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Introduction to the Study of the Foraminifera.

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LITERATURE

Introduction to the Study of the Foraminifera.

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Water, containing earth in solution or suspension, gives the atoms of such earth a freedom of moving according to the impulse of the pervading polar forces. These may be affected by the rotation of the earth atoms themselves as aggregation proceeds; and both the course of motion and the resultant form of the crystal or other aggregate may be modified according to the nature of the fluid field of such aggregation. This fact has been lucidly demonstrated by Bainoin’s beautiful experiments on the artificial production of organic conditions of aggregation of carbonate of lime, inducing the same degree of crystalline shape as when the atoms aggregate in the vital production of shell and coral.

When the fluid is pure water the atoms of the earth are aggregated, under polar guidance, into crystalline forms, distinct for each chemical kind of earth, and affecting, by the angles and planes of the crystals, characters of the “species” of the mineralogist. When the fluid is slightly impure, the operation of the polarizing forces is, and apparently, though not really, impeded, and the character of a crystal is proportionately lost: the modification of, and departure from, angular or crystalline forms being greater as the slime is thicker; and especially when the atoms of such are in the condition of an organ, through combination, to act and react upon the surrounding slime-suspending fluid, so as to attract or draw in outside atoms of slime, and be attracted by or drawn out to other particles of slime, of a similar nature.

The exuviations, ejections, and decay of organisms of all kinds and grades now supply to seas, lakes, rivers and other aggregates of water, the raw material for the re-organization of the all-pervading force which are termed “vital.”

This raw material abounds in, and indeed partly gives its character to, the kind of bed of sea or lake which is called ooze or “muck.” The nature and varieties of which are manifold. At whatever depth of the ocean such “muck-bed” has been reached, the contained slime has been observed, when duly scrutinized, to be manifesting the vital form of force, and modifying the shapes in which the atoms of earth—fluid or limy—may be aggregated within the vitally acting slime.

The bulk of the present folio of 310 pages is devoted to the description of the vast plates and 47 woodcuts to the delineation of the various leading forms in which the particles of carbonate of lime are stranded. The process is arranged within the portions of slimy matter, called, according to the prevalent character of their lime-aggregates, “Foraminiferous.” The “basin” or field of those aggregates has not been distinguished from that in which particles of lime or earth are precipitated, either in the form of fine needles, as in sponges, or of delicate cases, as in Polyzoa; nor from that substance in which the main part of the material in the fluid field of its existence, neither flint nor chalk is deposited, as e.g. in Actinopyga and Actinopyge. In some common organic basins has received the name of “sacreed” or rudimentary flesh, and of “protoplasm” as being of every form and condition (plant?) of structure, and from which it is evolved by a process of gradual differentiation. Under the latter term the author defines the substance as being “composed of an abundant mass of oil particles in a state of very fine division diffused through it: it is tenacious, extensible and contractible; it is disintegrative; it might more that oil water, but less than oil; and it is dissolved by alkalis, rendered transparent by acetic acid, and dyed brown by iodine. In the midst of this substance are usually seen variscrystals, or cavities containing a thinner fluid, which is often coloured; these are extremely variable, both in number and size, and their deficiency in any definite limiting walls is rendered obvious by their not unfrequent coalescence (p. 13).

Under what modification or combination of the general polarizing force, the slime of mud or ooze is disposed of in a protoplasmic centre of such low vital force is still undetermined; but, once begun, and growing as such, it succeeds of yet of carbonate of lime or centres; and the “Foraminifera afford one of the best examples which the animal kingdom can present of a progressive or lativitivare” repetition which is an essential feature of all low grades of organization. The primitive protoplasmic, and potential forms of the Foraminifer, however, contains lime-water in much greater proportion than either of the substances defined by the terms composing it; it combines the calcium of such water with carbonic acid, and precipitates it on its exterior as a thin porous crust. The same, or protoplasmic, or saccoidal, or “sacred” centres; whilst their beauty is mainly due to the repetition of the same structure on a regular basis. When the centres, or “sacred” centres, more have a curvilinear axis of growth; and the latter, being spiral, may be either flat, like the shell of the mantis, or may coil round as a whirl. But between the rectilinear and curvilinear forms there is a complete gradation.

When the varying conditions of the ocean-beds, which are the seat of the foraminiferous mode of resolution of vital force, are considered,—either in respect of distance from the surface, decreasing from depths exceeding two miles, as reached by the soundings of the Atlantic Telegraph Company, and through the waters of the Cape Farewell and the Island of Rockall, to the shallows of tidal shores,—in respect of the constitutional state of the material in which the slime-elements become aggregated into protoplasmic centres,—corresponding modifications of the foraminiferous state of lime and upon such centres might be expected,—are, indeed, inevitable under such low conditions of a centre of vital power, with the corresponding weakness of resistance of surrounding influence. Accordingly, a result of the summary of the observed forms of foraminiferous shells in Dr. Carpenter’s “Introduction” is, that a definition of a species is impossible, in the terms at least, as long as the persons who lead them have definite organs led themselves; and that the like “ordinary method of definition” of the genus of foraminifiers is “impossible. The pages of twenty, or thirty, are, nevertheless, devoted to the attempt to classify the zoologically unclassifiable Foraminifers. The efforts of the mineralogist towards systematic arrangement and meet with as inadequate a reward; but the conditions of the aggregation of mineral atoms, under the guidance of polar forces, are more definite and less varied than those in the complex solution which forms the ocean.

We have supplemented the author’s definition of the protoplasmic base or seat of the chalk-precipitator by the quantity of lime-water which fills out the delicate, filmy, albuminous lime. Our meaning is this: every river pours a solution of lime into the sea; but pure water only evaporates from its surface. All sea-water, therefore, holds (with many other salts) a proportion of lime in solution; and if this casitic earth were not disposed of, the effect of evaporation would, in time, unfit the sea for the purposes or as a medium of life. Amongst the instruments by which the shell is protected in the condition of a mild, insoluble carbonate of lime, the Foraminifera are the most active and the most widely diffused. In the deep-sea sounding to which reference has been made ("the surface layer of the ooze was formed of living shells; whilst its principal mass consisted of the exuviae of preceding generations.

To Ehrenberg we are indebted for the capital discovery of Algal proportions in which the shells of Foraminifera enter, either entire or comminated, into the formation of chalk. (Ehre Die Erkundung der Kreidefelsen und der Kreideermel gegen unsichtbaren Organismen, in the Transactions of the Royal Academy of Berlin for 1838; and Ehre noch jetzalter Landsc杂物en der Kreidefelsen und der Organismen der Polythalamien, 1839.)

When this constitution of the downs and marshes is compared with that of the cliffs of Albion (as it is generally examined), it is found to bear a close resemblance to that of the mud which has been dredged up from a great tract of the bed of the Atlantic, and which was composed of little else than the calcareous shells of Globigerina and other foraminiferous, with the silicious shields of the allied Polyphyletes.

If the finer part of a portion of chalk be washed away, the remaining sediment consists almost entirely of foraminiferous shells. They have also been found in similarly upheaved beds of older valleys, on the coast of the Silurian, in the instances of calcareous rocks of a consistency to be washed; and even in hard concretions of marbles foraminiferous shells can be detected, by the microscope, in polished sections and in thin slices laid upon glass.

Another kind of evidence of the shore-lines by the polythalamous Foraminifera in the formation of the earth’s crust has been made known to us also by the original and persevering labours of the great microscopist of Berlin, in his discovery that their shells occasionally become infiltrated by a solution of silicate of iron, which fills by precipitation, not the chambers, but the pores and co-extending canals, even to their minutest ramifications; so that when a shell thus infiltrated undergoes decomposition, a perfect internal cast of the original protoplasm and its root-like extensions remains.

Of such casts it has been shown by Prof. Ehrenberg that the green-sands which present themselves in various geological sheets of the Silurian system upwards, are in great part composed of shells of foraminiferous protoplasms, but on the other hand, one places before us far more exact representations of the configuration of the chambered shells, and of the connecting parts, than we could obtain even from living specimens by dissolving away their shells with acid.
Aggregates of slime, snot, or "protoplasm," however, occurring forth their pseudopodal extensions at one point only on the surface, cover the rest with a case which is imperforate. In the Milliccula, which are and were marine forms of porcellaneous texture. In the Lituolida, some kinds of which live in shallow seas or brackish water, the shell "annulus," or composed of foreign particles cemented together on the side of the protoplas. In the Gromida, of which many inhabit fresh water, the shell is membranous or "chitinous."

The freshwater Amoebida resemble the protoplasmic basis of the Foraminifera; but, the conditions for obtaining the lima are poor or absent in the sphere of their existence. The "type" of some of these minia. are clearly defined and beautiful organisms is alike. Since the great step which Dajardin ('Observations sur les Rhinopodes et les Infusores,' Comptes Rendus de l'Academie, Sciences, 1833) made in the right appreciation of their nature, observers have progressively converged in interpreting the results of the four or more, and in accordance with the following expressions of our author:

"The physiologist has here a case in which those vital operations which he is accustomed to see carried on by an elaborate apparatus are performed without any specific apparatus whatever.—a little drop of the particle of apparently homogeneous jelly changing itself into a greater variety of forms than the folded Proteus; laying hold of its food without members, swallowing it without a mouth, appropriating its nutritious material without absorbent vessels or a circulating system; placing itself to places without muscles, feeling (if it has any power to do so) without nerves, propagating itself without genital appendages, and not only this, but in many instances forming slightly covering of a symmetry and complexity not surpassed by those of any testu. animals." (p. vii.)

The large experience of the Foraminifera which Dr. Carpenter has accumulated from his own studies, derivations and direct, and from those of his conjoins in the present work, Messrs. Parker and Rupert Jones, has led him to the conclusion that—

"the ordinary notion of species as assemblages of individuals marked out from each other by definite characters that have been genetically transmitted from original prototypes similarly dis. tinguished is quite inapplicable to this group."

* The only natural classification of the vast aggregate of diversified forms which this group contains, will be one which ranges them according to their direc. tion and degree of the modifications of the original type, which they may have respectively acquired in the course of genetic descent from a common ancestor.

* Even in regard to these family types, it may fairly be questioned whether analogical evidence does not rather favor Assimilation the idea of their derivation from a common original than that of their primitive distinctness."

We have already noticed the influence of Mr. Darwin's volume, 'On the Origin of Species,' on the mind of the writer, the essentially distinctive character of which work is the attribution of all animal species, as descendents "from at most only four or five progenitors, and plants from an equal or lesser number,"—the author adding: a step further, namely, to the belief that all animals and plants have descended from some one prot. ontogeny. This is as close between the terms in which Dr. Carpenter repeats his main conclusion as to the origin of the aerie Foraminifera, and those in which Mr. Darwin expresses his conclusions in terms of all the living beings of this planet, that we are led to question whether a like influence has been applied to the progenitors and to the species and genera of antecedent investigators and classificers of the Foraminifera.

"The doctrine of the most interesting and instructive facts, of the identity of some (Ehrenberg determined it in ten) of the so regarded species of fossil Foraminifera of the chalk with still existing species, and of the identity of more of the Foraminiferous Nodarasia of the Triassic, and Ceratitidae, and strata, with existing forms, Dr. Carpenter explains it, agreeably with the Darwinian hypothesis, as a case of the genetic continuity between the Foraminifera of successive geological periods; graduating back. ward to the period when they began to descend from a common original," or, to use the Master's words, "from some one primordial form, into which life was first breathed," (Darwin, p. 484.)

According to this hypothesis we are compelled to consider or try to construct the planet's history in which the conditions of life, or the circumstances tending to change the modes of operation of all organic beings, or the vital direction, were uniform, or at least that the uniformity which led to the impossibility of life as long as the earth was uninhabited had only been broken so far as to allow of the variation of such form into those of a few pro. genitors. As a result of the gradation of differentiation of such progenitors from the primordial one being such as might be mani. fested by an Amoeba or whatever Dr. Carpenter may conceive to have been the original “father of all Foraminifera."

The inevitable corollary of the Darwinian hypothesis seems to us to demonstrate its weak. ness; and to show by contrast the superiority of the Lamarckian principle of the heterogenos production of the primitive types of organisms. Agreeably with this principle, we conceive that "particles of apparently homogeneous jelly' are now, as of old, being aggregated through the operation of existing interchangeable modes of force, under special conditions, capable of caus. ing, for example, the special characters of the Foraminifera.

The difference of atomic condition between a speck of jelly exercising the attraction and cohesion of all and sympathizing with such attraction is the by the force of more intimate atomic union, call it incorporation or assimilation, may not be greater than the difference between a small number in a non-magnetic and a magnetic piece of iron; it is certainly very analogous to the latter. The latter draws to itself objects of similar nature, and is unable to be attached to them, even to the weak field of a magnet.

Every observer of the movements of such a scaldal aggregate as an Amoeba, or Actinoplous, may recognize enough of the above-indicated correspondence with magnetic attraction and repulsion to place a fresh before his judgment, for unbiased consideration. From such properties of the jelly-mass compel the invoc. ation of a miraculous "inbreathing of life for their initiation, and of generation exclusively for their continued display. Analogy of the phenomena of convertible modes of operation of polaric force leads us to conclude that the differ. ent animal protoplasm and the soft and active states of mucus, is due to a conver. sion of attractive or other mode of polar

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into the mode called ‘assimilative,’ ‘organic,’ or ‘organic force.’ We believe, to use Darwin's expression, that such common species occurs under the conditions favoring it; that now as of old, the force that they have operated in the production of Foraminifera in the cove or bed of sea-beds from the娘娘 to the present day, for the possibility of such conditions of vivifying jelly-speaks, to the present day.

Dr. Carpenter's studies of the porous chalk-deposits in and on these jelly-specks appear, however, to have induced him to adopt a different conclusion; to assign the beginning of such organism to an occult cause, to an operation of force or to a concurrence of forces which have no place in Nature,—a creative force in fact, which Darwin could only express in Pen-}

tatelic terms as the primordial form “into which life was first breathed”: Such primordial form of Foraminifers, once created, with its power of growing by assimilative atomic attraction and of propagating by pushing out and detaching particles of its substance, spread and multiplied. The foraminifers offering in time spread in positions and fell under conditions which, by reaction on the primordial form, produced the diversified and its resultant conditions of the foraminiferous body and shell. The “Foraminifera of successive geological epochs are all descended from the first-created little particle of homogenous jelly, having the properties above quoted from p. viii of the work under review: the assumption of an occult, insensate, creative cause operating once for all, with the inevitable corollary of uniformity of vital conditions of existence during the hypothetical, uniform, primitive and primordial state of the earth's inhabitants, appears to us to be a less "simple assumption" than the following, viz., that the period when life became possible on the earth's surface the conditions were sufficiently varied to permit the conversion of the jelly into a special organic mode of force to operate under circumstances resulting in a variety of simplest forms of life, the form of "amoeba," "ophio-some," "amoeba," "lichen-some," \&c., and that such conditions have continued to operate in the heterogenous production of organisms without out conditions to the present day.”

The atoms, attracting and attracted, causing the pushing out and drawing in of the "sur-code," insusceptible at any part of the surface and assimilated, augment the mass, which buds out; in some the bud falls off, in others it coheres, and may form a polymathous or dendritic whole. So in the crystalline salt, the atoms, attracted to the surface, cohere according to the laws of crystallization and form, sometimes as beautiful dendritic whole, as in Fusilifera, zoophytes and plants. In all these cases the single cell and the primitive crystal continue to be independently and "heterogenously" brought into being.

When observation shows that a particular form of Foraminifer occurs in fossiliferous rocks of all ascertained geological periods, we deduce from the fact that the conditions of the heterogenous creation of such form have been the same. Instead of concluding that the particular form or kind of Nodosaria of to-day is the great-grand-ancestor of all the Nodosaria of the carboniferous period, itself the lineal offspring of the occulty-created primordial Foraminifer, we deem it the chemical rejuvenation, that the conditions of the "core" which led to the "fossil-line" form Nodosaria coming into being when coal-plants flourished, operate in like manner in producing that particular form of shell-making jelly at the present day. In like manner we regard the valuable labours of Messrs. Parker and Rupert Jones 'On the Nomenclature of the Foraminifera' as a suggestive body of proof of the degree in which uniform conditions of development of Foraminifer, characterized and named "specifically," have operated during long geological periods on the earth, and they act as a link between each other partly in blindness and partly from design. An old family, in a county town in "the light lands of Suffolk," hold themselves in retirement and dignified seclusion—their neighbors—let the truth out to pride: alas! they have a wretched secret to live down. The old squire and the eldest daughter, who are perfect for each other, have left their old manor-house, with the youth who is said to be the son of Darwin. It is expressly admitted by his disciple, and the authors, that there is no indication of any tendency to elevation towards a higher type in the foraminifers of the present period; but the significance of this fact seems to be lost. Dr. Carpenter in reference to the most important, and the most supreme, deduction from the numerous particulars in which he has ably and skilfully set forth in his "Introduction to the Study of the Foraminifers." In regard to the history of these most interesting and beautiful, though for the most part minute, forms of Protozoa, the salient features which, in zoology, will be remembered gratefully and with admiration of the originality, acuteness and perspicacity of the observers, are the determination of the true nature of the Foraminifers and their kinship to Amoeba and other freshwater rhiZopods by Dujardin,—and the discovery of their antiquity and important share in forming the earth's crust by Ehrenberg.

To the general reader there is no work on the Foraminifers which will prove more instructive and entertaining. This volume which Dr. Carpenter has brought out, with the aid of Messrs. Parker and Rupert Jones, under the auspices of the Ray Society. To the scientific reader, especially looking to the bearing of the recorded facts and observations on the generalizations of highest interest at the present phase of his science, the result, we regret to state, is such as the author himself recognizes when he speaks of his writing modestly, he confesses that he cannot venture to anticipate that his work will prove altogether satisfactory.”


The title of this work is in itself a novel, and suggests half-a-dozen stories at once. The story is well told, however, satisfy most readers; it is full, well considered, and well worked out. The interest is solid, and depends more on the delineation of inner life and character than on the accidents of a critical moment. The plot is broad, and the interest goes on increasing to the last page. The story is extremely well constructed; it is by far the best work of fiction Mr. Jeffresson has yet written, and in great measure realizes the promise of excellence given in his former novels.

The story turns on the traditional "skeleton" said to be everybody's secret, and Mr. Jeffresson gives his notion as to the best way of dealing with it. Everybody has some secret that he would not willingly impart to the world; and an authentic history of somebody else's "skeleton" has an attraction for every reader. Mr. Jeffresson's maxim for all secret sorrows is—"to live them down." There are different fashions of living things down: to keep any action or event absolutely secret is a wild hope—"it is on tardy feet to set," wrote Madame de Maintenon. Bluebird's key was but the type of human experience. Scour out an event so that you destroy the traces rich in one's memories, and it breaks out visibly in another. All the characters in Mr. Jeffresson's story have their secrets, and they act and react for each other partly in blindness and partly from design. An old family, in a county town in "the light lands of Suffolk," hold themselves in retirement and dignified seclusion—their neighbors—let the truth out to pride: alas! they have a wretched secret to live down. The old squire and the eldest daughter, who are perfect for each other, have left their old manor-house, with the youth who is said to be the son of

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