XXXI.—*On a true Carboniferous Nummulite.*

By Henry B. Brady, F.L.S., F.G.S.

[Plate XII.]

There are few time-marks in the geological record that have been regarded as better established or more definite than the first appearance of the Nummulite at or near the commencement of the Tertiary epoch; and any indications of an earlier history which would throw back the origin of this well-known genus to a Mesozoic or Palæozoic age can hardly be without interest to the student of those genealogical problems, the bases of which are found in the revelations of palæontology.

Dr. Carpenter, in his 'Introduction to the Study of the Foraminifera' (p. 276), says, "there is no fact in palæontology more striking than the sudden and enormous development of the Nummulitic type in the early part of the Tertiary period and its almost equally sudden diminution, bordering on complete extinction. The precise position of the immense beds of 'Nummulitic limestone,' the vast geographical extent of which has been already sketched, has been a subject of much discussion; but the researches of M. d'Archiac, Sir R. Murchison, Sir Charles Lyell, and others leave no further doubt that these beds belong to the earlier part of the Tertiary period, and that they correspond in position with the 'Calcaire Grossier' of the Paris basin, and with the 'Bracklesham' and 'Bagshot' beds of the London and Hampshire basins, in which deposits alone are Nummulites found in the British Islands. Although Nummulites have been described as existing at periods anterior to this, it seems probable that such descriptions have been founded on the occurrence of other helicoid Foraminifera bearing an incomplete resemblance to them."

The late Professor von Reuss, in his 'Entwurf einer systematischen Zusammenstellung der Foraminiferen'*, is scarcely less emphatic. He gives the distribution of the genus *Nummulites* as follows:—"Fossil (Tertiary, especially Eocene). *N. anti-*

* Sitzungsb. k. k. Akad. Wissen. Wien (1861), vol. xliv. p. 391.

It is not the object of the present paper to demonstrate the continuance of the genus through the later Tertiary to recent times; but, lest I should be supposed to agree with the latter part of this quotation, I may just state that, as far back as 1803, Fichtel and Moll figured two recent Nummulites from the Red Sea, under the names of *Nautilus radiatus* and *N. venosus* (Test. Micr. p. 59, pl. 8); and Messrs. Parker and Jones, in their essay on Fichtel and Moll's contributions to the Nomenclature of the Foraminifera, published a year or more before the above passage from Von Reuss, not only set this fact in a clear light, but instanced specimens in their collection of true recent *Nummulinæ* from Davis's Straits and from the Australian coral-reefs. I can only add that my own cabinet presents confirmatory evidence in abundance.

quior, Rouillier, from the Carboniferous limestone of Miatschkovo (*Orobias antiquior*, d'Eichwald), would form a remarkable exception if its complete agreement with *Nummulites* should be confirmed. I have not hitherto discerned any important distinction. The often-quoted living forms belong in part to *Amphistegina*, in part to *Operculina*."

Professor Seguenza, in a table of the geological range of the various genera of fossil Foramininifera* published almost simultaneously with the two works already quoted, gives with even greater decision the Eocene as the age of the appearance, the Miocene as that of the extinction of the true Nummulite.

It would be easy to add quotations of exactly similar import from the works of other palæontologists; but it is scarcely worth while to cite individual authorities for what, by its general acceptance, had come to be looked upon almost in the light of a geological dogma.

Gümbel's Researches.—Doubts as to the entire accuracy of this view have been raised from time to time, but they have not, until quite recently, been based on evidence sufficiently circumstantial to obtain much credence. Two years ago, however, Dr. C. W. Gümbel of Munich, in the preface to his memoir on certain "Jurassic precursors of the genera *Nummulites* and *Orbitulites*"†, reviewed the whole question of the existence of prætertiary Nummulites as it then appeared to stand. In his analysis the various published notices of Nummulites supposed to be of earlier geological age than the beginning of the Tertiary epoch are recounted, the circumstances on which they are founded criticised, and in some instances the results of a reexamination of the original specimens detailed. I propose to summarize the conclusions arrived at by Dr. Gümbel on this head, rather than venture upon an independent commentary, for which I should have but insufficient data.

Turning first to the Russian Carboniferous specimens already alluded to, Dr. Gümbel accepts Prof. Reuss's estimate of Rouillier's *Nummulina antiquior*‡—that is, that it may be a Nummulite, but that there is no sufficient evidence to prove the fact.

D'Eichwald's adoption of Rouillier's species, and his de-

* Foram. Monotal. di Messina, parte seconda (1862), p. 25.

† "Ueber zwei jurassische Vorläufer des Foraminiferen-Geschlechtes Nummulina und Orbitulites," von Herrn Oberbergrath Dr. C. W. Gümbel. Neues Jahrbuch für Min., Jahrg. 1872, p. 241, pls. 7 & 8.

‡ Rouillier and Vosinsky, "Études progressive sur la Géologie de Moscou," Quatrième Étude. Bulletin Soc. Imp. des Naturalistes de Moscou, 1849, vol. xxii. p. 337.

scription of an allied symmetrical form*, the two being placed together as representatives of a new genus "*Orobias*" (*O. antiquior* and *O. æqualis*), is dismissed in the same way as affording no evidence of value, owing to the absence of any details of microscopical structure. Indeed D'Eichwald's separation of these two forms from the genus *Nummulina* is grounded on the non-tubulation of the shell and the lack of any indication of a canal-system in the specimens he had examined.

Buvignier† described and figured an Upper Jurassic Nummulite (*N. Humbertina*) from the Astarte-marl containing *Exogyra virgula*; but here, again, Dr. Gümbel regards the representation as insufficient to set its Nummuline affinity beyond dispute, though lending probability to the assumption.

More recently Fraas‡ obtained from the Cretaceous formation of Palestine certain fossils which he assigned to the genus *Nummulina*, describing them under three specific heads. With regard to the first of them, *N. variolaria*, var. *prima*, Dr. Gümbel supposes that the traveller has mistaken the age of the bed from which it was derived, but does not give any very clear ground for this conclusion. The *N. cretacea*, Fraas, after careful examination of the specimens, is assigned to the genus *Alveolina*; and, lastly, *N. arbiensis*, Conrad, though certainly a *Nummulina*, differs so little from *N. biarritzensis* and *N. variolaria* that it is set down as probably of Tertiary age.

Nummulina jurassica.—The author then proceeds to demonstrate the existence of the Nummulite in strata of the Jurassic period, and describes, under the name *N. jurassica*, certain minute fossils collected by the Geological Surveyors in Franconia. The precise horizon at which the specimens were found was a sponge-bed of the *Ammonites-tenuilobatus* zone § and a portion of the *A.-dentatus* zone; the locality, Schaflohe near Amberg. The specimens are stated to be

* Lethæa Rossica, par Edouard d'Eichwald (1855–1861), vol. i. p. 352, pl. 22. fig. 16.

† Stat. Géologie d. Dép. de la Meuse, 1852, p. 338; Atlas, p. 47, pl. 30. figs. 32–35.

‡ Geol. Beobacht. am Nil, auf der Sinai-Halbinsel u. in Syrien, 1867, S. 82–84, Taf. 1. fig. 8.

§ The "zone of *Ammonites tenuilobatus*" is one of Oppel's original divisions of the Jurassic strata, and is well marked in the south of the Grand-duchy of Baden. My friend G. A. Lebour, F.R.G.S., of the Geological Survey, sends me the following note, extracted from Dr. Waagen's 'Essai d'une Classification générale du Jura supérieur' (Munich, 1865):—"The zone of *Amm. tenuilobatus* and *Rhynchonella inconstans* is equivalent to the 'Lower Kimmeridge Clay' of England, the 'Corallien' of La Rochelle, the 'Astartien' of Switzerland, and the 'Scyphia Limestone' of Swabia and Franconia."

regular, lenticular, convex bodies 5 to 7 millimetres ($\frac{1}{5}$ to $\frac{1}{4}$ inch) in diameter and 1 to $1\frac{1}{4}$ millim. ($\frac{1}{25}$ to $\frac{1}{20}$ inch) in thickness, margin obtusely rounded rather than sharp, surface polished and without visible perforations; some specimens not quite flat, but twisted. A section parallel to the surface shows six or seven rather broad convolutions, each consisting of numerous segments, the primordial chamber being large, and the spiral widest near the centre. The tubulation of the shell is most distinct at its thickest part.

Another Nummuline fossil of Upper Jurassic age, from Mösskirch in Baden, is partially described in the same paper. This is stated to be similar in size to the foregoing, but distinguished from it by its numerous convolutions of *equal* size and its much larger primordial chamber. The specimens, which are in the Baden Geological Collection, appear to be too imperfect to admit of more accurate description.

Summary.—Accepting Dr. Gümbel's facts and, in the main, his analysis of the labours of previous authors, the scattered record of evidence as to the appearance of the Nummulite at periods anterior to the commencement of the Tertiary epoch may be summed up, in a few words, as follows:—

So far as relates to the Cretaceous system, some of the reported specimens are not Nummulites at all, and there is reason to doubt the geological origin of those which are*.

With respect to the Jurassic epoch, Buvignier probably, and Dr. Gümbel certainly, have obtained veritable members of the genus from undoubted Oolitic beds.

Lastly, although the researches of Rouillier and D'Eichwald on the fossils of the white limestones of Russia indicate a a possibility of the existence of the Nummulite in rocks of Carboniferous age, their figures and descriptions are such as no subsequent author has been able to accept as definite or entirely reliable evidence on the subject.

NUMMULINA PRISTINA, nov. sp.

Introductory.—At the British Association Meeting in

* Prof. Zeuschner (Verhandl. Russ.-kaiserl. min. Gesellschaft, St. Petersburg, Jahrg. 1847, p. 105) mentions the occurrence of Nummulites in large numbers in a dolomite of Neocomian age immediately overlying Liassic beds in the Carpathian Mountains. The paper is mainly geological, and the fossils are not minutely described; but the Nummuline character of the organisms in question is apparently sanctioned and approved by Von Keyserling in a short paper at p. 17 of the same volume. Reference to the notices of Lower Cretaceous Nummulites would be incomplete without some allusion to Zeuschner's memoir, although the evidence it affords may not be deemed conclusive; and it may have been omitted by Dr. Gümbel on this account.

September last I described a minute fossil, *Archædiscus Karreri*, the chief interest of which lay in two facts:—first, that whilst strikingly Nummuline in its essential features, it presented a wide divergence in some not unimportant points of structure from the typical Nummulite; and, secondly, that a fossil with such generic affinities occurred low down in the Carboniferous series at localities far apart. The description of *Archædiscus* had scarcely appeared * when I received from my friend M. Ernest Vanden Broeck, of Brussels, a couple of packets of calcareous material, which had been forwarded with the idea that it might be of service to me in investigating the Foraminifera of the Carboniferous period.

The total number of Foraminifera which accrued from a patient search through the contents of the two packets was exceedingly small. Not more, perhaps, than three species were represented. One of them is a familiar Carboniferous form; and another, of which only a single specimen was found, may turn out to be new. Neither of these need be noticed at present, as my object is with the third, which even cursory examination showed to be a true and most characteristic little Nummulite. Happily in the present instance no doubt need exist as to geological origin; for both locality and horizon are very accurately stated by M. Vanden Broeck; and though I hope at a future time, when I may have a larger supply of specimens to work upon, to be able to elucidate further some minor details of structure, the material at hand has been sufficient to serve for the demonstration of all essential characters.

Zoological Characters and Structure.—Externally these little fossils are convex disks; the larger specimens are about $\frac{1}{30}$ inch in diameter and $\frac{1}{70}$ inch thick; the periphery is usually blunt and rounded rather than acute. They are bilaterally symmetrical or nearly so, white and smooth as to surface, the uniformity being broken only by radial lines more transparent in texture than the rest of the shell. A section on the median plane reveals a spiral of three or four convolutions, the whorls being nearly equal in width or only increasing slightly towards the periphery, a primordial chamber relatively rather large, the ordinary chambers few in number for a Nummulite, and bounded by curved septa.

The characters thus broadly stated may now be examined in detail.

With respect to the exterior but little more need be said. The relation between the diameter and thickness is apparently tolerably constant—that is, about as $2\frac{1}{4}$ to 1; larger examples, however, exhibit some tendency to spread out and grow thinner

* *Vide* Ann. & Mag. Nat. Hist. October 1873, p. 286.

at the periphery. When the surface of the test is not worn, the radiation is either very indistinct or appears in the form of curved lines of somewhat darker colour, but without sensible limbation; but in weathered specimens not only are the lines more or less elevated, but the centre from which they proceed is thickened and the test becomes to some extent umbonate also.

An accidentally split specimen (Pl. XII. fig. 4) will serve the purpose of a horizontal section. It consists of three convolutions, the outermost having sixteen chambers, and the second twelve or thirteen. Another, somewhat larger individual has precisely similar septation; so that, without assigning any great importance to it, the drawing may be assumed to represent a specimen with about the normal number of chambers for the adult condition.

The primordial chamber has been measured in three examples, and the diameter found to be ·004, ·003, and ·0027 of an inch, being respectively from $\frac{1}{7}$ to $\frac{1}{10}$ of the entire diameter of the test.

The minute tubulation of the shell is perfectly preserved, and may be easily seen in the transverse section under a magnifying-power of 100 diameters, as in Pl. XII. fig. 3.

The canal-system of the septa and marginal cord may be traced here and there, though only imperfectly. The transverse section (fig. 3) gives distinct evidence of the existence of the marginal cord; but the details of the structure are obliterated; and in the more highly magnified drawing (fig. 5) indications are not wanting of canals traversing the septa as well as the supplementary skeleton.

Such is a detailed account, as far as can be furnished from the materials available, of the finer specimens of this Carboniferous Nummulite; and in the absence of larger individuals or of fragments indicating their existence, they may fairly be supposed to be adults and fully developed examples of the species. But, in addition to these, a number of smaller individuals have been found apparently belonging to the same form, though neither so uniform in external appearance nor so unmistakably nummuline in character. One or two are somewhat explanate in their mode of growth, and if mature may pertain to an "Assiline" variety. Others, smaller still, not much more than a hundredth of an inch in diameter, are unsymmetrical, the convexity of the two faces being unequal and irregular. They probably represent either one of the early stages of the organism or perhaps an arrested condition of growth. Their precise relation to the fully developed form must be left for future determination, in the lack of sufficient specimens to work the question fully out.

Affinities.—The *Nummulina antiquior* of Rouillier and Vosinsky, judging from the figures accompanying their memoir, is essentially unsymmetrical. Not only are the two faces very unequal in their convexity, but there seems also a tendency to irregularity in the contour of the periphery. The *Orobias æqualis* of D'Eichwald much more nearly resembles the specimens before us in external characters. Its separation by the author from the genus *Nummulina*, on the ground of the minute structure of the shell (resting, as it apparently does, on negative data), need not be insisted upon. The absence of evidence of tubulation or canals may be dependent upon the process of mineralization; and their detection in fossils so minute, taken from a compact calcareous rock of such an age, must always be attended with difficulty. Nevertheless some doubt must rest upon this species until further specimens from the same locality, or at least from a similar horizon, have been minutely examined; and as it differs materially in size* and septation from the organism just described, it appears undesirable to associate them under the same specific name. I propose therefore for the Belgian specimens the name *Nummulina pristina.*

Referring to D'Archiac and Haime's monograph †, the figures most closely resembling the new *N. pristina* are those of *N. variolaria*, Sowerby, which represent a Nummulite of somewhat larger dimensions but remarkably similar in general external characters and septation. Thus the nearest allies, zoologically speaking, of the Carboniferous form are the small thick members of the "radiate" group regarded by Messrs. Parker and Jones as the western modifications of *N. planulata* ‡. *N. variolaria* especially is a poor and variable form whose descent may be easily traced.

It is not a little singular that in the Carboniferous precursor of the Nummulitic group we should have an organism so exactly corresponding in minutest features with its most modern representatives. This cannot be a mere coincidence. Is it not rather a curious exemplification of persistence of essential characters through innumerable ages, whilst modifications of the original, forming collateral "species," have, under favourable circumstances, exhibited an extraordinary development in size and complexity of structure and a corresponding increase in geological importance? Then, as external conditions have become less favourable, little by little,

* The diameter, as given by D'Eichwald, is five times as great as the largest of the Belgian specimens.

† Descr. des Anim. foss. du groupe Nummulitique de l'Inde, p. 146, pl. ix. fig. 13, *a–g*.

‡ See Messrs. Parker and Jones on the nomenclature of the genus, Ann. & Mag. Nat. Hist. 3 ser. vol. viii. p. 231.

the type has reverted to its primitive state, gradually dwindling in size, and losing by degrees those minor characters which were the easily recognized evidence of higher organization, and in its later history suggesting the lingering stages which precede complete extinction.

It has been already stated that one of the Nummulites described by Fraas from the Cretaceous beds of Palestine is named *N. variolaria*, var. *prima*, and that Dr. Gümbel's objection to its being accepted as a Cretaceous representative of the genus appears to be grounded solely on its supposed zoological affinity. The discovery of a form so similar, in rocks of a still earlier period, appears to render such an objection untenable unless otherwise supported.

Locality and Geological Position.—The locality whence the material containing the specimens above described was obtained is a Carboniferous-Limestone quarry near Namur—"*la Carrière du Fond d'Arquet*"—the exact geological relations of which will be best understood by a brief abstract of particulars, furnished to me by M. Vanden Broeck.

The Carboniferous Limestone of Belgium is divided by M. Dupont into six sets of beds, which have been named from the localities in which they are respectively best developed. They are as follows, beginning at the lowest:—*des Ecaussines*, *de Dinant*, *d'Anseremme*, *de Vaulsor*, *de Namur*, and *de Visé*. The section at the Carrière du Fond d'Arquet belongs to the top but one of these divisions, which is described as a black dolomitic limestone with large *Euomphali*—black and compact at the base, and dolomitic in the upper portion, the characteristic fossils being *Euomphalus æqualis* and *E. acutus*. The material collected was from three distinct bands of marly calcareous shale near the base of the section. Two out of the three contained examples of the Nummulite, though the number of specimens was exceedingly small in proportion to the quantity of material, and, owing to the nature of the matrix, almost all of them were more or less broken.

It may be well to mention that a single Nummulite of the same species has been found in a packet of greyish limestone débris from Flémalle near Liége, which, geologically, pertains to the uppermost of the divisions above quoted—that of "Visé;" but until further specimens have been obtained from the same horizon, this second locality must be regarded as requiring confirmation.

It only remains for me to express my grateful acknowledgments to M. Ernest Vanden Broeck of Brussels, to whom I am indebted for the material in which this interesting little Nummulite has been found. To the pains he has taken to verify every particular as to the exact position of the beds in

which it occurs, sparing no labour to ensure complete accuracy, the reliability of the geological portion of the present paper is entirely due.

To the kindly criticism of my friend and colleague Professor T. Rupert Jones, F.R.S., during the course of my work, I owe a good deal; and it is no small thing that in the results, as detailed in the foregoing pages, I have the entire concurrence of one who has contributed so much to place the classification and nomenclature of the genus *Nummulina* on an intelligible basis.

EXPLANATION OF PLATE XII.

Fig. 1 represents the lateral aspect, *fig.* 2 the periphero-lateral aspect of *Nummulina pristina*, magnified 50 diameters. Except a very trifling portion of the last convolution (which is broken away), this specimen is quite perfect.

Fig. 3 is a very accurate drawing of a transverse section, almost entire, magnified 100 diameters. It shows the somewhat large primordial chamber, the investing character of the alar lobes of the chambers of the spire, and the lamination of the test arising therefrom. The general tubulation of the shell is well seen; and at the lower end of the drawing indications of the marginal cord may be distinctly traced, though wanting in definition.

Fig. 4 is from a specimen accidentally split at the median plane, magnified 50 diameters; one of several, more or less perfect, found in this condition. The tendency to split horizontally at the median line is of itself a Nummuline peculiarity of some significance.

Fig. 5 shows a small portion of a horizontal section, much more highly magnified (200 diameters), the object being to demonstrate the existence of a canal-system in the septa and peripheral region. More difficulty has been experienced in obtaining good horizontal sections than transverse; this, however, has been sufficient to yield to Mr. Hollick (who has drawn direct from the object) very characteristic details of structure at one point in the peripheral convolution.

XXXII.—*Notice of some new Species of Fishes from Morocco.* By Dr. ALBERT GÜNTHER, F.R.S., Foreign Member of the Senckenberg Society of Frankfort.

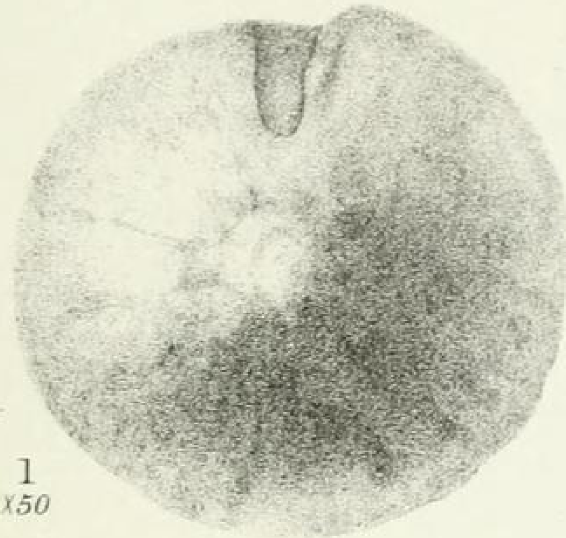
[Plates XIII. & XIV.]

A SMALL collection of marine and freshwater fishes, made by Dr. Rein and Dr. C. von Fritsch during their journey in Morocco, was placed by the former gentleman in my hands for examination. It contained four new species, which may be characterized as follows:—

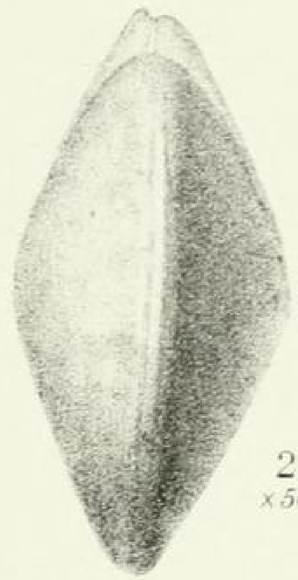
Serranus atricauda.

D. $\frac{10}{15}$. A. $\frac{3}{8}$. L. lat. 115.

I am unable to identify a specimen from Mogador with any

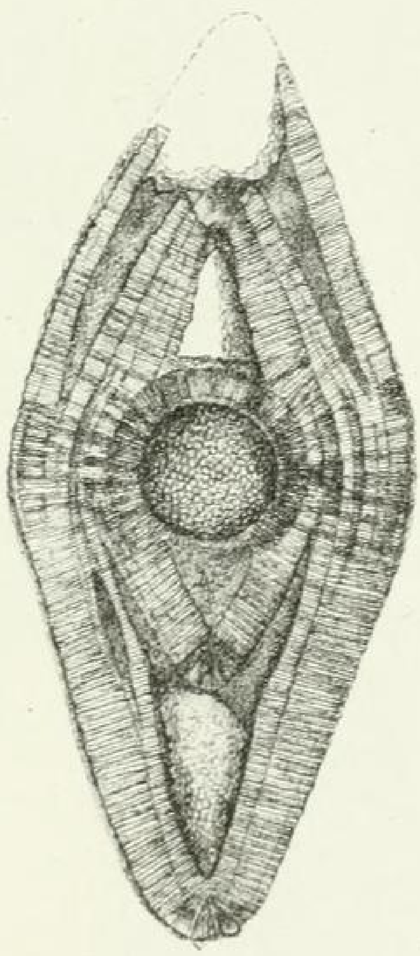


1
×50



2
×50

3
×100



4
×50

5
×200

A.T. Hollick ad nat. del et lith.

Mintern Bros. imp.

Nummulina pristina