

Philosophy, Travel, &c.

THE ORIGIN OF LIFE.

V.

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(Continued from page 673.)

IN order to assist the reader in following the lines of distribution of mammals a chart of the distribution of land and sea at the end of the Eocene period is attached. From this will be apparent the obstacles to the spread of species arising during that period, and the reason why lands distant from the North are behind the times in the type of life-forms of which they are the present abode.

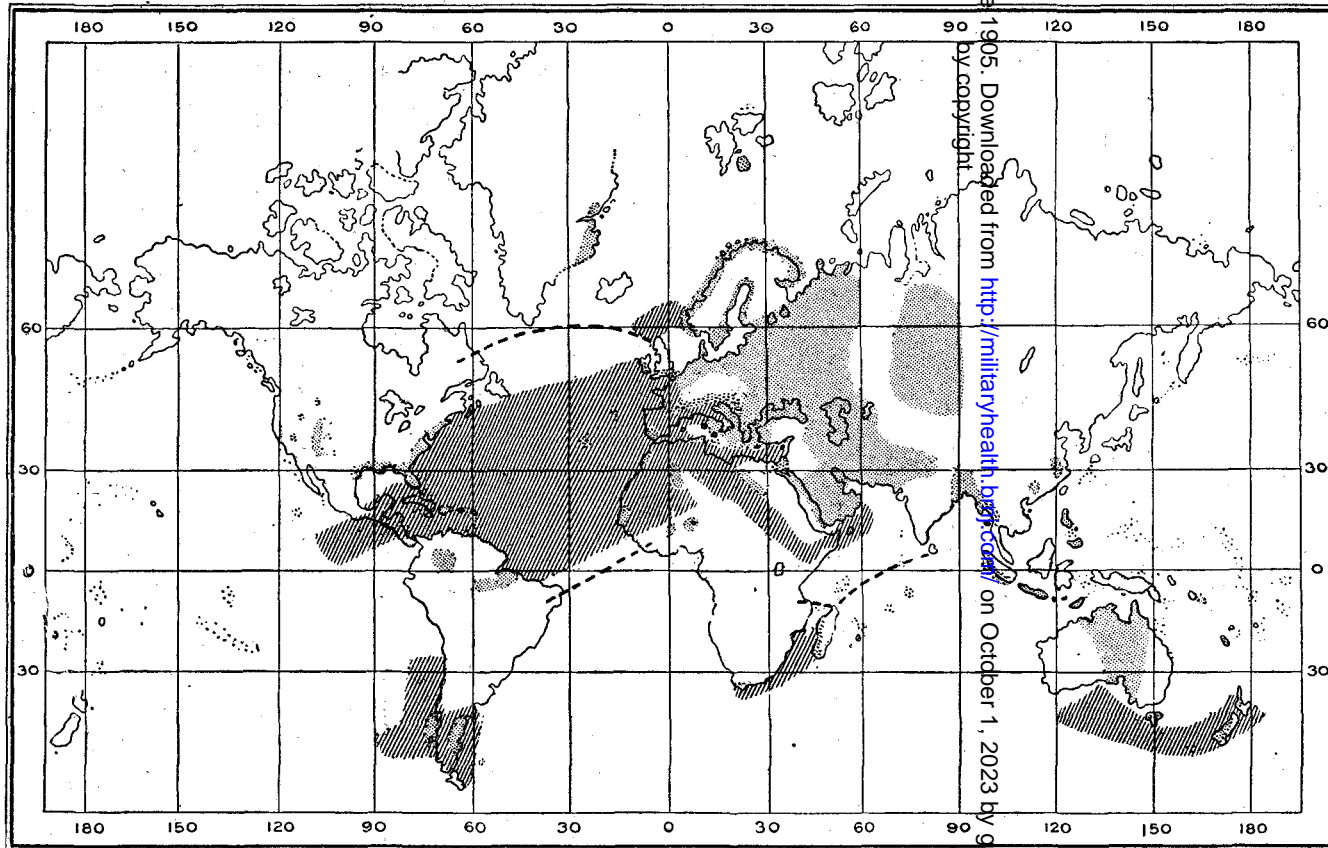
The earliest mammals are found in the uppermost Triassic rocks of England, Germany and North Carolina. They were marsupial forms. They occur later in considerable quantities in the Jurassic rocks of England and of the United States (chiefly Wyoming). These latter (Jurassic) beds contain remains also of an inferior order of mammals, the Monotremes. It will thus be seen that the less advanced order was the later in appearing, so far as the geological record can show at present.

The Marsupials do not seem to have relinquished their footing in Europe rapidly, where their latest occurrence is in the Oligocene beds of Hampshire and France. They are then found in the Miocene and Pliocene of Patagonia; and in the Pleistocene deposits in the last-named country, as well as in North America and Australia. They are limited to-day to America and Australasia.

The Monotremes, which now exist in New Guinea, Australia and Tasmania, continued from the Jurassic of England and Wyoming, where they first appeared, into the Cretaceous of those countries; they then spread to the Eocene of France and Puerco (United States). They are next discovered in the Pleistocene of Australia.

The Placental mammals are first found in the Lower Eocene beds of Europe and the United States. The earliest forms appear to be of types which have been called "generalised," for the reason that they possess characters which subsequently appear in more than one order of their successors. For instance, the Camels, the Chevrotains and the true Ruminants are descended from generalised

CHART V.



SEA IN TERTIARY TIME.

Shaded portions denote known seas.

Diagonal portions denote probable seas.

Broken lines, probable land connections.

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ancestors found in the middle Eocene of Europe and North America. These generalised types are found in considerable numbers, the animals possessing such well-differentiated characteristics that they must have been in existence for some considerable time before the Eocene period. As their predecessors have not been found we thus see another instance of the fact that the place of origin of life-forms has not yet been discovered. The fact that the generalised types referred to, buried as they were on the fringe of the Northern Continent, must have lived on that continent, points to that area, or some spot still further to the north which was connected with the North Atlantic land, as the country of their origin.

The Camel family has two main branches, to one of which belong the Camels of the Old World, to the other the Llamas of the New. Camels have been found in the Pliocene of Roumania, Russia, Algeria and the Siwaliks. Llamas occur in South America as far back as Pliocene times.

The Chevrotain family, found in the Miocene of Sansan (France), is represented by a branch having members now living in Ceylon, India and the Malay Peninsula and Archipelago, and a branch inhabiting West Africa.

The section of the Ruminants first appears in the Miocene of Europe, subsequently differentiating into various families. Of these the antlered ruminants occur in the middle Miocene of France and Germany, whence they have spread through Europe, America, as far south as Chili, Asia and North Africa. The Giraffe family is first found in the Pliocene of France, Greece, Samos, Persia, the Siwaliks and North Africa; the modern members are the Giraffe and the Okapi of Africa.

The hollow-horned ruminants (*Bovidae*) are first found in the Miocene of Europe, and are now distributed all over temperate North America, Europe, Asia and Africa. Of the Antelopes there are now only two species each in Europe and America, while in Africa they are numerous, as well as in Asia. They occur also in Japan, Formosa and Sumatra.

The three sections of animals referred to above are grouped together as pair-hoofed Ungulates.

Space will not allow of a description of the origin of each of the orders and suborders of placentals, but as examples of the dispersion of these animals one or two further instances may be mentioned.

Of the odd-hoofed Ungulates only three families are represented

at the present day. Generalised types of this order extend back to the Lower Eocene of Europe and the Upper Eocene of the United States.

One of the families, the Tapirs, is represented in the Upper Miocene of France by the genus *Tapirus*, which exists almost unchanged to-day in Central and South America, and in the Malay Peninsula, Borneo and Sumatra. The second family, the Horses, can be traced back to certain forms with five toes in the Eocene of the United States, the modern form dates from the Pleistocene of America and Europe. The horse became extinct in America, where it was restocked by the Spaniards.

The third family includes the Rhinoceros, whose ancestors existed in Europe and North America in the Lower Miocene period. They died out in America in the Pliocene period. Although at one time ranging throughout Europe and Asia, in the present day the rhinoceros is found only in Africa, India, Burmah, Malay Peninsula, Java, Sumatra and Borneo.

The Edentata of America have been traced back to certain forms of the Eocene of North America. Though these forms possessed incisors and rooted cheek-teeth, these structures were gradually eliminated more or less in subsequent fossil forms, so that now the ant-eaters have no teeth, while the dentition of other families is varied. The modern forms are found only in America south of Texas. The animals of the Old World formerly assigned to this order have been separated under a new name. Of these there are two families, one, toothless after birth, is found in Africa (East, West and South), India, Burmah, Siam, Cochin China, Japan, Malay Peninsula and Archipelago (greater part), and Ceylon. The other family is found in Africa only; most of the teeth possessed by this family are preceded by milk teeth. These forms can be traced back to others in the Oligocene of France, Miocene of Germany and Greece, Lower Pliocene of Samos and Persia, and Pleistocene of Madagascar.

True Carnivora are first found in the Lower Eocene of France and of the United States (Puerco). These early forms became differentiated, and are now represented by the Cats, the Dogs, and the Bears.

The Cats date back to the Upper Miocene of Europe and North America. They are now distributed all over the world, excepting Madagascar and Australia.

The Dogs first appeared in the Oligocene of France and Lower Miocene of the United States. They have since spread all over the world, including Australia.

The Bears commenced in the Oligocene of France, whence they spread to Europe, Asia, and North America.

A word regarding the Primates. The earliest known forms are the Lemurs. The earliest forms attributed to this suborder are from the Eocene of France and the United States, where they continued up to the Lower Miocene; they have not been found in subsequent deposits until the recent superficial deposits of Madagascar. At the present day their principal home is Madagascar; they also inhabit Africa, Ceylon, Sumatra, Java, Borneo, Celebes, South-eastern Asia, and the Philippines.

The Primates of South America form a group by themselves, without representatives in the Old World. The only fossil representatives belong to one of the two families constituting the group; they have been found in the Patagonian Pliocene and in the Miocene of North America. That they did not originate in Patagonia is shown by the absence of lemurs from the South American deposits.

The Apes of the Old World do not extend into America. Their earliest fossil representatives are from the Miocene of Würtemberg, Tuscany and France; they occur in the Lower Pliocene of Greece, and in the Pliocene of England, France, Italy, and the Siwaliks of India.

The Anthropoid Apes are first found in the Miocene of France, Swabia and Switzerland, the fossil remains being considered to resemble the gibbon. The chimpanzee and the orang have been found in the Siwaliks (Pliocene). The present distribution is—gibbons, Eastern Himalayas, South-eastern Asia and Sumatra; orang, Borneo and Sumatra; the gorilla, West of Africa; chimpanzee, Africa, from the West Coast to the region of the Great Lakes.

It was mentioned in a previous article (p. 85) that Quatrefages¹ traced man back to the Miocene period. Gaudry suggests that the flint implements found at Thénay, on which Quatrefages based his arguments,² were produced by the anthropoid ape (*Dryopithecus Fontani*), whose remains are noted above as occurring in the Miocene of France.

Cursory as is this sketch, it furnishes sufficient material to indicate that the larger life-forms have spread from a single land

¹ "The Human Species," International Science Series, p. 151.

² Joly, "Man before Metals," International Science Series, 1883, pp. 177 *et seq.*

area as opportunities have presented themselves. But this land area does not present us with a complete gradational series of forms; it merely gives us the earliest record yet discovered, and the one which most closely approximates completeness. It gives us sufficient to show that we must search further if we wish to complete the evidence necessary to obtain ocular proof of all the stages of the evolution of the main stocks, from which life-forms of the present day are descended. By adhering to the doctrine of descent from pre-existing forms we are driven, by a study of the distribution of species in the past, as well as in the present, to the Northern Continent, as that which, by the possession of the most complete series of ancestral types, shows itself to be nearest to the locality of origin. Animals have arrived at places distant from the locality of origin at epochs later than those during which they originated, terrestrial animals being directed in their migrations by the presence of connecting tracts of land. Isolation of land areas has caused, naturally, isolation of the terrestrial types existing on them at the date of their becoming separated from the source of supply. Thus, when Australia was isolated at some time in the Tertiary period its mammalian fauna was practically entirely marsupial, with the exception of the dog and some mice, and, perhaps, the bandicoot, and has since remained so. New Zealand has a few degenerate birds, in addition to some members of the mouse family. Madagascar was cut off shortly after the lemurs arrived there. At a later date Ceylon became separated from Peninsular India. South America is a land of Edentates. Africa contains a fauna resembling that of Pikermi, in Greece, some representatives of which lingered in Thessaly in the days of Herodotus. This fauna spread down to South Africa as soon as the disappearance of the Saharan Sea permitted of access, though some South African animals undoubtedly reached that country *viâ* the land connecting Ceylon and Madagascar and the East Coast.

These isolated areas present us with pictures of the fauna of epochs which in the North belong to a remote past.

“All the individuals of the same species, and all the species of the same genus, or even higher group, are descended from common parents, and therefore, in however distant and isolated parts of the world they may now be found, they must, in the course of successive generations, have travelled from the same point to all the others.”¹

¹ C. Darwin, “Origin of Species,” 1882, p. 406.

Since Darwin wrote "Origin of Species" further discoveries have borne out the truth of the principle therein enunciated. Nothing has since been discovered which can interfere with the truth of the doctrine of evolution, of descent with modification. What has been the initiating and guiding force which has caused and maintained that evolution has been the subject of much controversy, a certain amount of which has been due to failure to accord a liberal recognition to the principles of Darwin's and Wallace's theory.

Darwin propounded the fact that variability is responsible for the initiation of new varieties and subsequent species, genera, and higher groups. This variability is called into play by new conditions of life, necessitated by the struggle for existence. "Favourable variations" only are accumulated. But the value of the word favourable is an important qualification. Darwin means favourable to continued existence; for instance, the mole having acquired burrowing habits and resultant blindness, has acquired characteristics favourable to its degenerate mode of life. Variability may lead to degeneration.

The different types of animals as they have spread from the source of origin have undergone modification, through the power of adapting themselves to the exigencies of their surroundings. This we can see for ourselves in almost every family which we have been able to trace from the Northern Continent. The members of any family by the time they have arrived at a distant locality have differentiated into different genera, or species, or perhaps only varieties. Animals do not migrate through love of travel. They only do so under pressure—the pressure occasioned by competition for the necessaries of life, or by the necessity for the avoidance of predatory types.

Hence it follows that the weaker migrate. But, in addition to that the mere fact of migration must lead to variation, apart from causes which, similar to those in their original home, stimulate variation. The power to maintain the struggle for existence while continuing unchanged must be regarded as the highest attribute to which any animal could aspire, for it would indicate an organisation perfectly adapted to its surroundings, undamaged by adverse influences. Any failure to hold its own with its fellows entails disappearance or modification of the individual or group. Modification leads to specialisation, and specialisation confirms new habits, which again must become perfectly adapted to what is required to maintain the animal in the new phase it has assumed.

Failure in the least respect entails a repetition of the alternative between extinction and renewed variation, either of body or habitat, or both. It is obvious, therefore, that adaptability or variability is essential to the preservation of life-forms which are getting the worst of it in the struggle for existence; the life-form is preserved at the expense of modification of the type. Variation is the index of the inability of certain members of a family to maintain themselves when in competition with other forms. For instance, the animal which can preserve itself only by changing its colour is on the road to extinction—it is marked down as the prey of others. The beast of prey whose size diminishes in order that he may be less visible to his quarry is on the path to extinction, as he will fall a victim to larger beasts.

We can imagine the centrifugal process of dispersion taking place through long ages leading to the distribution over the earth of the weaker, and to renewed weeding out at each stage of the journey, until the types arrived at a limit beyond which they could not travel on land. The weaker must then have been forced to burrow or swim. Those that could not find a subterfuge disappeared.

But not only have life-forms spread, and varied while spreading, from their original home, but new forms have arisen, these being advances on improved lines in the development of the original stock. "Old forms are supplanted by new and improved forms."¹ We have seen in the course of this sketch the sudden appearance on the scene of forms possessed of entirely new characters, and we have been unable to find intermediate forms showing the gradual growth of the new characters. Such may be forthcoming in time. For instance, it has not long been known that the bandicoot (*perameles*) has a rudimentary placenta which places it on the borderland between marsupials and placentals. It may be a degenerate placental. But if not, the appearance of new characters of such a type are on a different plane to the degeneration of a five-toed limb into a one-toed, as in the case of the horse. Here we have the principle of mutation, as enunciated by de Vries, to point out that species spontaneously produce well-marked stable varieties which breed true. These come under Darwin's category of "variations which seem to us in our ignorance to arise spontaneously."² Certainly it is not known why such mutations occur, but that they do occur is sufficient to account for the appearance of new types, while the absence of their immediate ancestors can only be

¹ Darwin, *op. cit.*, p. 417.

² *Op. cit.*, p. 421.

explained by the fact that we have not yet discovered the site where such forms arose. The discovery of such a site will give us the missing forms, "only four or five progenitors,"¹ required to complete the chain of descent, or ascent, from the dust.

But in considering the progressive and the degenerate forms a further result becomes apparent.

Those dispersed life-forms that have arrived at the *ultima Thule* are weaker than those at the starting point, however robust they may on the surface appear to be. New Zealand possesses a luxuriant flora of an Old World type, which is being driven out by imported weeds. This fact is more evident to-day than when Darwin wrote: "It is said that the common Norway rat, in the short space of two years, annihilated in this northern end of the island the New Zealand species. In many places I noticed several sorts of weeds, which, like the rats, I was forced to own as countrymen. A leek has over-run whole districts, and will prove very troublesome, but it was imported as a favour by a French vessel. The common dock is also widely disseminated, and will, I fear, for ever remain a proof of the rascality of an Englishman, who sold the seeds for those of the tobacco plant."² This evidence of the extirpation of indigenous flora and fauna in the South by forms imported from the North is but a corroboration of the truth of the principle enunciated above, that the types which maintain themselves within the area of their origin (or perhaps, as we do not exactly know the area of origin, we should say, nearer the area of origin) are more robust than those which disperse. Reason would lead us, in view of the theory, to anticipate a result which observation has shown to have occurred, and not only in New Zealand, not only with regard to plants, but also to mammals, as in the case of the Norway rat, quoted above, and of the rabbit in Australia, and the modern horse in America. These last are not actively offensive forms; but if we were to introduce into Australia a collection of European mammals, male and female of each species, maintaining at least for a period a sufficient supply of fresh blood from the parent stock, we might confidently predict the ultimate disappearance, in the course of time, of the marsupials and monotremes.

Man also is not exempt from the law, as witness the melting away, in the presence of European races, of the aborigines of the

¹ *Op. cit.*, p. 424.

² "Voyage of the 'Beagle,'" Edition 1896, p. 513.

lands of the Pacific—a disappearance which is a “law of Nature,” and one which no legislation short of the removal of the white man can stem. The confines of the world stand to animal life in the same relation as the lion’s lair in the fable, regarding which the fox observed: “*Vestigia omnia adversum, nulla retrorsum video.*”

Other instances occur nearer home, where the red-legged partridge in some localities ousts the indigenous type; the Norway rat is driving out the long-tailed rat; the English sparrow is driving out other members of his tribe in North America.¹

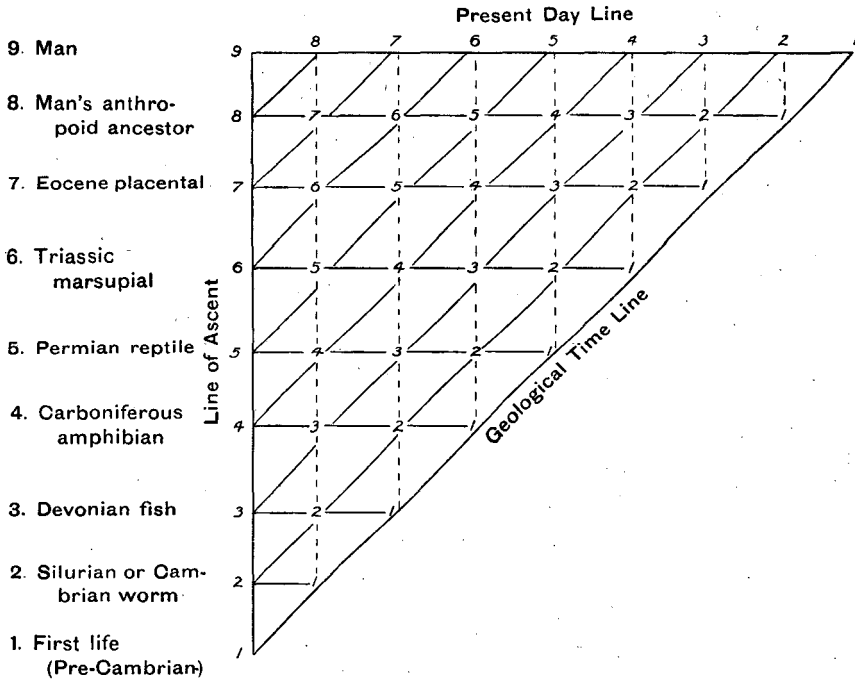
The whole scheme of distribution points to the same principle—the origin of parent stocks in some locality in the North; the dispersal of species from the same direction, in the first place by the driving out of the weaker members of an order to other localities where they can exist without pressure from their stronger comrades, provided they can adapt themselves to their new surroundings. In the second place by the expulsion of an old-established order by an order which newly appears on the scene, as in the case of the displacement of the reptiles by the marsupials, and of the marsupials by the placentals. The latter process, completed in Europe, is in progress in South America, and has scarcely begun in Australia. And thus we gain a reply to some of the propositions set forth on page 229 of this volume of the Journal.

We do not find a wide-spread origination of life with its subsequent development into higher forms in localities scattered over the earth, but we do find on the margins of the old North Atlantic continent a series of life-forms increasing in the scale of development, as represented by successive waves of higher forms, each more advanced than the preceding. This condition indicates that the old continent was itself, or was in close contact with, a locality where the origination of life was in progress, and from this continent the rest of the world was supplied with life-forms.

With regard to the proposition as to the formation *de novo* of protoplasm under favourable conditions from not-living matter in the present day, we have no ocular demonstration of its occurrence; neither do we see living transitional life-forms linking together the types. For if life were still originating from not-living matter, it must have done so continuously from the date

¹ For further instances see Darwin, “Origin of Species,” p. 59.

of its first appearance; it must further have gone through and be still going through processes of evolution on lines similar throughout all time. The result, both in the past and to-day, of such a process may be graphically represented by the following diagram :—



The lowest diagonal in the diagram represents a supposed continuous origination of life throughout geological time; along this line certain points are selected and marked 1, the column of figures above indicating the stage reached at certain periods in the dotted line of ascent.

A few of the leading stages in the evolution of man have here been represented to show how those stages would be to-day visible on the earth's surface, together with their intermediate links. Such stages and intermediate links are not present. We have had to dig for them, with as yet incomplete success.

We are forced therefore to conclude that there was one main line of descent, from which branches diverged through "variation," branches whose variation led in many cases to extinction—these branches are not represented in the diagram.

If living matter, therefore, were still forming from not-living matter, we should see among the living things of to-day every

stage of evolution, not only among microscopic plants and animals, but also among the larger living things. We should be in possession, in the present, of all the "generalised types," which preceded every phylum, every class, order, family or genus of every form of living thing, and we should be lost in a maze of the wildest bewilderment among the interminable variations of life-forms.

We should not be content to imagine that under the microscope from "aggregates of bacteria, by common consent regarded as belonging to the vegetable kingdom, we have the production of typical animal organisms,"¹ while we cannot see the natural corollary to such a condition, namely the extension of the same process to larger life-forms. Though we may witness mutation in species, we cannot place such a change as the genesis of an animal from a microbe in the category of mutations.

The study we have just completed shows us that though new varieties and even species are still being evolved, the process of origination of life is a thing of the past. The poets may sing—

And what is so rare as a day in June?
Then, if ever, come perfect days;
Then Heaven tries earth if it be in tune,
And over it softly her warm ear lays;
Whether we look, or whether we listen,
We hear life murmur, or see it glisten;
Every clod feels a stir of might,
An instinct within it that reaches and towers,
And, groping blindly above it for light,
Climbs to a soul in grass and flowers.²

But beautiful ideas cannot convince against knowledge.

We can see types becoming modified, especially under domestication; we can witness the conquest of the weaker with its consequent disappearance of species, but the whole of the sciences bear out the truth that the period of origination is past on this earth. Living matter has been launched on its career, and from parent to offspring must carry out its destiny subject to the tendency it has always possessed, the tendency to vary. But we cannot see, and we shall never see, its origination from the soil. We men of the present day may be generalised types of the creatures that are to be, but even of this our evidence is more of the nature of presumption than of science, seeing that the generalised type from which it may be presumed we sprang

¹ Charlton Bastian, *Nature*, vol. lxxi, p. 81, November 24th, 1904.

² J. R. Lowell, "Vision of Sir Launfal."

has not been discovered. We accept it as in keeping with the philosophy of evolution which leads us to the soil. Huxley's philosophical faith agreed with the writer of Genesis that man was formed out of the dust; the process was a thing of the past—"It can no more occur again."

So soon as that fact is finally accepted, the energies of the workers can be directed to a practical solution of the problem as to the locality where life arose. The vast collection of fossil forms point in one direction. The earliest known forms have been tracked to the northern land which lay between North-western Europe and North-eastern America. The labours of geologists and palæontologists have chiefly been confined to portions of the southern margins of that land; it remains to work out the deposits of the North, to lay bare the secrets of its northern fringe, and to correlate accurately the time origins of the northern strata with the strata further south. By working through the southern countries of the world we have seen by the distribution of *Amphibia* and Reptiles that the Trias of Germany preceded the Trias of the South (Africa, &c.); we must be prepared to acknowledge that the so-called Trias of Spitzbergen, where "it is easier to find vertebræ of a gigantic lizard of the Trias than bones of a self-dead seal"¹ is older than that of Germany; and we must be prepared to see that the so-called Cretaceous and Tertiary flora of Greenland may be older than the southern Cretaceous and Tertiary flora respectively. And still more, we must even be prepared to find the flora from which the plants composing the Pre-Cambrian Graphite beds were formed; we may look forward to finding the source of those Carboniferous plants (*Glossopteris*, &c.) which occur in the Carboniferous rocks of Australia, South Africa and India, &c., and which may have travelled from the North by a land route whose position has not yet been mapped out.

So far as knowledge has gone, she points to the North as the locality of origin. As to the source of life we have no actual knowledge, further than that of the biologist, who has proved that to-day there is no life without precedent life; knowledge which is verified by the above sketch, setting forth the progression, in the past only, of life-forms from forms low in the scale up to the Primates, preserved on or near the Northern Continent. Truly, many gradations are missing, but this is the only region which furnishes a record approaching such completeness as to

¹ Nordenskiöld, "Voyage of the 'Vega,'" p. 323.

justify the theory of evolution by a fairly continuous chain of facts. Other regions do not present such records. Any theory which would suggest separate areas for the origin of life would require for its support a complete series of life-forms in each area, and such a series does not exist in any other area than that indicated above. We know that there was a remote past when the earth was lifeless; in that remote past not-living matter became living. We know this because we can trace back all life-forms to non-differentiated masses of protoplasm, which must have arisen from a protoplasmic slime produced from materials composing the earth's surface. Though there is no other thing from which it could have arisen, we hesitate to accept, except as "philosophic faith," the fact that the first protoplasm arose from the chemical constituents of the earth. Such faith is a paradox resembling the definition by a Biblical writer, "Faith is the evidence of things not seen," a *jeu de mots*.

Gravity is not seen; we call it a law because we observe its working. Its working is the evidence. It is not held to be a matter of faith. Abiogenesis is not seen; that it worked once is as patent as the working of gravity; but we do not call it a law because we are hampered with traditional views of Genesis—traditions handed down since the childhood of our race, dependent not on the dictum of the Biblical account of Genesis, but on the interpretation of that dictum. If before reading the Biblical account we had absorbed Darwinism, we should accept the origin of life from not-living matter as an essential, and call abiogenesis a natural law. We should then find that it was not a matter of faith—philosophical or unphilosophical—to accept the Biblical account of Genesis; but we should be filled with amazement that the writers of that account possessed a knowledge of the beginning of things so closely in accord with the knowledge acquired by us, practically within the last century. Further, we might be inclined to think that when our knowledge is more complete the differences between the earliest record and the latest will not be so vast as to be of material importance.
