (which remains to this day) over any complex organism of the higher type? If it is true, as most scientists seem to believe, that unicellular organisms are, biologically speaking, immortal—this problem becomes the more acute. Can we account for these successive changes of policy on the part of natural selection without recourse to the dogma of "final causes"—which, according to Henderson, has countless times led to the truth "by teaching the investigator that the true description of an organ or physiological process was to be found in its utility to the organism as a whole" (p. 4). Is not utility a final cause? Is not adaptiveness, which lies behind variation, whether it is due to outward stimulus or inward orthogenetic thrust, proleptic, *prophetic,* future-facing in its very essence? But, the idea of final causes, without intelligence, is, of course, preposterous. It is, as Spinoza pointed out, turning an effect into a cause of itself. This logical offense is one which evolutionary theory is constantly in danger of committing. And just here our question about the meaning of "potential" finds an answer which opposes a final negation to the use of mechanism as a formula of explanation. Bowne says of the "potential": "This potentiality must in some way be an actual determination of the real; otherwise it would explain nothing. It was, then, an actuality of some sort, and yet not an actuality of a strictly actual type. And yet, how to represent the difference between a potential actual and an actual actual is something quite beyond us" ("Personalism," 1908, p. 176). How can that come out which was not actually in? Potentiality is a clear notion only on the plane of freedom. Here it means "the self-determination of the free agent!" Hence, the organism which develops, or the molecule which lives, must be interpreted on the level of free action. As Agassiz said to the Duke of Argyll: "The truth is, that Life has all the wealth of endowment of the most comprehensive mental manifestations, and none of the simplicity of physical phenomena" ("The Unity of Nature," p. 291). Professor Patten states the same fact thus ("Grand Strategy of Evolution," p. 38): "Molecules act as they would have to act if they were intelligent agents."

As Bowne rightly contends: "On the plane of necessity 'potentiality' is 'pure opacity.' It must be something which is at once real and not real, actual and not actual."

"Unless we can master this (antinomy), the alternative is to refer all motion, progress, development, evolution, to a supreme self-determination which ever lives and founds the order of things. In that case the past is not potential of the future, any more than summer is potential of winter, or the setting of the sun potential of the rising of the moon; but both past and future are phases of a movement which abuts on freedom and of which the successive phases are but implications and manifestations of the one thought which is the law and meaning of the whole. This is a meaning of potentiality which finds illustrations in experience and is understood through experience" (p. 179).

Mechanical causality is pushed out of the past—"everything is product and nothing is purpose." Progress has no meaning, any more than "potentiality" in a scheme of this sort. (See *op. cit.*, pp. 179-180.)

Such a system gives us no real picture of a truly developmental process. On the other hand, for all "who see in the antecedent stages of evolution a preparation for things to come, or the earlier phases of a progressive movement, the facts of evolution become the most impressive arguments for purpose in the world; for in that case the entire movement in its great outlines has a forward look, and is thereby marked as rooting in the causality of intelligence. And the argument becomes more impressive than the argument from detailed marks of special contrivance by as much as its boundless range transcends the petty extension and durations of the traditional discussion" (*ibid.*, p. 182).

CHAPTER VI

PROGRESS AND TELEOLOGY

The outcome of the investigation recorded in the immediately preceding chapters has been to make clear that we cannot harmonize a strictly or literally mechanistic or "causo-mechanical" interpretation of Nature with the idea of progress, even in the limited organic sense. Evolution of this type seems to work only horizontally. It distributes with meticulous accuracy but gives no increment. It originates nothing and makes no real advance. Its universe is rhythmical and cyclical but eternally self-conditioned and hemmed in by its own past states. Herbert Spencer's universe is of this type. He says ("First Prin.," stereo. ed. p. 552): "Every antecedent mode of the unknowable must have an invariable connexion, quantitative and qualitative, with that mode of the unknowable which we call its consequent. For to say otherwise is to deny the persistence of force." This statement seems to involve the self-contradictory notion that every state of the Universe is the same as every other. Of course, Spencer was too keen not to guard against this inference, for his scheme explicitly allows for the appearance of change. As he says elsewhere (*ibid.* p. 191): "The recognition of a persistent Force, ever changing its manifestation but unchanged in quantity through all past time and all future time is that which alone makes possible each concrete interpretation and at last unifies all concrete interpretations." But this is not real progress, nor does it give a true picture of what evolution really involves. This melancholy see-saw of mechanical equivalence can at best represent only the framework or condition of evolution.

Bergson ("Creative Ev.," Eng. tr., pp. 101, 102) says that the theory of mechanism makes outer circumstances which condition evolution the directing causes of evolution. "It excludes absolutely the hypothesis of an original impetus—I mean an internal push that has carried life by more and more complex forms to higher and higher destinies. Yet this impetus is evident, and a mere glance at fossil species shows us that life need not have evolved at all, or might have evolved only in very restricted limits, if it had chosen the alternative, much more convenient to itself of becoming anchylosed in its primitive forms. Certain Foraminifers have not varied since the Silurian epoch. Unmoved witnesses of the innumerable revolutions that have upheaved our planet, the Lingulæ are to-day what they were at the remotest times of the paleozoic era."

Certain it is that as we have noted already, that if evolution means anything to thought, it must be conceived of as the dramatic unfolding of a creative process which at every successive stage transcends itself in a never ending serial apocalypse of hidden power and beauty.

But this grand conception is absolutely nullified and swallowed up in the meaningless to-and-fro see-sawing of a machine which remains eternally what it was—masking its rigid unchangeableness under a deceitful appearance of mobility. In such a scheme of interpretation, any real progress is not only not provided for, it is made utterly unthinkable.

So far as Herbert Spencer is concerned it is not difficult to see how he is led into this quagmire of contradiction. His *ignis fatuus* is false abstraction. As Ward tersely expresses it (*op. cit.,* I., p. 248): Spencer "advances by way of the ascending scale of ideas, the concrete progress from physics to life, from life to mind, from mind to reason; but he professes to *explain* by falling back on the abstractions of pure dynamics. Yet on this level, if we could imagine ourselves confined to it, there is, as I have frequently urged, no real advance, no true evolution at all." There is no escaping this conclusion. It is a *reductio ad absurdum* of the whole naturalistic position. It is as if after making an ascent from level to level by the use of stairs we should attempt to explain the process by ignoring or denying the stairs. We are thus made to go from floor to floor by walking on the level where we began.

We must then attempt to frame some sort of an interpretation of the world-process which shall make possible and reasonable a belief in real progress. That "the concrete progress from physics to life, from life to mind, from mind to reason," represents the actual world-order and a truly creative process, I take to be the most certain of all certainties. Consequently any theory which does not recognize this fact and offer a reasonable explanation of it, is to be rejected, out of hand, as untrue—on that ground alone, if for no other reason.

The first step toward clearing the ground for a better theory is to define carefully what we mean by organic progress. It seems evident that progress is not confined to any advance in mechanical complexity. In this respect, it is difficult to see that the universe, *together with everything it contains,* is any more complex, except through combination or aggregation, than its constituent atoms. According to the new physics every atom is itself a universe—a microcosm of inconceivable intricacy of structure. More than this, there are locked up in every unit of matter, forces which if released would be sufficient to manifest themselves on a truly cosmic scale. Says Charles Kassel in a startling article (*N. A. Review,* Oct., 1922; "Immortality and the New Physics"): "We are told that the spectroscope will discover in a thimbleful of air the existence of a single particle of neon, coexisting with four million particles of other gases and that this inconceivably tiny particle contains no less than ten million millions of atoms. The idea of minuteness involved in such a statement is sufficiently staggering; yet, we know now that the atom is not the smallest thing in nature, and that it is the electron within the atom which must stand before our thought as the unit of matter. So unimaginably small, however, is this newer particle, that its diameter, as we are told by Professor Milliken in *The Popular Science Monthly,* is only about 100,000th that of the atom; and according to Sir Oliver Lodge the electron, as compared with the atom, is that of the earth and other planets to the solar system, or, as Professor J. A. Thomson has it, that of a dust particle to the entire volume of air in a lecture-hall."

"Within the atom, now become a very miracle by complexity, the electrons revolve with incredible swiftness about a common center, much as in our solar system the sun's satellites sweep about the central orb, with the orbits and spaces no greater in the latter case than in the former, relatively to size." As to locked up energies one illustration will do. Gustave le Bon says: "The fifth part of an American five-cent piece, if we could entirely dissociate it in one second, would give an energy equal to six milliards eight hundred million horse-power, the energy of a moving body being equal to half the product of its mass by the square of its velocity."

In like manner, there seems to be no comprehensive difference in complexity between the organism and its constituent parts. Every cell, like every organism, is a microcosm, the complexity of which defies complete analysis. The organism, therefore, is a microcosm composed of microcosms, the practical infinitude of which attaches both and equally to the whole and to all its parts.

Still further, there seems to be no such advance in structural complexity as we should naturally expect when we pass from so-called lower to higher organisms. The result of this fact is that organism becomes an ultimate fact, beyond which we cannot go, and complexity of structure is a primary and ultimate fact which cannot be resolved into any constituent simplicity and apparently does not admit of degrees.

Once again, there seems to be no advance in adaptability or capacity to survive in a given environment which is correlated to the difference between lower and higher organisms. Ameba is the peer of man, if not his superior, in this respect. Ability to survive in greater or less degree can be predicated only of individuals, not of classes. It does not correspond to the zoölogical scale.

Thus again we come to a stone wall—but from this point we can see a way out, for the idea of a real progress, can be justified when we come to look not at structures or mechanisms, but at the way in which living beings behave. An organism is low or high according to the mode of its life, the place it occupies, the work it does, its freedom of action, the range of its traffic with environment, the degree of its individuality, the grade of its intelligence, the extent and importance of the operations which it controls and directs. Biologically speaking, the word "complexity" defines "the result of specialization of parts leading to more extensive and more detailed division of labor" (Calkins: "Biology," p. 162). But this specialization of parts is a function of the working individual, and is a cause of complexity—as well as a phase of it. Increased specialization within the organism is the antecedent condition of increased freedom of action on the part of the individual, which is thus enabled to make a higher use of its mechanism. Moreover, increased specialization is the outcome of a selective and creative process in ontogeny by which the mechanics of mitosis are directed to an unseen and ideal end. I will explain in a moment what I mean by this.

First, let us set up a comparison and contrast. When we come down to it, in what sense, if any, is man, as an organism, higher than the ameba? Is it not that he has a wider range of freedom, a larger gamut of possible operations, a broader and higher environmental field? This relative freedom is due, structurally, to a "more detailed subdivision of labor" among his constituent parts. We cannot say that he is, simply as a mechanism, more complex, or that his standing as an organism is directly correlated with his complexity. It is quite conceivable that increased complexity might work away from freedom as it does temporarily in the human infant. At first his cerebral complexity ties him *hand and foot* as compared with the young kitten which can climb a tree within a few weeks of birth. But we can say that he has a wider range of functions and relationships. And this is due, in turn, to the fact that by specialization a large number of vital operations are taken care of without voluntary or conscious attention on his part—setting him free for a richer choice of activities. The ameba performs every vital function that man performs. He lives, he moves, he eats, he digests, he reproduces himself. But it required the entire organism, acting as a unit, to perform each of these functions. He walks by extemporized feet, he takes in food through an extemporized mouth, he digests in an extemporized stomach, he reproduces himself by dividing himself in two, also, one may say, in decidedly extemporaneous fashion. And the whole organism concentrates upon each of these activities in turn. Man's fundamental vital operations are, most of them, performed by an apparatus independent of attention. He is, therefore, higher because he can live in a larger way than the ameba.

The same contrast appears if we place man alongside of the anthropoid ape who is structurally so much like him as to be placed by the modern theory in the same genetic connection. The ape is higher in his degree than the ameba for the same reason that man is—he lives in larger fashion. His organic structure, based on more elaborate subdivision, allows him a freedom of action which the ameba does not have.

Man, as an organism, is superior to the ape on precisely the same ground that he is superior to the ameba and on precisely the same ground that the ape is superior to the ameba—he lives in larger fashion. Whatever may be the metaphysics of the case, man undoubtedly has a wider range of freedom than the ape. Now, his superiority is not due directly or solely to his being a more intricate mechanism than the ape. He has more cerebral surface and more brain-cells to be sure, but that is not the measure of the difference, and cannot be its cause. He uses his mechanism differently. He controls and directs it to different ends. He has a measure of self-direction (however to be explained) which the ape has not. In other words, man differs both from the ape and from the ameba, by virtue of the possession of organic powers which they do not have. It is not as a mechanism but as an individual that man differs and excels.

I do not see how the idea of gradation from lower to higher can be introduced into nature on any other basis. Man is not higher than the animals except according to this mode of measurement. He is in many respects a decidedly inferior animal, by comparison with others. He is larger than many but smaller than many others. He is less powerful, less active, less swift, less keen of sight and smell, less capable of physical defense, less specialized, less generalized, than many other animals.

On this principle which we have indicated, not only is man's position assured, but the general idea of gradations in Nature rests on a tenable basis. Furthermore, if the gradation can be related to the historic time-stream in some orderly fashion, there is such a thing as true evolution. Belief in progress becomes something other than a superstition or a contradiction. In the remainder of this chapter our aim is to show that this idea of progress can be related to the actual history of the world only as that history is looked upon as the outcome of creative purpose.

This fact is admitted, curiously enough, even by some who refuse assent to the theistic interpretation of teleology. For example, John Burroughs in a posthumous article entitled: "New Gleanings" (*Harper's Magazine,* Aug., 1921) says: "Our special good fortune is that we are capable of a higher development, capable of profiting to a greater extent by experience, than are the lower forms of life. And here is the mystery that has no solution; we came out of the burning nebulæ the same as our horse and dog, but why we are men and they are still horse and dog, we owe to some Power, or, shall I say, to the chance working of a multitude of powers, that are beyond our ken. That some being willed it, designed it, no; yet it was in some way provided for in the constitution of the world." This is a very significant utterance indeed. The violent logical somersault to avoid what appears to be an inevitable conclusion, is, perhaps, more pathetic than anything else; but the clear recognition that that which makes us "human" is the "capability of profiting by experience" beyond other living beings, and that this must be "provided for in the constitution of the world"—is the essence of the situation. This means that the appearance of man is the outcome of a cosmic trend which involves the meaning and value of the entire process.

Moreover, the explanation of that trend in which the meaning of the process is to be found, must not be framed in such a way as to deny distinctive meaning to the final outcome. The constitution of the world itself and the nature of the world-process must be so interpreted as to maintain the reality of that which is provided for in the one and attained by the other. To frame such an explanation, is the very task we have now on hand.

To begin with, we may count upon general assent to the proposition that unguided mechanical processes follow the line of least resistance. Looking at what we term inorganic systems, this law appears in the universal tendency to *run down;* that is, to use up their available energy and reach a condition of static equilibrium in which no more work can be done.

At this point appears the most striking contrast between the inorganic and the organic. Life does not follow this line of least resistance. Life *reverses* the process, sets itself against the current, manifests itself, in the phrase of Professor Osborn, as "essentially constructive," inasmuch as it "is continually giving birth to an infinite variety of new forms and functions which never appeared in the universe before." It may be that this process of reversal is, as Osborn insists, "still evolutionary rather than creative because all the new characters and forms of life appear to arise out of new combinations of preëxisting matter," but the point is that a clear contrast and duality of process is involved.

In addition, it is a curious use of terms to describe a process which, so far as appears, "marks an actual reversal of the previous order of things," as merely the taking of a "new direction" by energies already operating in the order which is thus reversed. If the known processes of what we are accustomed to call "inorganic matter" disclose the mode in which it subsists or the true laws of its operation, then life is something different, because it reverses the previous order. Life does not branch off from the non-living; it moves in the opposite direction. But as a matter of fact, all that is really needed for the point I am making is a definite change of direction, which is conceded. There could be no change of direction in the way of higher potency in an unguided mechanism—because any such change would involve a control set against the line of least resistance. The transition from the inorganic to the organic involves unmistakably such a change. If all the known facts of life go to show, as the evolutionist claims, that it arises out of new combinations of preëxisting matter set in a new direction, does it not follow that this new *set* is due to action immediately creative in the only sense which we need to insist upon here; namely, that it involves the release of new and original energy from whatever reservoir of power is behind the whole process. No one believes, or at any rate has adequate ground for believing, that living beings were created *de novo,* without reference to preëxisting matter. On the other hand, what evidence is there that the new forms and functions of living matter are *due* to forces resident in chemical atoms and native to them? There is none that is at all convincing. On the contrary the new and creative processes which show themselves in living beings have every appearance of coming from somewhere beneath and beyond the atoms. As Dr. Osborn says: "To our senses it appears as if something new is breathed into the aging dust."

And it is peculiarly significant for our inquiry that this *new* direction which implies a directive agency appears just at the point where a great step is taken in the way of progress, where nature passes from a lower to a higher level of operation. In other words, just at the point where new energy is needed, it seems to appear. The whole process is, therefore, mechanically speaking, up-grade, hence super-mechanical and purposive.

Something of the same sort is involved in the origin, along developmental lines, of the distinction between plants and animals. The order of evolution here is confused, and, from any point of view, difficult to follow. If, according to the older notion, now pretty thoroughly abandoned, we take animals to be modified descendants of plant forms, then (as Ward points out) we have not only to account for the very unevolutionary fact that the earliest stages of plant development resemble animal development; but we are confronted with another problem; namely, how the disuse of the power to create protoplasm directly from the inorganic and the formation of the lazy *delicatessen* habit of devouring it ready-made (which in itself seems clearly to be an act tending toward degeneracy) was followed by the vast increment of freedom and power which accrued to the animal after its separation from the plant.

If, however, we accept the newer view that both the plant and the animal are modified and differentiated descendants of the indeterminate *Protista*—the case is not essentially different. Some of these protista followed the line of least resistance in becoming seated or rooted, thus surrendering their freedom of motion, but *advanced* in the power which has always remained the distinctive and creative function of the plant in all its endless variety, to make protoplasm directly from the non-living elements. On the other hand, certain of the protista maintained the habit of free motion, meanwhile advancing through the development of manifold devices for its maintenance and improvement, but at the same time making themselves dependent for livelihood upon ready-made protoplasm. This is an evident and significant limitation inasmuch as it involved the surrender and loss of a high creative function. Professor Cope (quoted by Ward, *op. cit.,* I, p. 288) states the problem apparently without noticing it, and Professor Ward himself passes Cope's curious statement without comment. Professor Cope says: "The easy nutrition which ensued (to the animal) was probably pleasurable, and, once enjoyed, was repeated and soon became a habit. The excess of energy thus saved from the laborious process of making protoplasm was available as the vehicle of consciousness and motion."

The real problem here—which is ignored by both writers unless Professor Ward's playful remarks about the "protist who anticipated by untold ages the feat of little Jack Horner" are to be taken as an ironical statement of it—is to explain the initial stages of the whole process. My own idea is that it cannot be done without admitting the teleological principle which is clearly indicated in the outcome. The differentiation of plant and animal is the first and greatest step in the development of organic variety. Moreover, the release of energy from one use to another, spoken of by Professor Cope, is a method which, as we have seen, runs through the whole system and involves the most momentous consequences everywhere. But a mechanical explanation of the change seems entirely impossible. For it is at least questionable whether the energy gained by the easier method, adopted by the animal, of feeding upon living matter is not counterbalanced by what is expended in the maintenance of motility. Animal life would appear more costly than plant life in spite of gain involved in the animal's feeding habit. But, as we have said, the real problem lies in the origin of the change. There is something new and revolutionary introduced into the life process by which a group of *adapted* organisms is thrown out of equilibrium, broken up into two groups, and readjusted on new levels and along divergent lines. Fix your mind on the *Protista.* How did they live? Were they motile plants, having at once the power of motion and the ability to live on the inorganic, or were they true animals in being both motile and devourers of protoplasm? Or were these primitive *Protista* a *tertium quid* between plant and animal, being gifted with motility and able to transform the inorganic at one and the same time? This seems to be Professor Ward's idea. He states the case thus (*op. cit.,* p. 288): "It is at any rate certain that plant protoplasm and animal protoplasm are essentially one and the same; that the animal functions of motility and sensibility pertain to all protoplasm as truly as the vegetable function of assimilation and reproduction; that from unicellular organisms, the *Protista,* leading the free-swimming life of animalcules and yet endowed with the plant's power of transforming inorganic matter, there arose both unicellular organisms, the *Protozoa,* retaining and developing the former characteristics and also unicellular organisms, the *Protophyta,* with the antithetic traits; and, finally, that from *Protozoa* and *Protophyta* respectively all the more complex animal and vegetable organisms have been evolved." If one allows to pass without challenge the first members of this series—the *Protista,* themselves conceived of as doubly-endowed forms, the existence of which is purely hypothetical,—if, in addition, one is allowed to generalize protoplasms under the term protoplasm, which ignores all the specific differences which distinguish the various types of protoplasm; to define the functions of motility and sensibility as animal, and assimilation and reproduction as vegetable, and to assign both groups of functions to protoplasm *as such;* and finally to pass over the fact that the real distinction between plant and animal, *whenever that appears,* is the possession or the non-possession of the power directly to transform inorganic matter into living substance, then this scheme may pass muster. But this is asking a great deal, particularly as the gist of the problem is—why organisms possessing the powers *both* of plant and animal should split up and develop along divergent lines involving both gain and loss. This problem is the more acute in view of the consideration that these organisms were already comfortably adapted and quite capable of survival without change. Why should a motile organism surrender its motility if it could, while motile, live upon the inorganic? Or, why should an organism surrender its ability to feed upon the inorganic at the cost of becoming dependent upon those organisms which would so live even if in so doing it would have extra energy to spend in other directions? And why should it care to husband its energies for the uses of "consciousness and motion"?

The significance of this last question lies in the fact that the differentiation of animal and plant is one of the great upward and forward steps of nature—and that the transition is made not so much by difference in actual structure or function as by the introduction of a new tendency and habit of life. It is now understood that to define the difference between plant and animal in such a way as to put all plants in one class and all animals in another with no fundamental characteristics in common, is, among the lower forms at least, impossible. But the tendency which ultimately differentiates them is unmistakable from the very beginning. A writer in the London *Quarterly Review* of January, 1869 (quoted by Orton: "Comparative Zoölogy," p. 22) says: "There is at bottom but one life, which is the whole life of some creatures, and the common basis of the life of all; a life of simplest moving and feeling, of feeding and breathing, of producing its kind and lasting its day; a life which, so far as we at present know, has no need of such parts as we call organs. Upon this general foundation are built up the manifold special characters of animal and vegetable existence; but the *tendency,* the *endeavor,* so to speak, of the plant is one, of the animal is another, and the unlikeness between them widens the higher the building is carried up. As we pass along the series of either [branch] from low to high, the plant becomes more vegetative, the animal more animal."

The wide difference in habit between plant and animal when once it becomes recognizable and the complexity of the processes which are involved in that difference are thus stated by Orton: "A living being which has cell-walls of cellulose, and by dioxidation and synthesis of its simple food-stuffs produces the complicated organic substances, is a plant; while a living being which has albuminous tissues, and by oxidation and analysis reduces its complicated food-stuffs to a simpler form, is an animal." Granted that these definitions are not absolute nor altogether mutually exclusive on the lower levels of life and that there are organisms that seem to realize both definitions,—yet, the significant fact stands out that these divergent tendencies which are realized in antithetic operations are traceable down into the roots of life. Moreover, the antithetic operations of synthesis and analysis respectively on the part of plants and animals are, ultimately, in the highest degree coöperative and constructive. While they do not seem at all amenable to a mechanistic interpretation, the purpose of the two distinctive and yet related processes is quite evident. Professor Calkins says: "It is now known that plants, like animals, renew their protoplasm with oxygen, salts and proteins, and give off CO_2 and other waste matters the same as animals do, the only essential difference being their power to manufacture the proteins to be used as food. Their functions, *therefore, are fundamentally constructive while animals are destructive; all plant tissues and organs are differentiated to subserve this function while those of animals are mainly differentiated for the procuring of food, digesting and assimilating it.*" ("Biology," p. 67—italics mine.)

Now note: (1) that the two groups were derived from common generalized ancestors having, by hypothesis, *both powers* or the beginnings of both.

(2) That the division into two groups was due, not to mechanical causes, but to a double counteracting process of change in instinct and habit.

(3) That this change was due to tendencies moving apart at an angle, beginning at zero and diverging more and more widely as the process goes on, namely:

Protista < Protozoa—animals / Protophyta—plants

The origin of these diverging tendencies, the acquisition of the ability to operate in such opposite ways are mysteries for solution, emphasized by the fact that we start out with a homogeneous group.

(4) That this change has no survival value because the *Protista* were already successfully adapted. Besides, the change intensified the perils of existence by subjecting one group to the danger of being devoured (a very significant fact as we shall see later) and thrust upon the other group the necessity of finding a ready-made food supply.

(5) That this change becomes the basis of all future differentiation—plants and animals becoming differentiated in view of these divergent functions.

(6) That this change is absolutely necessary, not in the mechanical sense, but for the full development of nature as we know it. The check upon reproduction, both animal and vegetable, involved in the animal habit of living upon ready-made protoplasm is the only condition of harmonious and developing life that we can even imagine. To trace along mechanical lines the rise of two trends, in different directions, of instinctive adaptations which have no meaning whatever until their *purpose* appears—which is not the survival of the organism but the enrichment of nature and the realization of variety as an end in itself—is clearly impossible.

Another place where this same transcendence of purely mechanical operations can be observed, is in the process of cell-division. Professor Wilson says ("The Cell," pp. 368, 369): "It is impossible to resist the conclusion that one of the factors by which the position of the cells (and hence the direction of cell-division) is determined is a purely mechanical one, identical with that which determines the arrangement of soap-bubbles and the like. Very little acquaintance with the facts of development is, however, required to show that this purely mechanical factor, though doubtless real, must be subordinate to some other. This is strikingly shown, for example, in the development of annelids and mollusks, where the spiral cleavage, strictly maintained during the earlier stages, finally gives way more or less completely to a bilateral type of division in which the rule of minimal surface contacts is often violated. We see here a tendency operating directly against, and finally overcoming, the mechanical factor which predominates in the earlier stages; and in some cases, *e.g.*, in the egg of *Clavalina* and other tunicates, this tendency prevails from the beginning. In both these cases this tendency is obviously related to the growth-process to which the future bilateral embryo will owe its form; and every attempt to explain this position of the cells and the direction of cleavage must reckon with the morphogenic process taken as a whole. The blastomere is not merely a cell dividing under the stress of rude mechanical conditions; it is beyond this 'a builder which lays one stone here and another there, each of which is placed with reference to further development'" (quoting F. R. Lilie). The suggestive item here is that the process of cell-division and embryonic integration is related to an end which is not contained in the mechanism, but is really ideal. This is the basis of the Neo-vitalist's contention that there is in every living being a force which is related to the organism as a whole and transcends, directs and controls the mechanical adjustment of its parts. Basing his judgment upon the fact that mutilated embryos produce symmetrical bodies according to the plan of the normal organism and upon certain related facts concerning the regeneration of lost parts, Hans Driesch ("Science and Philosophy of the Organism," Vol. I, p. 141) says: "There can be neither any sort of machine nor any sort of causality based on constellation underlying the differentiation of equipotential systems." This is to say, that no machine occupying space according to a given arrangement of parts can remain itself when certain of its parts are removed. There is, therefore, in all processes of organic development a directive agency, call it vital force or not, which is supermechanical, in that it directs and controls mechanical processes toward an ideal end. This must be in some broad sense teleological. One cannot but feel that the ability of the germ to call into being a yet non-existent organism which exists only ideally or potentially so far as the germ itself is concerned cannot be interpreted in terms of unguided mechanism.

Still another instance of the same sort is presented in the evolutionary account of the origin of man's body by derivation from the lower animals. We do not wish to anticipate the fuller discussion of this topic—which belongs to the second part of this book—except in one particular. It is worth our while to point out the implications of the theory, *on the supposition that it is true.* The evidence for this derivation is based partly upon residual or rudimentary organs left in the human body, which formerly served some vital purpose but have been rendered obsolete by a change of bodily habit. These rudiments of organs still remain, we are told, as historic testimony to the change which has taken place. According to our scientific authorities this transformation of bodily structure in man has come about mainly through the acquisition of an upright mode of carriage. The question at once arises—since the change of habit has been sufficiently drastic to render these disused organs obsolete—why has it not erased all traces of their existence? The only answer to this question that we can think of is that heredity is too strong and that the germ-plasm has not been able to expel from its transmissive structure the remainders of a past and gone habit of life. It might be suggested as a possible difficulty that it seems strange that the new habit could so modify the germ-plasm as to transform the entire resultant organism in all the fundamental elements of its structure so completely and yet could not prevent the transmission of perfectly inert and inutile remainders from the past. These "reminiscences" as they have been called have no survival value—by hypothesis they fulfill no function—hence, they have only historic value. Do they also fulfill an historic purpose? This seems to be in the mind of Brooks ("Foundations of Zoölogy," p. 10) when he says: "They who are most convinced that the historical significance of these [various rudimentary] structures is an adequate explanation of their presence, are also most emphatic in their repudiation of teleology and in the rejection of the belief of Louis Agassiz, that they are a part of the language in which the Creator tells the story of creation; yet the assertion that their history accounts for their existence is as teleological as anything in Paley." The mention of Paley in this paragraph calls up the fact that Dr. Arthur Keith (in his book on Man) speaks with admiration of Paley's book on Anatomy, coming from the period when the human body was looked upon as a "machine of superlative construction, the final work of a power which had created all things." Keith goes on to say: "We have in later days neglected the study of the mechanism of the human body. Modern anatomists look on it as an anonymous missive which has come to them through the post of time, stamped with certain marks from which they try to interpret—and with some success—something of the whence and how it has come." In his fourteenth chapter, the author attempts to throw aside this Darwinian view—"to leave evolution behind him and study the cunning mechanism of the human body without mention of creation or evolution. How far that can be done the present chapter will show" (pp. 215, 216).

The first statement which he makes under this head is the following: "The manner in which the head of man is jointed to the body is an example of an effective and most delicate mechanism worked out under circumstances of peculiar difficulty."

Note carefully the implications of the language which he uses. A mechanical problem is to be solved. What is the problem? To join the human head to the body so that it can be moved independently of the body "so that the eyes can sweep the horizon from east to west by a turning movement and scan the heavens by a nodding or extensory movement" without impinging disastrously upon the sensitive spinal cord which is at the center of the mechanism. Keith points out that this mechanical problem has been solved by the simple device (which yet takes a page of print to describe) of modifying the first vertebra and fixing it as a pivot on the second vertebra. This mechanical device which, descriptively speaking, is just a modification or adaptation of the organism, merges absolutely into the ideal or purposive in the fact that this mechanical problem exists only in view of the unique habit of man in standing up and looking forward. It is also directly correlated with his faculty of speech. It is not, therefore, a mere mechanical problem in isolation—it is involved in the uniqueness of man's structure, function and life as a whole. How can one avoid using teleological language in describing such a process? It is explainable only in terms of purpose. We must remember that, by hypothesis, man is a modified descendant of a successfully adapted ancestor constructed on a far simpler, easier and safer plan. How then, can a purely mechanical adjustment under stress or pressure, or as a result of chemical affinity or mere biological adaptation, account for this modification which, while in itself mechanical, could not possibly be produced except as means to an ideal end, the mechanical solution of an ideal or constructive problem? Moreover, it is the outcome of a profoundly revolutionary change in the entire structure of the organism. Man could not have become man in sections. On the contrary, an intricate system of coördinate adaptations, mechanically distinct, yet all combining to a common result and necessary to its realization before it comes to pass, must have been operative in his coming. And back of all this hypothetical modification there lies a far-reaching question. What is the supervening cause of this supremely important, complex and creative structural deviation from animal to man?

If the greater part of these changes were brought about by his adoption of the plantigrade mode of progression and upright carriage, the one question then is how did the ancestor of man come to adopt this method of carriage? What was the thrust or urge which brought him upright and kept him thus in spite of the backward drag of ancestral habit and the burdensome awkwardness of an ill-adapted mechanism? The usual answers to this quite reasonable question are far from satisfactory. Begin, for instance, with an hypothetical arboreal anthropoid—thoroughly adapted to a life of climbing, swinging and walking on trees by the aid of the fore-hands. This adaptation to arboreal life is itself a modification of the ordinary quadrupedal method of progress on all fours. This arboreal anthropoid is forced to the ground either by his restless desire to travel or by the destruction of the trees in which he lived, or by a mere animal caprice. Keith holds that man is derived from a ground-walking anthropoid such as we have in view. Now, it seems to me quite clear that if this expatriated anthropoid *followed the line of least resistance*, which he would naturally do under the pressure of necessity in the struggle for existence, he would do one of two things. He would use the method which anthropoids when on the ground now adopt, and have used for ages, running with flexed knees and with the aid of their front hands placed palmwise on the ground—which is most effective and requires no modification whatever, or else he would revert to the quadrupedal all-fours method which would appear to be easier yet.

A few days ago I watched a particularly lively chimpanzee running in this semi-upright fashion with hands to the floor of a large cage. I cannot truthfully say that he was graceful, but I can heartily commend his efficiency. In a straightaway race he would have given a good account of himself before a pack of hounds. It seems certain that under the pressure of danger this animal would never have changed to the upright mode of progression. But if he did change at all, he would, as I have already intimated, revert to all fours, which is far easier and more economical than running man-fashion on two feet. I am the more convinced of this because in two apparently authenticated stories of the Mowgli type the feral human being ran with incredible swiftness, *on all fours*. This brings us back again to the question: What sort of an impulse drove the nascent human race to the upright position? I can see nowhere a satisfactory answer to this question except to admit frankly that this is one of the many coördinates of his being and becoming human. The adoption of an upright mode of carriage cannot be isolated as the real cause of the other vast structural changes involved in the becoming of man.[1] Certainly it cannot be put back of the psychical modification, which is the real and fundamental distinction of man. In other words, we are forced to the conclusion that the upright carriage and modified bodily structure of man including his cerebral increment, is the token and result rather than the cause of his being human. The psychic factor is creative here. At any rate, an unguided mechanical process does not account for this revolutionary and purposive change upon which the whole distinctive history of man turns. The full meaning of this point will be brought out in the tenth chapter. This conclusion is supported by other considerations. The problem of transition from lower to higher forms is complicated by the undoubted fact that the simpler and the more complex forms survive side by side under practically the same conditions. There is, therefore, no evident reason why there should be any such modification or advance in complexity at all—inasmuch as it multiplies danger. Another complication—which really suggests to my mind a rational solution of the whole question of adaptive modification—appears in this connection. Professor Brooks (*op. cit.*, p. 10) asks this question: "Is there any evidence that any change which is due to nature, from the segmentation of the egg to old age, ever takes place without a stimulus, or are the actions which are due to nature ever beneficial, except so far as the environment is, on the average, like the ancestral environment?"

He answers his own question thus: "The essential point is that, whether they know it or not, the changes in living beings which are directly due to nature are beneficial only so far as the conditions of their life are, on the average, essentially like those in which the lives of their ancestors were passed."

In other words, whether or not a given environmental

[1] See fuller discussion of this point in Chapter X.

stimulus calls forth a beneficial variation depends upon whether the strain which it places upon the heredity factors is bearable or not. No adjustment between organism and environment can be wholly mechanical and also assuredly beneficial. Professor Brooks says (p. 13): "The order of nature presents infinite diversity, the different ways in which events can be combined are innumerable, and no natural response [by which he means *mechanical* response, see p. 11] can be judicious or beneficial under all circumstances. We accordingly find, in all the living beings we know best and are intimately concerned with, a wonderful provision of their nature, by means of which those of their actions [mechanical or instinctive or independent or experience—see p. 11 again] which are most apt to mislead are improved and perfected and developed by normal use, so that we are no longer able to tell what they will do from knowledge of their nature alone, since their actions are in part dependent on their training and experience and on their individual contact with the world." This suggestion—that living beings are modified through experimental and, so to speak, mental adaptation to environment—that the real factor of change has been this seeking for new experiences, opens a fascinating realm for thought.

Professor Conklin (in the unpublished ms. already mentioned, entitled, "Mechanism and Vitalism") says: "Nevertheless mechanistic explanations of life and fitness and purpose are not complete, and many things are left unexplained. For example, the mechanism of trial and error by which Paramecium avoids extremes of heat and cold is based upon its ability to discriminate (differentiate) between favorable and unfavorable, satisfactory and unsatisfactory conditions. In some of the simplest forms of living matter as well as in the most complex this capacity exists, and for the present at least it cannot be accounted for on mechanistic grounds." This same mysterious modifying psychic factor is seen widely operative in nature. For example, among ants it is quite unmistakably clear that since certain types of polymorphism "have been developed by psychically highly endowed social insects, it cannot be adequately understood as a mere morphological and physiological manifestation apart from the study of instinct" (Wheeler: "Ants," p. 117). In other ways also it is equally clear that modification of instinct precedes and conditions changes of form and function. Thus, again, as in countless other instances, we are forced back upon the original constitution of living beings in order to explain their behavior. As Professor Conklin says (in the same connection as above): "Thus in our mechanistic explanations of fitness, we put in at the beginning what we get out at the end, namely, a capacity to discriminate (differentiate) between the fit and the unfit, and a tendency to retain the one and to eliminate the other. 'It is because living things are irritable, registrative, persistent, variable, that they have been able to evolve in adaptive ways' (J. A. Thomson), but we cannot explain the fact that they possess these qualities. Thus here as in all mechanistic explanations, we introduce in our causal facts the equivalents of the things which we seek to explain." Professor Wilson ("The Cell," p. 433) states the same truth in another way when he says: "The origin of that coördinated fitness, that power of active adjustment between the internal and external relations which, as so many eminent biological thinkers have insisted, overshadows every manifestation of life—the nature and origin of this power is the fundamental problem of biology." It will be necessary to follow these considerations further, almost at once; but first, let me suggest, that by way of a review of this phase of our subject, we attack in rather synoptic fashion, but with sufficient thoroughness, the problem of the origin and development of angiospermous (true flowering) plants. This is one of the most interesting and fascinating of all the problems of natural history and one upon which an immense amount of investigation, thought and ingenuity has been expended.[1]

According to our authorities, angiospermous plants appear first in the lower cretaceous beds, in comparatively small numbers and variety. Thereafter they increase with great rapidity until they predominate throughout the world. As Scott ("Evolution of Plants," p. 40) says: "In the beds below, angiosperms are altogether absent, so we seem to have got back here to their first appearance, and, indeed, there are no older trustworthy records of their appearance in any part of the world." The reader will recall that Professor Bateson in his famous Toronto speech based his assurance that modification has actually taken place, for one item, upon just this fact concerning the appearance of flowering plants. Professor Scott, on the other hand, looks upon it, and rightly as I see it, as a serious and perplexing problem. He says (p. 40): "This apparently sudden appearance of quite well-developed Flowering Plants is still, perhaps, the greatest difficulty in the record of evolution." He likens this appearance of flowering plants to the equally sudden appearance of man among the animals and correctly estimates it to be one of the major events in the history of life. Let us examine the case.

All true flowers have a common basic structure so that scientists have no great difficulty in supposing that they all are derived from certain common progenitors. Beyond this the evolutionary hypothesis involves the assumption that flowering plants are modified descendants of some related non-flowering or cryptogamous plants. The inductive argument for this derivation would naturally rest upon intermediate forms of which there is a rather scanty supply. Moreover, there is some difficulty in accounting for so great and apparently so sudden a change in the method of reproduction which involves profound general modification of structure without some very powerful external stimulus.

1 See below, Chapter X, for Professor More's discussion of this point.

In this exigency, the scientists resort to the supposed modifying influence of bees and wasps which, by a strange coincidence, to say the least of it, appear or seem to appear just before the flowering plants. Professor Scott says (*op. cit.*, p. 43): "This change [in plant life] doubtless chiefly depended on the simultaneous development of the higher forms of insect life." Here we note a most interesting cycle of relationships as well as a most complex biological problem. We have (1) a development of the flower for the insects. There can be no coöperation between the flower and the insect until the flower can attract the insect and feed him. (2) There has been a development of the insect by the flowers. Scientists have observed or inferred a modification of the mouth-organs of the insects (with accompanying changes) for drinking nectar. (3) There has been a modification of the flower by the insect of two kinds: mechanical, in changing its form, and vital or physiological, in hybridizing and multiplying varieties. (4) In this process, there have arisen an infinite variety of methods toward the same end. And just at this point, the evolutionary formulas show a tendency to slip out of mesh and to lose their grip upon the specific complexity which arises altogether apart from the resulting variations. For example, if the struggle for existence, natural selection and the survival of the biologically fit through adaptation account for the resultant organic diversity, by and large, how are we to account for the infinitely manifold ways in which adaptation is accomplished? So far as observation goes, in every instance, antecedent variety has developed into subsequent variety, and each unitary starting-point for new diversity is one member of a preceding diversity.

And the methods of obtaining that diversity are as manifold as the diversity itself. For example, the different ways in which plants are cross-pollinated by the action of insects form a most absorbing study. An interesting case comes to mind in connection with one of the clearest instances of true evolution that I know of. Lovell ("The Flower and the Bee," N. Y., 1918) instances, as an illustration of the manifold devices to be found among flowers for cross-pollination, the *Pea family* and *Wort family*. In the former, the stamens are long and project beyond the corolla. As a result the stamens are pushed down by an alighting bee, and the *thorax* of the insect is dusted with the pollen. In the Wort family the stamens are short and contained within the corolla. In consequence, the bee enters beneath the stamens and pushes upward, meanwhile getting his *head* dusted with the pollen. Both flowers were wheel-shaped in the beginning.

Three interesting questions at once arise here—no one of which appears to be answered by the evolutionary formulæ. First, was the bee responsible for the differentiation from the original type toward the developed form? Second, if so, what brought about the original difference between the primitive pea and the primitive wort? Did the bee bring this about? Third, why did the work of the bee result in the very different structures and different methods of pollination which appear in the developed pea and wort? In these two instances, starting near together, modification, under the same influence, has taken place in very different directions. The same formula cannot account for the specific difference. Lovell says, in answer to the above questions, that when flowers stand horizontally the bee lights on the lower side of the corolla, with the result that several of the lower petals are transformed into a lip which becomes a landing-stage; thereupon the upper petals become a sheltering hood (as in the well-known case of the Turtle-head). Lovell emphasizes the fact that in every case of difference in result, the antecedent condition—that is, the form and habit of the original flower is different. Hence an infinite variety has been produced. He quotes these lines:

"We are groping here to find
What the thought which underlies
Nature's masking and disguise,"

and asserts that color, form, nectar, guiding lines to nectar, devices for transferring pollen are *all ultimate facts,* which go back to the general beneficent trend in Nature. Scott (*op. cit.,* p. 174) states the problem from the viewpoint of evolution when he says: "It must be acknowledged that nothing is more difficult than to find out why one plant equips itself for the struggle with one device, and another attains the same end in quite a different way." Bergson says: "The Darwinian idea of adaptation by automatic elimination of the unadapted is a simple and clear idea. But, just because it attributes to the outer cause which controls evolution a merely negative influence, it has great difficulty in accounting for the progressive and, so to say, rectilinear development of complex apparatus, such as we are about to examine. How much greater will this difficulty be in the case of the similar structure of two extremely complex organs on two entirely different lines of evolution" (*op. cit.,* p. 56). This argument is still more effective in a case of structural coevolution as instanced in the text.

And, taking the relationship between plants and insects in the broadest possible way, no one can possibly be blind to the fact that the process is too complex and too evidently purposive to submit to mechanistic explanation without the hypothesis of guidance. Here are two separate streams of tendency in originally unrelated forms of life which must approach each other, *along separate lines of development,* sufficiently near to bring them into a common relationship of mutual service. The plant must have developed without the aid of the insects to the point where it could attract and satisfy the insect, and the insect must have developed without the plant to the point where it could use the flower for food. And if both began at separate points—the plant when it had no apparatus for feeding the insect and no use for the service of the insect, and the insect where it had no apparatus for feeding upon the plant and no desire for anything the plant could supply, their coming together and mutual adaptation for a life in common—the plant meanwhile desiring nothing but to be pollinated and the insect desiring nothing but to be fed—where the feeding and the pollination are parts of one coördinated process, the attempt to interpret this without purpose is condemned at the outset as impossible.

We are compelled to admit that, from the mechanistic viewpoint, the process is unintelligible. It is simply impossible to see widely separated threads thus drawn together and woven into an intricate and yet orderly pattern without recognizing what Lovell calls "the beneficent trend in nature," on a world-wide scale. And no *generalized* formula of struggle, selection and survival can explain the process with all its inner and constructive diversity—not only of result but of method. Moreover, the vital matters of origins, advances, creative transitions, upward and forward steps, are not taken care of. When, for example, Professor Scott says that the rise and progress of angiosperms were due to their adaptation to contemporary insect life, he appears to confuse two entirely different problems which refuse to submit to a single formulation. If by "rise" he means, as seems evident, origin by differentiation, then insects could have had nothing to do with it, for there is no reason why insects should have had any intercourse except of the most incidental sort with non-flowering plants. Nor is there any reason to think that the insects would have any modifying influence upon plants in advance of the appearance of flowers. Beside, there could be no utility in the activities of insects in advance of the sex-differentiation which makes cross-pollination useful. When, however, the mechanism of pollination had once become established, together with devices for attracting insect visitors and making use of them, and when the active experimenting instincts of the insects had led them to try to find satisfaction in feeding upon the nectar of the flowers, the spread and triumph of flowering plants could be reasonably explained according to evolutionary principles. "Progress" in this restricted sense could be explained thus, but not "Rise." But this leaves the origin and development of the flowering mechanism and the establishment of the mutual adaptation between insects and plants outside the evolutionary explanation.

A theory of development which is a mode of interpreting a phase of nature's history—can never explain the origin of that which is necessarily antecedent to the history, because it forms the subject matter of that history. Only by a singular violation of logical principle can the origin of angiosperms be explained mechanically by an adaptation which operates proleptically before it comes into being. Insects cannot modify flowers until there are flowers to modify which are subject to modification; and flowers cannot attract insects without insects that know and are fond of nectar. The two members of this coöperative association are necessary to its realization, but neither can be modified by the association until it has been established. In turn, the association cannot be established until both members are fitted for it. Both members of the association exist *in fitness for the association* before the association can be set up. They are prepared for each other before they can be related to each other. In other words, the mutual fitness precedes and conditions the mutual adaptation. The adaptation exists ideally before it exists actually. Therefore until we are willing to admit that there is behind the association of plant and insect a purposive trend in nature which is realized in that association, we have no explanation whatever of the association which actually exists. The process, therefore, is either teleological or unintelligible. The preparation of plants and insects for each other before any coöperation between them could be established, exists only in and for a foreseeing mind expressing itself and realizing its ideas in process.

CHAPTER VII

EVOLUTION AND CREATION

At the close of the preceding chapter we came into contact with what has been termed "the beneficent trend" in nature, by which is meant a directive factor above and beyond as well as within the mechanical arrangement and sequence. This directive factor we could interpret only in terms of mind. I take it to be an inevitable conclusion that wherever the end attained by a constructive process is not actually or physically but only ideally involved in the antecedents—like the music derived by playing from a musical instrument—we are compelled to infer intelligence, the presence and work of creative power at the disposal of foreseeing mind. To illustrate more fully the relationship thus suggested of the mechanical and teleological factors in the life-process, it is purposed to review with some thoroughness certain aspects of the work of Luther Burbank. The significance of this great experimenter's work for our purpose lies just in the fact that he *is* an experimenter and only secondarily a theorizer. Burbank has had more actual experience with plant life than many generations of ordinary scientists, and particularly in the direction of organic modification, or what may be termed "experimental evolution." His observations and deductions throw light upon practically every phase of the problem of evolution. Let us first take up Burbank's story of "How the Cactus Got Its Spines."

The experimenter's surmise was that originally the cacti had no spines, but that when animals appeared to feed on and thus destroy them, they developed spines in self-defense. ("Methods and Discoveries," Vol. I, p. 12, *et passim.*) He felt that it was only necessary to protect and cherish the cactus in order to bring about a reversion to the original spineless state, inasmuch as "it could only be the long continued danger of destruction which could have produced so radical a means of defense." Then follows the story of how, by planting a thousand cacti, Burbank reversed the process of evolution; turned back the clock of time several thousand years, and brought forth a new race of cacti "without the suspicion of a spine," etc. As a scientific explanation, in terms of a purely mechanical process, Mr. Burbank's fascinating narrative raises a number of rather stubborn questions. Let us examine the story. Mr. Burbank transformed the established type of prickly cactus by planting, cultivating, and protecting it. The protecting part, of course, contributes nothing in the way of a positive physical force affecting the life of the plant. Keeping enemies away is a purely negative process. On the other hand, in the planting in prepared and enriched soil and in the cultivation of the plant something is done actually tending to modify the plant by changing its environmental conditions.

In Mr. Burbank's explanation, however, the plant responds only to the negative condition presented by its cultivator by abandoning its acquired but ancient and established mode of defense against its enemies. That is to say, having, as the result of Mr. Burbank's protection, no longer any need of spines for defense, the plant ceased to put them forth.

From the naturalistic point of view, there are two incredibilities here. The first one is in the matter of origins. Going back to the time when the cactus, free from enemies and spineless, met a new menace in the shape of devouring animals and threw out its first line of defense, by what *mechanical* means did the presence of animals create the reaction in the form of spines?

Burbank's story of the cactus falls into two parts: (1) the struggle of the cactus to adapt itself to the increasing aridity of its habitat, which is thoroughly convincing; (2) its struggle with animal enemies, in the course of which it developed spines, which is not convincing at all. Here is the story.

Out of a million unresisting cacti eaten down, perhaps a thousand plants, more or less, had stamina enough to throw out new leaves and try again. These new leaves were changed, to meet the new menace, by the development of armor. Now, note the evolutionary method of thinking (*op. cit.*, p. 18). "This armor, at first, consisted of nothing but a soft protuberance, a modified fruit-bud or leaf; perhaps ineffectual in warding off the onslaught of the hungry animals." That is, so far, there was no reason why all of the plants surviving the first attack should not have been eaten. But, let us go on.

Of the thousand or so surviving the first onslaught, perhaps a hundred individuals survived the next attack,—but this time the new leaves were more spiny. Finally, after many repetitions of this process through elimination, survival, and renewed conflict: "There was developed a cactus which was effectually armored against its every animal enemy." This is entirely unconvincing from the mechanistic point of view for the simple reason that no *physical* cause for the chief developmental fact is even suggested. There is no explanation offered why the eaten down plants should have thrown out spines on their new leaves. The only mechanical operation involved is the eating down, and it is not alleged that the eating down directly and mechanically brought about the development of spines. The only explanation offered is the *need of defense,* which is a purely ideal consideration, not a result mechanically involved in the physical factors of the situation. Moreover, to a layman at least, it appears that the spines would have to be there in advance of the struggle in order to do very much good. A slow-developing protection, extemporized so to speak, in the heat of battle, could have only the most problematic influence on the outcome. In addition, the *tendency* to produce spines and the ability to produce them under any sort of external stimulus, would belong to the original constitution of the plant. Not all eaten-down plants produce spines in self-defense, and not all spiny plants are sufficiently guarded against foes. For example, interesting sidelights are thrown upon the relationship of plants to browsing animals in the following statements:

"The various protections of vegetation from the hunger of animals in this wilderness are notable. The *retew* has become so bitter that camels will not eat it, and I only saw it attacked by groups of kids, standing on end about it and eating the flowering branches. The more general defense is thorns, and the acacia, or seyyal, grows thorns like spike-nails, which might be thought to defy attack. But the camel has grown a mouth to correspond and browses placidly on the thorns without hindrance" (Petrie: "Researches in Sinai," p. 29). How, then, are we to account for the survival of the acacia? Here, adaptive modification works both ways, for the protection of the plant and for its destruction.

"Two qualities stood out in the flora, the predominance of spiny and thorny plants, and of those with thick, fleshy leaves or stems. All the coast lands were semi-arid, rain falling only during two or three months, and then but sparingly. So it was easy to account for the plants which hoarded water within their tissues, for not a rainy, but a rainless day. But although the thorny plants had been here so long that they were peculiar to the Galapagos, none had lost its guardian coat of spines, despite the fact that on most of the islands there were no grazing animals" (William Beebe: *Asia,* Nov., 1923, p. 812). Why should not these "protected" plants lose their spines?

The second incredibility of Burbank's explanation lies in the reason alleged for the reversion of the cactus to its former spineless state. The protection from enemies which is supposed to have brought about the abandonment of a defense no longer needed, was, as we have seen, a negative and not a positive influence—an ideal, not an actual physical condition with physical results. An enemy has no existence to a plant prior to or apart from its actual attack, and its absence could have no meaning one way or the other except to permit the plant to go its own way without interruption. If one could interpret the reaction of the plant to safety in terms of intelligence, then one could understand it. Birds and animals react to safety, relax their vigilance and become tame in a sanctuary. But that a cactus would relax its vigilance and doff its armor as a physical reaction to protection is incredible. There is, at any rate, no meaning to his interpretation unless one is willing to admit in nature a *protective trend*—a constant putting forth of energy on behalf of the organism. And this is just teleology.

As a matter of fact Mr. Burbank's whole conception of nature is teleological—so much so that one suspects that if his views were held by a theologian instead of a scientist, they would be considered somewhat naïve.

I do not here refer to his firmly expressed belief in "a higher power than man," a belief which does not prevent him from being a thoroughgoing evolutionist—but to his actual interpretation of nature.

All of Burbank's thinking on the problem of life is conditioned explicitly or implicitly by the "Scheme of Things," which might otherwise be called "The Divine Order." "In Nature there are no accidents, no lapses. Everything that is, is a definite part of the 'Scheme of Things'" (p. 182). On the other hand, Nature is a great Experimenter: "Nature herself has no hard and fast mode of procedure. She limits herself to no grooves. She travels no set schedule." "She gets one success out of a million tries." Therefore, laws are "man-made." We note, however, that varieties are "the product of fixed laws, never of chance." It is necessary to discriminate here; otherwise our author would be betrayed into contradiction. What he means is that Nature's regular order, *as we observe it,* cannot be erected into a fixed mode of procedure, an invariable and necessary sequence (as for example, the alleged sterility of hybrids) for the reason that such sequences are occasionally if not frequently transcended. "I like to think of Nature's processes as endlessly flowing streams; streams in which varied streams of heredity are ever pouring down through beds of environment; streams which, for ages, may keep to their channels, but each of which is apt at any time to jump its banks and find a new outlet" (p. 213). Therefore, he holds, that "the science of life is not an exact science" (p. 243).

Turning from this rather poetical description to plain matters of fact, we find the following principles developed from his work and observation.

1. No two living things in nature are alike and occasionally this unlikeness forms the basis of possible new beginnings—for example, among a million California poppies he found three that had a decided tendency to break away and found a new race.

2. Occasionally these breaks are violent leaps in which "freaks" or "sports" are produced. These productions are the outcome of Nature's constant experimentation in which individuals diverge to new paths of development, leaving the great mass of any kind unchanged.

3. Nature takes great pains to fix, preserve and make permanent the characteristics of each of her races or kinds.

4. When such a break comes: "Nature is always alert to prevent the break, unless it proves itself an advance, an improvement, from occurring" (p. 298).

All this interpretation of the source of variation rests upon Burbank's deep conviction that the only real unit in organic nature is the individual not the species, and that the latter are wholly mutable and "dependent for their apparent fixity solely on the length of time through which their so-called phyletic characters have been ontologically repeated" (see Kellogg: "Darwinism," etc., pp. 31 ff.). Therefore, mutations occur whenever a special stimulus can be brought to bear upon them. There is no sharp line of distinction between so-called Darwinian or fluctuating variations and those which are of the nature of "mutations" (DeVries) or discontinuous variations or "sports." So-called "new qualities" are "new combinations" of old qualities, both latent and obvious, a fact which Burbank takes to be proof positive that acquired characters are transmissible (Kellogg: *op. cit.*, p. 314). According to Kellogg, Burbank furnishes "no new categories of variations, but an illuminating demonstration of the possibilities of stimulating variability and of the reality of this general variability as the fundamental transforming factor." Applied to the origin of species Burbank's system is as follows:

A. All wild plants of any species are under almost identical environments having their energies taxed in the struggle for existence.

B. No great variations are likely under such circumstances, and what variations do occur are likely to be stamped out by competition unless specially useful. Occasionally a new variety might arise from a seed chance-sown in a region where a certain ingredient formerly present in the environment is lacking. In this case the variation is pathological but advantageous as (?) in the original "white-blackberry" of New Jersey. (Could not a variation arise through the presence under the above circumstance of an ingredient formerly absent but now present—variation by "stimulation" or "excess"?)

C. Crosses and hybrids are very often found growing wild where somewhat similar species grow contiguously. Among these only the useful survive and become fixed. When man discovers them there are no intermediate links left, if there ever were any, and the survivors are classed as separate species.

D. In cultivated plants the life-struggle is removed and variation becomes the rule.

E. Once a persistent type is thus broken up, "old latent forces may be liberated and types buried in the remote past reappear." So-called atavism is the "concentration of ancestral forces," always coming from individuals in the past.

In order to be a little more specific on the constructive side in the study of Burbank's work, let us carefully analyze his experience in producing the "Shasta daisy." This experiment is particularly valuable for several reasons. In the first place, Mr. Burbank dealt with wild forms fixed in nature. For this reason, the haunting uncertainty about unknown mixtures, always present in dealing with domestic races, was absent. In the second place, Mr. Burbank produced a form which, if found in a state of nature, would have been pronounced a new species, together with many new varieties. In the third place, this experiment of which we know definitely all the steps, throws most interesting light upon the relationship between natural and artificial selection.

In this case Burbank made a fourfold combination.

1. The familiar "ox-eye" daisy of New England (a chrysanthemum—*C. leucanthemum*) which had the desired qualities of hardiness and persistent blooming.

2. The closely allied ox-eye daisy of England and Europe (*C. maximum*). This flower is much larger and more robust than its American relative.

3. The Continental daisy (*C. lacustre*). 2 and 3 bear larger flowers than 1 but are inferior in grace and beauty. Both of them are coarse and weedy and have leaves on the stem, whereas the American form is usually free from leaves.

The first cross of 1 and 2 showed slight improvement over 1 and 2, in being earlier to bloom and more prolific in blossoms, which were also larger; but the flowers were tinged with yellow—not pure white.

4. This led to the use of the Japanese daisy (*C. Nipponicum*) which was distinctly inferior to both 2 and 3 except that its blossom was pure white.

When 1, 2, 3, and 4 were crossed, among innumerable seedlings, one was found with abundant, large, pure white blossoms combining the best qualities of all the parents. This seedling was isolated, and, by selection, fixed to breed true as the "Shasta daisy." We turn now to Burbank's illuminating explanation of this interesting result.

According to Burbank every plant is like a photographic plate which records in its structure environmental conditions through all its past, including the past of its ancestors. These impressions are more or less permanent according to the length of time during which the environment has been uniform. Heredity is, in Burbank's own words (Vol. II, p. 65): "The sum of all the environments of a complex ancestry back to the beginning." What we perceive as heredity in any given instance or in any succession of observed generations, is the element or elements in that complex vital record which have become dominant and fixed by repetition. All four of the daisies combined in the Shasta have a long history behind them, and all go back to a primordial daisy both like and unlike the four. The American ox-eye had a long growth in New England which adapted it for life there. The English and European daisies, in like manner, accumulated their own experience and developed their own types. The Japanese daisy also gained its experience and built up its protoplasmic structure in an environment at the greatest distance in time and circumstances from the other three.

Hybridization, through the mixing of the pollens which carried these modified structures, brought together conflicting tendencies and broke up the established hereditary structure. Burbank, in his own words, brought about "a notable upheaval in the hereditary traits of the daisies." He assumes two things in this explanation.

(1) That all daisies have descended from a common ancestral stock, quite different from any existing daisy and yet directly affiliated with all of them.

(2) That the different races (1, 2, 3 and 4) were evolutionary products that owed their individual traits of stem, leaf and flower to the joint influence of heredity (past experience carried forward from generation to generation) and environment (present experience).

The descendants of the primordial daisy traveled over the world and in the course of that migration were modified and adapted to the various environments into which they came; but the original kinship remains, so that the botanist puts them in the same genus,—they exhibit their original kinship and common origin together with differences in detail due to environment. We have then, for these species:

(1) A common ancestor who possessed the basic traits which reappear in all the descendants.

(2) A radiation of variants from this basic type under the influence of environment.

(3) In the remotest generation similarities which betoken that far-off common origin, and thus yield to orderly classification.

(4) All the variations which appear are hereditary in the sense that they are traits which are found somewhere in the ancestral line.

Burbank holds, on the basis of his unique experience—equal in extent, as I have said, to that of many generations of ordinary observers—that "every trait acquired by any organism through the influence of its environment becomes a part of the condition of the organism that tends to reproduce itself through inheritance" (Vol. II, p. 30). The basis, therefore, of variability is complex ancestry plus the multiplicity of environmental conditions. The Shasta daisy "owes its existence to the bringing together of conflicting hereditary tendencies that epitomize the ancestral experiences gained in widely separated geographical territories" (Vol. II, p. 33). What is the significance of all this for the study of evolution?

Mr. Burbank himself says that Nature never would have a produced the Shasta daisy because it was produced by "artificial selection," but "the forces evoked were those that Nature provided," hence his experiments give an "abbreviated transcript of the processes of natural selection through which species everywhere have been created, and are to-day being created in the world at large" (Vol. I, p. 34).

Here, we need to interpose some careful criticism. In the first place, note that Burbank's artificial selection is different from natural selection in several essential particulars.

(a) Burbank weeded out from his seedlings not those unfit to *survive* through lack of adaptability, but the unfit from the viewpoint of his *ideal daisy*.

(b) Burbank's selection was not merely negative in destroying the unfit, but positive in the sense of segregating and fostering for long periods of time and with discriminating care the selected individuals.

(c) Burbank's selection was directed to the end of combining through the accumulation of favorable variations the greatest possible number of excellencies in a single individual or group as the founder of a new strain. Natural selection, as it actually worked throughout the whole period of daisy-development, resulted in the distribution of excellencies throughout the various species *as though by allotment, e.g.*, stem and hardiness to 1, size to 2 and 3, whiteness to 4. There is no absolute *best* among these plants until Burbank enters and contravenes nature to an end altogether outside of Nature. Natural selection is not disclosed or epitomized in Burbank's work on daisies. On the contrary, natural selection is something wholly different both in method and result. In Nature, qualities are distributed—progress is, so to speak, generalized, and advantages are so dealt out as to make room for the greatest number of survivors. Rarely does any one organism so monopolize advantageous characters as to supersede other forms or to form a new species. If new species in Nature are developed as

Burbank developed the Shasta daisy, we are compelled to suppose a twofold operation, a rhythmic action, by which, first, on occasion, new species are produced and new levels of life reached through concentration or synthesis; followed by a generally static, or perhaps, better uniform condition in which advantageous qualities are widely distributed. This also implies, as indeed Burbank evidently thinks, that Nature constantly works toward improvement, a conclusion which admits teleology into the heart of the whole process.

(d) Burbank's selection made a draught on all the past history of the four strains of daisies, resulting in a profusion of new, odd and beautiful forms, harking back through heredity along the various lines of descent even to the time before the daisies were differentiated from the rest of the Chrysanthemum family. In striking contrast to this, natural selection repressed this exuberance of variation, submerged the greater part of the possible heredity and produced the four comparatively simple and insignificant daisies of Burbank's experiment, eliminated all the intermediate forms, and ended Nature's experiments with daisies then and there,—without apparent tendency to further variation. I cannot help feeling that in this contrast there is a truth of the deepest import for an understanding of natural processes.

In the second place, we note the impressive fact that there is nothing absolutely new introduced in all this startling outburst of creative variability brought about by the experiments. The undergirding of the whole process is the existence of *ancestors*—common to as many differentiated lines as you choose—but always possessed of basic qualities, either inherited or acquired, but in either case built into the constitution in such a way as to be capable of transmission. As the line of descent lengthens out, and the scope of environmental experience broadens, the heredity —which is this experience organically stored up for transmission—becomes more complex; but there is always an antecedent, *an ancestor with qualities to transmit.* Nothing in the way of variation appears anywhere in that line which is not accounted for by the environmental experience of some ancestor near or remote. Burbank, *e.g.,* accounts for the prodigious growing qualities of his "Paradox" walnut by referring to the experience of its ancestors under exceptional growing conditions as far back as the Carboniferous age. He goes so far as to say that one can tell by the habits of a plant growing to-day whether its ancestors, countless ages ago, were crowded or had plenty of room.

Let us now apply the principles involved in Burbank's interpretation of his experiments and observations to the matter of beginnings in the life process. Mr. Burbank himself seems to be a believer in abiogenesis. It is impossible to say whether or not his description of life-beginnings is to be taken as actual fact or as a speculative visualization of the process as he imagines. It does not particularly matter as Mr. Burbank is not on trial for his opinions.

He speaks of tiny living beings, simple cells, "the chemical products perhaps of salty water," nine hundred of which would have to bunch together in order to become visible. Waiving the question of the derivation of these tiny beings, even to the extent of admitting that they were somehow the product of "salty water," what is the nature of the problem presented to us? In the first place, it is evident that we have reached and passed the limits of "organic evolution" in Kellogg's sense and in the sense in which Burbank uses the term everywhere else in his writings. "Salty water" could not be the parent of these tiny living beings in the same sense, or in any like sense, as the far-off ancestor, however unlike in form, of the various daisies, was the parent of its descendants. There is something beside descent, heredity, variation, and environment involved in the process. "Salty water," not being organic, cannot acquire organic experience, is not subject to variation, does not reproduce itself, cannot transmit its qualities. In some mysterious sense, therefore, this transition from salty water to living cells is origination in a way totally different from the origination by descent of all derivative forms of life.

In the second place, again waiving the question of origins and granting the existence of these tiny living forms, the question remains, "What of them?" Are they competent to be the ancestors of descendants such as we know to have followed them in the order and succession of life? Mr. Burbank designates these tiny beings as "simple," but evidently we must not push this idea of simplicity too far. These beings must not be conceived of as being so simple as to be incapable of adaptation and organic commerce with environment in such a way as to accumulate experience and to incorporate it in the form of potential variability. These simple beings must be competent to produce, by a reproductive process, *by descent,* beings higher than themselves or the evolutionary process must stop where it begins. How to get organisms higher, not necessarily as individuals, but higher as races than their ancestors, is one vital phase of the whole problem.

According to Mr. Burbank, the next step in advance was not through internal improvement, but through coöperation, combination, the building up of organization, and the correlation of variability in the direction of improvement. I have no *a priori* objection to urge against this idea as a general proposition.[1] I merely suggest two considerations which should make one pause a moment or two before accepting it. The first is, that the idea that these tiny beings were possessed of the tendency to unite and to enter into combination in such a way as to correlate variation and to achieve advance, together with the apparatus necessary to put this tendency into actual operation, implies a very high degree of complexity in these supposedly simple forms.

[1] But see above, Chapter III, p. 76.

Inasmuch as Mr. Burbank holds that in nature there are no duplicates, every one of these tiny cells must have been related to the others in such a way as to make union between them possible. Moreover, it seems to me that in other respects this passage from single cells, however individual and complex they may be considered, to the multicellular forms of life, is no smooth and easy transition. The "life of the organism as a whole," with its exercise of preëminent domain over its own constituent parts, and the impartation of a pervading common life to its elements, is something so much deeper and more complex than the operations of a colony of individuals, like ants or bees, working to a common end, that it seems impossible to explain it as being built up directly through environmental influence upon individual self-subsistent cells. It seems to involve the somewhat transcendental notion of the preëxistence of the organism in its members, yet unassembled, and the seeming contradictoriness of an operation which is initiated by individuals and yet in the end subordinates individuals to an organization not in existence before the various individuals forming it are brought together.

Wilson says: "While, in the case of the unicellular organism and the germ-cell of the multicellular organism we can look upon the cell as an independent elementary organism or organic unit, the tissue cell [of the higher forms] can only in a limited sense be regarded as an independent unit; for its autonomy is merged in a greater or less degree into the general life of the organism" ("The Cell," p. 59). He says also: "There is, at the present time, no biological question of greater moment than the means by which the individual cell-activities are coördinated and the organic unity of the body maintained; for, upon this question hangs not only the problem of the transmission of acquired characters and the nature of development, but also our conception of life itself." The same authority also says, in further elaboration of this point: "Only in a limited sense can the cells be regarded as coöperating units. They are rather local centers of a formative power pervading the growing mass as a whole and the physiological autonomy of the individual cell falls into the background" (*op. cit.* p. 59, see note and and references). That is, the organism is something more than the sum of its parts even when those parts are conceived of as living units intimately associated and working to a common end. The body is something more than a close-knit community. The organism creates, organizes, and controls its component cells. The multicellular organism is thus an ultimate fact, incapable of being reduced to an aggregation of constituent simplicities. It exists at the outset *germinally* and remains throughout its history *creatively* complex. It cannot be produced developmentally by the assembling of separate parts mechanically fitted to each other—but originates creatively, out of the depths of Nature's resources.

Thus we are brought again to a position in which we have already found ourselves at intervals during the preceding chapters. We face hypothetical starting-points from which we cannot proceed in *either direction*. We are all the time being brought into the presence of creative beginnings which are yet finalities—starting-points which are yet permanent resting-places. For example, in the present instance we cannot grant for a moment that there is any inductive basis for Mr. Burbank's belief that "salty-water" of any known chemical constitution could have given rise to living beings even of the simplest conceivable structure without the interposition or manifestation *at that point* of a totally new type of cosmic energy. Such a result would involve a *creative synthesis* in which the decisive factor or factors (for there must have been more than one) would have to be of a sort hitherto unknown throughout the universe. How could it be otherwise? That the inorganic should under any circumstances become organic would mean either that what has seemed to be inorganic contains higher potencies than it has hitherto exhibited—which implies that it is not really inorganic but potentially organic—or that something new and hitherto unknown, call it substance or force or stimulus, has come from elsewhere in the universe to combine with *our* known inorganic to raise it to higher potencies. That any inorganic substance or compound, the chemistry of which is *known* to us, has in it the hidden capacity to become alive, is utterly beyond belief. Moreover, this would imply that a specific inorganic substance would be changed into an equally specific living being, but that the specificity of the inorganic antecedent could not, being inorganic and conditioned by the laws of the inorganic, have any genetic relationship to the specificity of the organic consequent, since this follows the laws of the organic. Besides, it is utterly inconceivable that any inorganic substance should raise *itself* to a higher potency. Its law forces it in the opposite direction. In other words, the derivation of the organic from the inorganic would be equivalent to creation *ex nihilo*.

On the other hand, if living beings are produced by the creative synthesis of the known inorganic and some hitherto unknown imported force or substance which is not organic, what is that unknown something, how does it subsist, and where does it come from? That there is a coöperative relationship between the organic and the inorganic in operations of living beings is evident; but so far as we know it in actual observation, life is a higher power, *sui generis,* which *creatively utilizes the inorganic.* It is a process or operation which reaches down, seizes and lifts the inorganic to its own level, and, having thus laid hold upon it, controls and directs it on its own plane and to its own ends. That is to say, life—not life in the abstract, but life as embodied in concrete specific living organisms of a definite type of organization—is an ultimate fact, quite as ultimate as the atom or any other reality in nature. There is another reservation, too, which we are compelled to make in this same line. We are no more able to get from the unicellular organism to the multicellular by way of simple mechanical continuity than from the inorganic to the organic. Here again, as we have seen, something actually new appears, namely, the organizing and creative principle of the organism *as a whole.* The multicellular organism, in this sense, is ultimate and underivable.[1] It is not a commonwealth of coöperative cells drawn together by a community spirit. It lives from the center out. As we have had repeated occasion to notice, the organism, in idea and in creative power, precedes its constituent cells and calls them into being through the constructive activities of the germ-cell, which seems to possess an intrinsic tectonic power which it throws into the growing embryo. Every step of embryonic integration is directed, as from a central office, by the germ-cell which builds toward the mature organism as the goal of a complex and yet orderly building process. This power, which is unfathomably mysterious, resides in the germ-cell alone and is purposive and forward-looking in all its operations. It is derivative in that it has come from preceding generations—but it is also, and in the highest sense, creative because it is the agent of an absolutely universal differentiation. We are not to forget that through the whole realm of organic being there appears an unqualified specificity which extends not only to all organisms and to all germ-cells, but also to all the inconceivably numerous constituent elements of all the germ-plasms. It thus becomes evident that mechanical continuity is broken at every one of countless myriads of vital points by *creative differentiation.* This universality of the individual among living beings is the token and expression of creative power and can be interpreted on no other basis. We have reached this point before and will come back to it again. Meanwhile let us follow for the moment another important line of suggestion furnished by Mr. Burbank.

[1] Refer to previous discussion of this point in Chapter III.

Apart from his rather doubtful speculations about origins, Burbank, for the most part, even in his speculations, keeps within empirical limits.

In one particular, as I have already suggested, he fails correctly to interpret the significance of his own operations. This is the more significant because at so many vital points he has furnished us with illuminating suggestions. He holds that in his production, for example, of the Shasta daisy he has epitomized the process of natural selection. This interpretation cannot stand. Burbank's method of selection does not correspond to Nature's, nor, so far as we can judge, is it directed to the same end. Burbank has improvement always in mind. He believes that Nature has also, but improvement according to Nature and improvement according to Burbank are two very different things. This is clearly seen in the contrast between Burbank's daisy and Nature's daisies—between Burbank's plums and Nature's, between any of Burbank's productions and Nature's. Nature's idea of improvement is to get the *best* for a given situation. Burbank's idea of improvement is to get the best absolutely, or from the human point of view. The methods are also different. Burbank's method is to concentrate the best qualities found in all the hereditary lines obtainable, *into one line of transmission.* He improves thus by consolidation. Nature distributes—apparently she would rather have four daisies each with one good quality than one daisy with four good qualities. Nature's improvement is in the line of general variety and adaptability along conservative lines. This, Burbank himself points out. He says for example, that out of a million California poppies (Escholtzia) he found but *three* that showed a tendency to break away along new lines. And how far did they go? If I understand him correctly, merely to the extent of producing a golden in place of a yellow or orange flower. Nature produces immense variety, but always within what we have called conservative limits.

Burbank has shown us by his experiments how new species could be produced by a selective process of the type which he himself employs. But, the point is, even Burbank's method of selection which Nature shows no inclination to follow, cannot be conceived of as accounting for actual organic variety on any monophyletic basis. Much less can Nature's slow and conservative method of development, illustrated by the comparatively rare and sporadic cases of hybridization known to us under natural conditions, be successfully applied as an explanation of organic variety. If organic variety has come about through descent, then, as has been pointed out before, it is a type of descent of which we know nothing in experience—even Burbank's experience. The "great ascent" has been made by some other process than that which we know in the contemporary operations of Nature. Change we know, descent with modification, evolution in that sense, we know; but modification of the sort and to the extent demanded by the idea of progress of the "ameba to man" type, under present conditions or under any natural conditions which we can even surmise as having existed in the past, we do not know. Besides, we are compelled to infer another mode of operation. There is everywhere in the records of the past, evidences of creative power, of constructive and originative energy, of a different sort from that which we see in Nature's uniform working under the established laws of descent.

This conclusion I think is suggested also by other items in Burbank's system of interpretation. For example, his idea that variability, which is the basic condition of evolution, is an excess of the individuality which pertains to every living being. This attaches variability to Nature's creative rather than to her distributive activity. On the other hand, he holds that species, which consist of relatively fixed and similar types of individuals, are formed by the action of environmental conditions unmodified through long periods of time; his further anti-Darwinian conclusion that variation is inversely proportionate to the intensity of the struggle for existence, which is supported by a great body of positive evidence, points in the same direction. The creation of new forms is, so to speak, episodic, with periods of fixity which form the staple of nature's everyday performance. Particularly important and suggestive is Burbank's insistence upon the necessity of seeking in heredity for the causes of variation. He emphasizes with true insight the intimacy between the organism and its environment whereby the whole past of the race is written, palimpsest-like, upon the recording fabric of the individual organism to be brought forth on occasion in variations. This judgment rests upon a correct apprehension of the complexity of the individual in whose constitution hereditary tendencies of uncounted generations are interwoven. This complexity is subordinated to racial or typical unity by the prolonged and steady pressure of uniform environmental conditions—but may be released in exuberant variability through cultivation or other breaking up of uniformity or by the collision of contradictory hereditary tendencies as the result of cross-breeding. Through all this Burbank holds true to his principle that *all* variability is due to heredity. For all that he speculates so freely about primordial organisms dubiously fathered by "salty water," both in his experiments and in his speculations upon them, he never looks for variations for which the actual ancestors of his subjects do not stand sponsor. And here he is on firm empirical ground. The necessity for ancestors to account for their descendants marks the boundary line of evolutionary thinking on the hither side of organic beginnings. Evolution, is, therefore, no explanation of Nature or of Nature's processes. It does not reach back to a true beginning nor does it strike down to a creative causality. It can merely describe one phase or type of natural process. To this position we have been led repeatedly along various lines of investigation. It looks very much like an assured conclusion.

The fact of the matter is, two almost diametrically opposed world-views are current under the auspices of the term "Evolution." Moreover, it is quite evident that these two antithetic world-views draw their support, and are in the way of being logical deductions, from two great ideas both attached to the conception of evolution, but which are really not capable of easy adjustment *inter se*. These two ideas, to begin with the fundamentals, are, respectively, *continuity* and *progress*. According to the former of these two ideas, the emphasis in our interpretation of the cosmic process is upon unity, the balance of antecedent and consequent, the mechanical exactness of equivalence in the successive manifestations of cosmic energy, the absence of leaps, the unbroken nexus of natural causalities throughout.

The other idea emphasizes the fact that the process is one of ceaseless change from lower to higher, from simpler to more complex. From this point of view every differentiation, from atom to solar system, from ameba to man, has been somehow the outcome of process. It has become increasingly clear as we have proceeded, that these two principles are not altogether compatible; that overemphasis upon continuity shuts out progress, and that the admission of progress modifies our views of continuity; and, more significant than all, that different world-views, as suggested above, emerge according as one or the other of these two governing principles is stressed. Professor Pratt ("Matter and Spirit," p. 186) has exactly expressed the difference between these two views where he speaks of the contrast between evolution considered as "a process of continual change in the time-stream such that at certain junctures something genuinely new may arise" and evolution as "a perpetual unrolling of the eternally given, such that each new stage was predictable from the preceding one." The reader will at once perceive in this distinction the key to the continual emphasis laid during our previous discussion upon the necessity for making provision for progress in our interpretative scheme. The evolutionist wishes to bring all changes, even those involved in the development of the highest forms of existence from the lowest, within the scope of one process. This means that the idea of continuity, of mechanical distribution, must be adjusted to the complementary idea of *creative origination.* No conception of development which does not admit of actual origination within the process as well as at its beginning can lead us along the pathway of ascent through which, by constant self-transcendence in successive stages, nature has been brought to her present richness of variety and gradation. Nor will it do to say that these successive upward steps have been brought about by new combinations of preëxistent substances and forces. As a statement of the phenomena of change at any given stage this idea of combination will do very well, but it explains nothing and there are limits to its application. Why such a combination took place at a given time rather than at some other time, how the units to the combination were fitted to each other in advance of their coming together and how they originated in physical separateness but in ideal unity, how mere combination or "creative synthesis" can involve not only *new* but *higher* potencies, are questions which remain quite unanswered. In all such statements, there is a seeming but fallacious verbal continuity which plasters over but does not hide "a creative leap" in the actual process.

Here is what Huxley says: "But expectation is permissible where belief is not; and if it were given me to look beyond the abyss of geologically recorded time to the still more remote period when the earth was passing through physical and chemical conditions which it can no more see again than a man can recall his infancy, I should expect to be a witness of the evolution of living protoplasm from non-living matter." On this sentence Professor Calkins ("Biology," pp. 67, 68) thus comments: "All biologists are practically agreed that living matter originated on the earth's surface from salts and other inorganic matter at a time when conditions of temperature, atmosphere and other physical characteristics of the globe were very different from the conditions to-day. At the present time, while ignorant of the first causes, all are agreed that living matter cannot arise spontaneously from non-living matter, and that all plants and animals come from the germs of their ancestors."

There are two items to be noted in these statements: (1) That living beings could *originate* at some period in the past in a manner totally different from any by which they can be produced under conditions now present and known to us. That is to say, that nature once possessed and exercised a power of origination which has never operated again and has since been lost. Living beings were once produced without reproduction, but ever since have been produced only by reproduction. (2) That this process of origination was due to a special, spasmodic, and unique activity on the part of substances which, though still in existence and operating according to known laws, have never been known to repeat their originative function and are now considered incapable of it. Granting that we have here a true account of what actually happened, it is perfectly evident that an unique, solitary, creative act like this cannot possibly be interpreted under the law of continuity.

To call this "Evolution" is the merest logomachy. To explain an event, which never happened but once, in which substances behaved as they never behaved before and have never behaved since and are now believed incapable of behaving, in which new laws and processes came into being changing the whole fact of nature, by reference to general laws operating before that time and since, is clearly the most violent sort of logical irrelevance. A tremendous chasm in facts has been crossed by a bridge of words and faith. And the violence of the logical solecism involved in the hypothesis of abiogenesis *under physical continuity* is still more clearly shown when we remember this fact: The coming of life has introduced an altogether new type of dynamism into the world process. Where do living beings get the energy which they control and utilize? From the inorganic, by assimilation and metabolism? Very well,—but where do they get the living inner *organic power* embodied in the organization which captures, stores and utilizes the energy drawn from the inorganic? A living being gets its energy for *expenditure* in the life processes (its pocket-money, so to speak) ultimately from the inorganic; but the organization with which it starts out, which is *itself*, organically speaking, and makes this commerce with the inorganic possible, it receives only by inheritance from its ancestors, and they from their ancestors back to the point of origin. This does not flow from the inorganic but from the reservoir of life in organic beings—it resists, conquers, and uses the inorganic. It would seem that there must have been an infinite store of living energy incorporated into the first living beings to allow its transmission without impoverishment from generation to generation. This, as Professor Osborn points out, is the mystery of "germ-evolution"—which is "the most incomprehensible phenomenon which has yet been discovered in the universe."

My fundamental contention through all the earlier pages of this discussion is here brought to a head. Progress, by which the world process moves forward from stage to stage, from beginnings to ends, from beginnings on lower levels to ends on higher levels, cannot be wholly interpreted in terms of unfolding or development. This conclusion, which is tentatively exhibited at every new advance, becomes unmistakably evident when we include that which is the goal of the entire process; namely, mind or personality. A mechanistic world-view logically excludes a duality of process through which alone the reality and autonomy of mind is made possible. Professor Pratt, in the passage already referred to, affirms that the action of mind according to its own "laws" is an undoubted reality in the realm of nature in which is placed the human body. "At many a juncture," he says, "personal will, reason, purpose, interfere with the working of mechanical law and contravene it. Of course, the resulting action of the human body in question will be capable, *after the fact,* of being described in mechanical terms; but it was not caused by mechanical forces or conditions, it was not part of any regular mechanical sequence, and it never could have been predicted by the most miraculously omniscient mechanist, even if he had been in possession of all the facts and all the laws of the physical universe." Such a view of the meaning of personality in its relationship to nature, here succinctly expressed, is necessary if it is to be allowed any reality whatever and the world view necessarily involved in it is of vital importance to the evolutionist. The issue, so far as evolution is concerned, is thus stated by Professor Pratt in a passage already quoted in part: "The question whether such a view is compatible with the evolutionary doctrine will be dependent for its answer upon the meaning one gives to evolution. If evolution be taken to mean a process of continual change in the time-stream such that, at certain junctures, something genuinely new may arise, then evolution and the Dualism of Process are by no means incompatible. If, on the other hand, by evolution we mean a perpetual unrolling of the eternally given, such that each new stage was predictable from the preceding one, that no really new thing is possible and that 'With the first clay He did the last man make,' then plainly we must choose between evolution and Dualism." More than this is true, for on this basis we must choose between evolution and personality in any higher sense than as an incidental or even accidental by-product of physical changes, for, as Professor Pratt says: "Conscious selves and their ways of acting are different in kind from material things and their mechanical laws." Still more, we must choose, as I have tried so often to show, between evolution in this narrow mechanical sense and progress for a process which is merely the "perpetual unrolling of the eternally given" is incompatible with progress.

Plainly, therefore, the only escape from a static universe wherein progress is a figment and personality has no place except, as some one has put it, as "the accident of an accident," is by way of a doctrine of creation, of "purposive origination," the seat of which is to be sought outside the phenomenal succession. This ultimate causality behind a gradually unfolding process which leads from beginnings to ends on ever higher levels, must be before and beyond as well as within the process, for it must be adequate to the whole process through all its stages. The only possible cause which can explain the unfolding of a progressive movement through steps to ends must contain the *whole,* not in the sense of mechanical equivalence, but in the sense of eternal, foreseeing creative intelligence. A rhythmic universe which eternally swings through a cycle of motions back to its starting-point, might conceivably be interpreted as self-existent and mechanically self-sufficient; but not a universe that leaves at once and forever its starting-point and moves toward a goal, progressively realized in every unfolding stage of its unceasing forward movement. From the first stroke to the last, the picture which gradually discloses its inner meaning reveals the artist. From the first atoms throughout all the stadia of cosmic history onward to whatever far-off divine event is still waiting, every advance step conditioned not only by those preceding, as in a mechanism, but also by those still to come as in a drama, reveals the Thinker as well as the Worker—creation as well as development. With this view of creation, Science has no legitimate quarrel. That this is true can be readily shown both by the anti-teleological arguments put forth in the name of science, and by the statements of thoroughly competent scientific thinkers. Let us consider some of these latter first.

Oscar Hertwig, speaking of the limitations of descriptive science ("Die Zell und die Gewebe," III, s. 258) says: "No one can tell through a physical chemical analysis why, at this place or that, under tension and pressure, certain cells form a little beam of bone, why here cells secrete saliva ferments, there have become adapted to the perception of light or sound or smell, or arranged together, form an eye or a labyrinth for hearing or smelling. We can, it is true, perceive and understand that everywhere these formations have relations to the nature which surrounds them, which physically and chemically can be recognized and understood as necessary; but the nature-process itself which has brought them forth, which calls all these purposive formations into life, is to us as unintelligible as a process of feeling and thinking which plays itself out in the apparatus of our senses and nerves." Along the same line is a remark of Wilson's ("The Cell," 2d ed. p. 434): "We cannot close our eyes to two facts: first, that we are utterly ignorant of the manner in which the idioplasm of the germ-cell can so respond to the influence of the environment as to call forth an adaptive variation; and, second, that the study of the cell has on the whole seemed to widen rather than to narrow the enormous gap that separates even the lowest forms of life from the inorganic world." More constructively still, Driesch (*op. cit.,* I, p. 272) remarks: "The power of active adaptation to indefinite changes would imply a sort of causal connection which is nowhere known except in the organism." Professor Conklin (in ms. herein before referred to) says, still more positively: "If such perfect adaptations be attributed to the chance occurrence of favorable mutations, do we not place upon chance an intolerable burden when we load upon it, not only all the wonderful adaptations in such an organ as the eye, but also all the multitudes of adaptations and co-adaptations which exist in every part and function of man or one of the higher animals? Most of all, when we consider the whole course of evolution 'from ameba to man,' from the simplest responses to the development of an intellect capable of studying the universe and its origin, and of recognizing and appreciating the difference between subject and object, the ego and the world, then most of all are we impressed with the thought that evolution has been guided by something other than blind and blundering accident. Evolution has not been an eternal see-saw; it has led somewhere. The fact that organisms can adapt themselves to changing environment is no accident; the fact that environment has so changed as to bring about progress is surely no accident." Professor Conklin also states that "it is impossible to reflect upon this fitness of the environment and indeed the whole order of nature, without recognizing our inability to explain finally such phenomena on purely mechanistic grounds."

The strength of the position occupied by those who hold to a teleological and directive principle in Nature, is shown even more clearly by the arguments of those who oppose the idea. For example, Kellogg (*op. cit.*, p. 325) quotes a statement on teleology from C. O. Whitman. The latter was a strong advocate of orthogenesis (the idea of determinate variation in the direction of improvement) and feels constrained to defend that theory against the charge of teleology. He maintains that orderly variation is no more teleological than disorderly. Moreover, the world is full of order, and all development from the germ onward is "rigidly orthogenetic." Then he argues that if a variation is simply a deviation in the direction in which a developmental process is running, it is not unreasonable to suppose that some deviations would run more freely than others, which would give an opportunity for natural selection. Then whole species may follow a certain line of variation by what may be called gravitation—which means, of course, along the line of least resistance. The development process is a flow of tendency like that of a river. In this stream a gravitational drift may give it a new direction, while evolution is the deviation of a whole species along one or more new lines. Then he puts this question: "And if we find large groups of species, all affected by a light variation, moving in the same general direction, are we compelled to regard such a 'definite variation-tendency' as teleological and hence out of the pale of science." It is worth noting that what Professor Whitman is really contending for is that orthogenetic variation may be due to antecedent physical causes and hence within the realm of science. With that I have no quarrel—but as an argument against teleology it is anything but strong. The figure is fatal to the argument. For what we find or what evolution finds in nature is a series of related variations *up-hill,* in the direction of higher potencies. The stream not only varies, changes its direction, leaps its old banks, but swings *up-grade.* In other words, evolution includes progress and is, therefore, teleological and creative. The answer to Whitman's point is that the necessity of teleology does not press here any more than it does wherever "order," of which nature is full, appears. An orderly variation is no more teleological than uniformity would be —and no more teleological than natural selection—and for the purposes of scientific description, none of these things has any direct relationship to teleology.

On the other hand, it is quite clear that at every point where determinate tendency reveals itself in results not mechanically contained in the physical factors involved, the implication is inevitably teleological. Professor Whitman goes on: "If a *designer* sets limits to variation in order to reach a definite end, the direction of events is teleological, but if organization and the laws of development exclude some lines of variation and favor others, there is certainly nothing supernatural in this, and nothing which is incompatible with natural selection. Natural selection may enter *at any stage of orthogenetic variation, preserve and modify* *in various directions the results over which it may have had no previous control"* (Italics mine). This statement allows considerable latitude to natural selection,—the "sieve" (DeVries) which lets through and holds back, but does not preserve nor directly modify; but, even so, according to Whitman's own statement, it can work only after direction is given by orthogenetic variation. And his explanation after all simply shifts the problem of teleology from the specific instance of determinate variation to "organization" and the "laws of development" which in reality are the very things to be explained. Given a steam engine, its organization and the laws of expansion, tension, and the like will explain all it does; but where did the engine come from? No one maneuver of a company of soldiers is more teleological than any other, but the regular, orderly, and purposeful procedure *as a whole* demands explanation.

How does it happen that we have organization at all and particularly organization of such a sort that, under fixed modes of procedure called "laws of development," it presents favorable variations by means of which through natural selection a world of variety, harmony, beauty and, above all, progress, has been produced? This is the real problem, and the teleologist is well content to take up the question of ultimate meanings wherever science is willing to end its descriptive activity. We do not affirm that any one adaptation or variation is more supernatural than any other. We do affirm that the whole process, orderly, constructive, progressive, leading from means to ends, from beginnings to fulfillments, is creative, purposeful, and in that sense, supernatural.

And we are not to forget that every specific problem in Nature involves the whole meaning of Nature. As Hellicott ("General Embryology," N. Y., 1913, p. 28) says: "In a real sense the problem of heredity thus becomes the same as the problem of development. And the [specific] problem —why the egg of the starfish develops into a starfish, is fundamentally the same as the problem—why the starfish is not a sea urchin; it is the general problem of the evolution of organic diversity." If it were shown that the starfish is a modified descendant of the sea urchin, or *vice versa,* the problem would be no whit nearer solution until we know the why and wherefore of nature itself. For this problem science confessedly has no solution. Evolution leaves it exactly where it found it. As Professor Conklin says (in the ms. mentioned above), "The universal presence of mechanism does not exclude the universal presence of teleology, and yet science cannot deal with teleology, but only with causes and effects and mechanisms; *given* matter and energy with all their *potentialities,* science deals with the succession of events in time, explaining them in a purely mechanistic manner." In other words, *mechanism* and *teleology* are but two ways of looking at the same succession of events, mechanism in terms of the events as events, in orderly succession; teleology in terms of events as the expression of creative power and intelligent purpose, or, as Professor Hocking puts it: "At every point the shapes of nature are but the *intaglio* of the spirit." It still remains true, in spite of, shall I say,—no, rather, *because* of our great gains in the knowledge of nature that the one intelligible final interpretation of Nature is in these words: "Every house hath a builder, but He that made all things is God."

CHAPTER VIII

COMPARATIVE ANATOMY AND BIOLOGICAL MAN

The attempt, the most ambitious detail in the program of speculative science, to include man within the scope of a theory of development applied to organic beings in general, starts out with one tremendous initial advantage which it would be a fatal mistake to underestimate. Within certain debatable limits, which for the time we may safely ignore, man is a natural being and subject to universal laws of organic development.

As an individual, he begins his career as every other sexually produced animal begins, as a single microscopic fertilized cell. From this cell, by a series of rapid, mysterious and incomparably beautiful transformations, including cell-divisions, differentiations and integrations of the most complex sort, which pass through stages of development, opening out from each other like the successive phases of a moving picture, he develops until embryonic maturity is reached. This whole process, in principle, is parallel with that of all other animals of the same class. The individual thus brought to embryonic maturity is born into the world, as other animals are born, thereupon entering into a new period of growth through perfectly familiar physical, chemical and physiological processes, ingestion, assimilation, oxidation, metabolism and the like which are common to the whole animal world. From the ovum to maturity, therefore, man is an organism among organisms, subject to the same laws, controlled by the same forces, and molded by the same processes. And these processes, are, if any processes may be so designated, purely natural, physical, chemical, physiological. Whatever there may be in these words generally they retain the same meaning when applied to man. When Haeckel says that man is *merely* a placental mammal, he is wrong about the merely, but indubitably right about the mammal. Man *is* a placental mammal. Of that there can be no possible doubt or question.

Further than this, man anatomically speaking is quite exactly classifiable animal. He belongs among the quadrumana, and here among the primates. According to the statement of Professor Keith: "Man is a member of that group of mammals we have named the higher primates. He is one of the three families included in that group. The central family is represented by the great anthropoids; man on the one side and the gibbon on the other represent the two other families."

It might be well for us to pause here for a moment and view the facts without prejudice. There is a zoölogical man. So far as observation goes, man (the individual), rises from the ground of nature by a developmental process entirely cognate with that through which other animals of the same class are produced. The outcome of that process is the production of an animal which according to the usual principles of classification, based upon bones, skull, form and structure of the brain and nervous system, teeth, digestive apparatus, specific liability to disease, blood-tests, height, and embryonic history, is definitely classifiable, all dislike and emotional objections to the contrary notwithstanding, with the herein-before-mentioned primates. The situation is even more striking than this statement would lead one to suppose. Professor Huxley says: "So far as cerebral structure goes, therefore, it is clear that man differs less from the chimpanzee or orang, than these do even from the monkeys, and that the difference between the brain of the chimpanzee and of man is almost insignificant when compared with that between the chimpanzee brain and that of a lemur. It is a remarkable circumstance that though so far as our present knowledge extends there is one true structural break in the series of forms of Simian brains, this hiatus does not lie between man and the manlike apes, but between the lower and lowest Simians, or, in other words, between the Old and New World apes and monkeys and the lemurs. Every lemur which has yet been examined, in fact, has its cerebellum entirely hidden, posteriorly, by its posterior lobe, with the contained posterior cornus and hippocampus minor more or less rudimentary. Every marmoset, American monkey, Old World monkey, baboon or manlike ape, on the contrary, has its cerebellum entirely hidden posteriorly by the cerebral lobes, and possesses a large posterior cornus and a well developed hippocampus minor." (Quoted by Darwin: "Descent of Man," pp. 201, 202.) That is to say, man is physically more closely related to certain members of this family of animals than some of the animal members are to each other.

In the presence of these undeniable facts it is argued that the physical kinship of man with the animals in general, and to this class of animals in particular, especially in the crucial matter of his becoming, is so evident, so comprehensive, so manifold and so deep-seated, that it is difficult to see how the added fact, if it be a fact, of connection by descent, can in and of itself add appreciably to the compromising nature of the connection already established by facts that no man can deny.

The fact, that every individual human being, with all his capacities and powers emerges from a minute ovum, brought into being by a physiological process and observationally like hundreds of others so produced, constitutes a problem for faith quite as serious as any reasonable theory of evolution possibly can, evolutionists forcibly urge. Biologists are beginning to feel the strength of their position on racial evolution, over against arguments drawn from religious and ethical considerations: they urge upon us, as I think very justly, that if emergence from the plane of nature by a developmental process necessarily compromises the spiritual position of man, that position is already destroyed by the unquestioned facts of individual ontogeny. As Professor Conklin states the case: "The animal ancestry of the race is surely no more disturbing to philosophical and religious beliefs than the germinal origin of the individual"—a fact which cannot be denied. This sentence expresses exactly what was meant when I said at the beginning of this chapter that the advocates of the developmental hypothesis in its application to man had a tremendous initial advantage. In the facts of individual ontogeny they have a case made ready to their hand. It is an instance in which the principles of one problem seem to be settled in advance by the actual facts of another exactly parallel. In regard to the argument in general, the late George Frederick Wright, who held a thoroughly conservative religious position says: "Upon comparing the bodily structure of man with that of the higher animals associated with him, the argument in favor of a common origin, so far as physical structure is concerned, is almost overwhelming." ("Origin and Antiquity of Man," p. 380.)

On the other hand, the evolutionists are under a certain very significant handicap in the attempt to include the whole man in any general or indifferent process of organic development. Man is undeniably different. He is a new type of animal. Both individual and racial development, however descriptively similar throughout the organic world, everywhere run along lines of uniqueness and in the case of man pass through altogether exceptional phases *en route* and finally reach an altogether new stopping place. John Fiske ("Through Nature to God," p. 82) says: "While for zoölogical man you can hardly erect a distinct family from that of the chimpanzee and orang, on the other hand, for psychological man you must erect a distinct kingdom; nay, you must even dichotomize the universe; putting Man on one side and all things else on the other." Huxley himself has very beautifully expressed the same truth: "Man now stands as on a mountain top far above the level of his humble fellows, and transfigured from his lower nature by rays of light from the infinite source of truth." ("Man's Place in Nature," ch. II.)

This fact of man's uniqueness and preëminence is unassailable—his remoteness from the nearest animal, the plainest, most undeniable fact in the known universe. Science no less than religion is compelled in its own interest thus to maintain man's position. Herein, to my mind, lies the essential falseness to science as well as to religion of Haeckel's position as stated in the previous chapter. He not only misinterprets the process—making it mindless and blind—he also belittles the result, making it futile. He seems to think that man has always remained the germ-cell with which he began—forgetting that he became not only religious, which perhaps was bad for him, but also scientific, which should have been good for him. He also forgot that a mere mammal has no history and no science.

Now, with the terminal fact of man's ultimate uniqueness and supremacy, on the psychical side, some say we do well to be content, affirming merely that the process of development through which man was produced does not account for the whole of him—whatever may be true of man's body.

This is a sort of philosophic or religious shortcut in dealing with evolution and is the usual method of discussion of this sort—but personally I am not satisfied with it for several reasons; some of these will appear later, but others I wish to state now.

My first objection is that by allowing one method of origination to man's body and another to his mind tends to introduce a vicious dualism into the very heart of the creative process. It seems to imply that we need the direct creative action of God to account for man's psychic constitution, but that a lower, indirect, secondary causation will do well enough for his body. Have we any real ground for such a division? I for one cannot accept it. The whole process is divine or none of it is. Evolution is either a mode of the divine procedure, the creative process itself in one of its phases, or else it lies altogether outside the interpretation of theism. This dualistic idea, like every other half-way notion about God, is doomed to failure. We loosen our hold upon God with one hand in order to grasp Him more firmly with the other—with the result that we come tumbling down out of our theism altogether. I have seen it too often to be in any doubt about it.

The second objection to this position is that no thorough-going or consistent evolutionist will be satisfied with this division of spoils. The evolutionist begins at once to build a bridge from the animal mind to man's. By a careful inductive or seemingly inductive method, which we as religious thinkers find it so difficult either to emulate or refute—from irritability or sensitiveness, which is a fundamental attribute of living matter, upward through tropisms, reflexes, organic memory, psychic integration, mental habit to consciousness, intelligence and will, the scientific reasoner spins his subtle web, at first light as air, but seemingly turning to steel in his hands. We shall meet this type of reasoning once and again before we are through—and it is safe to say that one who does not feel its force has never been brought closely into contact with it. However that may be, this thorough-going evolutionism is the only type really worth discussing.

There is a third reason why I am not willing to take the short cut and discuss evolution merely in the light of its psychic outcome in man. The advocates and exponents of Christianity need above all things else just now to come to close quarters with the theory itself, that is, to know evolution as it is developed by its advocates on its own ground and by its own methods. We must know for ourselves what it portends, the facts upon which it depends, and the nature of its interpretation of reality, what it is trying to do, and, above all, the range of its application.

For that reason, I am now to attempt to deal with man purely in terms of natural history—without appeal to any special psychic gifts which he may be supposed to possess.

There are three groups of anatomical facts in the structure and life history of the human being upon which, in addition to the general evidences for organic evolution in the world of life at large, to which the scientists appeal to justify their inclusion of man in the evolutionary scheme. The first group of facts which have been alluded to already will be dealt with more at length when we come to treat of personality. I shall merely summarize them here without pausing to criticize them. They come under the general head of man's physical solidarity with the animals. This means that his structure, even to the matter of constituent cells, is like that of his kin among the animals. His organs, their form, placement and functions are closely analogous to those of the animals. This resemblance extends to muscles, nerves and brain matter. The same cerebral centers, the same nerves, and the same muscles, control the same activities in man's body as in the animal's. The same disorders affect the same parts, and the same lesions produce the same results. "The motor centers for movements of the leg, arm, face, fingers, etc., in the brains of the lower animals, up to the anthropoid ape, have been exactly mapped out by experiments on animals. In the human brain the location of the corresponding motor centers is a duplicate of those in the brains of animals." The facts thus brought out by experiment and those discovered in the experience of physicians and surgeons who deal with the human body "absolutely demonstrate the solidarity of animal life, more especially in the case of the vertebrates, such as fish, birds, other mammals and man, the highest mammal." (Dr. W. W. Keen.) This solidarity of structure and function is taken to point toward community of origin.

The second group of facts come under the head of what Haeckel named "the biogenetic law." This is what is otherwise known as the recapitulation theory. The theory is that ontogeny resembles or repeats phylogeny—that is, in plain language, every animal including man, in his embryonic development, climbs his family tree. During his prenatal period he repeats, in a brief and rapid summary, the past history of his race, back to its beginning in the lower forms of life. This means that the unfolding history of unnumbered ages is reënacted within the narrow dramatic limits of a few weeks or months. The facts upon which this interpretation is based are, of course, not open to question—at least by a layman in science. As the embryologist tells the story of the developing embryo, one after the other of the stages which represent permanent forms in the life history of lower organisms are overtaken and left behind.

By a series of transformations which beggar the liveliest imagination, a single cell not unlike the ameba is multiplied into the complex multicellular organism of maturity; the single heart-pump of the fishes becomes the double organ of the higher vertebrates; gill-arches are changed into the ducts and tubes of heart and lung systems; the intricate central and sympathetic nervous systems develop from a simple median groove in the spinal column, which is gradually filled with neural matter, unfolding and integrating into the brain at the top. These are the stages which are supposed to represent the general course of development of vertebrate animals through ages past—hitherto a basal fact in the evolutionary interpretation.

I am going to deal with this argument somewhat at length because it has important bearing on a matter which I wish to suggest later. Meanwhile, we should attend carefully to a criticism of the theory.

The first step is to make clear that the interpretation of the embryonic facts in terms of the biogenetic law *does not stand the test of careful criticism.* It is, to begin with, a very striking fact that while the embryonic development of man is closely parallel to that of the higher anthropoids even where they differ from other vertebrates, *e.g.*, in the mode of the implanting of the germ, and of the roots of the teeth, and in the order of the rise of the membranes, the human embryo exhibits no simian stage, except in the form of the brain, which has an entirely different significance. Professor Keith in his book on "Man" says: "At no stage does the human embryo resemble the simian." Professor Keith explains this anomaly and other skips in the record of the past which is supposed to be reviewed on the basis of special placental adaptation to *intra-uterine life.* He says: "In a broad way and in spite of special development adaptations the human embryo does recapitulate *some* early stages of evolution."[1] This explanation is not altogether satisfactory—it has the appearance of being invented to meet a difficulty, but the real issue lies deeper. Professor T. H. Morgan of Columbia University, in his "Critique of the Theory of Evolution," has subjected the whole idea of recapitulation to a searching criticism in which he points out its real weakness.

In the first place, he emphasises the fact that on the basis of the most recent theory, that of Weismann and the geneticists in general, all variations are germinal in their origin and are carried in the germ-plasm. This theory destroys the notion that the bodily history of early organisms (even if gaps or falsifications in the record be accounted for as special adaptations) can possibly be telescoped into the embryonic development of their descendants. Incidental bodily characters could not thus become incorporated into the germ-plasm.

In the second place—and I beg you to note it carefully—the contention of DeVries, Bateson, and the newer school of biologists generally, that variations are discontinuous, that is, sudden and direct, has (as Morgan states it) "taught us that new characters that arise do not add themselves to the

[1] Cf. More ("Dogma of Evolution," p. 161) for a strong argument on the meaning of recapitulation.

end of the line of already existing characters; but if they affect the adult characters, they change them without, as it were, passing through and beyond them." In other words, the new characters and forms strike off directly from the starting point, form in themselves termini, and do not enter into the lineage connection to be carried forward along new lines. On the basis of these considerations, Morgan holds that embryonic parallelisms are to be interpreted as "embryonic survivals rather than phyletic contractions" (p. 21). Morgan also calls attention to the fact that the early embryonic processes of all animals, whether closely related or not, are very much the same. "The eggs of flatworms, annelids and molluscs segment in much the same way, though their relationship is distant and dubious." He continues: "The embryos of mammal, bird and lizard have gill-slits to-day because gill-slits were present in the embryos of their ancestors"—a statement which profoundly modifies, if it does not destroy, the biogenetic law. Kellogg also says: "The proof that man is descended from a fish because he has gill-slits at one period in his individual development, is not of the sort to be relied on too confidently." ("Darwinism To-day," p. 18.) Now as to the point immediately at issue, Professor Morgan holds that these facts are "entirely compatible with the theory of evolution"—but does not maintain, as did all the early Darwinians, that they *prove* evolution. He holds that the theory of evolution without the support of this biogenetic broken reed can stand with sufficient firmness on broad grounds of inherent reasonableness.

My point, however, is that embryonic parallelism does not prove *close* kinship or even kinship at all and must not be used as an argument for common descent. But I am not through with this biogenetic law yet. Here is another group of facts.

Attention has been called to the striking resemblance in appearance and action between the *cuthidia lepticordis* (a flagellate parasite of U. S. A.) and the spermatid (a phase in the development of the spermatazoön) of the rat—where no evidence of kinship by descent can be found.

Professor Ritter, who instances this case ("Unity of the Organism," I, p. 334), says: "The only ground for supposing descent in this case is the resemblance itself." Ritter explains the undoubted resemblance by what he calls "the well-known and widely operative fact of parallel adaptive modifications in development" (p. 338). He cites also the resemblance between the heart-muscle of the horseshoe crab and that of the vertebrates "where," he says, "there is scarcely a glimmering probability that the resemblance is due to descent." He also adds that innumerable other like instances could be adduced. There is, therefore, a parallelism of development among living forms not due to descent, a certain inevitable resemblance in the details of structure and life-history between unrelated organisms which are subjected to the same environmental conditions and thus compelled to live under like circumstances. We shall remember this later.

A third, and as matters now stand, a much stronger line of argument than that just instanced, is drawn from what are known as "vestigial structures" in the human body—organs or parts of organs in man which are no longer in use. These still remain as remnants apparently indicative of earlier and abandoned modes of life. The human body has been called "a bundle of reminiscences." Two hundred such structures have been enumerated.[1] They may be roughly divided into two classes:

1. Those structures which man shares, not only with his nearest of kin, the anthropoids, but with the vertebrates in general, some of them seemingly carrying us back to the dragons of the Prime.

2. Those structures which are vestigial both in man and the anthropoids, such as the nictitating membrane in the corner of the eye and what is known as the organ of Jacob-

[1] Cf. Lane: "Evolution and Christian Faith," p. 32.

son, a sort of auxiliary nose in the roof of the mouth which appears occasionally; hare-lip and divided palate which are ascribed to arrested development on the animal level; the *supracondyloid* process, a little hook of bone above the elbow, which is a reptilian feature and appears in about one person in fifty; the *azygos* lobe of the lung, which is a quadrupedal feature; a temporary arrangement of the internal organs after the manner of the four-footed animals, which appears and disappears in the human embryo; and finally, that jestful subject, the tail, which with all muscles attached also appears and is absorbed in embryonic development. The contention of the evolutionist is that these organs which are apparently useless are historic and point to the fact that man's body has been thus transformed largely by a specific process; that is, by the adoption of an upright mode of carriage, which has been obtained at some cost of efficiency. One enthusiastic biologist has asserted that practically all the ills to which human flesh is heir are due to two causes, our upright carriage, and our civilized and unnatural habit of wearing clothes.

Of the three groups of facts, thus hastily summarized, the second has apparently lost its force, as a *separate* argument, even among scientists. It remains however as a detail among the many facts which indicate the close parallelism in the life history of man and of the animals.

This parallelism we all admit. The question now to be considered is whether this parallelism establishes the doctrine of descent. It is quite clear, first of all, that it is primarily a scientific question. If true, it is a physical fact. As a scientific question it must be decided on the basis of scientific evidence. It is a vain undertaking to confront what purports to be physical evidence with a transcendental formula like the doctrine of creation. Such a proceeding can lead to nothing but intellectual confusion. If the doctrine of descent can be refuted by scientific evidence, very well and good. It certainly cannot be overthrown by assuming the truth of creation and then framing a dogmatic definition of creation so as to exclude descent as a modal description of the physical process involved in it. It is quite legitimate to urge that the scientific evidence falls short of being a demonstration. Careful scientific thinkers have pointed out this fact. In such cases demonstration is impossible. We are shut up to probabilities. It is also our right and duty to urge caution in view of the difficulties which beset the theory. These are many and serious. We should not forget, however, that no scientific theory is ever discredited solely by the fact that it presents difficulties unless those difficulties are greater than any which are involved in some rival theory. If the doctrine of a special and isolated creative act is the only alternative which can be presented to offset the descent theory, then, from the viewpoint of science, our case is lost at the outset because we can present no physical evidence in its favor.[1] The only source from which such evidence could be procured would be *the body of the first human being,* confessedly beyond our reach. The utmost that we can do is to show that the idea of special creation is compatible with the evidence which is offered to prove that man's body is of the animal type and has undergone transformation from one form of life to another, which leaves us in an altogether unsatisfactory position, with the probabilities weighing heavily against us. And this is only the beginning of difficulties.

In attempting a refutation of the doctrine of descent by a special form of the doctrine of creation, we are saddling ourselves with a hopeless task, for the case can never be made conclusive. Moreover, we are led into other complications which are specifically theological and interior to the doctrine of creation itself. Unless the doctrine of creation can stand *alone* without support drawn from doubtful conclusions as to the specific mode of its application *in certain cases,* it is doubtful whether it can stand at all.

[1] Cf. Morris Morris: "New Light on Genesis," Chapter I.

I very seriously question whether the idea of special separate creation corresponds to any fact in nature or to any truth in theology. From the point of view of science at any rate, it is a conception which is sure to meet unrelenting opposition. The sentence from Professor Lindsay, an ardent and thoroughgoing theist, quoted in the first chapter, is evidence enough on this point. The following from Professor Patten is still more specific: "Science, therefore, finds no time or place, or thing set apart and alone sanctified by one instantaneous, all embracing creative act. Cosmic evolution and organic evolution, the growth of suns and stars, of earth and plant and man, are continuous parts of one process. The more formal chemistry of earth and sea and air; the flowing chemistry of protoplasmic cell and organ; the molding discipline of associated nerve and muscle, eye and hand; the alchemy of associated lives in nature's household—are but different phases of one continuous, all-pervading process of creation." ("Grand Strategy of Evolution," p. 30.)

My question is: Is theism prepared to contest this statement in the interests of the uniqueness of man? If God is the creator of all things, is it necessary to assert that He has created some things separately? That there is a specific operation of creative power in every specific thing in the universe one may well believe; but that these specific integrations necessarily involve separate acts or are focused uniquely upon isolated points, is surely unnecessary. Are there *degrees* of divineness in God's creation? Is it conceivable that any creature should be brought into being without conditions and apart from environment, or without antecedents or in unrelated isolation? There is no hint of this in the Bible, and no gain to theology can possibly come from so indefensible a notion. This digitary idea of creation seems to me dangerous to theology as well as offensive to science. Moreover, it has special difficulties with respect to man. It really defeats its own end. The doctrine of isolated creation goes too far and proves too much. It always accompanies or is part of a general theory that creation forms, that is, *initial* forms are final forms not subject to modification, which is manifestly untrue. It is usually attached to a notion of specific rigidity which has no standing. As a matter of fact, where are we to draw the line between a first form separately created and a derived form mediately created? Surely the distinction does not involve the idea of creation itself which is involved in both forms. Can we measure the exact degree of likeness or unlikeness between the first and last members of a long line of descent and attach the idea of separate creation at every point where change enters in and a new form or type appears? Moreover, another difficulty at once emerges. If separate creations are necessary to account for specific characters throughout the world of life, the idea gives us no particular aid or comfort in solving the problem of man's uniqueness. He is thereby made no more unique than other specific forms. If we attach the notion of separate creation to uniqueness we must logically extend it to every created form, for, as we shall see, every living being is in a very real sense unique.

Again, any advantage which might be derived from the doctrine of separate creation on behalf of man, is immediately swallowed up by the fact that, by hypothesis, it happened but once—on the appearance of the species—whereas, in the case of man, the really significant thing is not the species but the individual. But, if we carry the idea of separate creation to the individual in unqualified creationism, we do it in defiance of heredity, meanwhile reducing the racial tie to zero; whereas if we hold that God created the whole race in its first individuals, we are at once entangled in a network of difficulties and are compelled to suppose that the value of the initial separate creative act is extended to all other members of the race through natural generation, that is, *mediately,* which surrenders the whole case. More than this, in urging that a special and unrelated creative act is necessary to account for man, we are compelled to hold that the Bible bases his uniqueness upon that fact, which is nowhere stated or implied. In addition, I would venture to urge a consideration—not at all a proof, but a probability of a sort which has had a very powerful influence upon my own mind. The idea of the separate and unrelated creation of man involves the idea of a jump directly from the inorganic to man, which would seem to involve the loss of all that had been gained through the process of organic development—an enormous, and, as I see it, an unbelievable waste. Man is, according to this idea, connected at once with a highly specialized organism without incorporated organic experience or instinctive aptitudes to free him from entanglement with the physical which he must direct and control with a new and untried instrument—his reason. There is too much evidence to show that the way had been prepared for this dénouement and an instrument elaborated for man's higher use to make this position comfortable. By what process this prepared organic instrument has been made a part of man's inheritance—the basis and condition of his higher development—is the problem. The question now resolves itself into this:

Is there any solution of this problem which can take up into itself and harmonize the ideas of *creation* and of *derivation,*—man's kinship with the animals and his unique preëminence as a spiritual being?

Professor Royce has stated his position on this point in a very suggestive and striking sentence. He says: "For my part there lies in all this discovery of the day, the deeply important presupposition that the transition from animal to man is in fact really an evolution, that is, a real history, a process having significance." ("Spirit of Modern Philosophy," p. 291.)

This affirmation is grounded upon a broader judgment as to the world-process in general which precedes it: "The mystery of the world is for us through and through a spiritual mystery. This great order is once for all divine" (*ibid.*, p. 270). A formula such as this enables us to assimilate any fact in nature or life. Simply as a fact it is identified as an element in the divine order. We can, at least theoretically, make the animal origin of man a part of our systematic interpretation of the whole process as a spiritual mystery just as soon as it verifies itself as a fact. In this system every *fact* is a *spiritual* fact. But is there any *empirical* basis for the idea that descent, if proved a fact, can be interpreted as belonging to a divine order? Will it submit to interpretation as a spiritual mystery? A careful analysis of the implications of descent in the sphere of undisputed application—in which it is an undoubted fact of the actual order—may help us at least a few steps on our way. All men, since the first members of the race appeared, have been brought into the world by what we are accustomed to call "natural generation." What is the purport of this fact?

Without attempting to formulate any of the deeper mysteries involved, and confining myself to simple description, I wish to point out certain general principles involved in the reproductive process.

W. E. Castle gives a definition of heredity which is accepted and amplified by Ritter. "Heredity," Castle says, "is resemblance based on descent." On the other hand, from the point of view of the parent, heredity is the transmissive property by virtue of which organisms stamp their posterity with their own likeness. Heredity is the function of order among individuals in organic nature, which controls reproduction in the direction of stability. If the operation of heredity were always absolute and unqualified, there would be no appreciable variation from one generation to another—the whole history of organic beings would be written in terms of the likeness between parents and offspring. Descent would offer no explanation of organic variety whatsoever. Evolution would be impossible if the life stream should thus be made up of linear series of like beings without end. On the other hand, so far as individuals go, the sway of heredity is never absolute. No organism ever reproduces *itself*. If we are to follow experience, the reproductive function carries with it the attribute of variability. Moreover, the play of environment enters even the germinal life of the organism, the conditions of life incessantly vary, and in varying, demand a certain amount of modifying adjustments on the part of the organism. Hence the similarity between parents and offspring is never absolute identity. There is, therefore, in every generation, the production of unique individuals, a real break in continuity, the appearance of that which is new, the ultimate source of which is to be sought in the creative power behind development from which Nature herself came. Professor Conklin says: "It is one of the marvelous facts of biology that practically every sexually produced individual is unique, the first and last of its identical kind" ("Heredity and Environment," p. 16). As Professor Patten puts it: "Creation from the scientific point of view is the birth of new things through the mutual services of preëxisting things." . . . "The ceaseless flow of creative services is evolution, and evolution is serial creation." All new things are unlike any of their constituent parts—"hence, they can be *measured,* or *compared only in terms of themselves*" (Italics mine). "The only attribute common to all of them is their inherent power to grow, or to create more new things" (*op. cit.,* I, p. 29).

Any living being, therefore, whether new simply as an individual, or new as embodying a new type, may be *derivative* in the sense of being conditioned by birth from antecedent individuals, and, at the same time, *creative,* with reference to the whole life process. There is, therefore, a transcendent factor in all reproduction even under the most familiar conditions. Back of this fact, there is one of the most extraordinary principles in all nature. The results of any process which instrumentally lays hold upon the creative forces of nature cannot be interpreted in terms of the process itself. When, for example, a gardener stirs the ground with his hoe, the results of his act are not to be measured by the hoeing itself. He presses a button or turns a lever to which all nature responds. He opens the earth to the chemical influences of sunlight and air. He also sets in motion the capillary circulation of the soil, which starts the surface-ward flow of water from unmeasured depths and may operate other unknown factors. The vegetation responds with instant growth. This result is out of all proportion to the conditioning act itself.

The physiological act of reproduction is closely parallel. In itself, this act is nothing more than cell-division; but, by it, creative forces are unlocked, of what sort and of what range we have no means of determining, and a new and unique individual is brought into being. The condition, but not the source, is the development of a germ-cell derived from the bodies of the parents; but the body of the offspring is not derived from the body of the parent, nor from the race as a whole. He is brought into being through a cosmic creative process which is conditioned, not caused, by a physiological event. In the case of a human being, the transcendence of result over process is further emphasized by the fact of mind in which a unique measure of individuation is involved. The derivation of mind from mind is unthinkable, the derivation of mind from body much more so, and the attempt to push the individual back into his chromosomes, as Otto puts it, always leaves something outside. And there is still another step to take.

According to this scientific theory now under consideration, a being was once produced (whether gradually or suddenly to be otherwise determined, it makes no difference at this point) who broke through from one level of life to another, who so completely transcended the individuals from whom he sprang as to demand a new formulation of the whole world-problem. In Fiske's phrase, he "dichotomized" the universe. What happened here? Just this, the same thing which happens at the birth of every individual, only on an incomparably vaster scale. A physiological act of the ordinary classifiable sort, or a correlated series of such acts, unlocked a still greater reservoir of creative power and a new and unique being appeared. There is an immeasurably greater disproportion here between the act and its result, but the same principle operates.

The distinctive qualities of man, his body, his mind, his personality, his selfhood, are left outside the physiological process. It may be described as condition but in no sense as cause. Man himself belongs to the disproportionate result, unaccountable by reference to the process itself.

But even this is not a complete statement of the case. While, so far as the principle involved is concerned, the origin of any individual from parents and the origin of man by ascent from the animal level are quite parallel, in another way the two are not parallel at all. In the former case, creative variation is within normal or ordinary limits under the control of heredity. The new individual is one of a series of *like* individuals, closely classifiable in every respect with his ancestors. In the latter case the new individual is, taken as a whole, unlike his ancestors to such an extent that heredity has been well-nigh swallowed up by variation. As Keith says: "Man has aberrantly evolved to his present position"—how aberrantly we shall see later. Whether he has done this rapidly or slowly makes no difference. It is the immensity of the distance traversed with which we are concerned. The goal must be in sight at every step of the way. Whether heredity relaxed its grip little by little or all at once, comes to the same thing. The point is that it did relax its grip in such extraordinary fashion.

And this brings us face to face with a new phase of the problem, namely, to relate this aberrant instance to what we otherwise know of nature's methods.

No generalization will help us here. Sabatier says: "At each step, nature surpasses itself by a mysterious creation that resembles a true miracle in respect to an inferior stage. What then shall we conclude from these observations, except that in nature there is a hidden force, an immeasurable 'potential' energy, an ever-open, non-exhausted fount of appearances, at once magnificent and unexpected."

This is quite true and as significant for the interpretation of nature as a whole as it is true. But then, sober second thought compels us to remember that nature, to all appearances, has been, so to speak, not exactly niggardly, but frugal in the manifestation of these hidden energies. Her amazing fecundity and originative genius has expressed itself in comparatively few elementary substances, fundamental processes and typical forms. Only at certain times, under certain circumstances, has she poured forth new types, introduced novelties, departed widely from regularity. "Nature is divergent, rhythmic and spasmodic in its creative progress, punctuated in time and place by variations in the rate, kind, or degree of things created." (Patten, *op. cit.*, p. 12.)

That is to say, periods of creative variation, of rapid change, of the outpouring of new forms, occur only at intervals, while the intervening periods exhibit a high degree of stability. At such times, heredity is in the saddle and variation kept within narrow limits. Wright holds, and I think most scientists would agree, that we always find relative stability of forms under uniform conditions; that adaptation once established, variations are disadvantageous, and usually fluctuating; that rapidity of organic change (granted flexibility enough for survival) is dependent upon radical environmental changes (*op. cit.*, p. 375). One of the most interesting illustrations of nature's conservatism, once an adaptation is achieved, is seen in the Mexican axolotl. This curious animal is now classified as the larva of the genus Amblystoma. It lives and breeds as larva and under certain favorable conditions does not transform. The larval form belongs to a different genus from the adult, and for that reason, until its real nature was discovered, was classified and named (Syredon) as a different animal. In the larval form it is eleven inches long, has a dorsal crest, a compressed tail, a large thick head, small lidless eyes, a pendant upper lip, and small teeth. As an adult it is nine inches long, it is smooth and shiny, lacking the crest, its tail is very little compressed, its eyes are large and provided with movable lids, and its teeth are quite different. As larva it is a water-breathing branchiate with gills, as adult, an air-breathing salamander outfitted with lungs. A writer in the "Encyclopedia Brittanica" thus comments on this creature: "When once sexually ripe, the axolotl are apparently incapable of changing, but their ancestral course of evolution is still latent in them, and will, if favored by circumstances, reappear in the following generation." This instance shows, for one thing, that a leap as broad as from one genus to another may be accomplished at once by metamorphosis, and that even an immature form may become fixed when once adapted to certain conditions of life. Returning now to the main discussion, it is, further, a fact that during the historic period actually under scientific observation, the intervals of creative variation have been comparatively rare.

Professor Conklin says: "Only about fourteen times in the whole history of life upon the earth have new animal phyla appeared, and many of these were more blind alleys which led nowhere, not even to many species; there have been no new phyla since fishes appeared in the Silurian age, no new classes since mammals appeared in the Triassic and birds in the Jurassic" (*op. cit.*, p. 20). Moreover, the trend to stability under the grip of heredity has been sure and comparatively rapid. Professor Conklin goes on to say: "Each of these classes of vertebrates reached its maximum of complexity in the ages immediately following its appearance, and thereafter only maintained this level or more frequently underwent a decline. Measured by geological time, organisms rather quickly reach the limits of their progress in any particular line. Diversities may continue to appear in all these types. Many new species have been evolved and are still appearing; there have been diversifications and adaptations almost without limit, but progress in the sense of increasing complexity of organization has practically come to an end" (*ibid.,* p. 21). For the most part, the appearance of really new forms came to an end long ages ago and the production of such forms has been confined within rather narrow geological limits.

It is interesting to compare with this general situation a striking fact about man—that most of the racial differences within the human species which compass a wide range of variation were fixed about as now at the very beginning of human history. Human characteristics have been remarkably stable ever since. As Wright says: "So far as we can see, there are absolutely no changes in the anatomical and physiological characteristics of the race since the earliest monuments were decorated with his features" (*op. cit.,* p. 373).

The point which we have now reached is this: the transition from animal to man was evidently a wide departure from nature's method as seen elsewhere in the world of life. This is shown not only in the extent of variation taken as a whole, that is, the sweep of it, but also and even more in the method by which this result apparently was attained. If we can read his physical history in his bodily structure, man was produced by a process of specialization in certain directions—such as walking, speaking, carriage of the head, etc., combined with a very complex and baffling process of synthetic generalization, which makes him an anomaly both of the history and of the result. We shall deal with this matter more in detail in a later chapter; here, it is sufficient merely to point out that nature's ordinary method of producing variations from common stocks by increased specialization in one direction or another had to be entirely superseded in order to produce man. As we shall see, a number of tendencies which are elsewhere divergent are brought together in order to set man in the path of his distinct development. Everything here points to a violent disruption of man from his nearest kin. He is classifiable among them only by placing emphasis upon separate points. In his total make-up he stands very much alone. Again, man appears in history as a single species, not only of his genus, but of his family—the only representative of this family.[1] This is in itself anomalous. There are of course other cases of the sort, single surviving representatives of genera, but these are usually if not always remnants of a warring group—confined to a narrow range by loss or lack of adaptability or by environmental change—forbidden to advance beyond impassable barriers. But this is not true of man. He makes his first unquestionable appearance with all the vigor of a nascent race on a broad line of triumphant advance, which sweeps from continent to continent and from island to island in successive waves of migration—and, for the most part, where he has gone he has stayed. He has at any rate peopled the whole inhabitable earth. The seeming narrowness of his pathway of possible escape from the animal level is in striking contrast with the breadth and vigor of his universal advance when once he has broken through. Not only so, but the homogeneity of the entire world-group

[1] This point is disputed not only with respect to prehistoric or evolving man, but with respect to historic and contemporaneous man. Professor Lane (*op. cit.*, pp. 55 f.) conducts an interesting argument for different human species. As his argument is against special creation and is based on acknowledged variations among men, we need not consider it at length. His conclusion is very suggestive and sufficiently justifies the position of the text: "For our purpose it matters little whether man be considered as constituting one species with several varieties, or several; the fact remains that these types are remarkably constant when kept from intercrossing, and that they could only have arisen by descent with modification from a common source of mankind" (p. 56). It is a remarkable fact that in recent phyletic charts all the fossil races of man except the Cro-Magnon are thrust aside from the main line. (See below, Chap. X.)

of mankind is a still more astounding feature. Man is fecund, variable, and adaptable, but he still remains throughout the world a single species. He has never shown within recorded history a single out-species variation.

This is the more striking when one places him in his position among the animals. Huxley ("Man's Place in Nature," p. 146) places man at the top of an order of seven families. Running them downward we have this arrangement:

1. Man.
2. Catarrhine or narrow-nosed apes of the old world which contain the higher species.
3. Platyrrhine or broad-nosed apes, all but one new world species.
4. Marmosets of the new world.
5. The lemurs.
6. Chiromys, a subdivision of lemurs like rodents.
7. Flying lemurs not unlike bats.

Huxley speaks of these gradations, "leading us insensibly from the crown and summit of the animal creation down to creatures from which there is but a step, as it seems, to the lowest, smallest, and least intelligent of the placental mammals." There are several tremendous leaps involved in these insensible gradations, as Huxley himself has shown, if one attempts to go from top to bottom—but never mind that. My point is that man is a single *species* of an order consisting of six other populous and varied families, with manifold and appropriate subdivisions all through them. That is, taking this whole order, nature has played the game of variations, up and down, in and out, *ad libitum,* while man remains, in the broadest sense, the only one of his kind. And this leads me to introduce the question: Is it possible that man could ever have developed more than a single species? I know that speculation has it that several races of men preceded and prepared the way for the surviving species—*Homo Sapiens*—but this is speculation. Professor

Patten has given good reason for the belief that "the triaxial system of growth has practically reached its limits in man. No notable modification in man's architectural plan, in his physical dimensions, organic structure, or vital power, is likely to take place, even in the very remote future" (*op. cit.*, p. 253). That is, man, the single species, is the limit of development looking forward. The very possibilities of man are thus exhausted within the limits of a single species. Turning now from the upward to the outward verge—is it possible to vary the human type beyond the present racial limits aberrantly without destroying the type—getting monster and not man? Many races and individuals are human, in the higher sense, as some one has said, for purposes of classification merely—but they are structurally human, they belong to the species, and they are, even in this higher sense, potentially man, but they could not be less and be human. The limit in the direction of degeneracy or arrested development is also within the species. And looking backward, is not the same thing true?—that the moment we get to the point where you can use the word man, we are already within the limits of the one species. The use of the terms ape-man or man-ape does not modify the situation in the least. The ape-man is either potential man—and potential man is real man simply waiting the touch of occasion to evoke his potentiality—or actual ape. There is no category intermediate between these two. Whatever may be the truth about human origins, an ape which is ceasing to be ape and becoming a man is no genuine ape. He has already transcended his proper category.

It is not a question of process at all but simply of result, the reality of which depends altogether upon its immediacy. Man may approach the line of racial birth by a million steps, by any conceivable sort of gradation, he crosses the line at a bound. Ontogeny and phylogeny are alike at this point. Phyletic gestation may be of indefinite prolongation, birth is an advent. Ancestry stretches back indefinitely until it appears to merge in process, the individual emerges by a leap—all of which is to say that processes culminate and that culminations are always *synthetic, creative,* and therefore *sudden.* As Patten says, new products always transcend their constituent parts.

This brings us to a point where, I think, a genuinely constructive insight is possible. In reviewing the whole course of cosmic history as science recounts it to us, especially as it relates to man, I am struck by a certain lack of inevitableness in the appearance of man. From the viewpoint of natural history, he does not seem to fit into the picture or perhaps we should say, the frame does not altogether fit around him. You will recall a remark quoted and repudiated by Professor Conklin, which conveyed the idea that the evolution of self-consciousness was a colossal cosmic blunder. This remark may seem rather silly as coming from a beneficiary of the aforesaid blunder—a blunderer's opinion on blunders is probably not worth much—but there is a certain undeniable aptness about it to one who has looked carefully into the matter. The scene of nature appears so complete, harmonious, concrete, and self-contained without man. Leave him out, and nature, from top to bottom, from verge to verge, contains no anomalies.

It is vast, complex, mysterious, and in some aspects of it, terrifying enough—but, so to speak, seamless. There is no real rift in the structure, no gaps of utter unlikeness, no flaw in its continuity, no break anywhere in relationship; everything belongs to everything else. Atoms are at home with organisms, organisms on the sunny earth or in the shadowed waters, play tag with atoms in homely fellowship. Every living creature is neighbor to every other and at home in the same world, whether that world is a drop of water or "the vast and wandering ocean." These living creatures fight and claw each other with fierce energy, but bear no malice even in the thick of the fight, accept the result without protest, and when it is all over, lie down to dreamless sleep, side by side in the same kindly, all-enfolding dust. There is nothing in the whole animal world that does not fit, that is not congruous with the whole, that suggests paradox or contradiction. It is throughout an absolute democracy of instinct, law, and coöperative fitness,—man alone excepted.

I am quite aware that in one sense what I have just said is rhetorical nonsense. We cannot erase man from the picture of nature, and it is a contradiction to look at it as if he were not there—but in another way what I am saying is the deepest truth. I submit, that in this universal household of life, man is not merely an exotic, but an alien, always and everywhere an outsider. The whole history of man's relationship to nature, from magic to science, whether he is seen worshiping, fearing, hunting, or taking notes, shows that he is a stranger. He lives in a different way, fights with different weapons, survives by virtue of a different mode of adaptation—but one thing, he never is, wholly, at home in nature.

Wherever he may be thought to have begun in the final event, he is thrust along a pathway of his own to a position by himself. Self-consciousness entirely aside, man, savage or civilized, is at an immeasurable distance from his nearest of kin, without the pale of their close-knit, homogeneous fraternity.

The outspreading threads of variation, crossed over and knotted here and there so as to leave nothing in the organic world entirely alone without fellows of some sort, finds no real counterpart in man's relationship.

There are five thousand known species of ants, a hundred thousand or more species of insects, scores and hundreds of species of birds and mammals, all different, but all within one great kingdom, obeying one set of laws, realizing a common end. And the gist of what I have been saying is this—man cannot be gotten into this closed circle by any method of classification whatsoever. The modern theory, in its extreme form, in attempting to set man's origin among the animals and interpret him as a highly developed animal, has simply accentuated his difference from the other animals. In so doing it has complicated not solved the problem. For to the wonder of what he is, we have added the more inexplicable wonder of his becoming. To microscopic cells and submicroscopic fibers, cytoplasm chromatin and the like, mechanical carriers of likeness and unlikeness from one generation to another, and to all the twice-told tale of physical changes in cell-division and multiplication, we are compelled to attribute a secret potency, a magical creative power, a concealed predestinative decree, to produce by altogether familiar processes, uniting into a gulf-stream of cumulative tendency running through an ocean of fluctuating variations, an altogether unique result.

Moreover, this result, man, involves in his make-up an exquisite delicacy of internal adjustment, in cell and fiber, in brain and nerve, in bone and muscle, possible so far as we can see, only at a certain pin-point of space. Possible, certainly, within the narrowest limits of extensive variation,—possible, that is to say, in a single little world and within a single species. Through countless ages and through an infinite bewildering variety of operations, the whole cosmic process has been trained upon a mark so small, so distant, and so easy to miss as this small solitary creature man. And, since the target has actually been hit, the world-problem has been completely changed. Man upsets the balance of life, throws things away from the old center of gravity. All the processes and methods of nature hitherto used, enter into new combinations, reveal hidden potencies. The world in general revolves in a different axis since man was produced.

And thus finally we arrive at the paradox of the situation. No finite intelligence acting upon the data supplied by the history of vegetable and animal life could have predicted the coming of man. Following up every hint and suggestion, physical or psychic, within the animal circle, nowhere do we find any item which compels us to say: "At this point man is inevitable; here is a place where variation and heredity, working according to known laws, are bound to produce, not a better animal animal-wise, but an animal of a different sort, man-wise. Man is not the desired x of a problem otherwise unsolvable. Nature cannot be said to seek man or to be unhappy without him. Paul's saying about the world "groaning and travailing in pain" for man is religious poetry, not natural history. In this sense nature is only too well content without man. There is nowhere a hint of want or need. And yet, on the other hand, once here, man at once becomes the center of the whole scene, and his advent the most significant event in cosmic history, hitherto. But he is still contradictory, inasmuch as he discloses meanings in nature which otherwise seem to be foreign to nature. And the question resolves itself in my mind to this: If nature is purely natural, that is, complete and self-contained within the sphere of the inorganic, vegetable and animal, I do not see how man got here at all. I am disposed to hold that unless we believe that man draws in from beneath and beyond the world of nature as otherwise known, a transcendent and unique being, we shall be compelled to agree with our biological friend that man is, really, a cosmic mistake, a meaningless interpolation in a story otherwise comparatively easy to read.

CHAPTER IX

THE BIOLOGICAL BASIS OF PERSONALITY

THE argument for evolution in general, and, in particular, for the inclusion of man in the development series, is, as we have noted, drawn largely from the structural and morphological resemblances or homologies to be found in greater or less degree throughout organic nature. To repeat the words of Professor Kellogg: "The homologies or structural correspondence in gross and in detail which the study of animal and plant comparative anatomy reveals, can have but one possible scientific explanation—community of ancestry, the blood relationship of organisms" (*op. cit.*, p. 17).

We have already pointed out one intellectual pitfall along this line of reasoning. It is that the argument will be carried on, after the homologies have ceased appreciably to exist, or have long since been swallowed up by differences. The degree of resemblance should have its commensurate effect upon the assurance of kinship in every case.

There is another danger in this mode of procedure—of quite an opposite type—namely, that homologies will still be insisted upon long after any probability of common descent has faded away in spite of them. That is to say that homologies may still persist in cases where the general resemblances which indicate community of descent are non-existent or of negligible value. Moreover, it is just at this crucial point where we are looking for evidence of transformation and seeking the footprints of development on its upward way—that the argument from homologies shows a tendency to slide under our feet. For example, Professor Patten ("The Evolution of the Vertebrates and Their Kin") puts forth the thesis that "The vertebrates have descended from the arachnids." According to Ritter (*Am. Naturalist*, Vol. XLVI, No. 550, p. 627) Patten, whose industry, originality and general brilliance as an experimental zoölogist, are undeniable, puts forward a dozen or more morphological and structural resemblances between arachnids and vertebrates—all, or at any rate, most of which hold true as *homologies.* And yet the argument itself has signally failed to convince biologists that Patten is correct. Why? Clearly because homologies alone cannot prove descent in the absence of ascertained lineage and beyond certain well-defined degrees of resemblance.[1] In addition, the evidence from structural or developmental likeness may be neutralized by other points. For example, this arachnid hypothesis is seriously compromised by the fact that it is compelled to suppose that the transformation of the arachnid involved its turning bodily over on its back and inverting all its organs in such fashion as to make its under side its upper, and vice versa. The case is further complicated by the fact that a similar argument may be very plausibly urged on behalf of three or four other theories—*viz.,* the crustacean hypothesis, the annelid hypothesis, the amphioxus hypothesis and the enteropneust hypothesis. As I say, all these theories are plausible but unconvincing because in spite of homologies they are manifestly too *far-fetched*—they fail to bridge the vast gaps which are left between these hypothetical distant relatives. And, be it remarked, it is not the *distance* between these forms that is hypothetical, but rather the alleged relationship between them.

Now, that which is true of the relationship of arachnids and vertebrates is true of all the hypothetical genealogies which have been framed of sufficient range really to help us in reconstructing the upward march of organic development.

[1] Attention should be called to the check on the use of homologies suggested by Vines: Enc. Br., 11th ed. (old form), Vol. 21, p. 774a. Art. "Morphology of Plants."

I do not, of course, refer to genealogies within the historic limits of known races of plants and animals, but only to the far-flung lines of descent of "the ameba to man" type. These are apt to blur just at the point where they should be most definitive and become most hypothetical when they should be inductively most secure—when crossing chasms and bringing the distant near together. I think I can best make clear what I am driving at by giving a brief résumé of Ritter's critique of Patten's arachnid argument. As a general conclusion, Ritter holds that the arachnid hypothesis is to be rated not above nor below its four rivals just mentioned, but alongside of them as exhibiting nothing more than *possibility*—not up to the level of the weakest *probability*. And the critic is not at all backward about saying why he so judges. He asks in the first place, "What would constitute a demonstration of the parenthood of vertebrates?" To this question he makes the following careful answers.

1. Direct observation—which is, of course, impossible. There is no contemporary evidence.

2. The discovery of a series of fossils intermediate between some primitive vertebrate and the assumed ancestor and containing no gaps great enough to raise doubts as to the genetic connection. Professor Ritter holds that the lack of evidence connecting any vertebrate with the invertebrate becomes more impressive as time goes on.

3. Actual transformation under observation—which is too improbable to merit discussion. "No one of these three constituents of a cogent argument for the descent—and no convincing argument really exists." The logic of the argument for transformation lies in the amount of actual resemblance between two forms supposedly related. The danger is that inductive reasoning will be abandoned for deductive, leading the reasoner to commit the fallacy of begging the question. Assuming that such an ancestor existed, we can show how a given organ arose. Patten says that "by merely stripping off the superficial disguise of our

hypothetical arachnid we can see the *harmonies* of structure and growth with vertebrates."

Ritter replies: "If the hypothetical arachnid existed, it might have undergone such a transformation as the one suggested. But the first point is yet to be established—did such an animal ever exist?" The evidence of the observed facts of arachnid structure leads to the supposition of an arachnid which might have been transformed into a vertebrate. It is evident, says Ritter, that "no hypothesis can add of itself any new facts." The only safe use of hypothesis is "to help toward answering a question by formulating a clear provisional answer to that question. The making of hypotheses and using them before they are themselves proved for the solution of other problems than those to which they immediately pertain is perilous business" (p. 631).

That is to say, to infer from arachnid structure, in general or as known in experiment, a given type of *arachnid* as the founder of the *arachnid* family, is a legitimate use of hypothesis—but to use this hypothetical arachnid a second time, to explain the hypothetical descent of vertebrates from arachnids is to hang an hypothesis on an hypothesis—which is in effect a flagrant begging of the question. But logic aside, the real point I am after is that in attempting to construct such a genealogy as that from arachnid to vertebrate—generalization is almost inevitably resorted to. It is *arachnid* and *vertebrate,* both abstract and generalized, not a specific known arachnid A and a specific known vertebrate B which are thus connected. The same sort of supposition appears in almost all the attempts that have been made to derive any of the great orders by transformation from other stock. For example, ants, which appear suddenly in the Tertiary age, are considered by evolutionists to be modified descendants of the solitary wasps. That they *have* descended from some earlier form and did not arise abruptly as they appear in the geological record, the evolutionist is, of course, convinced. When, however, it comes to making out a genealogy and specifying an actual ancestor, the best that can be done is to say that the ants *must* have come from a form *not unlike solitary wasps* like *the Bembecidæ* or the South American *Allodaper*. This is very likely—at any rate it is not worth disputing about—I merely wish to point that even in a transition of such moderate extent as from wasp to ant, the genealogical line blurs, and a generalized ant, so to speak, is derived from a generalized solitary wasp. Not only so—but we are compelled to note the strange and unmanageable complications involved in the transition. In the first place, as all authorities agree, the first ants which come to light in the genealogical record are true ants very like our modern species. In particular, the communistic habit has been in force for ages and the division into castes also. Now, if ants are modified solitary wasps—(1) they abandoned aerial life for life on the ground; (2) they abandoned solitary life for communal life, which involved a change of instinct and method of life which can hardly be connected with their descent to earth or to their survival. This communal development involved among other things, either as cause or effect, an acquired ability on the part of the mother ant to survive the hatching of the brood so as to care for it. This in turn is made possible by the ability (also acquired) to pupate at an early period. A second step was that young undeveloped workers stayed with their mother, reversing the solitary tendency again. Then the colony became unstable and divided into two classess, *reproductive* (males and females) and *alimentative* (workers or undeveloped females).

The interesting thing about this story of development is that it is *synthetic*—due to the supposedly fortuitous coöperation of several more or less unrelated tendencies, all of which involved a nearly complete break in habits with the past,—for example, the descent to the ground, which is preliminary to the whole movement, has no direct or causal relationship to the communal development. One cannot see how the change from air to earth brought about the accelerated pupation upon which the community development seems to hinge, while the formation of castes seems to be without close relationship to either of the other changes. In addition, we are left with the utterly baffling problem of the origin, establishment and supremacy of a sterile or nearly sterile caste as the center of life in the community. All the forms of evolutionary theory have been tried on this problem, and all have proved inadequate and unsatisfactory. Almost in despair, Wheeler and others admit "that the cause of these changes must be deep-seated within the organism," and that in attempting to deal with them we are face to face with "the all-pervading enigma of living-matter" (Wheeler: "Ants," p. 109). The conclusion of the whole matter thus far is that descent, in the presence or absence of homologies, except in a limited number of cases is very hard to prove. This, I take it, is the real meaning of the much discussed deliverance of Dr. Bateson at Toronto in the fall of 1922. The significance of this paper has been disputed, *pro* and *con,* so much that one almost hesitates to use it. I shall venture to present the results of a careful reading of the paper. The discussion is important and suggestive and has a direct bearing on the theme of this chapter.

Dr. Bateson ("Evolutionary Faith and Modern Doubts," *Science,* Jan. 20, 1923) nearly at the beginning of his paper makes the statement that the discussion of evolution had come to an end for lack of progress. First as a result of the study of morphology, and second, through studies in variation and heredity "the doctrine of secular transformation of masses by the accumulation of impalpable changes became not only unlikely but gratuitous" (p. 56).

In addition, the study of pairs of well-characterized but closely allied species showed (1) that neither could have been evolved (gradually) by natural selection from a common intermediate ancestor, and (2) that they could not have come thus from each other. In these cases there is lack of intermediate forms. All new varieties fall into recognizable types. The Mendelian clue has also failed in spite of the fact that at one time it looked as if new species might easily be the result of new combinations of heredity factors under the Mendelian laws. The total result is that "when students of other sciences ask us what is now currently believed about the origin of species, we have no clear answer to give. Faith has given place to agnosticism for reasons which, on such an occasion as this, we may profitably consider" (p. 57). The essential reason for this attitude is this: "As we have come to know more of living things and their properties, we have become more and more impressed with the inapplicability of the evidence to these questions of origin. There is no apparatus which can be brought to bear on them which promises any immediate solution" (p. 57).

Dr. Bateson then shows that genetical research reveals the existence of *gametes* or germ-cells and *zygotes*, constructed of male and female gametes as the result of fertilization—but we know that back of the order represented by the gametes and zygotes there is another order (still to be explained) of the chromosomes, and while "the transferable characters borne by the gametes have been successfully referred to the visible details of nuclear configuration, . . . we cannot see how the differentiation into species came about. Variations of many kinds, often considerable, we daily witness but no origin of species" (p. 57).

That new species *have* arisen on the earth seems to be evidenced by the fact that angiosperms (flower-bearing plants with true seeds) did not exist in the carboniferous age, but are abundant later. There is no actual proof that angiosperms descended from preceding forms, but it is easier to believe that they did, because (1) we have world-wide remains from the carboniferous era, (2) angiosperms would from their very nature spread widely and (3) their remains would certainly be found. (On the origin of angiosperms see above, ch. VI.) He reaches the conclusion that "In dim outline evolution is evident enough," but "the origin of species is utterly mysterious." Variation of the known sort, however extended in time, does not give species. "Time cannot complete that which has not yet begun" (p. 58). That "species are the product of a summation of variations" is negatived by the frequent sterility of hybrids. If species had a common origin, where did they get the ingredients which make sterility? This would involve a variation in which something is *picked up*. Now, variations are distinguishable as positive and negative (in spite of the objection of Drosophila workers). The evidence for variation by loss is abundant, but for variation by gain *rare*. But specific sterility must be due to gain. Even where the sterility is not absolute and fertile offspring can be obtained the sterility must be of the positive sort (p. 59). *The production of sterile hybrids from completely fertile parents which have certainly come from a common origin, is the evidence waited for* in order to establish the origin of species by variation. This evidence is not forthcoming. Since this evidence is vital our knowledge of evolution shows a gap. "Our faith in evolution is unshaken," but we have "no acceptable account of the origin of species" (p. 59).

Natural selection in general is true, but it is not applicable to specific cases. The organism must "make good," but there is no way to prove that any given variation is helpful (p. 59). Variations by loss (of heredity factors) are evident in Drosophila but few "new dominants," that is, "positive additions" seen among hundreds, and these apparently not viable (transmissible). Single wild species as the ancestors of domestic animals are scarcely ever to be pointed out. A "multiple ancestry" is the almost unavoidable conclusion, because "modern races have positive characteristics not found in existing species and not obtainable from combinations. In domestic races "new ingredients" are added. "Lost races" form a poor recourse in the absence of positive evidence. There is something lacking in our knowledge. We can get a round pea from a wrinkled one only by crossing. Such seeds appear, but have the starch of round peas or are produced by stray pollen. The fern-leaf primula will not produce the palm-leaf, nor a star-shaped flower produce the old type of *sinensis* flower. Transferable characters do not produce real new species, and there is no reason to suppose that such characters could be accumulated enough for new species (p. 59). "Specific difference, therefore, must be regarded as probably attaching to the base upon which these transferable characters are implanted, of which we know absolutely nothing at all" (pp. 59, 60). DeVries' experiments with primroses and other plants do not help us—"that which comes out is no new creation"—there are no new species of *Œnothora.* We really know:

(1) Novel forms, but no new species from pure parents.

(2) That the organism is a double structure involving ingredients from both sides, male and female parents.

(3) From the male and female sides of the same plant these ingredients may be (a) very differently apportioned and (b) the genetical composition of each may be so distinct as to warrant the idea that two forms specifically different may be derived from the same plant—but this is nothing really new. The above conclusion as to new species stands (p. 60). The future of biology is imperiled (1) by the ignorance of genetics on the part of systematists and (2) by the failure of geneticists to realize the complexity of the real world of life. The conclusion is that, while our faith in evolution is unshaken, we are ignorant of the actual modes and process of evolution. Our doubts concern "not evolution but the origin of species," which is a "technical, almost a domestic, problem." "Any day that mystery may be solved" (p. 60).

Professor Osborn in a review published in *Science,* Feb. 24th, 1923, takes Dr. Bateson somewhat severely to task for inaccuracy. He affirms that the fact of evolution with the origin of species, including the human, has been known at least since 1869 (p. 195). Dr. Bateson, according to Professor Osborn, "does not clearly distinguish between his own personal opinions based on his own field of observation and the great range of firmly established fact that is now within the reach of every student of evolution who surveys the world of life under natural conditions."

On the other hand he credits Dr. Bateson with being correct in his opinion "that neither the causes nor the mode of origin of species have been revealed by the old study of variation, the newer study of mutation or the still more modern study of genetics." This conclusion is by no means lacking in value—for "if this opinion is generally accepted as a fact or demonstrated truth, the way is open to search for the cause of evolution along other lines of inquiry" (p. 197).

The admitted truth in Dr. Bateson's discussion is all that interests us. If it be true that neither the cause nor the mode of origin of species have been revealed by Variation, Mutation, or Genetics, what becomes of the "accepted" principle of Descent or of the irresistible arguments supposedly drawn from "homologies"? Variation, Mutation, Genetics—all three center upon the idea of connection between species through descent, and constitute the only three ways in which Descent can readily be conceived of as working. These three departments of research in which the principles of descent have been profoundly studied for a generation or more have not only failed to furnish the facts necessary to put the doctrine of descent[1] on a firm basis but have progressively uncovered facts which have made it more and more difficult to understand how descent can be viewed as the vehicle of progressive change such as is in-

[1] Not as fact, be it understood, but as explanation.

volved in the idea of evolution. This is the conclusion to which we have been steadily and irresistibly led since beginning our investigation. Evolution in the sense of modification is true, descent within certain definable limits is also true; but descent as the key to progress, as the vehicle of ascent, as the causal principle in organic advance and as the explanation of organic variation of the synthetic and creative type apparently is still awaiting proof which shall satisfy even its strongest advocates. The genetic connection between living forms by which the world has been made the home of graduated organic variety must be interpreted under some other category than of descent alone. Some creative power which carries with it the principle of orderly and progressive change, which carries life from platform to platform of upward advance, must be found before the idea of evolution can be looked upon as an adequate theory which interprets all the known facts. A new and broader type of evolutionary theory is imperatively needed.

I wish now to point out certain facts which enforce this same truth in connection with man's relationship to the lower animals.

As we have already seen, the mutual relationships of animal forms with respect to descent is a very complicated question and the evidence unsatisfactory except within very narrow empirical limits.

The genealogy of the vertebrates as a whole is peculiarly difficult and no general agreement among zoölogists has been reached. Within the quadrumana themselves, as Huxley has pointed out, there are several gaps very difficult to bridge, while between them and the quadrupeds the trails of kinship criss-cross in the most bewildering fashion.

Taking the quadrumana as a whole and accepting the homologies which have been offered at their face value, there are several major difficulties in the way of accepting the common idea of man's descent.

The most conspicuous, and the most significant fact in the whole case, viewing it zoölogically in the open, is this: no one of these animals stands at the top, and excels the others by possessing, individually, those features which go to make up what we should call the higher development. The characters in particular, which, in conjunction, would involve an approach toward the human, are scattered throughout the whole family. For example, St. George Mivart has made a close comparative study of man and the apes, graded according to the usual standards of organization. He enumerates forty-four skeletal characteristics by which he establishes a comparison between the various quadrumana extending from the lower monkeys, nearly on a level with the quadrupeds, through the half-apes to the apes proper. As the result of this broad and accurate comparison, he shows, first, that the development is most uneven,—that is, every member excels in some particulars and falls behind in others. No one group shows a tendency to combine the best qualities of the order and to break away toward a higher level.

He shows, in the second place, that if man has sprung from this family by development upward, he must have come in some sense from the whole family as it now exists or has existed during the known past. There is no definite point of attachment—no clear-cut line of descent, no probable genealogy. He is like them all and unlike them all. We have here what we have always when such lines of descent are attempted, a hypothetical and generalized ancestor, unlike any actually known, and a blurred and synthetic line of descent. That this line of descent is blurred, everything that is said about it even by the most enthusiastic evolutionists goes to show. Dr. Osborn himself must be included here, for he says: "Man has descended from an *unknown* apelike form somewhere in the Tertiary" (*op. cit.,* p. 274). I have been accused of "quibbling" (by Dr. Conklin) in treating rather lightly so positive a statement about an "unknown ancestor." Professor Conklin says that Professor Osborn means merely a "relatively unknown ancestor." So be it. It is surely not quibbling to infer that this ancestor has not been identified either individually or in connection with any known apelike form. He is still in that sense hypothetical. I call attention again to Professor Ritter's warning about using hypothetical ancestors to substantiate hypothetical descent. In addition, this descent is not only *hypothetical* but also *synthetical.*

Broadly speaking, man represents the synthesis of structural tendencies widely operative in the animal world and often running in different and even in opposite directions. Mivart describes this relationship as not a line but a *network* drawing in from various directions to man at the center.

For example, in the formation of his foot, his hips, arms, legs, spine, mechanism of the head-carriage, vocal apparatus and numerous other structural details connected with his upright carriage and plantigrade mode of progression, speaking and other habits, including one muscle at least peculiarly his own. Man has been specialized in one direction, *for walking.* On the other hand, the ape, with his long arms, his prehensile hind-hand, his peculiar shoulder musculature, has been specialized quite as far in the opposite direction, not for walking, but for climbing and swinging. That is to say, if man and the apes were ever together, they have moved east and west along divergent lines from the common center—which could not possibly have been a primate of any known type either living or extinct. For a beginning of a movement like this we are driven far back of any known forms. Nature has elaborated the ape apeward to the limit, and that limit is not in the direction of man at all.

On the hypothesis of descent, man did not descend from the ape, any more than the topmost apple on a tree descended from one on a lower limb. Both must have been produced by a process which, however cognate in the matter of origins or analogous in the matter of process, diverged far back in cosmic history. And it becomes difficult to bring it under descent at all.

As Professor Mivart says, any other theory is impossible—for "if man and the orang are diverging descendants of a creature with cerebral characters, then that remote ancestor must also have had the wrist of the chimpanzee, the voice of long-armed ape, the blade-bone of the gorilla, the chin of the simian, the skull-dome of an American ape, the ischium of a slender loris, the whiskers and beard of a saki, the liver and stomach of the gibbons, and the number of other characters before detailed, in which the various typical forms of higher or lower primates, respectively approximate man" ("Man and the Apes," pp. 176, 177). It seems appropriate to repeat here what I have said elsewhere, that the kind of descent which could affiliate, under categories of variation and heredity, man and the lower animals, is altogether different in its range of effects from any of which we have empirical knowledge. This is a creative type of transformation through descent not found in like degree elsewhere.[1]

And that brings us to another point of peculiar significance. The *embryonic* development of man is quite cognate with that of his animal kin except that he does not pass through any distinctly simian stage. His undeveloped brain does resemble that of the quadrumana, as at an earlier stage it resembles the quadrupeds. But the transitions are remarkable. The ascent from the quadrupedal to the primate level comes in the third month of embryonic life—with a rush—but with one exception to be noted later, man attains his distinctive brain development, which gives him nearly

[1] A glance at Professor Simpson's phyletic chart of man and the other primates will show how far back man's line runs *without a named ancestor*. Cf. this chart (in "Man and the Attainment of Immortality") with that in the Yale Lecture, "Evolution of Man." See discussion in Chapter X.

a hundred per cent. more cerebral material than that of his anthropoid contemporaries, not before but after birth. This cerebral development is, therefore, not a phase of embryonic integration but of growth in infancy and youth. Look carefully at the facts.

The brain of the human embryo at three months is the size of a marmoset's, lower down than the monkey. At birth it is very slightly larger than that of the newborn gorilla; but the brain of the gorilla is at birth 65 per cent. of its full size, while that of the child does not attain the same percentage of its total size until its second year. By the fourth or fifth year the brain of the human child has attained over 80 per cent. of its tissue. On the other hand, its cerebral growth continues rapidly during adolescence and slowly but continuously on to old age. The significance of these facts can hardly be overestimated. The distinctive human increment of cerebral development falls outside the embryonic period altogether and comes under a new and distinctive set of processes. Man has not only attained a higher level of development, but has gained this height by a method of growth distinctly his own. This method of disproportionate growth after birth does not obtain anywhere else in the animal world. The slight brain-growth maintained by the anthropoids after birth simply gives him what the physiologists call the "corporeal concomitants" of his congenital development—the plain English of which is, that he is practically finished at birth.

There is another aspect of man's physiological growth which is equally striking. The differentiations of his bodily structure connected with his upright carriage, namely, the lengthening and straightening of the lower limbs, the horizontalizing of the feet, the lengthening of the lumbar region of the spine, also take place, in large measure, *after birth.* According to Keith ("Man," pp. 134 f.) the lower limbs of a new-born child are ⅖ of his standing height, while in the adult they are ½ or more. In the new-born child the lumbar part of the spine is 27 per cent. of its total length (the proportion in an adult chimpanzee), while that of the adult man is 32 per cent. In childhood the lower limbs grow more rapidly than the body, and rapid changes take place at hip and knee joints to straighten and extend the legs.

In the human embryo at six months the lower limbs are 55 per cent. of head and trunk length, at birth 62 per cent., and at maturity 102 per cent. The most curious fact about all this differentiation is that it involves no prolongation of the period of gestation—which is practically uniform with man and the higher anthropoids. It does involve, however, a tremendous difference in the period of adolescence. In man that period is usually placed from the fifth to the twenty-second year, in the monkeys from the second to the fifth year, in the gibbons from the second to the sixth year, and in the great anthropoids from the fourth to the fourteenth year. Old age in man is placed at sixty-six years, in the gibbons at eighteen, and in anthropoids at forty-two. According to Keith, long life came with the larger body while man has unaccountably extended the life period.

The significance of this prolongation of infancy, adolescence and the period of growth generally, together with the crowding of rapid and revolutionary changes into the postnatal life, is at once evident when we note that the physical concomitants of man's distinctive development are found here. Moreover, it is coincident with the dawn of intelligence and wider coöperation with the outside world. This coincidence cannot be an accident.

John Fiske always prided himself upon making the discovery that the prolongation of human infancy was really the key to man's evolution. This was his "original contribution" to the theory. But, we ask, what is the causal order of the process? The prolongation of human infancy is evidently of the greatest significance in every way. It is the physiological condition upon which depends the crucial fact that man, beyond all other animals, is dependent upon the permanence of the family union which gave him birth and also upon education or experience as well as individual effort. He has more to learn even physically at birth than all other animals together. But, the prolongation of his infancy is quite as evidently a result of the increased complexity of the organ which he controls and upon which he depends. Moreover, his survival throughout the lengthened period of helplessness, which necessarily involves unique dangers, must have been dependent upon a heightened social instinct on the part of his parents. The mere fact of prolonged infancy solves no problems, because it is the product of an already attained principle of growth by which his maturity in power is delayed; which, in turn, rests upon an already attained increase of complexity in bodily structure. We are left groping for a principle of differentiation which sets him apart from his animal ancestors both in the manner and in the results of his growth. In other words, the hypothesis of descent leaves us with a more complex problem than the one with which we started.

And the case is further complicated by another matter which concerns the comparative order of embryonic development in man and the apes. In the apes the intra-parietal sulcus, one of lateral brain-furrows, develops in the embryo before the fissure of Rolando and is more deeply grooved. This goes to show, according to evolutionary principles, that it was *older* in point of development,—which is confirmed by the fact that as we go down the scale, the fissure of Rolando becomes less and less important until, with the lemurs, it disappears altogether.

In man the case is exactly the opposite. The fissure of Rolando appears first and is most deeply grooved. This means, when we compare the case of the apes—on the theory that man came from that family—a complete break between individual and racial development, another falsification of the recapitulation record at a most critical point.

The real significance of this fact, however, appears when we note that this reversal of order is due to the upthrust and outpush of the two convolutions of the brain which have to do with the movements of hands and limbs, the strength and straightness of the lower limbs and the facial expression, all of which are directly connected with distinguishing human characters.

This brings us directly into contact with the supreme problem of human existence which lies on the frontier of all the sciences and philosophies, the relationship of mind and brain. This problem, which can be solved only by accepting all the known facts, whether they submit to synthesis or not, is not essentially changed by the theory of descent, for it appears in sufficiently crucial form in the study of human embryology. How to relate the transcendent fact of the individual mind to our undoubted germinal beginnings is entirely unmanageable by the empirical method. Professor Conklin is not lacking in boldness when he says, bluntly: "The only possible scientific position is that the mind (or soul) as well as the body, develops from the germ." That this is descriptively true, no one denies. That it really represents the inner actuality of what takes place, neither Dr. Conklin nor any one else is competent to say. When he continues to argue that the "mind of the individual develops by a gradual and natural process from a simple condition which can scarcely be called mind at all, from the cell to the embryo, from the embryo to the infant, from the infant to the child, through adolescence to maturity" ("Heredity and Environment," pp. 45, 46), he is true in general to the phenomenology of the process, but his statement is still purely descriptive—it has no explanatory value. And a problem which defies empirical handling in its simplest form, that is, in the derivation of the individual from his own kind, becomes truly staggering when complicated with the idea of ascent from a lower level. We shall meet this problem again and try to deal with it more thoroughly.

Just now let me call attention to this fact. All development involves transformation. Professor Ritter says: "One of the most obvious and indubitable facts about all organic development is transformation." Again he says: "The living, growing organism is creative in the highest sense and that on a vast scale." Moreover—and here is the point to which I have been coming all along—the development of the human brain as a thinking organ is transformative and creative in a sense which cannot be applied to any other process in this world. The brain is not an intellectual instrument to begin with. It has to be intellectualized. It has to be actually transformed by the molding power of the being using it and by the actual process of using it.

Not only in its higher use as an instrument in the making of concepts and in the formation of intellectual, moral and spiritual ideals, but even in its humbler but still distinctive motor activities, so far as they relate to the outer world, the brain of man has to be educated, and that by the individual himself. He is not born with a complete outfit for life, but must acquire it by attention and effort. His "wonderful mental faculties," says W. H. Thomson, "including that of speech, were not connected with brain matter at birth, but were created afterward. They were created by the individual himself automatically modifying his own brain." ("Brain and Personality," p. 30.)

The proof of this, as Dr. Thomson is careful to point out, is not to be sought in metaphysics, but has been supplied by a study of the physiology of the brain. This truth, which cannot be gainsaid, for it is supported by facts, that brain intellection is the creation of personality by individual action and is not a congenital gift or developmental possession, proves the transcendence of the personal over the physical and determines our approach to the whole problem.

The otherwise unsolvable problems, that the size, weight, shape, and so far as we can tell, the organization of the brain within the limits of normality, has no definite bearing on mentality, that the brain is a double organ with a single consciousness and with mentality seated in either lobe indifferently (as determined by so slight a thing as right- or left-handedness) while the opposite and twin member is idealess, the occasional shifting from one center or convolution to another without loss of mental power, the separation through training and exercise of the mental faculties from the elementary and congenital functions of sensation and motion, the comparatively negligible difference between the animal and the human brain, the rise of man's cerebral differentiation after birth, the fact that it differs physiologically from the animals chiefly in the power of speech, which is the creation of personality and is the gift of man alone —all point in the same direction. Personality is an absolute, underivable and creative fact within the physical order. If descent is allowed it must not be confused with derivation. Man is not derived by descent—he "draws from out the boundless deep." This is equally true whether we are speaking of the race or of the individual. Man's descent is not his derivation. Say what we like about heredity, emphasize as we will the intimacy between man and his ancestors, press home as close as may be the dependence of mind on body in origin, growth and life, we explain nothing. It still remains true, as Otto says: "Our life is only the blazing up in these bodies of a flame which, in some inexplicable way, had fallen upon them and associated itself with them" (p. 301). And whenever this mysterious flame is kindled, it is never far from the infinite source of life.

The real problem of life in man, therefore, is not his connection with the world process, but his relationship to the creative power upon which all things, in being and becoming, the molecule, the living cell, the animal and man alike depend. But this creative relationship in the case of man is unique—one which sets him apart from all other forms of life. Man alone is given the raw materials of life for his own molding. He is not created in the sense in which the star or the cell or the tree is made. As Professor Hocking beautifully expresses it: "As to structure, human nature is undoubtedly the most plastic part of the living world, the most adaptable, the most educable. Of all animals, it is man in whom heredity counts for least and conscious building for most. His major instincts and passions first appear on the scene not as controlling forces, but as elements of play, in a prolonged life of play. Other creatures nature could largely finish: the human creature must finish himself" (*op. cit.*, p. 10).

Man then is a spark of the being of God—set free to make itself. He is a co-creator with God in his own life. For this reason an apostle can say: "Therefore, work out your own salvation with fear and trembling for it is God that worketh in you both to will and to do of His good pleasure."

Heredity + J. C.

ac. Nov 22, 1925 P.m.

CHAPTER X

EVOLUTION AND HUMAN HISTORY

In the preceding chapter, the conclusion was reached that the chief biological differential of man is his relative immaturity at birth. As compared with the full range of his normal development at maturity less is accomplished for him through embryonic integration than is the case with any other organism. The consequence of this undeniably unique fact is that more of his life history is written by himself, even in its earliest beginnings than is true of any other living being.

The full significance of this peculiarity is that man alone among animals has a true history. He is both a maker and a recorder of history. And this history, taken in the large, is the record of his progressive conquest of his environment. So far as nature is concerned this victory is, in certain aspects of it, very complete and very wonderful. As we have already seen, man began and had to begin with the subjection and use of his own brain and body. This was his first, and, in many respects, his most significant achievement. He not only correlated brain and body as the instruments of nature control, the mechanical apparatus of thought and invention in dealing with the world of things, but he discovered and developed his own inner resources and created arts, sciences, philosophies and religions. At the same time he bent himself to the conquest of the external world, and has carried it forward to a point of real and eminent distinction. He has conquered hunger (in the sense of making continuous provision for it), he has conquered cold, he has conquered distance. He has adapted himself to all kinds of food and to all kinds of weather. He has discovered, combined, subdued and governed hidden forces of nature about which, in the beginning, he could have known nothing. Henry Drummond ("Ascent of Man," 5th ed., p. 107) says: "Man has expanded until the world is his body. The former body, the hundred and fifty pounds of organized tissue he carries about with him, is little more than a mark of identity. It is not *he* who is there—he cannot be there, for he is everywhere. The material part of him is reduced to a symbol; it is but a link with a wider framework of the arts, a belt between machinery and machinery. His body no longer generates but only utilizes energy; alone he is but a tool, a medium, a turn-cock of the physical forces." This gives us at least a rhetorical setting for this truth: The animal, in contradistinction from man, is the product of the environment and except within the narrowest limits, the slave of environment all its days. This is the reason why the animal has no real history. When it has reached the typical form and life of the species and adapted itself to the more or less limited environment in which that species can flourish, its day is done and its story is told. In actual control of its environment beyond the narrow range of a constructive instinct, like that of the ant, the nesting bird, the beaver, or the earthworm, it cannot go. As Otto truly says (*op. cit.,* p. 334): "In this respect the animal is not a step in advance of the stone or the crystal."

On the contrary, when all has been said that can be said about the zoölogical man,—when we have dissected him, mapped out his brain, articulated his skeleton, analyzed his bodily constitution, classified him and published his hypothetical family tree, we have not yet written one line of his distinctive history. Without this history, which man himself has written, the cosmic process *at once* loses its creative significance by losing the standard by which alone progress can either be defined or measured. Take out of the world story that which man—not the primate but the thinker and the doer—has thought and done and *natural history* reigns supreme, but all idea of creative ascent is at once expunged. This result is inevitable. "Life knows no great and no small. The immense gulf we place between ourselves and the humbler creatures, even to the lowest, rests only in our fancy. The hand of the barnacle, the claw of the spider, the eye of the crustacean, the lancet of the gnat, even the cilia of the microscopic rotifer, are as wonderful and ingenious as the organization of man. In nature's workshop the lowest has received as delicate care as the highest; indeed, in its eyes there is no lowest and no highest" (Kassel, *The Christian Register,* Sept. 5, 1912). This being the case, we must look elsewhere than to natural history for a true understanding of man's place in the universe—and, by the same token, for a criterion of cosmic progress.

And just here we are confronted by a searching question: How shall we relate the natural history which has produced man to that other history which man has produced?

In other words, how shall we account, on the basis of a natural process of development, which is at once universal and impartial, for the appearance of a being who, when once he grows up, turns the tables in such radical fashion as, in a measure, to control and direct the power which produced him? Professor Hocking has very beautifully expressed the fact which we are now considering. He says ("Human Nature and Its Remaking," p. 9): "Consider that his infancy is longest, his instincts least fixed, his brain most unfinished at birth, his powers of habit-making and habit-changing most marked, his susceptibility to social impressions keenest, *and it becomes clear that in every way, nature, as a prescriptive power has provided for her own displacement.*" Our question based upon this outstanding fact, then, is this: How has this paradoxical result come about? Nature mothers a child, "in origin one with the creatures of fin and fur and feather," for whom she cares no more than for any of the rest of her teeming household.

This child grows up, tells nature things about herself of which she never dreamed and wheedles her into doing things which involve a radical departure from her age-long and settled habit. In a word, nature has produced an unique being by methods not at all exceptional. This anomaly we have noticed before, but we must now study it more attentively.

For purposes of suggestion and as a basis of comment, let us temporarily accept the guidance of John Fiske and permit him to tell this story of man's arrival on the world stage as he sees it. It will be necessary to be brief and to condense many pages into a few lines, but it ought to be possible to make his general meaning clear. Fiske holds, with many others, that: "along with the general development of mammalian intelligence, a point must have been reached in the history of one of the primates when variations in intelligence were more profitable to him than variations in body." "From that time forth the primate's intelligence went on by slow increments acquiring new capacity, while his body changed but little. . . . When once he could strike a fire and chip a flint and use a club and strip off a bear's hide to cover himself, there was clearly no use in thickening his hide or sharpening his claws." Hence, at this point, physical evolution ceased, while mental evolution went forward toward man. This involves the familiar distinction called by Principal Griffith-Jones "natural selection and mental selection," and by Henry Drummond "the arrest of the body and the dawn of the mind." Fiske goes on: "For a million years or more nature invested all her capital in the psychic variations of this favored primate, making little change in his body except so far as to aid in the general result, until, by and by, something like human intelligence of a low grade, like that of the Australian or the Andaman Islander, was achieved. The genesis of humanity was by no means yet completed, but an enormous gulf was crossed" ("Through Nature to God," pp. 83, 84).

The first question which this schematic outline of man's genetic history suggests is this: Is it to be taken as "methodology" or "metaphysics"? (This happy antithesis is Professor Pratt's.) Is this narrative to be taken simply as a description of the method of man's creation at the hand of God, or must we take it as a causal explanation of how man came to be? So far as Mr. Fiske himself is concerned there seems to be no doubt about the answer to this question. The title of his book and the entire course of his argument put beyond question his belief that in the evolutionary scheme which he has constructed we have simply a description of the divine method of working. On this basis, we have but to ask whether or not it seems probable that this has been the actual method which the Creator has used in bringing man into the world.

On the other hand, if such an account is to be taken as a causal scheme—in conjunction, for example, with the monistic antitheism of Haeckel, the question is quite a different one. We shall take up the latter supposition first—considering Fiske's scheme without Fiske's teleology and theism. It becomes at once evident that the whole scheme, as a naturalistic explanation of the course of unguided mechanistic evolution along the line of least resistance, is impossible. It is an Alice-in-Wonderland package of incredibilities.

The first of these is the notion of nature's "favoring" this hypothetical primate. Just exactly what does this mean? The personification is evident and in itself unobjectionable. It is clearly impossible to describe nature's operations which everywhere, at the very least, "mimic" purpose without using language which implies purpose. The usage, as Darwin admits, is ambiguous but unavoidable. But when we explicitly disavow the idea of attributing purpose to nature and strip away the ambiguity involved in Fiske's description in order to describe in plain and literal terms the actual process of nature, what do we mean by such an expression?

It seems evident that the notion of nature as "favoring" any organism is inadmissible. Natural selection, to which reference is evidently made, is a mechanical operation of the environment, acting as a "sieve" to eliminate the biologically unfit. It is, therefore, as we have seen, entirely a negative process which works by destruction. From this point of view, nature can be said to favor only those organisms which she fails to kill. What is really needed here, and is not supplied, is an explanation of the production of favorable variations in the direction of higher intelligence sufficient in the aggregate to bridge the gap from animal to man. Fiske's scheme implies *two processes,* which, on a naturalistic basis, are wholly incompatible. One is, a rigid natural selection by which only useful variations ("profitable" is his word) can survive. Recall his words: "variations in intelligence became more profitable than physical variations,"—psychic advance takes the place of thickened hide and lengthened claw in the struggle for existence. The other process is a fostering "life-investment," the favoring of a selected animal or series of animals. Recall his exact words here also. Nature "invested all her capital in the psychic variations of this favored primate . . . for a million years or more." This means, on the basis of naturalism, a purely mechanical unintelligent, unforeseeing nature *prefers, protects,* and, in some fashion, *nurses* a line of variants from the animal stock in the direction of man. To what end? To produce a type of animal which shall survive her destructive mechanism of elimination by virtue of superior intelligence? Or is the development of intelligence an *end* in itself? But on the naturalistic level there are no ends, in the sense of purposes, only results, mechanically produced, pushed out of the past along the line of least resistance. Moreover, apart from all other considerations, man cannot be considered as the possessor of an unique type of intelligence or as an end in nature without completely wrecking the naturalistic scheme. This has been uniformly urged by naturalistic writers themselves. The moment it is admitted that man may be allowed to stand apart and occupy a place by himself, he becomes to naturism a *lusus naturæ,* a being no longer capable of any natural classification. (See Robinson, "The Mind in the Making," pp. 65 f.) Professor More ("The Dogma of Evolution," 1925, p. 381) says: "If the spirit or soul is merely an evolution of life, then I can see no need for a separation of religion from the other customs and habits of social life nor, in fact, from the social life of any other animal. The doctrine of evolution is a rational doctrine, and it cannot be made to include the spirit which is essentially irrational and miraculous. From the point of view of nature and nature-doctrine alone considered the attributes of God and of the soul are solely matters of faith and intuition and can be neither proved nor disproved by science." Again (*ibid.,* p. 387), Professor More states the alternatives with convincing clearness when, at the end of his final lecture he says: "Unless it can be indisputably proved that man, with his infinite variety of thoughts and emotions, is but an aggregation of mechanical atoms held together and moved by physical forces—an hypothesis for which there is not the slightest proof—there seems no necessity to deny the existence of a spiritual world not subject to the laws of mechanical energy or circumscribed by the space limitations of material or electrical substances." The alternatives, therefore, are: Man a spiritual being with unique qualities and characteristics or man a mere nature product, the outcome of forces and operations entirely familiar to us elsewhere. Fiske's scheme, then, in which *nature* is represented as one who foresees, plans and works toward man as an *end* —who favors a line of primates because man is in view at the end of the line—is tenable only in view of his teleology. Explicit and avowed theism alone makes such an interpretation tolerable.

The second incredibility discoverable in this scheme, interpreted on the basis of naturalism, is in the idea of variations in simian intelligence leading upward to man. There are several difficulties involved in this supposition. The first one is the idea of psychic variation *in any such amount* as the theory requires. Let us grant, in order to save time, all that can reasonably be claimed for simian intelligence (or animal intelligence in general). Is there any historical evidence whatever for the supposition of variations in this direction of sufficient amount or value to carry any individual or group of simians appreciably nearer the human level? It is not contended that such a variation is impossible to conceive of as having taken place at some time in the past—it is strongly urged, however, that we have no ground for believing that such an event could have occurred as an item in the ordinary routine of simian life or under any known laws of hereditary succession. In addition we must remember that the psychic variations of Fiske's scheme must be correlated with accordant physiological variations which must precede or accompany such radical transformation as is involved in transition from animal to man. Mr. Fiske seems greatly to underestimate the importance of the changes in bodily structure which go along with these psychic changes which must have led toward man's body. And this correlation of bodily and psychic changes seems to be strangely lacking. The brightest individual for example which I have observed in the monkey-house of the New York Zoölogical Park is a little black-faced monkey, about a foot high, with a tail twice as long as his body. This individual is at least a million and a half years away from man. Psychic variations do not seem to relate themselves to bodily changes leading in the direction of man. In the second place, taking it for granted that psychic variations in large amounts may be given in the natural order, it is still true that such variations, in any degree known, do not begin to bridge the gap between animals and man. It is not merely that such variations do not go far enough—it is that they do not go in the right direction, or rather that they do not furnish the right materials. We cannot build a suspension bridge out of sawdust, even if we have a million carloads. The difference between man and the animal is not essentially a matter of intelligence and, therefore, cannot be bridged by variations in intelligence—however liberal our allowance of such may be. The difference is in kind, not in degree, absolute not relative. No one is interested, or perhaps no one ought to be interested, in curtailing the psychic powers which should be assigned to the animals higher or lower. We must allow to them the power of storing impressions, making comparisons and drawing inferences, and reasoning to the extent of relating means to ends. But when we try to relate that mental life to physical structure and grade it upward toward man, we are met by a double challenge.

In the first place, we are not prepared to admit, without an argument at any rate, that the simian which is anthropoid in brain is any more human in intelligence than the dog, or the trout that lurks in the pool. Is intelligence a matter of cerebral cortex? The trout has none, but is surely nobody's fool. Is intelligence a matter of convolutions? The beaver has no convolutions and the sheep has very deep ones. Is intelligence a matter of size or organization? Then how are we to account for the ant, who has no brain at all except a little nodule of nervous matter on the end of the spine, and yet is in some respects the wisest of the whole animal family? Do we here confuse intelligence and instinct? Well, who knows precisely the difference between these two mysteries, and is it not correctly said that instinct is simply organic intelligence? But, in the second place, as we have already intimated, the real difference between man and animal does not lie here.

In the *kind* of intelligence which forms a common denominator between man and animal, are we certain that man is unmistakably the superior? Take, for example, the trout just mentioned. The duel between man and the trout is a contest of intelligence but not of the same order nor on the same level. The human side of it is the abstract undertaking of fitting a lure to the appetite of the trout and hiding it from his intelligence while the trout's job is the concrete one of warding off danger in whatever form it presents itself. Put man to the same undertaking as the trout's with the same means to accomplish it, and it is at least doubtful whether man's intelligence, *measured by the same standard,* will appear so superior. It is as an inventor, a maker and user of tools and weapons, that man has won his battle with the animals. Moreover, in making a comparative measurement of man and animals we must not omit the inventive faculty of the latter, their hunting skill, their facility in disguise and the use of lures. The point here is that the essential difference between man and animal does not lie here at all. Man's preëminence does not consist in his possession of superior intelligence, but in his possession of spiritual selfhood. It is not his intelligence *per se,* but his use of it, that really counts. Professor Ritter states the case, from one point of view when he says: "Could we imagine a chimpanzee possessed of as much laboratory knowledge of organic chemistry as an Emil Fischer, that knowledge would be really meaningless were the creature's mind that of a chimpanzee in other respects" (*op. cit.,* Preface X).

Otto states the same truth in a more positive way: "Psychical capacity is nothing more than raw material. It is in the possibility of raising this to the level of spirit, of using raw material to its purpose, that the absolute difference, the impassable gulf between man and the animal lies." There is another difficulty involved in this theory of human origins, interpreted according to naturalism. Professor Fiske, of course, would not admit what is inevitably implied in the naturalistic scheme, that those psychic variations were not due to design, but were mere mechanical results—in fact *accidental,* and consolidated into rational order by being acted upon by natural selection. His teleology here helps him out of the difficulty involved in the supposition that *order* is the creation, out of "hit or miss" variation, of the environment. But, hit or miss variation of the mechanistic sort sufficiently linear and cumulative to bridge the gap from animal to man is unthinkable.

Moreover, the moment we try to relate these psychic variations to natural selection under the terms of survival value—we are in difficulties both at the beginning and at the end of the process. Utility and survival fail to grip the problem.

The utilitarian theory fails even to explain much that we find in the natural order even before man appears, as, for example, organic beauty. Newman Smyth ("Through Science to Faith," p. 157) states the case effectively at the close of his chapter on "The Significance of the Beautiful": "The Beautiful is a universal characteristic of the natural order. There is a tendency toward beauty in nature. Nature will be beautiful. Biology shows how to some extent use and beauty coincide. The beautiful frequently and in many ways is advantageous to life. Then it is naturally selected and enhanced. Natural science shows partially, at least, how nature may have woven her variegated threads in the rich garment of life. But beauty is superabundant. It transcends the uses of life. It is elemental, structural, constitutive in nature. . . . Loveliness exists above all its uses for its own sake. Beauty is an end in nature. It is as truly an end in nature as life may be said to be an end in evolution."

In the second place, when we try to realize the conditions under which man began to live on the earth, we are presented with this difficulty common to Darwinism everywhere, but particularly acute here. Variations in the possession and use of the distinctively human type of intelligence can be considered as having value in the physical struggle for existence only when sufficiently advanced to permit the invention and use of utensils and weapons. The objection that nascent powers not yet in use do not aid in the warfare of life, is peculiarly cogent with respect to man. The transitional stage, when reason was simply nascent, not yet arrived—when instinct was waning, and action through logical inference was being born—must have involved a racial infancy more or less prolonged and of the greatest peril. That psychic variation, beyond mere increase in animal cunning, should have been invariably and from the beginning favorable, is inconceivable. The arrest of the body, even when accompanied by psychic advance, must have involved multiplied dangers. The extermination of the unfit or less fit must have been terrific. That this struggle, when mind was nascent and the use of the higher faculties still novel and difficult, did not result in the total extinction of the species could be accounted for only by an almost miraculous combination of favoring circumstances—a mitigation of the physical severity of his lot not at all contemplated or provided for by the theory. As a theory, then, of beginnings, this scheme is not satisfactory. It has often been pointed out that man survives hard conditions only when the penalty of weakness is not death.

At the other end, we are confronted by the irrational redundancy of the final outcome. If variations in intelligence can be directly and mechanically correlated to the struggle for existence and survival, how can we explain the excess of the result. Man's distinctive attributes, which blossom forth in the creative arts, the beginnings of which go back so far, and are so characteristic, language which even in its simplest forms so transcends the mere utilities, to say nothing of painting, sculpture, music, poetry, romantic love and religion, cannot be reduced to an utilitarian basis nor explained in terms of survival value. Why nature should go so unnecessarily far in achieving a near-by result nobody has ever been able to explain.

Let us single out of this aggregation, for special mention, this item of language. This faculty with all its concomitants of physical adaptation distinguishes man. One can understand that the heightening of the ability to make significant sounds—which the animals possess—might serve a "favored primate" in the struggle for existence, but why this non-utilitarian excess of development in the case of man? This seems pure wanton waste on the part of a frugal nature. Dr. William Hanna Thomson says four things about the faculty of speech to which we preface another statement, making five in all, which will serve to bring out our meaning here.

1. No speaking animal has ever been discovered nor can one be imagined. To say nothing of the psychical powers demanded by speech, there are also too many physiological concomitants involved. The conformation of the vocal organs even in the highest animals, including the anthropoids, forbids this supposition. That animals make sounds by which they can communicate with each other and have various ways of expressing their emotions, no one who has lived much in the open can doubt, but this is very different from the invention of a system of symbolic sounds to express ideas.

2. No speechless human race has ever been found.

3. Every language has a similar basic structure in spite of all difference. Language reveals the essential unity of the human race.

4. The faculty of speech involves a limitless power of creation.

5. The mind in the full sense of that word precedes speech and is the creator of it. "One might as well," says Dr. Thomson, "trace a navigable river to a bottle of water as to suppose that the inexhaustible stream of human speech has any other source than the limitless spirit of man. Now my point is that such a development may be interpreted as the realization of a spiritual purpose in the life of man—but it seems to me clearly impossible to bring it within the narrow limits of an utilitarian theory which contemplates only "use-

ful variations" which have merely a survival value. The possession of this power is one of the elements which give human life value, but we can scarcely imagine Nature endowing man so lavishly with that which has spiritual value only—for the sake of making him a better animal and saving him from the pangs of hunger or the claws of other wild beasts. Granted that the spiritual man is the goal of the world process, and all becomes clear—but mere utility for purposes of survival have long since been left behind.

> "Words, words, words"
> "What but for Shakespeare's and for Homer's lay,
> And bards whose sacred names all lips repeat?
> Words, only words; yet save for tongue and pen
> Of these great givers of them unto men
> And burdens they still bear of grave or sweet,
> This world were but for beasts, a darkling den."

Mr. Fiske himself affirms that the natural selection of physical variations would not account, in any sense, for the existence of man. "From such variations through a dozen eternities nothing but new forms of plant and beast in endless and meaningless succession could be derived." Therefore, *natural selection* of *psychic variations* becomes a necessary link in the chain of hypothesis—but an exceedingly weak one. Can we imagine *mindless* Nature shifting her interest from physical variations, to which she has given her absorbed attention for countless millions of years, to psychic variations and concentrating for another series of eons upon its elaboration. The very idea of *natural* selection of psychic variations seems to be self-contradictory.

And this brings us directly to another incredibility in this scheme of things—the limitless draft upon time which it necessitates. The exact point of this objection should be clearly understood. It is not the idea of time alone—millions of years in preparation, a million years or more in elaboration, for we are familiar enough with these vast millennial processes in nature. The incredibility lies in the combination of *time* and *trend* in a mindless, mechanical scheme. Think, for example, of what is implied in the notion of an organic movement, involving the preservation of infinitesimal changes for a thousand millenniums along a single upward line and to a single end. It implies an eonian care for minutiæ, infinite sowing for a far off harvest. How can one conceive of a process so slow, so apparently fortuitous, and yet so inexorably certain and so grandly cumulative? And one amazing feature about it is that it has left no appreciable trace behind it. A million years of workmanship with hardly so much as a chip or a shaving to tell the tale! Does nature deal only with final results? Think of the myriads of intermediate forms which must have existed to link man with the lower forms of life! And yet whatever may be said of the lower stages, for the upper stadia of advance we have almost no units or remainders of the process. And the result is extremely curious. By this process of gradual modification and unbroken linkage we reach, on the one hand, the Quadrumana, a numerous but curiously loose group of families; and on the other hand, a single compact species and no indubitable common ancestor of the two related lines preserved. And this is the more strange because, by hypothesis, the ancestors of man must have been favored in the struggle by psychic variations, and yet only the end results remain, each in its own place, the one indubitably animal and the other no less certainly man.

In Professor Simpson's account of the origin and early history of man, diagrammed (on p. 64 of "Man and the Attainment of Immortality") and discussed in the accompanying text, the following group of six items stands out.

1. The modern human species divided into races 400,000 years ago.

2. This modern race diverged from the primitive human races (Eoanthropus and Neanderthalensis) 500,000 years ago.

3. This same modern species branched off from the stock which bore Pithecanthropus 700,000 years ago.

4. The modern species diverged from the stem of the great orthograde primates (the ancestral line of orang, chimpanzee and gorilla) 1,000,000 years ago.

5. The separation from the small orthograde primates (the ancestral line of gibbon and simian) 1,100,000 years ago.

6. The separation of the human line from the common stem from which all primates have descended occurred 1,200,000 years ago.

It is, of course, to be remarked that the scientific value of these schemes, both of genealogy and chronology, has been impugned (see, for example, Professor More, *op. cit.,* p. 148f.) as based upon a questionable dogmatic assumption at the beginning and involving a large admixture of guess-work throughout. But, my point is that, right or wrong, this chart does not exhibit any real *line* of human ancestry. There is no identified or apparently identifiable ancestor of man anywhere in the whole million or more years. The only named animal which comes anywhere near the meeting-point of the stems common to man and the other primates is Propliopithecus (of which Professor Simpson gives no description), making a sort of stubby thumb on one side of the branch which terminates a million or more years later in the modern gibbon and simian.

In the diagram which accompanies Professor Lull's Yale Lecture (*op. cit.,* p. 36) this Propliopithecus is called a "structural" ancestor of man (which means, of course, deductively inferred). But on the direct line to man, except for the generalization of the class Simiidæ, there is no named ancestor all the way to *Homo Sapiens.* It is significant also that no chronology accompanies this chart and that Professor Lull ends his lecture thus (*ibid.,* p. 37): "With the apparent insufficiency of evidence, however, judgment as to the antiquity of our species should be withheld for the present."

The method by which Propliopithecus is arrived at is shown sufficiently by the following sentence from Professor Simpson (*op. cit.*, p. 65): "The data are still much too scanty to afford any completely satisfactory account of the derivative relationship of these remains; none the less, it is clear that if we wish to represent to ourselves the period at which the Primate forms ancestral to man branched off from the stock common to him and the modern anthropoid apes, we have to place it previous to the earliest known forms that could be thought of as ancestral to any of the Simiidæ." This inference, from the necessities of the case, gives us Propliopithecus. As a matter of fact, Professor Simpson's own statements show that the classification of practically every fragmentary fossil specimen itemized is in doubt. So far, then, as animal antecedents are concerned the statement that no identified ancestors are known, is fully justified.

When attention is given to the primitive human races which paleontology has identified and named the same fact appears. On Simpson's chart the stem of modern man diverges from that which is common to him and primitive man 500,000 years back. In the Yale Lecture the ancient races stand at right and left of the modern line as mere distant collateral relatives, and far back of them, also at one side, stands Pithecanthropus, a *discarded intermediary form*. I shall have more to say about this being, one hardly knows what else to call it, a little later. It is necessary here to note, however, that while Pithecanthropus (according to a rather generous measurement of skull capacity) is placed about halfway between man and the *known* apes—five hundred years from either end of Fiske's line—even so it is not an ancestor nor a missing link because it is either animal or human. Professor Tyler ("New Stone Age," p. 16) says:

"Opinion was long divided nearly equally between those who considered it as the highest ape and others who held it to be the lowest man."

The point here is not the dispute as to whether this creature is animal or human—but whether it could be conceived of as of mixed category, both human and animal. We have discussed this point elsewhere, perhaps sufficiently. As a matter of fact no one seems prepared to classify any actual fossil remains thus dubiously. There are grades among the animals, higher and lower. There are grades within the humans, higher and lower—but the line of approach from the animal to the human is at least a half million years short and the one connecting link is evidentially dubious. The whole intermediate region between man and animal is practically vacant of evidence. My contention is that such a process of prolonged and gradual change as Fiske depicts, in spite of gaps in the geological record, should have strewn the earth with remains. As a result of the fact that it has not evolution has spoken and is speaking confusedly of man's origin. The line of his descent has lengthened, tangled and become increasingly tenuous. We have no definite ancestor in the past, and no direct, clearly defined line of approach to the present and no certain stages of advance in the process. Professor Tyler says: "We lose sight of our ape-man as he advances toward the threshold of manhood not far away." That is, we lose sight of him without being able first to identify him, and consequently, as Professor Tyler admits, "we still lack foundations for any hypothesis as to when, where or how the erect, ancestral ape-man emerged into real manhood." If the natural history of man were of the million year sort depicted by Fiske and Simpson would this meagerness of archeological evidence of his ascent be possible? Professor More admirably summarizes the situation as regards man when he says (*op. cit.*, p. 160): "As for man, we have found the roof of a skull, two molar teeth, and an abnormal femur in the Pliocene deposits, and from them there has been constructed a manlike skeleton. In the next period, or Pleistocene, man is found well scattered over the earth and well advanced in civilization, using fire and implements of stone and wood. Here, again, a dominant form arises suddenly and without close ancestry, as monkeys and men are now supposed to be collateral branches from an earlier mammalian type." Note, please, Professor More's use of the word *again*. He calls fresh attention to a fact which has been pointed out repeatedly in these pages that just at transitional points where concrete evidence for ascent is imperatively needed to make the evolutionary theory inductive the facts fail and the argument tends to blur, resorting to generalizations, "structural" forms, types and the like. He instances, as appearing, according to the evidence, suddenly and unheralded by transitional forms, the earliest fishlike swimming forms, the first vertebrates, the first air-breathing amphibians with feet and legs; the first feathered birds of which Professor More says "the appearance of feathers as an apparatus for flying is as nearly impossible a fact to explain by evolution as can be imagined"; the first angiospermous plants still unexplained; recent placental mammals (pp. 154-160). And back of this significant summary he puts the statement with which we must all agree, a statement in harmony with much that has already been urged herein, that "Evolution must begin with animals high up in the scale of differentiation and all stages from them to prototypes which were originated supposedly in the warm ocean slime of the Proterozoic epoch are pure conjecture." (p. 154.) [1]

To return to man, Professor Simpson in his fourth chapter has conducted an elaborate structural pedigree for man, beginning with a generalized "tree-shrew" (one of the Tu-

[1] It is impossible because of lack of space to transfer to these pages the whole body of my notes on Professor Simpson's chapter. I must ask the reader to review the material in that chapter and consider my remarks in view of it.

paiidæ) and following the clue of cerebral organization up to Pithecanthropus which is identified, as "in a sense a 'missing link' in that it represents a form morphologically between the anthropoid apes and man" (pp. 87, 88). But, as we have already noticed, opinion has divided and remains divided as to which side the line this dubious creature belongs. We do not need to hold the balances, only to point out that Professor Simpson's carefully conducted search ends in uncertainty. The whole narrative is marked throughout by equal uncertainties. For one thing, we are astonished to note the naïve fashion in which psychic factors are introduced into this story of structural modification, increased curiosity correlated with increased vision along with augmented faculty of attention and improved coördination of mental processes. This progressive gain in mental power is dependent upon increased vision, itself the outcome of complex structural changes, which in turn are contingent upon the acquisition of the arboreal habit. To me, at least, this combination of historical physiology with psychology is entirely unconvincing. It involves what I can only think of as an entire series of carefully constructed *non sequiturs* —like a ladder made of rungs laid serially in the grass, without connecting side-timbers. The series is perfect—the connection is nil. This is quite evident when we consider that the line of hypothetical advance is constructed upon the basis of changes in structure and habit which have occurred in the case of millions of animals without the alleged results in mental advance accruing. Climbing trees, using the forepaws as hands, standing on the hind legs, focusing the eyes, and all the rest of the factors which are adduced as combining to produce man, have been in operation millions of years and upon countless generations of animals without producing any of the psychic effects alleged in the case of man.

That this *is* a case of *non sequitur* is made more evident by the exceptional and non-classifiable elements which undeniably have entered into the process. The arm of exception as well as of "coincidence" has been stretched to the breaking-point. The animal ("shrewlike form") with which the story begins had "precocious" cerebral hemispheres and climbed into trees without any particular reason. All the development leading toward man's mental development *up to the point* when the advancing human race broke with the anthropoids was consequent upon this shrewlike animal taking to the trees. The last step was taken when the still advancing human stock descended from the trees. According to Professor Simpson, man was differentiated from the parent stock at about the same time as the anthropoids (see diagram, p. 64 and text pp. 72 f.). This is of immense importance. If true, then the emergence of the human stock was brought about in the same general situation as that of the anthropoids. Man thus becomes an aberrant offshoot under identical physical conditions. The modification, then, must have been due to something inherent in the stock or something specifically different in its response to the stimulus of environment or something individual and peculiar in the stimulus applied. This becomes the more apparent when we note that the great and "fatal" difference between man and the anthropoids was that the latter were too perfectly adapted to arboreal life, "conforming entirely to the immediate environment" (p. 73, cf. Marshall Dawson; *op. cit.,* Ch. I.). According to Jones "Homosimius" is "a case of successful minimal adaptive specialization," for man in contrast with the anthropoids *"left the way to the ground open."* To this Simpson adds: "Man alone of all living forms has never adopted any limiting protective adaptation either of structure or manner of life" (p. 74). In other words, man's ancestors conformed to the environment enough to be transformed (as by passing from the ground to the tree-tops), but not enough to be fixed. What a narrow road had to be traveled in order to reach mind! But was not mind at the beginning of it? We are compelled to note the mutual relationship of complex, inter-acting factors all of which *had* to be associated in bringing about this advance.

The greatest weakness, however, in the whole evolutionary scheme to account for the origin of man on a basis of natural development, is its failure to arrive. The ascending line of the animal increasing in intelligence and in its outreach toward the human level, eventuates in what from the human point of view, is practical imbecility. The offspring of the "anthropoid genius" is the human moron. This picture somehow fails to be convincing. As Professor More (*op. cit.,* p. 119) puts it: "We heard much, during the last century, of 'missing links,' but we should remember, since each offspring varies from both of its parents, that the chain of organic evolution, connecting two different species or genera back to their common ancestor, has as many links as there have been generations in both species. Each ancestor as we go back in a genealogical table is thus a link in the chain of evolution, and if we think of man as the descendant of the first protoplasm, the number of these steps or generations, becomes inconceivably great. In the popular mind the 'missing link' has become identified with the hope of finding the bones of some wretched, filthy being which could not be called a monkey and which no one would be willing to call a man. It is, perhaps, an odd fact that the ancestors of animals are presented to us by evolutionists as other animals well fitted to thrive in their environment and adapted to enjoy life; only in the case of man do we get the picture of inefficiency, half man, half monkey, which is indecent and degraded." As a matter of fact, the logic of the whole system seems to be wrong. The hypothesis is that, starting at zero, the cortex has developed through the interplay of brain and stimuli and *pari passu* has conditioned the mental development of modern man. The function of the cortex, in the last analysis, is to deliver man from the direct control of the environment, to correlate his stimuli, to organize his responses, to store his impressions, and enrich his experiences, so as to introduce thought, deliberation, and freedom into his actions. That is to say, that on the naturalistic basis, environmental stimuli acting upon a rudimentary brain has developed a mechanism for its own limitation and control. The development of a thinking mechanism from a non-thinking one through stimuli, which at most could do nothing more than supply materials for thought to a thinking being, is an impossible hypothesis. Moreover, the cortex itself, as a mechanism, could not possibly think, any more than a piano of itself could discourse sweet music.

The whole state of the matter seems to indicate that in this speculation we have somehow gone astray—we are out of the path. It ought, therefore, to be possible, by retracing our steps to find out when and where we stepped aside. There seems to be more than a hint of this in Fiske's own statement. The reader will remember that he says, in speaking of the arrest of physical evolution and the progress of mental development that when the favored anthropoid could strike a fire, chip a flint, use a club or strip off a bear's hide for a coat—there was no further need of developing his bodily powers. Here is the kernel of the whole matter. When an anthropoid can do these things he is no longer animal, he is already wholly human. We shall see in the next chapter that Fiske does not really get to man at the end of his development scheme—it is none the less clear that he has begun with the essential educable man. When we find a fireplace, or a heap of hand-chipped flints, we know that man has certainly been there. And the truth is this: Man, the whole man, is necessary for every line of human history—all the way from chipped flints to modern invention. Whatever gradations may appear in human knowledge, rationality, which is behind all advances in knowledge and skill and conditions them all, appears at once, as a totality, as a preconditioning entity. When we write *man* on the page—we have, *in posse* if not *in esse,* all that constitutes man.

And at this point, it might be well for us to review the evidence and summarize the situation.

1. It is reasonable to suppose that the Creator made use of the gains in organic development previously made as the basis of man's unique life which is clearly indicated by the general connection between him and the lower forms of life.

2. Any direct affiliation with his nearest living kin among the higher animals or with any known species of extinct animal seems clearly impossible because of his synthetic type of structure and widely different mode of development.

3. His peculiar development both in body and in cerebral structure seems to be the result rather than the cause of his being human. This is indicated by the fact that (in ontogeny) his ascent to the human level is achieved by leaps, by a unique prenatal development and by swift transformation in the period of early infancy.

4. There is an almost total and quite unexplainable absence of evidence for a gradual development through intermediate forms.

All these considerations seem to point in the same direction—to the conclusion, namely, that man made his appearance by an act of God, and by a sudden upward leap, developmental in the sense that it involved a directive synthesis of processes already in operation throughout the animal kingdom and an inherited organic basis, but creative in the sense that it was not contained, and therefore that it cannot be explained, by anything which went before.

Professor Macloskie of Princeton states the case with precision when he says: "The forms discovered and identified as connected with man are unmistakably human, and evidences point to high gifts of one kind and another." He adds what seems to be a necessary conclusion from all the facts: Man's "evolution must have been of an extraordinary kind, specially expedited so as to leave no tracks behind and with new endowments of unique grade."

In this connection Professor J. Arthur Thomson has made two remarks of arresting weight and significance. The first is this: "Man has transcended his ancestry"—which introduces the unique at the end of the process. He also says: "It is likely that man had his starting point as a prepotent anthropoid genius," which admits the unique at the beginning of the process, for as Professor Thomson says: "It is not merely that a genius has more brains: he has a new pattern of brains, and a large mutation is a new constitutional pattern."

Of course, the question at once arises, how far can we admit it (genius) into our conception of the anthropoid without declassing altogether as a proper anthropoid—but it is preferable to state the case in a less hypothetical way. The physical mutation from anthropoid to man, which must have been by far the greatest in all organic history, and, therefore, sudden—the greatness of it and the suddenness of it making it inexplicable simply as an item in the physical history of the cosmos, is yet but the index and symbol of a still greater event, the explanation of which is in God alone. The real mystery of the advent of man is not the appearance of a brain, of whatever uniqueness of type, but of that which transcends and uses brain—mind, self, spiritual personality. There is *process,* slow, hidden, gestatory—and there is *culmination,* sudden, transcendent, inexplicable. Both are phases of the divine working. As Richard Le Gallienne has said: "Yet, when the moment [in process] at last comes, as the alchemists used to say 'of the great projection,' and the various baser metals darkly seething in the crucible, in a sudden glory, become the living gold, the transmutation is none the less a mystery, a miracle, because we have caught glimpses of a process, which for all our watching explains nothing."

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Nov 15 / 15 — R.M.

CHAPTER XI

EVOLUTION, SIN AND REDEMPTION

It has been acutely remarked that if evolution could account for personality, it could account for sin. Sin, according to any reasonable definition of it, must be a state or condition of personality. It is, therefore, an idea to which the full concept of personality only can give content and meaning.

Evolution might conceivably explain personality, and thus, by inclusion, sin, if it could explain anything. The truth of the matter is, however, that whenever evolution is used in any other way than as a *modal description* of the process of correlated change which lies between a given antecedent condition and another given consequent condition, it immediately and inevitably becomes an unconscious feat of mental juggling in which there is surreptitiously slipped in at the beginning that which is taken out at the end. We have Professor Conklin's word (already quoted in another connection) for this (ms. *ut supra,* p. 11): "Thus in our mechanistic explanations of fitness we put in at the beginning what we take out at the end, namely, a capacity (on the part of organisms) to discriminate (differentiate) between the fit and the unfit, and a tendency to retain the one and to eliminate the other. 'It is because living things are irritable, registrative, persistent, variable, that they have been able to evolve in adaptive ways' [Thomson], but we cannot explain the fact that they possess these qualities. Thus, here, as in all mechanistic explanations, we introduce in our factors the equivalents of the things which we seek to explain." The point here is that what, under the category of explanation, is a logical solecism, is, as description, legitimate, true, and illuminating. There is nothing, in the whole discussion which we have reviewed in these pages, so unmistakably clear or so important as that the evolutionary formulation of the world process is *modal description,* not explanation; science, not metaphysics.

So much for the situation in general. Now for the immediate question. To attempt a biological explanation of any problem of the moral life which is so profoundly implicated in the mystery of personality, is to undertake not merely an impossibility, but an absurdity. The very concept of sin belongs to man as standing outside biological history, in the sense in which that phrase is applicable to every other living organism. Sin is a function of man's uniqueness. Every attempt, therefore, to frame a biological theory of sin, is simply under one guise or another *to explain it away.* (Of course I am not objecting to the use of biological analogy or the extension of the term biological to cover all the facts of life. Biology is used here in the strictly technical sense.) For one thing, in the organic world as biology interprets it, there are no revolts, no anarchies, no contradictions, or anomalies. In this realm the dictum of the poet is literally true, "Whatever is, is right." If we except certain reflex disturbances introduced by man into nature, and excepting also the effect of nature's operation on man, nature is under law, harmonious and orderly, a legitimate, and in a loose sense at any rate, whatever happens is a necessary element in the cosmic program. Therefore, the very attempt to fit sin, which is *by definition* moral anarchy, as a constituent element, into a scheme like this, is itself a contradiction,—the solving of a problem by the denial of its existence. In the very nature of the case there can be no evolutionary explanation of sin for the reason that sin belongs to a realm in which evolution in the biological sense plays no part. This conclusion will be stoutly resisted. Let us see if it is true.

Edward Clodd, the British materialist, has made this statement: "If mind is an entity independent of brain, it would not only stand outside the ordinary conditions of development, but it would also maintain the equilibrium which a dose of narcotics or of alcohol, or which starvation or gorging alike rapidly upset." Mr. Clodd gives away his case by his method of stating it. No one claims, or should wish to claim, that mind is independent of brain,—how could it be so long as we are in the body? What we wish to affirm is that the mind is not *identical* with the brain. For the mind to be independent of the brain, in Clodd's sense, so that the brain could be drugged or otherwise poisoned without upsetting the mind, would be not only fantastic but immoral in the extreme. The brain, which is the mind's instrument of contact with this sphere of reality, is necessary to its valid operation. But that is not to say that mind and brain are identical. On the contrary they are at once associated and antithetic. Their association and harmonious interaction in the interest of a single unified consciousness is one of the major problems of our existence. On the other hand, to deny this twofoldness of mind and brain is to eliminate the problem of duality in our being, but to put another in its place, which stubbornly refuses to be set into any rational view of the world. This applies to the second part of Clodd's statement. The first part, which assigns to mind, on the theory that it is distinguishable from brain, a certain independence of what he terms "the ordinary conditions of development," by which he means organic evolution, must be frankly admitted. This must be admitted unless we make psychology a subdivision of biology. The *history* which mind produces, and evolution which produces mind, cannot be brought under a single movement operating by identical resident forces. The ground for this distinction lies in the fact that the development *to* mind (with respect to man) is impersonal, unwilled, cosmic; the development *of* mind is personal, voluntary, under the leadership of a *rational ideal.* We may not define both these movements as *evolution* unless we are willing so to broaden the term as to admit the idea of a revolutionary change in method. "At this point," says Marshall Dawson, "there is a break, or lift in the evolutionary process" ("Nineteenth Century Evolution and After," p. 108). He then quotes: "Organic evolution is pushed onward and upward from behind and below. Human evolution is drawn upward and forward from above and in front by the attractive force of ideals." In order to have a moral universe we must *at some point* or other allow for the introduction of freedom. Most of us would connect freedom and its concomitant moral responsibility with man, as the above quotation seems to imply. Others would introduce freedom much further back, even with the beginning of life.

As Bergson ("Mind-Energy," p. 17) says: "Consciousness and matter appear to us, then, as radically different forms of existence, even as antagonistic forms, which have to find a *modus vivendi*. Matter is necessity, consciousness is freedom; but though diametrically opposed to one another, life has found the way of reconciling them. This is precisely what life is,—freedom inserting itself within necessity, turning it to its profit. Life would be an impossibility were the determinism of matter so absolute as to admit no relaxation."

It does not matter so much, however, where we introduce freedom, whether with life or with man—so long as it is admitted within the world-system. It is clear, however, that moral responsibility, the moral reason, is a constituent of personality, of moral self-consciousness and conditioned upon its appearance.

Now, either moral selfhood is a new thing in the world when it historically appears, or it is a new combination, or an unexampled extension and refinement of that which is already in existence,—in either case it is unique. It can be interpreted only in terms of itself, it is neither something else nor the development of something,—it is itself and nothing else. As unique, the history of the moral self cannot be interpreted in general terms or be submitted to any formula or be reduced to a common denominator with other and different processes or operations. Marshall Dawson, already quoted, who has a very sturdy and outspoken doctrine both of sin and redemption, gives us a new "evolutionary" definition of sin as follows: "Sin is conduct of a member of a higher species that is appropriate to or characteristic of members of a lower species" (*op. cit.,* p. 130). It is evident that this definition is merely formal or analogical except as it is applied to man and to man only as he is interpreted in terms of freedom and responsibility. Arrested development is a common fact in nature. Numberless forms, as we have already noted, have remained stationary throughout organic history, while their fellows have gone on to higher levels; but the failure to progress does not involve culpability except in the case of a being who is free to progress and under *moral* obligation so to do. Degeneration, which is inverted evolution, is also a common fact in nature, but the descent to lower levels of organic activity does not imply demerit except in the case of a being who in the exercise of freedom turns away from a line of conduct which to him is obligatory. It is undeniable, therefore, that the material for any interpretation of the doctrine of sin is not furnished us by the theory of evolution. We may, indeed, apply the formulas of biology to the moral history of man. We may legitimately speak of man's moral "evolution," or moral "arrest of development," or moral "degeneration," provided we remember that the biological element in this analogy is to be characterized and defined by the moral, but that the moral must not be denatured by the biological.

The primary limitation of this evolutionary account of man as ordinarily stated ought also to be noticed. Professor Patten says (*op. cit.,* p. 32): "Biologists, the chief exponents of evolution, are accustomed to think of organic evolution only, and of that largely in terms of natural selection, mutations, and germ plasma. But in the great domains of astronomy, geology, and chemistry, in science, religion, and government, and in a host of other domains, all of which are the products of evolution, these terms are inadequate, or do not aptly apply. Natural selection and the survival of the fittest are perhaps the broadest terms used in the biological sciences, but the processes so designated have no creative value. The terms merely imply that a definite sequence of products ensues, or affirm the self-evident fact that something already created is selected for survival, or that it endures. They do not suggest how it was created, why it survives, or wherein its fitness lies."

While this criticism is leveled broadly at the prevalent evolutionary theory of life in general, it applies most pertinently to the Darwinian account of man. For example, John Fiske (see preceding chapter), for all his million years of development does not really get to man at all. He says that "something like human intelligence of a low grade, like that of the Australian or Andaman Islander, was achieved. The genesis of humanity was by no means yet completed, but an enormous gulf had been crossed." We shall consider these Australians and Andaman Islanders later—but we must give attention first to this strange fact, that after a million years or more, the genesis of humanity was not yet complete. Why is Professor Fiske so cautious here? Why are the results of this long process in which nature so fully expended herself so indecisive? Is it not that the formulas of variation, natural selection, and the apparatus of the struggle-and-survival theory in general do not really give us a rational account of man? Is there not something *absolute* and transcendent in personality which cannot be accounted for by any theory of graduated variations from animal antecedents? Fiske's formulation seems to lack the elements of "creative value" which are needed to reach the fact of personality.

A much more detailed and up-to-date formulation of the rise from animal to man is given by Professor Conklin. He says ("Heredity and Environment," pp. 32 f.): "The elements out of which the psychic qualities of man have been developed are present in all organisms, even in germ-cells, in the form of sensitivity, tropisms, reflexes, organic memory, 'trial and error' and a few other properties; in more complex animals these take the form of special senses, instincts, emotions, associations, memory; in the highest animals and especially man, they blossom forth as intelligence, reason, will and consciousness. Many stages of this development may be seen in various animals below man, and also in the development of the human personality from the germ-cells." This diagrammatic representation of the ascent in living forms from sensitivity to reason must not be taken literally as a history of the actual development or we shall be landed in fallacy. For, in the first place, these so-called elements are not entities (like eggs or germs) which are in themselves capable of development—they are powers or capacities of organisms, each of its own sort, and can never become anything else. Tropisms, sensitivity, reflexes, are what they are to the end of time. In the growth of the individual organism they may become associated with other activities, or they may give way to other activities, or they may themselves come to fuller expression, but they cannot be changed into something else. The same organism may at one time possess and exhibit nothing but tropisms or reflexes or organic memory; at another, rise to a higher level and exhibit instincts and emotions, and at still another stage, exhibit reason, will and consciousness. But all through, these *activities* remain distinct—they do not change into each other. They exist successively or simultaneously as determinations, activities, constitutional or functional powers of the organism. They have no separate or self-contained ground of existence. An animal may *feel* as a board may be *white,* but feeling in itself, like whiteness in itself, is an abstraction. Whiteness has no existence apart from white objects, and feeling has no existence except as an idea apart from feeling beings. No organism can climb on tropisms, reflexes, or the like, as on the steps of a ladder from a lower to a higher level. The organism climbs, if it does climb, by virtue of its own inherent power in response to the environment, by unfolding and enlarging itself, by the progressive attainment of its end; in a word, by self-realization. Its powers or activities indicate and measure, on the one hand, its essential constitution, and on the other, the status of its development.

If we talk about the development of man's psychic qualities out of the elements which are present in all organisms, we shall reason fallaciously unless we keep clearly in mind that what we really mean is that a succession of organisms, *genetically related,* pass through various phases of psychic advance from tropisms to rational intelligence by a cumulative process analogous to the development of the individual man himself from the germ to maturity. Such an analogy is implied in Professor Conklin's last sentence. Human ontogeny, from germ-cell to maturity, is the history of one and the same individual, which shows the various stages in the development of powers which are potential at the beginning. Human evolution, by analogy, is the history of one and the same *racial* type, whose characteristics also are potential at the beginning. The successive organisms in the evolutionary series correspond to the successive phases of development in the ontogeny of the individual. If the germ is potential man, so also is the ameba, or whatever form stands at the beginning of the series leading up to man. One important qualification must however be kept in mind in the framing of an analogy between man's development from the germ-cell and his evolution from lower forms of life. That qualification is that in one case we have development *in the same kind* which, however mysterious, is quite different from an ascent from below. Man passes through stages of development analogous to permanent stages in the lives of the lower animals, but that does not prove that those stages have the same meaning. Man's stages from below upward are cyclical phases in the embryonic life of his species and as an organic process involve a return to the same level from which they start. The movement here, accomplished by rapid changes occupying a few months, is from man through the germ to man again. On the contrary, as already indicated, the evolutionary ascent, taken by itself, involves a single movement from *below upward.*

In what sense then does the analogy hold between the germ-cell from which the human individual is derived, and the primordial form from which the human race is derived? In what way is the primal form potential of man? Is a movement of ascent which is not backed by an instrumental descent from a causal level adequate to the whole process, even conceivable? The answer to these questions brings us into the presence of the causality which underlies the entire process which culminates in man, both in the inorganic and organic phases, and justifies Professor Patten's contention that the biological formulas do not reach far enough to grasp the whole problem. The immediate significance of this fact is that the biological approach to man through descent does not get there and that no summation of psychic variations on the organic basis really gives us personality. It is a process which approaches the human level but does not reach it.

Curiously enough this conclusion is borne out indirectly and negatively at least, by Professor Conklin's own statement. As I read his statement he does not really get to man any more than Mr. Fiske does. It may not be an overstatement to say as he does that other animals possess reason, will and consciousness, though possibly the word reason will bear watching—but I do not insist. As it stands, this statement does not contain a definition of man in the *full* breadth of the distinction which separates him from the animal world. Professor Conklin does not venture to include, or at any rate does not include, *self-consciousness* in the catalogue of psychic qualities which are found in rudimentary form in the animal. But this is the essential man, in whom the distance from the animal is really found. The same limitation in the evolutionary scheme, which, when it is violated, results in fallacy, is shown in a sentence of Professor Tyler's. He is speaking of the coming of man and says: "Whether we think Pithecanthropus (the Java 'ape-man') was approaching or had already passed the threshold of manhood, depends upon where we draw the line between ape and man, a line largely artificial and as difficult to fix as the day and hour when youth becomes of age, and what characteristics we select to mark it" ("Men of the New Stone Age," p. 17).

The fallacy here is twofold. It implies that the transition from man to ape is the same in kind as that from youth to manhood—which as we have already seen are two phases in the development of the same individual, and, second, that the difficulty in fixing the time of the change is the same as in establishing the fact of the change or in recognizing the completeness of it.

I think this uncertainty is not justified even in connection with man's body. Professor Keith says: "There is not a bone, muscle, joint, or organ in the whole human body but must have undergone a change during the evolution of our posture,"—which change must include among others the revolutionary transformation which has taken place in the formation of the human organs of speech. The same writer says that man (zoölogically) "has progressively and aberrantly evolved to his present position,"—a fact which involves a creative transcendence of all previous development.

If man has come by way of evolution and through descent, he has yet come definitely and with clearly marked distinctiveness. Although we may not be able to mark the time of definite transition—possibly because of the very fact that it was not gradual but sudden, a true "mutation"—we may yet be certain that it was definite, a genuinely historical process through which a new cosmic level, involving a new set of values and a new law of progress, was attained. And right here is the place to combat once more the notion that there can be a category intermediate between ape and man such as is implied in the expression "ape-man." The belief that such a transitional monster cannot exist rests on grounds entirely apart from the question of descent and altogether independent of the discovery of apelike fossils of whatever sort or degree. The first man who appeared would, *at his appearance,* be untouched by educative influences and by hypothesis the inheritor of an animal bodily organism, but this does not at all involve the supposition that he is fractionally an animal. The first man is man, with a full psychological endowment *in posse,* else he is no man at all. His bodily form might be what you will. Human personality inhabiting and animating an inherited body might require several generations to inscribe its high qualities on the structure and expression of that body. But to affirm that the earliest man was less man than his latest descendant because of the limitation of his inherited body, is simply to beg the question. A half dozen sciences seem to me with united voice to resist this conclusion.

The conclusion that man represents a sudden departure from his ancestry has been gaining ground for many years. In 1910 Professor Metchnikoff ("The Nature of Man," p. 57) speaking of "the sudden" appearance of new species said: "It is probable that man owes his origin to a similar phenomenon. Some anthropoid ape, having at a certain period become varied in specific characters, produced offspring endowed with new properties. The brain of abnormal size placed in a spacious cranium allowed a rapid development of intellectual faculties much more advanced than those of the parent and those of the original species. . . . These suggestions involve a conception of the mind which is in harmony with known facts. From time to time prodigies are born with some talent far greater than the gifts possessed by the parents." This idea has been reiterated by Thomson (*ut supra*) as something more than a mere surmise and is also favored by Otto (*op. cit.*, p. 133) who says: "There is nothing against the assumption, and there is much to be said in its favor, that the last step from animal to man was such an immense one that it brought with it a freedom and richness of psychical life incomparable with anything that had gone before—as if life here realized itself for the first time in very truth, and made everything that previously had been a mere preliminary play." We may also say that this fits in with the general attitude of scientists to-day as voiced by Professor Thomson and still more emphatically by Professor Conklin, that the great steps or lifts in evolution have come through mutations of greater or less magnitude.[1] As Professor Orr rightly says, with this hypothesis, "the whole problem of man's origin assumes a new character." While this does not, of course, explain the appearance of man, it does give us in nature doctrine an origin for man in harmony with his unique position. And another conclusion of great importance may be drawn from this idea as Dr. Orr puts it ("Sin as a Problem of To-day," p. 173): "Certainly, if such a 'big lift' [Thomson] took place in the origin of man, it is not on the physical side only it is to be looked for; the psychical must be included. Since, indeed, it is the psychical which determines the characters of the organism, rather than *vice versa*, it may be held that it is primarily with a rise on the psychical side that the bodily rise must be connected." At any rate we have abundant justification for holding that the transition to man does not involve the absurdity of semihuman gradations. It seems to me that we need not hesitate to pick the character-

[1] It is perhaps true, as Professor More says, that "if the theory of jumps is ever accepted, evolution parts company with physics and chemistry and would not differ essentially from the belief in special creation" (*op. cit.*, p. 214), but it is none the less inevitable. As Professor Conklin said to me: "The theory of mutations has come to stay."

istic and distinctive marks of man anywhere we find him. There is always and everywhere one unique characteristic of man as man even at his lowest,—his capacity for education and development, and his peculiar need for and dependence upon education. This inalienable characteristic—his capacity for education—forbids his possible classification with animals, even temporarily, and when he is taken at the lowest.

It is a curious fact that while this distinctive educability is admitted as the distinctive mark of historic and contemporary man of all degrees, this peculiarity does not seem to have been logically applied to the crucial matter of origins. The transition from animal to human mind is to be found, not in mere gradations of intelligence, but in the ability to profit by experience, to learn by means of general principles widely applicable to new conditions. And it seems quite clear that the possession of reason, in the unique human sense of the possession of general categories, precedes and conditions the accumulation of knowledge. Hence it is that any summation of animal types of intelligence through however long a line, leaves an unfilled gap which has to be *leaped* before man can be reached. Professor Fiske designates the quasi-human mentality arrived at by his million years as *something like* human intelligence, like that of the Australian or Andaman Islander. The Australian is clearly a bad instance to choose, for his educability is well known. The Andaman Islander is a slightly happier instance for Fiske's case, for he has the smallest skull of any known human being and resists civilization. But, his capacity, standards, ideas, and conduct are wholly human and by no means despisable. Otto meets frankly and sufficiently the challenge involved in both cases. He says: "Naturalism asks whether the difference, let us say, between a Fuegian and one of the higher mammals such as an ape, is not much less than between a Fuegian and a European. This sounds obvious, if we measure simply by habits, morals and possibly also the content of feeling and imagination in a savage as we find him. And yet it is obviously false. I can train a young ape or an elephant, can teach it to open wine bottles and perform tricks. But, I can educate the child of the savage; can develop in him a mental life equal in fineness, depth, and energy, frequently more than equal to that of the average European as the mission to the Eskimos and the Fuegian proves, and as Darwin frankly admitted" (*op. cit.*, pp. 332-33). He might have added also what is quite as true and quite as significant, that the child of the European, deprived of social advantage and education and placed in an impoverished environment, "vacant of our glorious gains," will in the course of a very few generations sink to the level of the savage.

Moreover, the savage cannot be taken as altogether representative of the primitive man. He cannot be accepted as our contemporary forefather—nor does he represent merely an arrest at an earlier stage of normal social development. The savage is typically unprogressive—even retrogressive—because hardened in the matrix of binding custom. He has as long a pedigree as the civilized man and is the outcome of the play of social forces operating through ages past. The primitive man, on the contrary, stands at the beginning of progress and was a pioneer in it. He was the pathfinder of progress, when that path led through the trackless wilderness of a new world.

He was the creator, the inventor, the discoverer. What a genius he must have been who first kindled a fire, built a hut, cooked a meal, domesticated a grain or an animal! Psychologically speaking, man's first and most primitive inventions were his most original achievements.

The current opinion about primeval savagery continually confuses capacity with attainments. On the contrary, as we have said, the first crude chipping of a flint, the first speaking of a word, involved, potentially and in promise, the whole range of human capacity. A keen reviewer of two recent and important books on contemporary primitive peoples (see N. Y. *Times*' "Book Review," Dec. 10, 1922) opens his review thus: "The outstanding truth evolved from a reading of these two bulky volumes is that, after all, the workings of the human mind are much the same in all of us. These men, remote from civilization and low in the scale of development as they are, are 'savages' only in outward aspect. In both is the measure of self-respect which differs only in kind [1] from that of the so-called higher races."

The man—the whole man—precedes the first line of human history.

There is another group of facts which is peculiarly suggestive in this connection. There is no such thing within the range of human experience, so far as evidence goes, as a lapse from the human to the animal level,—this statement is made on the basis of many and careful observations which have been made in idiocy, insanity, and moral perversion.

When we speak of animalism or brutality in connection with man, we speak in metaphor. Whether there are atavisms of the animal sort in man, I do not attempt to say,—experts differ on the subject. As an explanation of human degeneracy, animal survivals do not seem to be necessary where a substratum of animal life is always present. But, while man may fall morally, and in his fall show animal-like traits, he never descends to the brute level. Man remains man through all his perversions, whether due to congenital incapacity, disease, or moral wickedness. Maudsley, the great English alienist, maintained that the inherent majesty of the human mind was evident even in the ruin wrought by madness. Moreover, Maudsley's own argument for the dependence of personality upon organization—which we do not question—shows that actual relapse to the animal level of mental or moral life is outside the range of possibility. The mental and spiritual impairment which he traces to physical derangement, as the result of

[1] By kind, he evidently means "outward form."

lesion of the brain cells or other injuries to its structure—never involve a lapse to the subhuman level even when the victims pass through all the stages of derangement which ends in death. They are always perversions or malformations of the human. (See quotation from Maudsley, in Brooks: "Foundations of Zoölogy," p. 227.) The cases of Fred and Joe, already referred to, those unfortunates whose brains were so degenerate, but who were yet completely human; the apelike boy (described by Krause of Berlin), whose brain though of normal size "differed from the human in every respect and approached in its whole structure rather the Simian than the human type," exhibit the same fact. Both Virchow and Hartmann, as Dr. Christianson says, "made a careful and close study of the boy, as they likewise did of Margaret Becker, another apelike idiot, yet both these authorities concur in the decision that in these abnormal creatures the positive psychological faculties and qualities of the ape are wanting, while every characteristic of a human being is present" (p. 84)

Man is unchangeably man, a fixed type for all the wide limits of racial and individual variation, which history and psychology show to be within the range of his possibilities. His degeneracy is quite as human as his normality. Whether man came from the animals or not, it is certain that he attained permanent typical standing in his own kind and can never go back. The abnormal man is no nearer the animal than the normal.[1]

This implies that there is an absolute meaning to the word human. There is a certain inalienable quality pertaining to the human being which must condition all intelligent study of his character and history.

[1] Professor Buckham ("Personality and Psychology," 1924, p. 180) states the case admirably from another point of view when he says: "The acceptance of the evolutionary hypothesis by no means fills in the gulf between man and the animal, for the reason that no sooner was the transition from animal to man made than the gulf between them began widening and has continued to widen ever since."

Now, this is at once the starting point and the crucial fact in the Christian teaching about man, both as regards sin and redemption, which two ideas are in the Christian scheme inseparable from each other and from the basic idea upon which both rest. Grant this, that man is a true person, rational, free and therefore responsible for his own acts, and all things else necessary to a true doctrine about him logically and inevitably follow. The moral experiences of man belong to his life as man and are the unfolding and expression of his moral personality. This is a basal and unshakable fact. Dr. Schurman says: "The scientific moralist, instead of moving comprehensively over the fields of animal life, must brood intensely at the altar fires of the human heart. However deep the mysteries of man's moral nature, no irradiating light falls upon them from the non-moral world without. The moral being is more than a child of nature; he is the member of a kingdom where time and space are not. Yet is virtue not withholden from scientific survey, since its manifestations fall in time and constitute a part of the history of humanity." Dr. Schurman also points out the fact that we have no really objective data on animal and prehistoric morality, hence the ideal of a "physical ethics" remains unattainable; and he concludes that there is "no place for ethics save as a branch of human history" ("Ethical Import of Darwinism," pp. 28 f.). The Biblical idea is that man's history from the moral point of view is in part the record of a great moral perversion and an equally great possible moral recovery based upon the essential greatness of the being who is the subject both of the one and the other. It is because he bears the image of God that man is capable either of moral perversion or of moral recovery.

It is evident that the only question which can be discussed here is this: Is man a fallen or sinful being? The court of appeal in the establishment or refutation of this teaching—we speak now from the point of view of the seeker for truth—is not biology but human psychology and history. Neither the idea of heredity nor of atavism nor the theory of animal survivals gives us real aid in solving this moral enigma. If man must own to a physical tie with the animals through descent and has received his body by inheritance, it could not have been as a hampering limitation, much less a congenital abnormality. It must have been under normal conditions—that is, under law. Man did not receive an inheritance of exacerbated passions which a nascent intelligence and feeble will vainly tried to curb—like a small child trying to control a team of horses already at full gallop when he takes the reins. This could not be, for, by hypothesis, man receives his physical inheritance on the level of nature. In the animal the bodily impulses are orderly, rhythmical, and for the greater part, regulated in respect to normal stimulation and adjusted to the welfare of the organism.

Now, the distinctive fact about man, and this is tremendously significant, is that his bodily instincts are set free from rhythmical control and attached to his reason, his will—his selfhood, and therefore immediately become a moral problem. As a matter of fact, man's undoing is not his body, which at least he shares with the animal, but his human mind—his distinctive and unique human self. The body becomes simply one condition or instrument of his behavior as a moral person. Man alone has the power to abstract the gratification of an impulse from the immediate stimulus which arouses it and to pursue it for its own sake. Herein lies his unique peril. The glutton is not the victim of his stomach, nor of his appetite, but of his unregulated imagination. He calls up a vision of gustatory delight and gorges himself, often to the disgust and rebellion of his body, which is always as decent as one allows it to be. In the same way every element of the physical life is taken up into connection with man's higher powers and becomes an element in a moral problem. If his mind is right, if his imagination is under the control of his reason and his conscience, if his personality is morally unified in seeking the good, his physical life will take care of itself. Man's worst sins are not those of the body,—in fact, the seat of sin is not in the body at all—but in the perverted and unregulated self. Here again the uniqueness of man is clearly manifested. Just as his highest powers are uniquely his own, so also, and by consequence of these higher powers, the moral issues of his life are uniquely his own. The ranges upward and downward which lie within his reach are commensurate with each other, and both are dimensions of his greatness. "Low they fall whose fall is from the sky." And these considerations bring us around again squarely to the Christian position.

And at this point we must guard ourselves, not against scientific evolution, which has nothing to say on this subject, but against loose evolutionary thinking. An argument against the Biblical idea of a moral fall, or the conception of sin as involving a real lapse, has been drawn, but quite illegitimately, from the general consideration of man's ascent. It is put like this: according to the Bible man has fallen, according to evolution he has risen—his trend is upward. As has already been indicated, we cannot derive a theory of sin directly from the phenomenon of degeneration in nature, urged by Griffith-Jones, Drummond, and others, as a counterpoise to this argument from ascent. Degeneration of structure, function and even position in nature is quite a different thing from moral degeneration in man. It is a suggestive illustration, nothing more. We may, however, point out, as Marshall Dawson has convincingly shown, that evolution is not a one-way process which excludes the idea of moral degeneracy by its notion of an automatic, universal, and mechanical upward progress. A large part of Mr. Dawson's valuable book is devoted to showing the mistake made by early evolutionists in identifying evolution with inevitable and mechanical progress (see "Nineteenth Century Evolution and After," *passim*). The reaction against this word has been so pronounced that Professor Conklin introduces a discussion of progress with this deprecatory word (Yale Lectures, "Evolution of Man," p. 159): "The very word 'progress' calls forth a reaction from some people not unlike their response during the war to the word *Kultur*." On the other hand, the ideas of ascent and fall do not conflict because they do not necessarily apply in the same way nor at the same place, and, because even simultaneously they are quite compatible. A man may rise and fall simultaneously in two departments of his life. He may rise to maturity and fall from innocence at the very same time. He may gain intellectually and lose morally. The race itself may gain and lose, rise and fall, either at once or by successive transitions. Seneca's essays became more elaborate and beautiful as he gained in discrimination and literary art, while his life became progressively an ever sorrier travesty upon his moral preachments.

Moreover, ascent in the biological sense ends before the moral issue is even possible. Kept within reasonable bounds, the theory of evolution does not even touch, much less contradict, the idea of the fall. Professor Conklin is one of the few biological writers who seems to realize this primary fact. He says: "He who has awakened to the fact that he is a social and moral being, who knows the better and does the worse, he has fallen from the higher to the lower. Until reason and the moral sense are developed in man, there can be no fall; there is nothing to fall from" ("Trend of Evolution," p. 236). This statement shows clearly enough that evolution cannot offer a denial of the fall. It is also clear that from the viewpoint of science, the frontier of discussion has been reached. Science, as such, has nothing further to say. It can tell us something of the making of man, but not of his unmaking.

But the question at once arises: From what does man fall, and what is the nature of the fall?

Professor Conklin answers this question in his own way, from the viewpoint of the evolutionist; and in so doing, raises questions which we shall wish to consider. He says: "When these [reason and the moral sense] are developed, there arises a conflict between the old habits of unreason, irresponsibility, and sensuous pleasure, and the new ideals of reason, responsibility, and duty; when in this conflict the former overcome the latter, there is a moral fall. In this sense the fall of man is no unique historical event; it is a part of the personal experience of all men" (*ibid.,* p. 236). This is clearly not physical science, it is psychology and moral philosophy making use of the evolutionary idea to explain man's moral condition. On this basis, the fact of some kind of a fall is evident—no scientific theory can shake it. Professor Conklin's interpretation is, to my mind, not altogether adequate. It does not go to the root of the problem. It states adequately enough the platform from which this fall occurs—an important matter in view of what some evolutionists have been wont to urge—but it does not state adequately the *standard* from which the fall occurs, nor does it make sufficiently clear the level to which the fall leads nor the mode of the fall; and it does not touch upon the still deeper question, which we shall have to reserve for separate discussion, why this fall is universal. The consideration of these points will carry us into the heart of the matter, according to the Christian view of it.

According to Professor Conklin's idea, man falls from the platform of responsibility and duty *back* to the level of the old habits, once innocent enough in the life of the brute, but now wrong because normally outgrown. The lapse is, therefore, a relapse. This involves the idea that the twofold experience of innocent and irresponsible brutehood and responsible manhood is known to the same individual. This seems to me to confuse two things—the relationship between animal impulses and moral control in a human individual, and the relationship between brute inheritance and new-found vision and responsibility in the emergent human race at the beginning of history. These are wholly different problems.

For this pertinent question at once emerges: In what form does the life of duty and responsibility present itself to the nascent human race, beginning its life without precedent or precept from those gone before and without control from a more or less moralized social group already established? What is the content of this new vision of ideals and how do these ideals make their appeal to man as he tops the crest of the ascent and realizes that he is now man?

Does it not seem that these ideals would allure as they dawn—would these ideals not create a desire for them in harmony with the vision of them? Why this strange aversion to these dawning ideals; which to a normal being in conscious possession of new-found powers of mind and spirit, would seem to be infinitely attractive—"fresh fields and pastures new" for this newcomer to moral selfhood? The natural history of the fall thus seems to me at the outset unnatural.

Moreover, to bring us at all within reach of the meaning of the fall, we must also take into consideration the fact that these ideals must present themselves as obligations—not merely possibilities—otherwise no moral situation would be created at all. This raises another question—in what way can ideals be considered as possibilities; that is, opportunities for self-realization; and ideals considered as obligations addressed to conscience and the moral sense be fused together in one common experience?

Again, according to Professor Conklin, the fall is a reversion to the irresponsibility of the animal,—formerly innocent because nothing better was known, but innocent *only* so long as nothing better or higher comes into view.

But, reason and sense in man do not represent two separate platforms of existence, but a single twofold mode of existence. This animal nature of which we are thinking is an inseparable part of man's constitution. He carries it along with him permanently—he does not leave it behind.

It is not a former condition to which he reverts—it is a present problem which he has to solve. He cannot abdicate his instincts in favor of reason any more than he can abdicate his reason in favor of his instincts. He simply *cannot* revert. He must go forward in the transformation of his instincts upward or downward, for better or for worse, by the use or misuse of his higher powers. Man has got to live as an animal and come to terms with his instincts in order to live as a man. And, the difference between the best man and the worst man so far as bodily appetites is concerned is purely a matter of motive and mode of control—outwardly a question of degree. The wide latitude of opinion among moralists of all ages as to just exactly what constitutes a physical life of responsibility and control, is indication enough of the difficulty of the problem. And many of us have learned that it is not by rule, but only by the power of liberating grace, that we can solve this problem at all. Therefore, I cannot believe that the moral problem in this form could have been presented to man at the beginning of his experience. I have wondered if Professor Conklin did not realize this subconsciously at least when he said: "Only in him in whose soul are lofty ideals can there be any adequate consciousness of a fall." Perhaps not if you press the word "adequate,"—but a real fall may be possible so long as there are real ideals, even if they are not lofty in one sense. And I do not think it possible to interpret the fall of man in terms of so difficult and subtle a problem, at the point of transition from instinctive control and animal innocence.

In addition to this, I take it that the idea of a lapse to the sense level is no adequate account of what has actually taken place. The fall of man, if we are to judge by what we know about him, has taken place rather in his inner moral nature. It is a loss of spiritual integrity, a deprivation and misuse of his highest powers. Its manifestation in bodily excesses, which are themselves abnormal, due to the driving power of a creative imagination feeding a desire which is only instrumentally of the body, is not the center of disturbance, nor by any means its worst symptom. It is in the procession of man's highest powers that brings us to a measurement of the real depth and meaning of his fall. In his aberrations of his reason, in the anarchism of his will, in the defilement of his imagination, in the perversions of his emotions and affections, in the venom of his hatreds, in his wars, his cruelties, his oppressions, his lusts and his greeds—in these we find the elements of his fall, the measure of his degradation.

He cannot live the life of the animal. He cannot drop simply to the sense level. He cannot retrograde in this way at all. There is about man and about his sin the sinister majesty and inner contradiction of the fallen angel, rather than the unmoral innocence of the animal.

And now, let me suggest an answer to the question which was raised a few pages back, as to the fusing into a single mode of experience, of ideals as possibilities and ideals as obligations.

As I see it, this is possible only through relationship to a personal being who is known both as authority and law. Need we hesitate to postulate such a condition as the starting-point of human history? I believe that evolutionary theory has sometimes missed the mark and distorted truth as well as unnecessarily compromised ethical interests by not recognizing and emphasizing what reasonably may be termed a period of human childhood and adolescence under the divine tutelage—which clearly enough we have in the Bible. Here again, Professor Conklin gives us a helpful hint. "According to the Biblical account, Adam and Eve were naked, houseless, uncultured; in body fully developed, in mind and soul, children" (p. 235). That is just what I want and all that I need. Why not make more of it? In this picture of primitive man I believe the Bible has put the truth which the ethnologists too often have missed.

In my early studies, I gave myself a great deal of unnecessary trouble in trying to figure out how much the primitive man knew about God, whether he had a revelation or not and whether he was a monotheist or not. I see now that all this speculation is beside the mark. The vital question is not the form of his knowledge or his mode of interpretation, but the central relationship, the primal harmony, the dewy freshness of the world's first beautiful morning of innocency when "God saw all that He had made, and behold, it was very good."

I here and now confess my faith that there was such a period and that it was both primal and normal. Hence, my conviction that whatever ages of degradation and brutishness there may have been—and human history has only too many such—were not in the direct line of creative development, but followed it as aberrant and degenerative, as a clouded and stormy day sometimes follows a beautiful morning.

And this picture of man's beginning fits exquisitely into the interpretative scheme of the Christian redemption. When Jesus said that we must become as little children in order to enter the Kingdom of God, He brought into view as hope and promise, on a higher level and in terms not of untried innocence but of victory after trial and combat, the beauty and harmony of life's glad morning. As Professor Hocking, notable interpreter of the spirit of Christianity, says: "Rebirth or conversion for Christianity means a recovery of something which children have not yet lost. It might not occur to us to regard a child as a lover either of God or of man, but, what can be said of him is that with all his puny self-assertion, his original sympathy with his enveloping personal world has not been broken" (p. 342). That is the world I want—"original sympathy—broken"—that is man's history. The Christian doctrine of sin while ethical is not ethics, for it is essentially religion. Christianity traces the universal disease of mankind to a maladjustment of relationship with his personal, enveloping world, primarily God, secondarily self and the moral law within, and finally nature and society. The tree of human life has withered, lost its leaves, failed of its fruit because it has been uprooted. And the Christian redemption through the grace of God in Christ, is the recovery of this sympathy—in theological terms, reconciliation with God.

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CHAPTER XII

EVOLUTION AND THE INCARNATION

It is, we believe, well within the bounds of moderation to say that the most daring speculation (to speak of it in the most noncommittal terms readily within reach) in the history of human thought is the teaching familiarly known as the doctrine of the Incarnation, set forth in the New Testament and the historic creeds of the Christian Church. No other religious affirmation, excepting only the assertion of the Divine Existence itself, seems to carry so many and such far-reaching implications of every conceivable sort. It is not too much to say that the acceptance of this doctrine, in any consistent and thoroughgoing way, will appreciably affect every item of a man's creed and practice. It involves a very complete orientation of his life both in theory and action. As a consequence, inasmuch as the theory swings out, by way of generalization, from what appears to be a most inadequate fulcrum, to cover all time, all space, and all history—even that of the stellar universe, it seems to many thinkers evidently to flaunt itself in the face of all reason, and to defy the rules of decent intellectual moderation. To make Galilee historically the center not only of the world, but of the cosmos, and to concentrate into some thirty years in the reign of certain Cæsars, "the meaning and value of eternity," when looked at in the light of astronomic time and stellar magnitudes, seems an undertaking more suited to Bedlam than to the sober councils of modern scientific thinking. And yet, to as great and profound a mind as that of Robert Browning, this audacious affirmation was the center of all truth and the sum of all sober reasoning:

> "I say the acknowledgment of God in Christ
> Accepted by the reason, solves for thee
> All questions in the earth and out of it."

We shall perhaps be wise to agree at this stage neither to accept nor to reject this conception lightly.

In view of what has been said about the radical nature of this idea and its far-reaching consequences, it is surprising to discover that, in its historic inception, the doctrine of the Incarnation is nothing more than the primitive Christian attempt to solve the problem presented by the person and work of Jesus, the Nazarene. It was just that, and now, in this far off day, it remains just that.

That word *problem* should catch the eye and arrest the attention. And this introduces us to this fact of instant and primary importance, that to His contemporaries Jesus presented from the first an insistent and even overwhelming problem to the intellect. He won their deep and abiding affection, He awakened their somewhat sluggish intellects to intense curiosity, He kindled their rather prosaic imaginations, He touched their commonplace spirits to fine and unexpected issues, He made them ultimately into the pioneers and creators of a new era,—but, first of all, He puzzled them. Naïve as they were supposed to be in their uncritical opinions and primitive enthusiasms, their hero-worship, their national hopes, and all the rest, they did not know what to make of Him, and no wonder! They were plain, blunt men to whom a fish was a fish, and a *denarius* a *denarius;* to whom God was God and man was man, and the idea of any intermediate being between God and man, and partaking of the nature of both, was as unthinkable as something intermediate between a fish and a denarius and partaking of the nature of both! Jesus brought no such metaphysical puzzles in his teaching, but *in his person,* he broke their fixed categories into fragments. They were forced to think the whole problem of God, man and the world through afresh with no adequate training in dialectics and with no cultivated insight into the meaning of the questions their minds were asking. Whether or not these untutored fishermen and traders could even have worked the thing through without the help of the intellectual and spiritual genius of Paul, I am not prepared to say; but work it through to a conclusion they did, a conclusion which has had many not intellectually insignificant adherents through all times since. What I am principally trying to say is that the doctrine of the Incarnation arose out of history, and particularly out of a most practical necessity arising in that history—the necessity of finding an answer to a question which would not down: "What manner of man is this?"

Nor is it out of place, or impertinent, to suggest that this problem is with us yet—still alive, still insistent. It is no exaggeration to say that from the day that He first appeared until to-day, He has always been the major problem of human history. This problem cannot be solved merely by negation. We may reject the Incarnation for any one of several plausible reasons; but the problem of Jesus is not solved by this rejection. It was not so solved in the first century, nor in the third, nor can it be in the twentieth. Too much happened then and too much has happened since to release us from the necessity of a constructive interpretation. As Professor Bevan ("Hellenism and Christianity," p. 62) says: "But for us this particular world round about the Mediterranean nineteen centuries ago has an interest of an altogether peculiar kind. Something happened in it so momentous, it is believed, that it marks a new beginning in human history. Our popular reckoning, looking back upon the past, divides it into the years before and the years after an event which took place at that moment of time. Into the stream of passing generations there entered just then, there was seen for about thirty years, some one who has been ever since the great problem. He was not among those who, while they were here, wrote down the words which men may still read. He wrote nothing. All we know of what He was, of what He said, is from the memories of His friends. But what was written in those memories was of such a sort that the world has never since been able to escape from the personal force which grasped it through that reflection."

He was, and is, and is certain to remain a problem to the intellect, whatever He may be to the heart. It seems to be clear enough from all the history of thought on the subject of Jesus, ancient, medieval, and modern, that no solution of the problem of Jesus which does not leave an unresolved residuum of mystery and real difficulty is possible for us in the present state of human knowledge. And this fact, which is illustrated in our day as well as at any time in the past, is a single but very significant and unmistakable indication of the magnitude of Jesus as an historic entity. No serious attempt to interpret Jesus can be dismissed with a contemptuous gesture.

The force of the impact which the personality of Jesus made upon His contemporaries, and the greatness of the problem which He presented to their minds, is shown by the method which they adopted in the attempt to find a solution. They undertook to interpret Him in terms of a threefold relationship,—to God, to the human race, and to the cosmos. And in the outcome, He is, with respect to all three, centrally placed.

The impression of unique and solitary greatness made by Jesus upon those who saw Him, and listened to Him (for it is entirely futile to deny to Jesus complete recognition and acceptance by contemporaries) is shown by the fact that the question of His nature and position *turns up in this form.* Such was the primary registration of his quality upon his own circle. He could be understood only in terms of the highest and most universal categories, the *divine,* the *human,* and the *cosmic.* And it is a most remarkable fact that these first interpreters of Jesus succeeded in doing what the Church has never been able to do since—to interpret this uniqueness, this solitariness in character and position, without the subtleties of metaphysics. Every student of Christianity has felt the world-wide difference in atmosphere in passing from the New Testament to the great ecumenical creeds. The first interpreters of Jesus, including Paul himself, had no rigorous dialectic, no philosophic method in the modern sense, and a very inadequate vocabulary. Their teaching about Christ is unsystematic, though with all its striking variations, remarkably consistent. The Christology of the New Testament then is practical, occasional, experimental, emotional, not formal nor logical nor self-conscious. The whole experience of James was so fresh and altogether unprecedented that it had to create its own vocabulary, to invent its own symbolism and doctrinal forms *in actu* as a live spring bursting newly from the earth digs its own channel. The whole interpretation of James in the New Testament is singularly alive, free, spontaneous, but along with this deeply serious in the attempt to seize and hold, to express and preserve, the transforming influence of the personality of Jesus upon the minds and hearts of his followers. And in the attempt to express this overwhelming experience, and to get it into terms which could in some measure make it articulate and conveyable, they reached out toward the only categories which would serve—God, man, cosmos.

And we should duly recognize the difficulties which confronted on all sides these pioneers of Christian thought. In reaching toward God for a category of interpretation they were confronted at once by the exclusiveness of monotheism. The application of the category of divinity to one who was, in some sense, obviously human, was to violate not only every principle but every instinct of the indoctrinated Jew. For the Pagan, the line between God and man was indeterminate and wavering. Men were more or less constantly crossing the frontier of divinity—which was not far away from any man of unusual power or influence.[1] But for the

[1] See my "Roman Emperor Worship," *passim*.

Jew, as we have just said, such an easy apotheosis of a beloved hero would be utterly impossible. The evidence of mental strain, of a real growth in thought by which a high monotheism was made to accommodate the suprahuman man Jesus, is evident in the New Testament. And this movement of accommodation did not involve in the least any lowering of their monotheism. On the contrary, the monotheism of the New Testament carries on fully and adequately the doctrinal tradition of the prophets, at once completing it and harmonizing it with the new facts which are not added on to it or merely harmonized with it, but carried into it and incorporated into its heart and substance. This is the key to much that we shall have to say later. On the other hand, the interpreters of Jesus were confronted with a no less serious difficulty of another kind in applying the category of humanity to Jesus. Our modern mind is so absorbed by the question of Christ's deity that we often fail to realize how difficult it was for the disciples to apply the category of man to their teacher. Largely under the influence of the New Testament we have a greatly enlarged view of man (in spite of our evolutionism); but we should much more readily appreciate the position of the followers of Jesus if we could subtract from our concept of man all that Jesus added to it. The point is that, taking *man* as revealed and measured by men, Jesus transcended the category. If these are men, and this is man, then Jesus is not a man. This reasoning still holds—to this extent at any rate; we must historically make a twofold classification of types, mankind *and* Jesus. But this consideration was far more powerful when Jesus first appeared and before he had had time to modify the category of humanity that other men had made. No one had ever seen a man like him. If he is allowed to stand as the measure of a man, he was and is the *only* man. Therefore, the interpreters of Jesus were quite as bold in applying the category of humanity to him as they were in calling him divine. And the conception had to be modified to admit what Jesus added to it, the perfect, the sinless, archetypal, divine *Man*.

Now, in the same way, and apparently impelled by some instinct deeper than reason and more powerful than logic, the interpreters of Jesus placed him at the heart of the cosmic process. We are at a loss to trace directly the rise of this thought and its development, for it presents itself only in maturity and has left no trace of its course. We may take it for granted that it arose under the compulsion of the thought that he who occupied so central a position with respect both to God and man must in like manner be at the center of the natural order. What this implies we shall consider later. But now it is important to note, that the new doctrine centered in Jesus includes nature. Certain it is that no teaching which involves God and man and professes to throw light upon them can be silent and negative as regards nature.

Now, let us carefully take notice of what we have found in the New Testament. Jesus is interpreted in terms of a threefold solidarity with God, with man, with the cosmos. As we have seen, this conception was not systematized, as we term system, nor embodied in definitions, nor reënforced by dialectic, but it was tremendously felt and clearly expressed—fairly driven home with passionate emphasis and utter conviction. Deeper than any formally reasoned thought lay this distinctive conviction, that Jesus was somehow one with God, with man and the natural order, and yet somehow categorically distinct from them all. He was not the invisible God *as such,* for He was visible. He was not the whole of humanity, for He was to observation a man among men. He was not the cosmos, for he walked in company with his friends in the fields and along the shores of the lake. And yet, He did somehow convey the irresistible impression that He did unveil God, that He did sum up humanity and disclose the inner meaning of sun and star.

These things, as we have seen, were so deeply felt by the early interpreters of Jesus that they set out to formulate them into a faith and a Gospel. And just at this point they were confronted by their problem: How to set forth such transcendent and mysterious facts in any apprehensible way! The problem was (and *is*) how to make a message, a proclamation of good news, out of mysteries so great. When the interpretation came it was in terms of Jewish ethical monotheism, but yet, a monotheism modified to the very core of its heart by new elements supplied by Jesus himself.

And we must not forget this fact, that the early believers were in actual contact with Jesus and that only through their attempts to give meaning, coherence, and articulateness to that experience, did they reach the goal of their thought about God and man and the natural order. They went through Jesus to man, through man to the cosmic order of which man is a part, and through the cosmos to God, who ordained it. As they went on this intellectual voyage they carried, so to say, Jesus with them, and all their ideas were modified, enriched, and completed through what he himself supplied. Thus ultimately they saw Jesus everywhere, as the heart of man, as the heart of the cosmos, as the heart of God. And their experience of Jesus became an interpretation of life and reality, and that interpretation became a part of their thought only when they came to realize through Jesus that God is love. But when once they realized that Jesus had not merely told them about God's love, but had revealed it by embodying it, namely, the everlasting Fatherhood of God, the idea of the Incarnation became inevitable. For never can any mind separate from God in love or worship that One in whom the love of God has been revealed. George A. Gordon ("The Christ of To-day," p. 50) says, without exaggeration: "The New Testament writers are in captivity to their Lord; they are His bondservants; His empire over them is something amazing, and without a parallel in human history. Through these writers we behold an entire generation in the rapture of a great love. . . . Out of that mood came the thought of the ascendency, the divinity, the essential deity, of their Master. The apostolic faith in the deity of Christ was an outgrowth of his sovereignty over apostolic life."

It is a most striking fact that the interpreters of Jesus formulated their doctrine, not in terms of ontology or a theory of being, or essences, but in terms of a *divine action*—"the Word became Flesh." Jesus was not One who began to be at birth, but One who came on a holy quest from a higher sphere. He came into the world by His own free self-conditioning, self-limiting act. By a sacred mystery of love and grace, the nature of which no attempt is made to explain, He who belonged to the sphere of God, became genuinely human. The Son of God became Man. Being what He was, and so manifested, Jesus became God in the flesh, and, as God manifested, became the focus of the Divine self-revelation both through nature and man. The point of all this, which we need not further elaborate with respect to our present inquiry, is this; the historic Jesus became an unique, solitary, supreme figure, by choice and act, and in most literal fact brother to all men; but in His inner being, One who stands alone—in whom "dwelt all the fullness of the Godhead bodily."

The first question here for us is not whether this interpretation of Jesus is true, in itself, as respects Him, but whether the category itself is usable. We are not concerned first of all with what may be called doctrinal difficulties—such as might arise in connection with any attempt to define the Divine and human factors in the Incarnation. Our problems are preliminary to these and must be stated in another way. Is the category of Incarnation usable? Is the conception of one, unique, central, supreme Personality, in whom the revelation of God in nature and man is focussed, compatible with the modern scientific view of the world, and specifically the evolutionary formulation of the world process? There are some who will affirm at once, offhand and with unconcealed impatience, that such an idea is absurd, and not worthy of discussion. But why? There are two considerations which are usually introduced into an *a priori* attack upon the Incarnation such as we are now considering. The first one is drawn from the general scale of magnitudes—historic and cosmic, as related to the historic position of Jesus of Nazareth.

Professor Buckham ("Christ and the Eternal Order," p. 87) has stated this objection (which he does not share), drawn from Jesus himself, with great clearness and force: "Modern science seems indeed to shatter this conception [the creative function of Christ] as an empty dream. If there is creation at all, it must be continuous, and the process of evolution, by which the universe came to what it is, knows Jesus Christ only as a minute and hardly distinguishable product of human development, having no more to do with its stupendous movement of world-architecture than an insect has to do with the creation of the sun in whose warmth it basks."

It is quite evident, however, that no inference can be drawn from the relation of Jesus to the cosmos without taking into account the position and significance of the human race. We cannot begin an argument with Jesus as the starting point, since confessedly the significance of Jesus depends in part, if not altogether, upon our estimate of the value and significance of human history. Thus the depreciation of Jesus carries with it, often if not always, a commensurate depreciation of human history. Although Jesus may be supremely significant in human history, yet, if that history is itself of negligible importance in the history of the cosmos, it would be impossible to assign cosmic significance to Jesus. And we do not need to go very far in order to discover that the depreciation of man is the background of most of the current objection to the idea of the Incarnation. The naturalistic interpretation of evolution is really compelled to this view of man, as witness Haeckel's often quoted dictum.

Lord Balfour ("Foundations of Belief," 1895, p. 30) has given classic expression to this view of man: "Man, so far as natural science by itself is able to teach us, is no longer the final cause of the universe, the Heaven-descended heir of all the ages. His very existence is an accident, his story a brief and transitory episode in the life of one of the meanest of the planets. Of the combination of causes which first converted a dead compound into the living progenitors of humanity, science, indeed, as yet knows nothing. It is enough that from such beginnings, famine, disease, and mutual slaughter—fit nurses of the future lords of creation—gradually evolved, after infinite travail, a race with conscience enough to feel that it is vile and intelligence enough to know that it is insignificant." It is quite evident that such a sweeping depreciatory flood like this would carry away with it the doctrine of the Incarnation; but it would also carry with it many other things, including, one would suspect, the cogency of the depreciation itself.

Looking carefully at this argument, it becomes at once evident that it is drawn *from* evolution rather than rationally grounded in it, and that it appeals to imagination rather than to reason. We can easily see what this idea of human insignificance does to the conception of the cosmic significance of Jesus, but we perhaps do not perceive so readily what it does to the philosophy of evolution itself. If we are to say with Celsus and many moderns that human life is insignificant and has no cosmic magnitude because of the limited space it occupies and the brief time its history covers, where are we to look for any real criterion of progress, or any real standard of value for the cosmos itself? Considered simply as a dance of atoms it may be entirely reasonable to say that a dance of atoms in the brain of a scientist is of no more significance than the dance of similar atoms in some inorganic maelstrom; but from the viewpoint of science this ought not to be so. It would really seem as if the progress of science ought at least to have intact, in our reconstructed world of values, the position and dignity of the scientist. But this, the theory of human nothingness, if impartially applied, will not do. It is a sword of two-edges, which can only be seized by the blade, certain to cut the hand which wields it. And is it not evident that on the premises of science such an idea cannot possibly be true?

It is admitted by most thinkers that life itself occupies but a tiny portion of stellar space, and that its history from its beginning, vast as it is, covers but a handbreadth of cosmic time. But it is not thereby reduced to insignificance. Is it not true on the contrary, that when life appeared, in whatever minute and simple form, into its appearance is gathered up the significance of the uncounted eons leading up to that event and preparing the way for it? Is not life the goal of inorganic process? If not, is any real evolution, in the sense of a concatenated series of intelligibly related events, even thinkable?

In the same way, when man appears, when there is added to the long series of transformations which issued first in the orderly world of inorganic elements and subsequently of plants and animals, a being of rational discourse, capable of science, art, and religion, does not the center of interest shift to him? Is not his "little day" crowded full of the meaning which is to be attached to the ages of preparation, inorganic and organic, which led up to him? It is again a question of values, a question which at bottom involves the existence of a real universe and a real science. To quote Bevan again (*op. cit.*, p. 192): "The types which preceded modern man along the line of descent, form not only a chronological series, but a series of modifications with a uniform tendency, marked by the distance of man from the beast. But when you call this tendency *progress,* you imply that there is an increase of good along the line, a change from lower to higher in some scale of spiritual *value,* and this at once raises questions as to our *standards* of good, of value." And such standards cannot be found either in atoms or living organisms as such, nor anywhere in the life process below the point where the plan of the whole begins to emerge in the being who in science, art, social service and religion binds the beginning and the end of the process together in a rational unity of progress and order. If we admit that man is the goal of evolution, which is really implied in every belief that evolution really means anything (for otherwise we have seen it has no goal), we are prepared to go a step further. By exact analogy, if there appears in the course of human history a man who is seen to be the crown and glory of manhood, who while head and shoulders above his fellows is yet seen to be one of them, revealing their hidden, latent, or crippled possibilities, does not the center of interest, in the search for ultimate justifying values upon which the rational meaning of the cosmic process depends, shift to him? If man is the goal of evolution thus far, then a supreme, typical, central personality, in whom is gathered up the meaning and worth of manhood, becomes the crown and summit of the entire process. And looked at the other way about, the appearance of such a person, in the course of the historico-cosmic process becomes a proof that the process has both a goal and a law of progress. It thus becomes evident that an impatient dismissal of the claims made on behalf of Christ to cosmic position and importance have far-reaching and disastrous results.

It may be objected that this argument, while it does allow cosmic significance to man and specifically to the supreme man, does not give the significance required to prove the Incarnation—only the appearance of an unique man. This is admitted at once. All that is claimed for the argument is that it does away with the forms of the objection drawn from the insignificance of man in that it shows that valuable things, including the premises of the objection itself, are taken away also.[1] The positive argument for the Incarnation must move along another line. But first, there is another objection which must be faced. It also is drawn from the theory of evolution, or, more correctly, from the monistic philosophy which is often connected with that theory. Professor Arthur Drews, the German protagonist of the Christus-myth hypothesis, for example, has affirmed that the doctrine of the Incarnation is the greatest obstacle to the spread of the monistic philosophy, because it focusses or concentrates the divine self-manifestation into a single, supreme, and central historic personality. Monism rejects such intense individualism. Drews and those who think with him scout the idea of a divine Man and advocate a divine humanity which involves the idea of a universal diffusion of the divine reality. This is of course an *a priori* judgment which must submit to the criticism of fact. All that need be said just here is that it finds little support from human history or from the most recent discoveries in science. It is patently contradicted by the history of human genius, which appears suddenly and unaccountably. A genius differs from his fellows in this very thing, that he introduces a new type of mind and concentrates in himself gifts and powers which others do not have, which are participated in by virtue of simply being human. A musical genius, for example, like Beethoven, possesses an unique fullness of power in his art

[1] It is a very striking fact to which I wish to call especial attention that Professor Wyckoff (in "Acute and Chronic Unbelief," N. Y. 1924, Chapter VII), working independently and entirely in the realm of psychology has reached the same conclusion which I have reached through biology. It is to be noted that neither of us is constructing or attempting to construct a Christology. We are both concerned simply with the compatibility of a high doctrine of Christ with the modern view of things—one in the realm of psychology, the other in that of biology. The result, in both cases, is the discovery that the cosmos and man need and find a place for the Christ of the historic Incarnation (see especially Wyckoff, *op. cit.*, pp. 215 f.).

which not only sets him apart from ordinary men, but even from other great men in his own class. Occasionally, and in the same saltatory and unexpected fashion, a universal genius like Leonardo da Vinci appears, who has extraordinary powers in many different fields—who indeed, appears to be not so much an individual as a syndicate. Such men have ancestors like the rest of mankind, but transcend them,—they have fellow men, but outclass them and stand apart in exalted singularity. More than this, scientists seem to agree that the great forward steps in evolution have taken place in this same way, by sudden transitions, by the appearance of uniquely endowed individuals who carry in themselves the potentiality of great cycles of new development. Man himself seems to have appeared in this fashion. Whether one takes the last in the animal series or the first in the human, the transition involves the sudden appearance of a new type, transcending ancestry both near and remote, drawing to a creative center in himself tendencies widely distributed and powers faintly adumbrated in the lower forms of life, thus becoming the individual fountainhead of an unexampled development. Only by such an interpretation of human origin can we hope to harmonize the antinomies of man's anomalous position in the world of organisms. Professor J. A. Thomson ("Bible of Nature," p. 206) says: "Even if we knew precisely what cerebral differentiations and integrations are conditionally associated with man's higher powers, even if we could place these in line with a series of changes in animals, we should still have to say—'the man arose, an organism at length rational; to him all things became new'—he spoke and he was moral."

There is, therefore, in the theory of evolution in the hands of its most recent interpreters, nothing to forbid us to expect in human history, or to find in Jesus Christ, an unique spiritual genius, who in His own person sums up for us the meaning of history both cosmic and human, who by the unexampled richness of His personality is fitted to become the head of a new spiritual system. *This,* historically speaking, is what is claimed for Christ.[1]

It may be objected again, both by those who accept and by those who reject the Incarnation, that simply finding a place in the general scheme of things for an unclassifiable religious genius does not prove nor begin to prove the high Christology of the New Testament and of the Church. This of course must be granted at once. Such a claim would be absurd. But, we did not start out to *prove* the doctrine of the Incarnation at all, under any conditions, much less as an inference of some sort from the order of nature or the implications of biology. On the contrary, all that we planned to do was to combat the notion that there was an inherent incompatibility between the scientific world view and the Incarnation. In so far as the Incarnation is a transcendent fact, it must be dealt with in connection with our general theory of causation. But since the only objection, even of a quasi-scientific character, to the Christian doctrine must be drawn at the point where some established physical fact is impugned or some physical principle or law is violated, it is quite pertinent to the discussion to show that there is room in the system as science interprets it for a supreme creative personality who reveals God and who also discloses the meaning and establishes the value of the world process.

And we must not overlook the fact that Jesus belongs to history, that His character, His story, His influence, are in the records and cannot be expunged. The problem of Christ is far more searching than any nice questions in the criticism of ancient documents. It involves the meaning of all history. Any interpretation of the total reality which fails to include in its survey man and The Man—is certain to go astray.

1 Since the writing of this chapter, I came upon Bishop Temple's stimulating book, "Christ the Truth," 1924. See especially Chapter VII, where somewhat the same line of thought is developed as in this section of my text.

We should not forget the warning of Professor William James: "Mechanical rationalism is narrowness and partial induction of facts; it is not science." And this narrowness and partiality are shown long before we come to the fact of Christ. But when we do come to Christ, a world theory, which cannot take Him in, exhibits climactically its complete inadequacy throughout.

There is too another method of approach to the whole subject. The frontier or borderland of discussion between scientific theory and religious thought is the relationship between the impersonal and personal, matter and mind, things and persons,—however one chooses to word it. The task of harmonization must be accomplished by the establishment of a *rapprochement* between those whose interests, on the one hand, are in the processes and results of physical investigation, and those whose predominant interest lies in the region of human life. If matters were as they should be in this world, scientists should be the ones to guard the frontiers of physical knowledge from their own tendency to transgress, while those whose dominant passion is personality (which, in the final analysis, is the meaning of the religious interpretation) should be careful to patrol *their* own border against the tendency to depreciate the significance and sacredness of the physical. Human nature being what it is, however, the tendency has been and still is for these two groups of workers to split apart into hostile camps, and for each party to guard its own frontier in jealous antagonism to the other. On the one hand, the scientific interpreters are prone to push forward the boundary lines of the impersonal until there is room nowhere in the universe for true personality. Freedom is banished. Mechanism becomes everything. Consciousness no longer has any real meaning, but becomes a shadow, an "epiphenomenon," an accidental and utterly inexplicable phosphorescence thrown off in the process of molecular change—which change is the real and only significant business of the cosmos.

It has often been pointed out by competent thinkers, notably the Earl of Balfour in his two brilliant volumes of Gifford Lectures, that this naturalistic scheme logically issues in blank skepticism—in a suicidal theory which makes belief in any truth irrational. He says, for example ("Theism and Thought," p. 231): The conclusions of naturalism "discredit its premises. The doctrines in which we believe throw doubts upon the truth-producing value of the process by which we have come to believe them. For we remember that these reasons are without exception not only reasons, but effects. They all form part—a very insignificant part, no doubt, but a part of the causal web which constitutes the naturalistic universe. As effects, they owe nothing in the last resort to reason or purpose. If snatches of reason and gleams of purpose occasionally emerge in the latest stage of the evolutionary process, this is but an accident among accidents. It neither removes our difficulty nor modifies its character. Everything we believe, we believe because in the order of causation blind matter and undirected energy happened to be distributed in a particular manner countless eons before man made his earliest entry on the cosmic stage. From this senseless stock, and from this alone, has sprung, according to naturalism, all that there is or ever can be, of knowledge, practical or speculative, earthly or divine—including of course the naturalistic theory itself! How then can we treat it with respect? Whence come its credentials? The possibilities of error are countless. By what freak of fortune, by what gambler's chance, has it come about that these irrational influences have blindly but successfully shepherded mankind into the narrow way that leads to truth?" In view of all the facts, it is evident that the scientific world is badly in need of an adequate philosophy of personality. For its own sake, as well as for the sake of human welfare—to which presumably it should be made to minister—science must have some better theory of the mind and its operations than is supplied by a universal extension of the principles of mechanics. And it seems too that the principle of evolution ought to point the way to such a desired rational synthesis of mind and the cosmos, of personality and the natural order. If evolution has any real meaning, that meaning must be found in man, in whom the process eventuates. For, again, if the process has any real meaning, if indeed we are capable of saying that such a process has taken place, or of thinking upon the subject at all, the world must be the work of reason, and that from the beginning there has been a progressive unveiling of an infinite, Causal Mind whose thought the world is and whose intelligent purpose is the source of our rational insight. The principle of revelation, once accepted, puts meaning and beauty into the whole movement, from primeval ooze onward. Without that principle, the cosmic process has neither meaning nor beauty nor moral worth. This may not seem so to others, but to me every step forward in the program of science which uncovers the physical secrets of a mindless universe, makes it the more meaningless and horrible. There is no real progress, no real standard of worth, no real goal, no real preservation of values. It is a blind process from nothing to nothing, a body without a mind, a beautiful mechanism without a soul.

And just here the significance of Jesus comes in. Jesus is a fact, and as a fact He irradiates the world of space and time, of life and history, with light. For Jesus is a part of the cosmos, and the cosmos cannot be really studied without taking Him into consideration. Professor Simpson is right when he says ("Man and the Attainment of Immortality," p. 302): "In some way or other, all thought upon ultimate problems, in so far as it makes any claim to completeness, inevitably leads back to the question, what think ye of Christ? for He stands forth as the most momentous fact in the whole world process, and in the realms alike of fact and of thought—that process reveals itself as a unity."

Scientists must not overlook the fact that the unlimited extension of the impersonal to cover the whole of reality will in the long run be deadly, not only to religion, but also to science. Physical science alone cannot make the world good, or contented, or happy. No one with any sense wants the scientist *as such* to mix the incompatible, and teach science in any other way than in accordance with the facts and principles of the science which is taught.[1] But he should recognize that the foundations of his science are based upon the assumption that the world is intelligible and that human life is worth while. And this means in the final analysis that the whole of life is a revelation of God.

In another passage from the book already referred to (p. 307) Professor Simpson puts in brief what I have been trying to say: "In personality, indeed, we recognize the depths of spiritual life, and the thought of the divine immanence is readily suggested to us. But the compulsion of the divine power we feel only in the presence of experiences which seize us with immediate force as the revelation of the actuality and activity of God. This occurs supremely and uniquely in the person of Jesus Christ. In His case, the ordinary canons of analogy and correlation fail. There is something here that has never been known before, something about which we can say—just because we understand the world process so much better—that it will never, in that particular form, be known again."

We have been arguing, all through this chapter, that once we recognize personality as the crown and goal of the world process, we shall have no real difficulty in seeing the cosmic significance and supreme value both to thought and life, of Jesus. And the value of Jesus in relationship to this revelation idea is that He, being at once historical and transcendent, brings together all the scattered threads of process into a central, organic unity in His own person. It is Jesus who weaves into a fabric of meaning and beauty, of grace

[1] It would be fatal to theology, in the long view, as George Adam Smith says, to demand that "physical science shall be put through a theological filter."

and love, the unattached threads of our "unfinished universe." By making God real and bringing Him near in nature and life, He informs both nature and history with light and life. And this is just what is involved in the doctrine of the Incarnation.

Professor Glover ("Jesus in the Experience of Men," p. 110) says: "If God was really, as the Neo-Platonists said, 'beyond being,' if he could neither be apprehended nor set forth, imagined nor grasped by reason, feeling, or any human faculty; if there was no link between God and man, then Jesus was as futile in the long run as any other man. But this the Church would not believe, and it denied the antecedent, and affirmed a real essential link between God and Jesus; whatever 'being' might be, it was not an impassable gulf between Jesus and God, it was something in which they were one.

"All the Incarnation doctrines point to the same conviction, that Jesus does reveal God. If he does not, then it would look as if human experience had very little real value, as if little were to be learnt from it, whatever clarity and force of mind were brought to bear on it. For if Jesus does not reveal God, our chance of learning of God from souls of less depth and purity and intensity is small indeed. We shall be driven back to the vagueness of the later Greek speculation; nor is that a distant risk. One effect of the discoveries of natural science, of the progress made in that field, is to emphasize the grandeur and wonder of the mind (if we may venture so much) that underlies the creation.

"We are liable to lose ourselves in a dim consciousness of a power that deals with universals at best, a power to be surmised, not known, of which little can be predicated beyond ingenuity and efficiency—features more and more staggering as we track out the laws and forces at work in the world, and less and less human with every accession to our knowledge. Less and less human (if the adjective may be allowed) this power becomes, less and less intelligible to humanity, because ingenuity and efficiency do not make character; and in proportion as they are magnified without the balancing attributes of love and tenderness, they make their possessor more awful,—awful to the verge of hateful.

"But this line of thought ignores the better part of our experience, and the part which can be more closely and clearly understood and known. And this gives its significance to the person of Jesus."

So much then for the outlook toward Christianity from the side of science. On the other hand, the interpreters of religion are equally in need of an adequate philosophy of the impersonal, accompanied by a true sympathy for the principles and aims of science. As we have already seen, the doctrines of religion do not involve any specific nature theory. To religion, personality is all in all, and nature is but the sphere or arena and condition of personal activity. As from the side of science personality is apt to recede into the background and be lost amidst the operations of mechanism, so from the side of religion the whole system of natural causation is apt to dissolve into the idea of personal activity. To religion *as such,* there is but one Cause.

We do not purpose at this point any discussion of the nature of causation or the problems connected with it, except to make one observation. Religion for its own sake must develop an adequate philosophy of the impersonal. The teacher of religion must absorb and interpret the facts which modern discovery has put at our disposal. We must not overlook the fact that to interpret the natural process wholly in terms of personal will and act is to burden theology with an unbearable load of physical difficulties and moral problems. And here a true theory of evolution will help us. For the key idea of this theory, stripped of irrelevancies, inconsistencies, and excesses, is progressive realization in *form* of an immanent creative idea. This process may be looked upon from the viewpoint of nature as the progressive unfolding and realization of nature's latent possibilities.

This process is a continuous unfolding from within, punctuated at intervals with great uplifts, disclosures of hidden possibilities, consummations which transcend antecedent conditions and bring new eras of development. In all this there is something of surprise, something unpredictable, something which is not foreseen. Professor Conklin has said (Yale Lectures, p. 153): "Indeed, who at any stage in this greatest drama of all time could have predicted the next scene, much less the final ending?"

And, moreover, such a drama becomes utterly inconceivable without purpose, foresight, and creative plan.

> "God dwells in all
> From life's minute beginnings, up at last
> To man, the consummation of this scheme
> Of being, the completion of this sphere
> Of life."
>
> —BROWNING.

But, the evolution idea permits us to look upon the world not as finished product, but as organic process, each stage of which points to something beyond itself. This in itself is great gain. To look at the world as complete in all its parts, a fixed product, is to make all its imperfections finalities, and to load its evident incompleteness upon God. Moreover, the idea of evolution enables us to grasp the meaning of the divine self-conditioning, a creative Kenosis, beginning at the lowest point in the organic and coming to final expression in man, but conditioned at every stage by the laws and powers of that status of being. Thus we are able to understand that God may condition Himself in the inorganic atom, in the plant, in the animal, in man. Such a progressive process points inevitably to God. Progress is impossible without a reserve of unexpended power at the beginning, and a graduated release of creative energy as the process goes on. Once more, the evolutionary idea helps us to solve the paradox involved in the coming of Christ, who comes by process and yet transcends it. The immanence of God in matter, in law, in orderly process, becomes eminent in the supreme personality in whom God *for the first time in history* adequately expresses Himself. As Walker ("Christian Theism," etc., p. 293) says: Nature then "is the One going forth in His love to find the many, not as a mere play of the Divine Life, but as the expression of that Divine Reason and Love that God eternally is." God's purpose of love becomes visible in Christ, after ages of preparation, the beginnings of which are found in the very roots of the cosmos. In a divinely directed, developmental process there is room for the unique, for the new. Professor Orr says ("Christian View of God and the World," p. 318): "With the view I hold of development as a process determined from within, I do not feel the need of emphasizing these (stadia of advance) as 'breaks.' We have indeed, at the points named, the appearance of something entirely new, but so have we in a lesser degree with every advance or improvement in the organism, *e.g.,* with the first rudiment of an eye or new organ of any kind. The action of the creative cause is spread along the whole line of the advance, revealing itself in higher and higher potencies as the development proceeds. It only breaks out more manifestly at the points named, where it founds a new order or kingdom of existence."

"The task of history," says Simpson (*op. cit.,* p. 305), "is to attempt as far as possible to show how under, and indeed in spite of, the universality of law, that which is unique arises. Scientific explanation, in terms of natural law, often seems to make it more difficult to realize how the special and unique can arise. Yet, in an evolutionary process, once it is *proved to be* (italics mine) a progressive process, there is more reason to consider everything unique; there is no duplication, no repetition. But in any case, universal laws, which are statistically based, can never explain, or in the realm of the organic, enable us to predict completely with reference to the particular or individual case."

In addition, the uniqueness of Jesus is related not merely to the appearance of the individual, but to the meaning of the process as a whole. "Creation is the primary Kenosis (self-emptying of self-limitation) of which the Incarnation is the central and most significant fact—central because Jesus Christ made real that for which the whole process came into being" (Simpson, *op. cit.,* p. 313).

This same fact that the coming of Jesus was not an isolated wonder, even of Divine Grace, but a disclosing of the inner meaning of the world process, shows us why, from the viewpoint of revelation, an incarnation was necessary. Jesus could not reveal the meaning of the world process without being at once of it, and above it. And this throws a flood of light upon a passage otherwise perhaps inexplicable:

> "I am the root and offspring of David;
> The bright, the morning star."

CHAPTER XIII

SCIENCE, IMMORTALITY AND THE WORTH OF MAN

To this point then, in the final analysis, any serious discussion of the meaning of the world process must sooner or later come: What are we to think of man, his origin (in the ultimate sense), his nature and his destiny? Here is the focal center of all interest not purely scientific in evolution. There are three fundamentally distinct views which may be held on this subject.

The first one is that of thoroughgoing naturalism, in any one of its many forms:—namely, that man is simply a product and function of the universe conceived of as a self-contained material system—"substance and the law of substance." Man is the product of an evolution, the main business of which, whatever incidental by-products in the way of consciousness it may produce, is the utilization of energy and the distribution of matter. According to this idea, logically carried out and rigidly enforced, man is of no more cosmic significance than any other organism which evolution produces and then, in due course, dissolves into its constituent elements for redistribution through the discursive operations of nature. All that we have been wont to think of as constituting the uniqueness of man, his spiritual nature, his consciousness, his moral responsibility, his freedom and his moral behavior, are explained by their antecedents as discoverable in the physical history of such a universe as we have described.

The second view, advocated with such earnestness and vigor by Professor Huxley in his famous Romanes lecture is that man as a moral being must separate himself from the cosmic process and oppose it at every step, building for himself "an artificial world within the cosmos" for the preservation of his spiritual ideals, Man's moral and spiritual life is a continuous battle *contra naturam*. As Professor Pringle-Patterson forcibly states it ("Man's Place in the Cosmos," pp. 19, 20)—according to this view, "Man with his ideal standards and his infinite aspirations appears consequently upon the scene as an alien without rights in a world that knows him not. His life is an unexplained intrusion in a world organized on other principles and no way adapted as a habitation for so disturbing and pretentious a guest." Hence, the conclusion is that man must forever beat his spiritual wings against the cage of an alien environment which remains unyielding to the end. Now, it is interesting to note that while the first of these two theories absorbs man in the world and makes his ethical life a continuation and expression of a process which in its fundamental aspects is unmoral, the second theory separates man from the cosmos by an impassable chasm, holds to the unique and singular character of his moral nature and makes his whole life to consist in his antagonism to a process which in some sense must have produced him. And that introduces us to the fact that there is a third view of man's relationship to the cosmic process—which neither absorbs man in it nor wrenches him violently apart from it, by recognizing that the cosmos fulfills itself in man as rational, responsible and moral. We thus at once spiritualize and moralize it and, without separating man from the world process, get a universe worth while and at the same time obtain *cosmic backing for man's* ideals and longings. But, and here is the point for us, such a universe must find its true end and both realize and reveal its inner meaning in the *spiritual man*.

It is this view of the world and of man's place in it that undergirds and justifies the faith in immortality—which is one item in the spiritual self-estimate of man.

It may be said, without fear of contradiction, that the hope of immortality is as old as humanity, at least as old as the experience of death. During the greater part of human history and with the greater part of human beings who have lived on the earth, immortality has been far more than a hope—it has been a settled conviction. Even in the final resting places of men who lived before written history began and before writing itself was invented we find, generally speaking, the indubitable evidence of a belief in a future life. In fact, we may go further than to say that primitive man everywhere has believed in immortality. He has not so much believed in it as that he has found it impossible to conceive of death as anything more than transition to another state of being. This stands for the greater portion of antiquity, the Hebrew race under the Old Testament being only an apparent exception.

In modern times, since the rise of critical thought, the belief in immortality has become subject to a tidal movement, rising and falling. And the striking fact about this periodicity, this ebb and flow of faith, is that it is not independent, not a thing operating by itself, but is a part of a larger tidal ebb and flow. The belief in immortality seems to rise and fall with the intensity of faith in God and the correlative faith in the worth of man. God, duty and immortality are inseparably linked together, not only in the thought of Kant, but in the minds of most men who have thought deeply and seriously on these matters.

John Fiske's argument for immortality based upon evolution and making use of the congruity between organism and environment through ascending and extending ranges of correspondence to man, who is a citizen of eternity, is one of the finest bits of constructive dialectic I know of—and yet in the outcome Fiske justifies his belief in immortality—"as a supreme act of faith in the reasonableness of God's work."

The question, therefore, of the bearing of a scientific theory such as evolution upon the reasonableness of belief in immortality, is part of a larger question, the interpretation of universal causality and the meaning of our human existence in general. Otto has very finely said that teleology can never be denied to any process provided the outcome is of sufficient value to justify the purposive interpretation.

A cosmic process which ends in man and then ends man cannot be interpreted as embodying purpose in any adequate or worthy sense. Immortality, therefore, is no mere other-worldliness, no mere rainbow on the other side of a valley of bones. It is a question of immediate, permanent, spiritual values in the cosmic process. If we accept Haeckel's dictum that man is nothing more than "a temporary modification of the universal substance," we shall be hard put to it to maintain any real conviction of true spiritual values, at any point, beginning, middle or end, of the whole world process.

It seems, therefore, quite clear, that while unbelief in this particular, as in any other, may be *evolutionary*, evolution in itself has no negative bearing whatever upon this faith. No process can be used to explain itself, and arguments to disprove its purposive meaning or spiritual value can be drawn not from its beginning, nor from its course or method, but only from its end, as that is actually disclosed to us. In other words, one must begin with the denial of spiritual worth to man before he can make any proper use of evolution in negation of man's spiritual convictions or hopes.

In short, man himself, with his gifts of insight and understanding, stands in the way of any interpretation of the universe which reduces him to insignificance. Haeckel once said that he had carefully searched the universe and had found no evidence of intelligence anywhere. One wonders that he never thought to look in the mirror. A universe without intelligence would scarcely be likely to contradict itself by producing a scientist capable of conducting a search for evidences of intelligence and capable of commenting upon their absence. The scientist himself is to me a living disproof of this creed of negation. Nor can we imagine a decent universe, to say nothing of a rational one, producing a being capable of understanding and interpreting her mysteries only to reduce him to nothingness at the latter end:

"From nightly towers
He dogs the secret footsteps of the heavens,
Sifts in his hands the stars, weighs them as gold dust,
And yet is he successor unto nothing
But patrimony of a little mold,
And entail of four planks.
Thou hast made his mouth
Avid of all dominion and all mightiness,
All sorrow, all delight, all topless grandeur,
All beauty and all starry majesties,
And dim transtellar things; even that it may be
Filled in the ending with a puff of dust.
Arrased with purple like the house of kings
To stall the gray rat and statelily lodge the carrion worm.
Mother of mysteries in a thousand tongues,
Who bringest forth no saying yet so dark
As we ourselves, thy darkest."

The very statement of such a tragic farce as this abhorrent Sadduceeism would make of this great world is its sufficient refutation, as the poet saw. The only way in which such a view of man can be established is through a crude and uncritical sense philosophy which reduces man to an accidental by-product of changes in matter, the very existence of which, in the form demanded by the theory, is open to question.

First of all, let us think of what modern science has done to this crude philosophy. For one thing it has transformed the world of matter. Look out upon the world to-morrow as your eyes see it. There it is—a world extended in space, flooded with sunlight, with the blue of the sky, the white of the fleecy clouds, the distant smoky outlines of the hills, the green of the woods and hedges, the splendor of the sun—a world objective, outside and beyond yourself, solid, continuous and quiescent—and then remember that you are not looking at the world that physical science sees at all. That world is not bright nor dull, nor green nor gray, nor blue nor white, nor solid, nor continuous nor quiescent—but a colorless, lightless, soundless system of vibrations brought about by incessant atomic explosions, molecular disturbances, whirlpools in a medium of which we know nothing except that it is neither visible nor tangible. These vibrations mean nothing in the way of form or color or of objective reality until they impinge upon our peculiarly constructed central nervous system which reacts, we know not how nor why, and are translated into the totally incommensurate terms of consciousness. These colorless, soundless, formless vibrations, differing only in length and rapidity and pitch—come to us out of an immensity which we cannot otherwise know—and are made over by us into the mental qualities of form, sound and color which we associate together and call the world. No theory of the universe and no doctrine of man in this day and generation can stand for one moment which does not recognize and squarely accept this fact—that man, in his sense perception, in his unifying consciousness, in his interpretative reason is not an accidental by-product of cosmic process, but the living center of a universe which without him is dark, silent and formless.

We have recently been taught that matter is energy, but what is energy? Professor Soddy in his "Interpretation of Radium" says: "I cannot too plainly insist that available energy, though immaterial and intangible, has a definite and real physical existence. Were it not so, coal would not be the very expensive commodity it unfortunately is rapidly becoming" (pp. 21, 22). What is this energy which sleeps in coal, but is not coal; which awakens at the touch of fire, but is not fire; which turns belts and wheels, but is not a belt or a wheel; which is immaterial and intangible, and yet is the source of all that we have considered material and tangible?

Radium itself has transformed our material universe. Professor Soddy says of radium: "At first we were compelled to regard it as unique, dowered with potentialities and exhibiting peculiarities which raised it far above the ordinary run of common matter. The matter was the mere vehicle of ultra-material powers—but in the outcome this one element has clothed with its own dignity the whole empire of common matter. The aspect which matter has presented to us in the past is but a consummate disguise, concealing latent energies and hidden activities beneath an hitherto impenetrable mask. The ultra-material potentialities of radium are the common possession of all that world to which in our ignorance we used to refer as mere inanimate matter" (p. 169). And do not forget that man, *the accidental by-product,* "the greatest mistake in the universe," as one biologist calls him, has stripped off this mask, penetrated this disguise, pushed his way into the unpublished secrets of solid, inert, impenetrable matter, which opens up as we advance into the workshop where from its "building stones" of the infinitely small are framed the majesties of the infinitely great.

Again, may I ask you to note that no physical theory of the universe can possibly resolve the interior difficulties created by the interpretation itself, without submitting to creative reconstruction at the hands of critical thought. First of all, it is impossible by this method to arrive at any satisfactory unity. Whatever else we may have to go without we must have a universe—but this is not easy to get on physical terms. I do not refer merely to the departmental nature of science, although this is an important and significant fact, often overlooked. We have not science but sciences and from these sciences there is no physical return to unity. Science, even with its conceptions of the conservation of energy and universality of law, does not, alone and unaided, give us a real universe because the energy is transformed as we pass from one group of phenomena to another and the law opens up into a complex of laws operating very differently at different levels and in different fields. Lloyd

Morgan, for example, parallels selective synthesis in chemical reaction and organic life with apperception (mental synthesis) in the mental life of man, but admits that these three operations are very different. In space and in time all things objectively considered lie outside each other, and the nexus which binds them together eludes both physical observation and formulation. The ideas of gravitation and ether, both universal and unifying, are enigmatic and contradictory as physical concepts.

Thus in science we divide the real world which is one in conscious experience into sections in order to describe it, and in so doing are at one or two removes from reality and are able to find no way back. Science has tended to become more and more abstract and has come under the influence of mathematical formulas and shorthand symbolic interpretations of reality in terms of molecules, atoms, electrons, ions, etc.—all of which are interpretations of natural problems in terms of their own analysis.

As a matter of fact, under the manipulation of science, the universe breaks up into a plurality of evolutions—which it finds difficulty in getting together again. For example, Professor H. F. Osborn, in his notable book on "The Origin and Evolution of Life," analyzes the world process into four evolutions, in which four distinguishable and yet interrelated complexes of energy are used. These are:

1. The inorganic environment consisting of the sun, the earth, water and the atmosphere.

2. The organism which becomes such by utilizing the energy of the environment and by coördinating its own energies.

3. The heredity-germ, which (whether preceding or following the organism we do not know) is a center of potential energy and controls the energy complex of the developing organism.

4. The life environment which is made up of the related world of organisms. You will notice that the unifying idea

here is energy—nowhere defined in the book, which, while it is unitary, does not at all simplify the problem. In addition to the difficulty of conceiving how energy can be at once the inorganic complex, the organism, the heredity germ and the life environment—how energy can be energy, can capture energy, store energy and discharge energy at the same time, Professor Osborn leaves us with two major problems on our hands without even the apparatus for their solution.

A. We are not told how these four evolutions are related to each other and particularly, how the evolution of the germ is related to its threefold environment and its own inner development.

B. We are left with an unresolved conflict on our hands between description and explanation. By every implication of scientific description the universe ought to be, and indeed is, finite. Every atom of matter is related to every other both in time and space. A physical relationship in time and space is necessarily finite—within a limit—which limit is the nexus of physical relationship. On the other hand, explanation of the present state of the universe in terms of origin and development implies, as Royce points out: first, "that at an infinite past time the particles of matter now together in the stars must have been infinitely distant from one another; and second, that, since every state, even the present one, presupposes and demands *all* the previous states of this unrhythmical process as physically necessary antecedents, the present state of the universe could not be unless that antecedent state of the mutually infinite remoteness of its parts actually did precede" (*op. cit.,* p. 331). That is to say that the physical limits of the universe were once limitless—which is a contradiction.

C. Physical realism endows us also with an unresolved conflict between mechanism and development. Scientific explanation demands that whatever is in the world is necessary. The only necessity we can conceive of is involved in mechanism, where the consequents are contained in the antecedents and explained by theme. But if life is, in the strict sense, mechanistic, if the organism is a mechanism, literally and absolutely, how can there be true evolution?[1] Ritter says that "the living, growing organism is creative in the highest sense and on a vast scale." If it is creative how can it be mechanism? A mechanism which continually transcends itself and by *epigenesis* produces new results not mechanically contained in the antecedents is also a contradiction.

D. Physical realism, finally, leaves us with an unresolved dualism between necessity and teleology. The doctrine of ends finds the explanation of process in the outcome to which process is a means. Realism finds the explanation in the process itself, conditioned and controlled within itself. And yet it is utterly impossible to conceive of process thus interpreted as aiming at the real world which we know. Teleology must be in the process because it is manifest in the result. Mechanism is itself teleological—by which characteristic mechanism transcends itself.

It seems, in the light of this general situation, that one conclusion inevitably follows—that science strictly speaking yields nothing in the way of explanation, cannot solve its own problems, cannot generate its own theory. The world process thus described carries us beyond itself to reality. We can get unity, harmony and intelligibility only when we interpret nature as well as man in terms of mind—not our mind alone, but the mind which our mind finds revealed in the world process. This is real—all else is the manifestation of reality, not very reality itself. The discovery thus made of the priority and creative preëminence of mind makes an important contribution to our study of human destiny.

Evolution has often been interpreted as unfavorable to the idea of survival, by scaling down the difference between man and the animals and by bringing the physical and the psychical within the compass of a single process—thus eliminating by degrees the substantial basis of immortality;

[1] See above, Chapters III f.

that is, the *metaphysical ground* of life beyond the reach of physical death. I reply that no such result follows. In the first place, it is to be remembered that evolution did not invent this question, nor first suggest a negative answer to it. That question was first raised by the fact of generation, by development of man from the germ-cell. Many a theology has been wrecked on the rock of human embryology. Besides, the idea of immortality cannot rest securely upon a merely substantial basis. Such a basis is not adequate, if it could be made real to thought. Immortality cannot be considered as an intrinsic possession of man at all. The escape from materialism does not necessarily put us in indefeasible possession of a metaphysical immortality. That which had a beginning, even by creation, may have an end also. And certainly God did not create what He could not destroy. I am not arguing for conditional immortality, but against unconditional immortality—because I believe it to stand on dangerous ground. This idea might do for Greek speculation or for modern spiritualism, but it does not satisfy the Christian conception. This rests squarely upon the tenable ground of our worth to God and our value in His sight. Immortality is fellowship with God, which cannot even be conceived of as having an end. God is not material or immaterial—words which belong to the human sphere—but pure spirit, true and absolute Being.

The very fact that we live in a world which exists as a reality only in, through and for thought, and that we are endowed with this creative power, whose source and seat must be in God, is an indication that we are or may be of such value to God as to be worthy of preservation in His universe. This, I suppose, is as far as purely speculative thought can go—further we must go by revelation. But we have come along far enough to see what revelation can do for us. We have a context for it in the natural order itself. The Bible speaks to the same end, though in clearer language, as does the cosmos.

This conclusion may be brought into direct relationship with facts of experience. As we have already seen, man's experience with his brain indicates that the mind transcends it, forms it, controls it except under abnormal conditions and even then in a sense, and uses it.

Dr. Christianson says ("Brain in Relation to Mind," pp. 13, 14): "It is a biologic maxim that function precedes organization, for while we may also say that necessity develops function in much the same sense as we say that it is the mother of invention, it is evident that the use of means to a given end implies the preëxistence of a specific potentiality, having a plan in the abstract, for only the preëxistent can be the cause of a necessity. Thus it follows that something of a mind must exist before a brain can be found."

Professor J. Arthur Thomson ("Bible of Nature," p. 245) says: "May it not be that mind lies in the egg, not inactive like a sleeping bird—but doing for the egg what the mind does for the body, unifying, regulating, in a sense directing it, not insinuating itself into the sequence of the metabolism, but, so to speak, informing them and expressing itself through them. We mean that the regulative principle, the entelechy, which many embryologists find it necessary to postulate, in giving more than a chronological account of an individual development, is that resident quality of a living organism which in its full development we call mind."

The other Thomson (W. H.) says ("Brain and Personality," p. 239): "It is a power not of the brain, because it is the masterful human will that makes the brain human." "We might even say that if a human personality would enter a young chimpanzee's brain where it would find all the required cerebral convolutions, that ape could then grow into a true inventor or philosopher." This sounds somewhat paradoxical, but the cases of Fred and Joe, Margaret Becker and the ape-boy of Berlin make it something more than a paradox. In the course of these studies we have found altogether new meaning in Paul's expression: We are workers together with God.

It is, however, from within the Christian redemptive interpretation itself that we get the clearest and most satisfying certification of human immortality. There we get in unqualified positiveness a divine valuation of human nature, not merely at its best and highest, but at its lowest and meanest, in terms of love and redeeming grace,—the very stuff of which the assurance of immortality is made.

We have noted a tendency in evolutionary thinking to lose sharpness of definition in dealing with man. J. Arthur Thomson has said ("System of Animate Nature," Vol. II, p. 553): "The recognition of our solidarity with the realm of organisms has been of great importance, and we cannot go back on it. Yet it has perhaps blurred our appreciation of Man's apartness." This is true. The line between him and the animals becomes uncertain and wandering, and the very concept of humanity is sometimes allowed to slip away and be lost in the twilight of man and beast—but not so in Christianity. If ethnology is sometimes at a loss to classify backward races, and individuals—Christianity never is. Its classification is never based upon actual attainment or position in the scale of culture, but only upon that inalienable human capacity for recovery, reconstruction and development. The Andaman Islander may be hard to civilize and low in the scale of manhood—he is yet a man—with all the possibilities of a man. Christianity stakes its credit upon this universal, inalienable human capacity.

It binds the whole race together first in a brotherhood of need. Sin is universal—not necessary, not because of an animal inheritance, not as a phase of growth, nor as a stage of evolution—but as a common experience, an outcome of social solidarity. Sin cannot be explained—if it could, it would no longer be sin—but the universality of it, given our human nature as it is and the closeness of the social bond which binds us together, adds no new element to the essential problem. Backward and forward, from the individual to the group and back again, the evil contagion has spread, both as personal guilt and as undeserved woe, both as act and state—both as a down-dragging factor of the nature and as an inward determining choice of the personal will. We cannot attempt here to disentangle these threads, but we must recognize that evil is race-wide—a token as well as a result of our universal human brotherhood. But we may hold also that this condition is not absolute. The grace of God in Christ is as universal in its promise as the fact of our human need—is the one guarantee, sealed in the death and the resurrection of the historic Christ, that man, even alienated in mind and will from God, is of infinite value and therefore immortal by the purpose and intent of God. This is the supreme factor in a rational hopefulness to be found anywhere in the world. As Dr. Orr said: "Sin has appeared. Redemption is God's answer to it, and the vindication of His allowance of it." This is our natural stopping place. We cannot deal with the details of the great future as the Bible reveals it—but we have reached a large place of assurance and hope. Whatever darkness still hides the future of men, we may be certain that none will miss the goal through any fault of God or any deficiency in the provisions of His Grace. We may be certain also, now and for all future time, science will discover no facts which will destroy our fundamental conviction that this is a good world whose Maker and Builder is God. Some time the physical universe will be removed, as Henry Drummond said, as a scaffolding is taken down from a building "not because it is unworthy but because its work is done."

"So life stands with a twilight world around,
Faith turned serenely to the steadfast sky,
Still answering the heart that sweeps the ground,
Sobbing in fear, and tossing restlessly.
Hush, hush, the Dawn breaks o'er the eastern sea,
'Tis but thine own dim shadow troubles thee."

GLOSSARY

NOTE: The author has tried to define his terms when and where used in the text but intention is no guarantee of performance. Hence, this list of the more technical terms used in the discussion.

Abiogenesis or *"Spontaneous Generation"*—The idea that at some time living matter has originated from non-living matter. Among modern scientists this idea is confined strictly to the first living forms or original ancestors of present forms. Formerly it was loosely applied to various animals popularly supposed to be produced from non-living matter—e.g., the horse-hair "snakes" of our boyhood.

Adaptation—Favorable adjustment to the conditions in which an organism lives.

Ameba—A very simple one-celled animal sufficiently described in the text.

Ætiological (*etiological*)—Pertaining to the science of physical causation.

Atoms—The fundamental units of matter—see *Molecules.*

Bryophyta—A class of cryptogamous plants which includes mosses, etc.

Cell—The unit of living matter, so-called because formerly it was erroneously believed to be hollow.

Creation—(a) In the scientific sense.

(1) The outcome of creative synthesis in production of new things through the recombination of already existing materials.

(2) Increment or gain in process—epigenesis q.v.

(b) In the theological sense.

(1) Absolute origination or creation *ex nihilo.*

(2) Any process looked upon simply as Divine action.

Chance (see index under "accidental")—The unknown antecedent or antecedents of observed change—used of variation.

Chromatin—The minute particles or granules which form a part of the structure of protoplasm.

Chromosomes—The filaments of the cell-nucleus which separate in the process of cell-division.

Creationism—Any theory which throws the responsibility for organic history back upon the original constitution of organisms.

Cytology—The science which deals with the nature and operations of living cells.

Cytoplasm—That material of the cell body which is distinguished from the nucleus.

Elementalism—The theory that organic phenomena are traceable to the constitution and structure of the living cells—see *Organismalism.*

Empirical—Theory based on experiment or observation.

Environment—External conditions of living beings. In the case of the germ-plasm the environment includes the body of the organism even to the cell in which the germ is contained.

Epigenesis—The idea that development and evolution are essentially creative in process—see *Preformationism.*

Fitness—The outcome of adaptation—harmony with environment which insures survival.

Gamete—A single reproductive cell, either male or female, detached from the germ-plasm by sexual activity, and ready for fertilization—see *Zygote.*

Gametophyte—The sexual phase in plant reproduction.

Gene—See *Inheritance-factor.*

Germ-plasm—That element of the cell-protoplasm which is directly concerned with reproduction and heredity.

Homologies—Similarities or parallelisms of structure among organisms, e.g., the arm of man, fore-leg of horse, wing of bird, etc.

Idio-plasm—That portion of the new cell which is derived from the parents in distinction from that which is produced by growth.

Inheritance-factor or *gene*—The unit of hereditary transmission, each one or each group of which is genetically connected with some characteristic of the offspring.

Isomeres—Different substances composed of the same atoms in different arrangements.

Mendelism—The theoretical interpretation of heredity based upon the observation and experiments of Gregor Mendel (1822-1882), Abbot of Brünn.

Metazoa—Animals consisting of many cells.

Mitosis—A form of cell-division.

Molecules—Structural combinations of atoms—formerly used of atoms.

Mutation—A sudden or discontinuous organic variation.

Neurons—Structural units of the nervous system.

Nucleus—The chief organ of cell-activity.

Ontogeny or *development*—The life-history of the individual from germ to embryonic maturity.

Organismalism—The theory which emphasizes the unity of the cell.

Orthogenesis—The theory of determinate variation directed and controlled from within by the organism itself.

Phanerogamia—Flowering plants.

Phylogeny—The life-history of races.

Protista—Hypothetical primitive organisms ancestral to plants and animals.

Protoplasm—The basic and universal substance of all living beings.

Protozoa—Animals consisting of one cell.

Protophyta—Plants consisting of one cell.

Psychic—Descriptive of all mental phenomena even the most elementary.

Pteridophyta—An order of plants which includes ferns, etc.

Recapitulation—The theory that each individual in development or ontogeny (q.v.) repeats the life-history of its race.

Somatic—Pertaining to the body.

Specialization or *organization*—Complexity of structure which involves a higher degree of physiological division of labor.

Zygote—The composite cell formed by the union of male and female gametes (sex cells).

INDEX