CHAPTER 1

The Modern Onion-Coat Theory

For more than half a century some form of the evolution theory has been regarded as the only adequate explanation of the origin of the plants and animals, including man. That this theory has been and is now almost universally taught in the educational institutions throughout the world, is too well known to need any proof.

In support of this theory, various lines of argument have been advanced, from morphology and comparative anatomy, from heredity, from embryology, and from the study of the fossils, that is, from geology and paleontology. Of all these, the last named is the oldest and by all odds the most important. Indeed, as we shall see in some of the following pages, the prevailing theories of geology, which are more than a hundred years old, were the first to suggest the idea of a gradual development among the animals and plants; and, during all the time since, the facts (as they have been regarded) of an orderly succession of various kinds of animal and vegetable life that have inhabited the world one after another during many millions of years, have always been regarded by clear thinkers as the chief, the only indispensable, argument in favor of organic evolution. As William North Rice has expressed it, "The theory of a progressive evolution of forms of animal and vegetable life is absolutely dependent upon the succession of fossils in the geological strata."1

1 Methodist Review, July, 1924, pp. 556, 557.

The various other arguments for organic evolution have been discussed by the present writer in another work.2 Here it is proposed to consider in some detail the prevailing theories of geology, especially that theory upon which organic evolution is so absolutely dependent; namely, the idea that a long series of different kinds of animals and plants has occupied the world during an incalculably long period of time, and that scientists have been able to determine with accuracy and absolute reliability the order in which these successive types of life lived and died. For more than a full century, the world has been told that certain forms of life lived long before others came into existence, and that still other forms came into existence only long ages after these second ones had all disappeared; in short, we have been told that this orderly sequence among the various kinds of life is absolutely reliable,

not as a mere theory, but as a historical fact. Our present inquiry is to determine, as best we can, the grounds on which this succession of life is based, and to examine this subject in the light of the well-established rules of inductive science, to see whether this definite order of succession among the fossils is a fact or only a theory; and if only a theory, to see how reliable it is in the light of modern geological discoveries.

2 "The Phantom of Organic Evolution," New York, 1924.

It will be essential for my present purpose to assume that the reader is more or less acquainted with the elementary facts of geology. For the details regarding the stratified rocks and their fossil contents that are essential preliminaries to an understanding of the present line of argument, I would refer the reader to my recently issued textbook.3

3 "The New Geology," A Textbook for Colleges, 1923.

Here it will be in order for us to note how the geological age of any newly discovered set of rocks is determined by modern geologists.

On coming to any region that has not yet been examined and described, the investigator first determines the stratigraphical relationship of the various strata, following them from their outcrops as far as possible, noting any changes in the beds themselves, and especially in their fossil contents. Certain of these strata that have similar fossils are grouped together into what is termed a formation, which is the geological unit for classifying the rocks. The beds above this formation, or the ones below it, which have other kinds of fossils, will be regarded as having been made at some quite different time, the relative age being determined by the well-known principle that the lowest beds must have been deposited first. This is called the principle of superposition; for in any specific locality it is only a matter of common sense to say that the lowest beds are evidently the oldest. But whether these lowest beds were deposited thirty minutes before the beds above them or thirty million years before, will be a matter which we shall postpone for later consideration.

When the one or more formations in this new locality have been worked out and their fossil contents determined, names are given to these formations, generally based on local geographical names; but these names have at first only a local or notebook value, until the fossils which they contain have been carefully compared with the fossils of other regions. If it turns out that these new fossils are like others already well known from elsewhere, the local names may have to give place to others more generally known and already accepted; and

then these new strata are said to be the equivalents of these more familiar strata perhaps a thousand miles away. If these new fossils turn out to be considerably different in some respects from any collection hitherto known, they will probably be determined as intermediate (in general classification rank) between two well-known formations in some distant locality. In either event, these new beds will be correlated as to the time of their formation with other strata already known from elsewhere, as being either equivalent or older or younger; and thus they are assigned to a definite place in the long geological succession, and we are confidently assured of the particular period of geological history during which these beds were formed.

Two examples of how these methods work out in actual practice will be sufficient to illustrate this point. In 1902, the first fossil shells were collected on the Antarctic continent. Out of about a dozen specimens, some were immediately recognized as ammonites belonging to genera found only in Cretaceous strata; or, to put the case in a more strictly accurate way, all rocks in which any such fossil ammonites occur are always classed as Cretaceous. Accordingly, on the strength of these few ammonite shells, these rocks in the Antarctic continent are declared to be of the same age as the Cretaceous beds of England and America.

The exact "age" of the Tampico oil beds of eastern Mexico was long held to be uncertain. But quite recently a single fossil rudistid pelecypod, Sauvagesia degolgeri, was found in these strata; and now we are assured by a prominent government expert that this single characteristic fossil "establishes the Cretaceous age of the San Felipe formation in its typical exposures west of Tampico."4

4 " Proceedings of the U. S. National Museum," T. W. Stanton, Vol. 59, p. 453.

Hundreds of instances might be given of similar methods, where one or two "index fossils" have served to settle once for all the geological classification of extensive sets of strata. Grabau and Shimer have published two large volumes, entitled "North American Index Fossils," which are splendidly illustrated; and whenever a geologist is in perplexity as to the classification of certain beds, if he finds in these beds certain representative "index fossils," he can settle the case in five minutes, with the help of these tabulated and illustrated examples. If, however, he does not have access to these rare and expensive lists of index fossils, the field worker can box up a few typical specimens of fossils and send them to the nearest expert paleontologist, who will tell

him the exact "age" of the rocks from which they were taken, providing these fossils happen to be what are regarded as typical or safe "guide" fossils, or "index" fossils.

Not all fossils are regarded as suitable for thus determining the age of a set of beds. Multitudes of fossils are considered as ambiguous, because they are found to occur in many different formations. And where none but these indeterminate fossils can be found, geologists have to rely as best they can upon other criteria, such as stratigraphy, or the lithologic characters, to make a correlation of these beds with the other standard formations from elsewhere, and await the discovery of more conclusive fossil evidence. But whenever certain representative trilobites, or brachiopods, or graptolites, or belemnites, or ammonites, or what not, are found in the rocks, no geologist or paleontologist would have the slightest hesitation in assigning these rocks to a very definite place in the long geological succession, no matter what the beds might look like, and no matter what other kinds of strata were found occurring either above or below.

That the fossils are in reality the sole test of the "age" of the rocks in which they are found, will appear from the following quotations, which are typical of many more that might be given. Grabau tells us:

"The primary divisions of the geologic time scale are, as we have seen, based on the changes in life, with the result that fossils alone determine whether a formation belongs to one or the other of these great divisions."5

5 "Principles of Stratigraphy," p. 1103.

H. S. Williams tells us the same thing, with even more details in the statement:

"These systems [Quarternary, Tertiary, Cretaceous, etc.], although actually arbitrary groupings of the stratified rocks of particular regions, have come into use as the primary divisions of the rocks whenever chronological sequence is considered. In describing any newly discovered fossiliferous strata in any part of the earth, the first step to be taken, in giving them a scientific definition, is to assign them to one or other of these systems upon evidence of the fossils found in them. The character of the rocks themselves, their composition, or their mineral contents have nothing to do with settling the question as to the particular system to which the new rocks belong. The fossils alone are the means of correlation."6

6 "Geological Biology," pp. 37, 38.

Our object now is to decide whether this method of determining the age of a newly found set of rocks, that is, the method of assigning these rocks to a definite place in a system of world-chronology, is in all respects a scientific one, conformable in all essential respects to the methods followed in the other sciences, such as physics, chemistry, or astronomy. If we are already sure that there has been a succession of life on the globe, and if we are already certain of just which types of life existed at certain periods, and can be absolutely sure that other types of life were not then in existence, we may feel confident regarding the geological age of a newly discovered rock deposit by comparing its fossils with those of this series as already determined. But how did geologists first determine this order of successive life-forms? Or how can we now prove in logical, scientific fashion, that there has actually been this succession of life on the globe in a particular order? In other words, how did geologists first construct their elaborate index? To illustrate the matter further, how are we to prove that when the Cambrian forms were existing in one locality, let us say New York, this assemblage of animals and seaweeds really prevailed everywhere on earth, or at least that no other higher types, such as dinosaurs, or elephants, or men, were then in existence anywhere else, perhaps on the other side of the globe?

During the last two or three generations, probably thousands of students have asked themselves these questions. Sometimes they have ventured to ask their instructors; but they have usually been told that the founders of the science "have ascertained" that certain fossils occur only in certain rocks; and what can this possibly mean except that certain kinds of life lived only in a certain age of the world's history, that these were in turn succeeded by others, and so on to the end of the list?

But is this the only possible explanation? Pretty slim data, one would think, on which to build so large and momentous a conclusion. Is the student of chemistry, or physics, or astronomy told that the basic facts and principles of his science have been worked out long ago by the founders of the science, but that these foundation principles are too recondite and too difficult to be explained to beginners? At any rate, should not the student in geology be directed to the definite persons, to the particular time and place, when these foundation principles of the geological succession of life were first worked out and logically established?

But let us examine this supposition that only certain types of life were living in a certain geological age.

At the present time, in our modern lakes, seas, and oceans, samples of every grade of life are being buried for fossilization in different localities, - worms, mollusks, crustaceans, insects, reptiles, amphibians, fishes, mammals, and human beings, all are now becoming candidates for fossilization. As we proceed backwards in time, how are we to know when we arrive at a time in the past when this principle would not hold good? In other words, if we hold strictly to scientific methods, how can we ever get back of the time when all these forms with which we are now acquainted were living together contemporaneously? How can we, except by dogmatically assuming a supernatural knowledge of the past, fix on a time when only a very limited few of the lower forms existed on the globe? The current geological theories say that there was such a time; and the whole science as now commonly taught, indeed the whole scheme of organic evolution, rests on the supposition that such was the case. But how are we to prove such a statement in strict scientific fashion? Or how can we justify this idea as to its details without assuming the very thing that we are trying to prove?

To some, it may seem like a very extravagant statement for me to say that in the whole field of scientific study there is to-day nothing of such tremendous importance and far-reaching consequences as is the definite determination of this very point: Are these successive ages, or the successive groups of life in a definite order, as pictured by the current geology, actual scientific fact, or are they mere evolutionary assumption? Can these distinct successive ages be proved objectively, or must we confess that their existence is a mere speculation, quite incapable of objective proof? However, when we realize that all the alleged chronological relationships between the different groups of fossils are absolutely dependent upon this idea and that the whole scheme of organic evolution, with all that has been built upon it, is built up logically around this geological concept of successive types of life, my statement of the-vast importance of this problem will appear natural and reasonable. It is the most important and the most far-reaching problem before the scientific world to-day; and we shall do well to examine it with the utmost care and thoroughness.

The present writer has examined all the literature of geology and paleontology published during the past century or so, which deals with the problem we are here considering. This portion of geological and paleontological literature is very scanty, either because the leaders in

these sciences have given little attention to the basic ideas of this problem, or because, after thinking about it, they did not know what to say regarding it. Only four authors that I have been able to find, - Spencer, Huxley, Nicholson, and Suess, with possibly one or two others that I may have missed, - have written anything of importance or have attempted to sound the logical bottom of this problem. It will be convenient to consider what each of these four representative men has said upon this subject.

Herbert Spencer, in his early essay on "Illogical Geology,"7 did not seem to think that the way in which Lyell and his followers had built up their main doctrine of an orderly succession of various types of life was a praiseworthy example of the methods to be pursued in natural science.

7 "Illustrations of Universal Progress," pp. 329-380, New York, 1890.

He starts out with Werner, of Neptunian fame, and shows that the latter's main idea of the rocks always succeeding one another over the whole globe, like the coats of an onion, was "untenable if analyzed," and "physically absurd"; for among other things, it is incomprehensible that these very different kinds of rocks could have been precipitated one after another by the same "chaotic menstruum."

Werner had taken for his data the way in which the rocks happened to occur in "a narrow district of Germany," and had at once jumped to the conclusion that they must always occur in this relative order over the entire globe. "Thus, on a very incomplete acquaintance with a thousandth part of the earth's crust, he based a sweeping generalization applying to the whole of it."8

8 Page 332.

Werner classified the rocks according to their mineral characters; but when the fossils were taken as the prime test of age, the "original nomenclature of periods and formations," says Spencer, kept alive the original idea of complete envelopes encircling the whole globe one outside another like the coats of an onion. So that now, instead of Werner's successive ages of sandstone making or limestone making, and successive suites of these rocks, we have successive ages of various types of life, with successive systems or "groups of formations which everywhere succeed each other in a given order, and are severally everywhere of the same age. Though it may not be asserted that these successive systems are universal, yet it seems to be tacitly assumed that they are so…. Though, probably, no competent geologist would

contend that the European classification of strata is applicable to the globe as a whole, yet most, if not all geologists, write as though it were so."9

9 Page 339.

Spencer then goes on to show how dogmatic and unscientific it is to say that when the Carboniferous flora, for example, existed in some localities, this type of life and this only must have enveloped the world.

"Now this belief," he says, "that geologic 'systems' are universal, is quite as untenable as the other. It is just as absurd when considered a priori; and it is equally inconsistent with the facts,"10 for all such systems of similar life-forms must in olden time have been of merely "local origin," just as they are now. In other words, it is folly to claim to have a scientific knowledge of a time in the remote past when there were not floral and faunal provinces and districts, as there are to-day, one type of life existing in one locality, while other and totally different kinds existed somewhere else. Though Spencer does not go thus far, it evidently implies a supernatural knowledge of the past to affirm, as the life-succession theory does, that such unnatural conditions ever prevailed. But the merest tyro in logic can see that the whole scheme of organic evolution is moonshine, if we find out that these various groups of fossils, now supposed to have been successive or in a true historical series, were really contemporaneous with one another after all.

10 Page 340.

In the world to-day, the only world which can serve us as a reliable guide in things scientific, we continually find radically distinct faunas living side by side, only a few miles apart. The fauna to the north of Cape Cod is quite different from that to the south of the same spot; the Red Sea fauna was different from that of the Mediterranean, until the two began to commingle, by the digging of the Suez Canal. Two very distinct faunas coexist on the opposite sides of the Isthmus of Panama.

Spencer gives some examples of this sort, though he does not say, as he might well have said, that Cambrian trilobites may have been strictly contemporary with Cretaceous ammonites and dinosaurs; that the Carboniferous flora may have coexisted only a comparatively few miles away from the Miocene flora, or that the Mesozoic dinosaurs may have lived in certain localities, while the mastodons and megatheriums and mammoths and saber-tooth tigers were also roaming the plains not a hundred miles away.

However, after quoting from Lyell a strong protest against the older form of the onion-coat theory, under which it was taught that only certain kinds of sandstone and marl and shale were made at certain epochs, Spencer proceeds thus:

"Nevertheless, while in this and numerous passages of like implication, Sir C. Lyell protests against the bias here illustrated, he seems himself not completely free from it. Though he utterly rejects the old hypothesis that all over the earth the same continuous strata lie upon each other in regular order, like the coats of an onion, he still writes as though geologic ' systems' do thus succeed each other. A reader of his ' Manual' would certainly suppose him to believe that the Primary epoch ended, and the Secondary epoch commenced, all over the world at the same time…. Must we not say that though the onion-coat hypothesis is dead, its spirit is traceable, under a transcendental form, even in the conclusions of its antagonists?"11

11 Pages 342, 343.

The conclusion thus rather timidly put forward is absolutely unavoidable. For if we are ashamed of this modern form of the onion-coat theory - namely, that fossiliferous groups of life were successively universal over the globe - we can only disclaim it by admitting in full the alternative of geographical provinces and districts, or, in other words, admitting that very diverse types were living contemporaneously in the oldest period of which we have scientific knowledge, just as we find them doing to-day. And then, how are we to set limits to the possible diversity of these contemporary forms in that early time, that morning of the world? But the current system of geology denies that very diverse types could have been living contemporaneously in the long ago; hence we must own that we have this modern form of the onion-coat theory, a real biological onion-coat theory, still taught as science in practically every college and university throughout the civilized world.

Spencer then examines at considerable length the kindred idea that the same or similar species "lived in all parts of the earth at the same time.„ "This theory," he says, "is scarcely more tenable than the other."12

12 Page 343.

He shows how, in some localities, there are now forming coral deposits, in some places chalk, and in others beds of mollusks; while in still other places, entirely different forms of life are existing. In fact, each zone or depth of the ocean has its particular type of life, just as

successive altitudes have on the sides of a mountain; and it is a dogmatic and arbitrary assumption to say that such conditions have not existed in the past, or to limit in any way the diverse varieties of life that may then have coexisted in widely separated localities.

"On our own coasts, the marine remains found a few miles from shore, in banks where fish congregate, are different from those found close to the shore, where only littoral species flourish…. "Were it not that the assertion seems needful, it would be almost absurd to say that the organic remains now being buried in the Dogger Bank can tell us next to nothing about the fish, crustaceans, mollusks, and corals that are now being buried in the Bay of Bengal."13

13 Page 353.

Herbert Spencer entitled his essay, "Illogical Geology," and he evidently had difficulty to keep within the bounds of parliamentary language when speaking of the absurd and vicious reasoning at the very basis of the whole current geological theory; for, unlike the other physical sciences, the great leading ideas of geology, such as uniformity, the succession of life, etc., are not generalizations framed from the whole series or group of observed facts, but are really dogmatic statements supposed to be axiomatic, or at the most very hasty conclusions based on wholly insufficient data, like that of Werner in his "narrow district of Germany." Sir Henry Howorth14 has well expressed the urgent need there is of a complete reconstruction of geological theory:

14 "The Glacial Nightmare and the Flood," Preface 7.

"It is a singular and a notable fact, that while most other branches of science have emancipated themselves from the trammels of metaphysical reasoning, the science of geology still remains imprisoned in a priori theories."

But Huxley also has left us some remarks along the same line, which are almost equally helpful in showing the essential absurdity of the assumption that when one type of life was living and being buried in one locality, another and very diverse type could not have been flourishing in other distant localities, - in other words, the absurdity of this modern onion-coat theory.

This is how he expresses it:

"All competent authorities will probably assent to the proposition that physical geology does not enable us in any way to reply to this question: Were the British Cretaceous rocks deposited at the same time

as those of India, or were they a million of years younger, or a million of years older?"15

15 "Lectures and Lay Sermons," ed. 1913; p. 27.

"All that geology can prove is local order of succession. It is mathematically certain that, in any given vertical linear section of an undisturbed series of sedimentary deposits, the bed which lies lowest is the oldest…. For areas of moderate extent, it is doubtless true that no practical evil is likely to result from assuming the corresponding beds to be synchronous or strictly contemporaneous; and there are multitudes of accessory circumstances which may fully justify the assumption of such synchrony. But the moment the geologist has to deal with large areas, or with completely separated deposits, the mischief of confounding that 'homotaxis' or similarity of arrangement which can be demonstrated, with 4synchrony' or identity of date for which there is not a shadow of proof, under the one common term of 'contemporaneity,' becomes incalculable, and proves the constant source of gratuitous speculations."16

16 Pages 29, 30.

Yet even so clear a thinker as Huxley usually was, does not seem to have had more than a twilight vision of the real questions involved in this modern onion-coat theory. For it is not a question of whether the British Cretaceous fossils lived contemporaneously with the Cretaceous of India. No doubt they did; for the human mind instinctively believes that representatives of the same types of life, no matter how distant geographically, must have been connected in time and must have been related to one another by descent. But it is really the converse of this proposition that needs to be critically examined; namely, the assumed denial that very dissimilar forms in England or India or America were also contemporaneous. Could not the trilobites and the ammonites have lived contemporaneously in the same ocean? And might not the dinosaurs and the titanotheres and mastodons also have been living (in separated localities) on the lands at the very same time? The new geology says that they were thus contemporary, while the evolutionary theory of successive ages denies it; for it is useless to talk about distinct geological ages, if dissimilar types were contemporary in the long ago as they are to-day.

Huxley, indeed, seems to have caught a glimpse of the absurdity of denying that there must have been zoological provinces in the long ago, for he says:

"A Devonian fauna and flora in the British Islands may have been contemporaneous with Silurian life in North America, and with a Carboniferous fauna and flora in Africa. Geographical provinces and zones may have been as distinctly marked in the Paleozoic epoch as at present."17

17 Page 30.

Certainly; but if this be true, it is equally certain that the Carboniferous flora of Pennsylvania may have been contemporaneous alike with the Cretaceous flora of British Columbia and the Tertiary flora of Germany and Australia. But in that case, what becomes of this succession of life which for nearly a century has been the pole-star of all the other biological sciences - I might almost say, of the historical and theological as well?

What if the Mammoth, the Mastodon, and the Megatherium were really contemporary with the still more gigantic Brontosaurus, the Diplodocus, and the Brachiosaurus? What if the ichthyosaurs, the plesiosaurs, and the mosasaurs swam around in the same seas in which lived the trilobites, the ammonites, and the nummulites? Personally, I do not see anything strange in such a suggestion. But if someone denies all this, how is he to prove the impossibility of such contemporaneity? I think I am fairly familiar with the facts regarding how all these creatures occur as fossils. I am also familiar with most of the literature of the science, both that of my contemporaries and that of two and three generations ago. And yet I must confess that if some of my friends were to undertake to defend the thesis that these animals could not have lived contemporaneously, he would have to put up a good deal better argument than any arguments along this line with which I am acquainted.

Must it not be admitted that, in any system of clear thinking, this whole idea of there having really been a time when only a certain limited number of life-forms were in existence, and these more or less universally distributed over the whole globe, is not only not proved by scientific methods, but is essentially unprovable, quite outside the limits of natural science?

Huxley, in point of fact, admits this, though he goes right on with his scheme of evolution, just as if he never thought of the logical consequences involved.

"In the present condition of our knowledge and of our methods [sic] one verdict - 'Not proven and not provable' - must be recorded

against all the grand hypotheses of the paleontologist respecting the general succession of life on the globe."18

18 Ibid.

These remarks of Huxley's indeed, were so near to the whole truth of the matter, that it almost seemed as if geology would follow the example of the other sciences by emancipating itself from the trammels of metaphysical speculation, and donning the garb of demonstrated fact. But it appears that his criticisms only served to awaken the theorizers long enough to use this new light about zoological provinces and districts to help them out of some minor puzzles into which their theory had led them; for outside of a few admiring references to this idea of "homotaxis," subsequent writers have seen in them nothing suggestive of the miserable logic on which the whole theory of successive ages, and thus the evolution doctrine also, has been built up.

Prof. H. Alleyne Nicholson19 is almost the only other writer who has considered it worthwhile to try to defend this doctrine of successive ages; and we must next note some of his remarks illustrating how near this idea of projecting our modern conditions of geographical distribution back into the past came to wrecking the inherited onion-coat theory, the spirit of which, Spencer says, is still traceable, "under a transcendental form, even in the conclusions of its antagonists."

19 "Manual of Paleontology," General Introduction, 3d ed., pp. 47, 52.

"When it had been clearly established," says Nicholson, "that particular groups of strata in Europe were characterized by particular assemblages of animals and plants, it was, not unnaturally, concluded that similar or identical assemblages of organisms would be found to characterize corresponding groups of strata all over the world. This led to the idea that the successive faunae and florae observable in the area first examined had been universally distributed over the whole globe [that is, the onion-coat theory was still retained]; from which followed the old catastrophic view that the close of each geological period had been signalized by a more or less complete extinction of the animals and plants then in existence, and that a new fauna and flora had been introduced at the commencement of each succeeding period."

He continues:

"It is, however, now universally admitted that in nature the chronological succession of rocks, as determined by fossil remains, is local and not universal, in the sense that the precise order of

phenomena must necessarily have differed in different regions. That this must be so is proved by the existence at the present day of 'zoological provinces'; by the fact that dry land and sea must always have existed since the beginning of Paleozoic time at any rate, and that sedimentation can, therefore, never have been universal; and by the certainty that the sedimentary deposits now in process of formation, and therefore necessarily coeval, contain the remains of dissimilar groups of animals and plants."

Page after page is devoted by this author to enlarging on this principle of true science, which teaches us that dissimilar groups of life are now coexisting in separate localities, and that if we hold fast to real experience, and project our modern conditions of geographical distribution back into the past until we find positive evidence of the contrary, we cannot attain to any scientific knowledge of a time when this principle ought not to hold good. But it is surely one of the most amazing things in the whole history of natural science to see how neither Nicholson, nor Huxley, nor Spencer, nor any of their thousands of followers, have realized how completely this principle removes the whole foundation on which rests the idea of relative time-value, which still persists in assuring us that when a Carboniferous group was existing here, a Cambrian group could not have been existing over there, and Cretaceous and Tertiary groups somewhere else. That an assumption of such a supernatural knowledge of the past, totally at variance with our modern knowledge of plant and animal distribution, still flaunts itself in our eyes from every textbook professing to deal with the earth's early history, is an anachronism almost passing belief. Some day, when this science is reconstructed by being built up on inductive principles from the present instead of being postulated from the past, this part of the history of natural science will make a most amazing story for our posterity.

"The Face of the Earth,"20 by Eduard Suess, of Vienna, is acknowledged by all to indicate the high-water mark of geological literature. In that work, several references are made to the problem of what these geological classifications really mean; and finally the author leaves it unsolved, as one of the largest tasks he must bequeath to the next generation of investigators.

20 Oxford, 1904-1909.

Three or four times he alludes to "the remarkable fact that it has been found possible to employ the same terminology to distinguish the sedimentary formations in all parts of the world."21 But it is quite

obvious that this is only the modern aspect of the onion-coat theory in what Spencer calls its '6 transcendental" form; and it is equally obvious that, if we look upon the geological series of life-forms as having no intrinsic time-value whatever, but as being only an old-time taxonomic series of that ancient world, as will appear later, this "remarkable fact," which seems such a puzzle to this accomplished scientist, becomes as clear as sunlight, and immediately falls into its natural place in a scheme of true inductive geology.

21 Vol. 2, p. 540.

In his picturesque way, Suess puts one of the characteristic features of this modern onion-coat theory in the form of a question, as to how the Silurian formation, one of "the very earliest of them all," "recurs in parts of the earth so widely removed from one another - from Lake Ladoga to the Argentine Andes, and from Arctic America to Australia - always attended by such characteristic features," and how it happens "that particular horizons of various ages may be compared to or distinguished from other horizons over such large areas, that in fact these stratigraphical subdivisions extend over the whole globe."22

22 Vol. 1, p. 8.

Two illustrative examples of what Suess here refers to may be given. The graptolites are among the most characteristic fossils of the Ordovician;23 and they are minutely graded off, each particular type serving as the index fossils for one of the various zones. And "graptolite zones, with the same or closely similar species, and in the same order of succession, are found in Great Britain, the St. Lawrence and Champlain valleys, and in Australia."24

23 Lower Silurian of Europe.

24 W. B. Scott, "Introduction," p. 572.

Regarding the divisions of the Jurassic, we have also the following from the author just quoted:

"Even the minuter divisions, the substages and zones of the European Jura, are applicable to the classification of the South American beds."26

25 Pages 681, 682.

It is this ghost of the onion-coat theory which disturbs the banqueting of our modern geologists, to which Professor Suess alludes in the above-mentioned quotation, and which he mentions repeatedly throughout these four remarkable volumes.

As already remarked, Professor Suess considers that this fact, that even the minutest subdivisions of the geological series extend over the

whole globe, is one of the great unsolved problems of the science; for he says that "if we could assemble in one brilliant tribunal the most famous masters of our science, and could lay this question of the student before them, I doubt whether the reply would be unanimous, I do not even know if it would be definite."26

26 Ibid.

Of course, from the standpoint of current theory, this question must ever remain without explanation; for the one thought pervading this whole work of Professor Suess is that absolutely nothing in the direction of an exchange of ocean and dry land is now going on, and thus we have no modern analogies to explain how those great universal "transgressions" of the ocean took place in the past. In other words, uniformitarianism is now found to be bankrupt as an explanation of the past geological changes. But how simple this problem becomes, how natural this whole phenomenon appears, when we look upon the geological series as only an old-time taxonomic, or classification, series, artificially arranged, of the various floras and faunas of the ancient world, all of which, however, may have lived contemporaneously with one another!

As this explanation never had occurred to him, Professor Suess concludes his discussion of this subject with the very explicit statement that if an inquiring student were to seek an answer to this problem in his "Face of the Earth," "he would not find in it an answer to his question."27 In other words, the most accomplished and most philosophical geologist of modern times has no explanation of why this "transcendental form" of the old onion-coat theory works so well when applied to the classification of the fossils from all parts of the world.

27 Vol. 1, p. 15.

But why should not an ancient taxonomic, or classification, series work as well as a modern one? All the geological formations, and all the subdivisions of the geological series, little and big, are merely old-time taxonomic divisions, with geographical names attached. They are based not on stratigraphy (except locally), but wholly on taxonomic considerations; and why should not a taxonomic series, if all are agreed to follow it, be just as applicable to Australia, or Peru, or Alaska, or Florida, or England, or Germany, as here in the United States, - provided, of course, we happen to find specimens with which to illustrate it?

This is all there really is to Professor Suess's wonderful conundrum; and it is astonishing that he and others cannot see it.

But if this be true, there is nothing left of the geological succession of the fossils, except a purely artificial arrangement, valuable as a working classification, a tool for convenient study, but with absolutely no other scientific value whatever. That the parts of this series have relative time-values in and of themselves, is grotesque in its want of logic. No clear thinker would ever dream of such a thing, if this idea were not now given an artificial life through the accumulated momentum of a hundred years of use and scientific prestige. That this idea can longer continue to be reverentially respected and actually used as the basis for constructing evolutionary trees of descent for the various animals and plants, is a sad example of mental inertia, and of the difficulty of dislodging a venerable falsehood even from the minds of scientifically trained people.

It may be worthwhile to gather into concise form the facts we have learned thus far:

1. The geological ages depend wholly upon the types of life supposed to have flourished at these various periods; and the age of a rock is determined by its contained or associated fossils.

2. Spencer not only saw the absurdity of Werner's onion-coat theory, but he blames Lyell and the other modern geologists for still perpetuating the absurd idea that the geological formations are universal over the globe, and says that we now have onion-coats of fossiliferous rocks, instead of the old mineral onion-coats of Werner.

3. Huxley acknowledges that geology can prove nothing more than local order of succession; that when we come to deal with large areas, there is "not a shadow of proof" for saying that one type of rock in England was or was not formed at the same time as other rocks in America or Africa; and that all the paleontological notions about the general succession of life on the globe are "not proven and not provable."

4. Nicholson, and indeed all modern geologists, seem quite ashamed of the onion-coat theory of Werner; and they try to prove themselves clear of it by speaking rather timidly of the principle of zoological provinces and districts, partially admitting that dissimilar groups of life must have existed contemporaneously in the olden time as now - how dissimilar, they dare not say, because to admit this principle fully, must forever destroy the idea of successive ages of life. For if we renounce entirely this modern form of the onion-coat theory,

must we not admit that mammals may have lived on the land while trilobites were living in the sea, or that nummulites may have been contemporary with the graptolites, or oaks, beeches, and birches contemporary with the lepidodendrons and sigillaria? And then what will become of the theory of successive ages!

5. Professor Suess seems dazed at the universal spread not only of the larger groups or systems, but also of the particular horizons or stratigraphical subdivisions; and he remarks with astonishment that it has been found possible "to employ the same terminology to distinguish the sedimentary formations in all parts of the world." He feels very doubtful whether, if all the masters of the science were assembled together and this problem were propounded to them, the reply would be unanimous, or even "definite." As for himself, he has no explanation.

6. From all this discussion, it follows that the distinctions in regard to age which are made between the various fossil animals and plants, are not scientifically established, and have no scientific value. A fossil is not necessarily old because it has been found in a Cambrian bed; nor is one necessarily young because it occurs in a Cretaceous or a Tertiary. In other words, the Cambrian fossils may not be a day older than others from a distant locality classed as Tertiary or Pleistocene. The common-sense distinctions in age are still left us, and may be applied with confidence in any specific locality, based on stratigraphy alone, but we must abandon any world-scheme which would try to make certain fossils to be always and necessarily older than others. The latter is a pseudo-scientific idea, with no support in actual fact.

On the other hand, what geology has been dealing with all these years under the name of a "phylogenic,, series, turns out to be nothing but an old-time taxonomic series, buried somehow, and at some time or times, which must be determined later and by other considerations. But there is absolutely nothing in the geological record to forbid our believing that all these various types of life were really once living contemporaneously together in an older state of our world. How long ago they lived, or how they were buried, are questions which we are not yet prepared to solve. There are many other facts which we need to consider first. For here we have been studying only the abstract idea of the geological succession. And we find that geologists have in reality been taking the taxonomic series of an older state of our world, and have been thinking that they saw in this taxonomic series a true historical succession.

It is as if a man were to find an immense library, and were to insist that all the books listed under A, B, and C were really printed long before those listed under X, Y, and Z; and as if he were to support this idea by carefully showing how all the A books were published simultaneously in London, Chicago, Atlanta, San Francisco, and even in Paris, Berlin, and in Sydney, Australia; and so on all through the list. And then he expressed a wonder how it happened that the publishers in all these scattered localities had each hit upon the same idea at the same time as the others, and all had thus issued books alike.

How long would such a theory pass among educated men as being strictly scientific?

So much, then, for the a priori argument. We must now look at the history of the idea, and in subsequent chapters consider the stratigraphical features of the theory.