

there is usually no black at all at the base of these feathers, the outer tail-feather being entirely white. In some examples, however, there is a little black at the base of this outer tail-feather; and hence I can only look upon the Bornean bird as a race of the Indian one. It has been named *C. suavis* by Dr. Sclater.

Now the name *Turdus macrurus* of Gmelin (S. N. i. p. 820) is founded on the "Long-tailed Thrush" of Latham (Gen. Syn. ii. part i. p. 72, pl. xxxix.), which is said to have come from the Island of Pulo-Condore, off the coast of Siam. The species from this island will doubtless prove to be the same as the Siamese and Burmese birds; but, as figured and described by Latham, it agrees with *C. suavis* of Borneo. If, therefore, it turns out to be specifically identical with the latter, the name of *macrura* must take precedence of Dr. Sclater's name *suavis*. At all events, in the face of the uncertainty that exists it seems better to speak of the ordinary Indian bird as *Cittocincla tricolor* (Vieill.), founded on Levaillant's plate cxviii. in the 'Oiseaux d'Afrique,' where a very fair figure of the species is given; and considering that there is a bird in existence which has a white outer tail-feather, as figured by Latham, his "Long-tailed Thrush" ought not to be referred, in any case, to the common Shámá of India and Burmah.

IX.—Notes on the Trochamminæ of the Lower Malm of the Canton Aargau (Switzerland). By Dr. RUDOLF HAEUSLER, F.G.S. &c.

[Plates III. & IV.]

THE zone of *Ammonites transversarius* (= Birmenstorfer Schichten = Étage Argovien I.) is represented in the Jura of the Canton Aargau by alternating layers of greyish more or less compact limestones and softer marls of the same colour, which overlie the ferruginous marls of the Upper Dogger (Callovian), and are covered by the clayey marls of the Middle Argovian étage (zone of *Terebratula impressa*). Their lithological character is nearly the same throughout the canton; but their fauna and flora change considerably towards the upper limit; and though it is quite impossible to subdivide this complex of strata into distinct subzones, yet, chiefly for microscopical researches, it is convenient to adopt three different horizons, which in the course of this paper I shall call A, B, C.

A comprises the oldest sediments of the zone, covering the *Ornatus*-beds of the Callovian, with predominant limestones and a richly developed fauna of Cephalopoda.

B, the beds with lithologically analogous character, and numerous Brachiopoda and Crinoidea.

C comprises the youngest marly beds with *Nulliporites* and few animal remains.

According to these artificial subdivisions the microscopical fauna is different: the arenaceous Foraminifera, chiefly the *Trochamminæ*, reach their maximum development in the lowest beds A, where they are associated with *Lituola* (*Haplophragmium*, *Haplostiche*, *Placopsilina*), *Endothyra*, *Plecanium*, and other arenaceous and hyaline species (*Nodosaria*, *Dentalina*, *Cristellaria*, &c.). In many cases the unfavourable condition of the minute shells, caused through pseudomorphoses, incrustation with iron-pyrites, or atmospheric influences, makes the determination of the species impossible.

The Foraminifera mentioned in this paper were obtained from materials collected during a twelve-years' stay in the Canton Aargau, from all the different localities where the zone is exposed, but principally from the following:—Staffelegg (near Aarau), Densbüren, Auenstein, Kreisacker, Büren, Hottwyl, Hornussen, Bözen, Mandach, Villigen, Birmenstorf, Schambelen, &c.

The oldest known arenaceous Foraminifera of the Swiss Jurassic formation are some rare placopsiline *Lituolæ* attached to the shells of *Gryphæa*, *Pecten*, and *Ammonites* of the Lower Sinemurian beds, where they occur with numerous varieties of *Nodosaria*, *Dentalina*, *Marginulina*, *Cristellaria*, &c.

Trochammina appears for the first time in the Bajocian, and ranges from here through the whole Upper Dogger, but only in two species (*T. incerta* and *T. filum*). With the Lower Malm the arenaceous and some other Foraminifera become more abundant, so that these beds have yielded up to the present time almost as many species and varieties as the rest of the Swiss Jurassic formation together.

In these sediments all the principal types of the genus *Trochammina* are well represented; most of them disappear suddenly towards the Middle Sequanian beds. Some of them are only known from the beds A of the *transversarius*-zone; *T. incerta* and *T. gordialis* are occasionally met with in the beds C and the zone of *Terebratula impressa*. The Upper Argovian limestones, with a more littoral fauna of numerous *Myæ* (*Pholadomya*, *Goniomya*, &c.), contain several of the *Trochamminæ* of the Lower Argovian (*T. incerta*, *T. gordialis*,

T. flum, *T. jurassica*), which mount into the beds of the Lower Sequanian (zone of *Am. bimammatus* and *Hemicidaris crenularis*), where chiefly one small layer with numerous spines of *Rhabdocidaris caprimontana* is noticeable for the small but well-preserved microscopic shells.

It is very probable that these compact limestone sediments, formed under somewhat similar conditions as those of the lower Birmenstorf Schichten (chiefly the beds crowded with Hexactinellid sponges), may contain all the species of the latter, which, owing to the difficulty of collecting them, have not yet been found. The higher beds of the Malm have not yet been carefully examined; but from the few microscopic specimens from the Middle and Upper Sequanian and the Kimmeridge group, it seems that *T. incerta* and *T. gordialis* are the only representatives of the genus. These were also found in the Sequanian of Olten, Solothurn, and Ste. Ursanne, and in the Kimmeridge beds of the neighbourhood of Pruntrut.

The few pieces of Alpine Upper Jurassic rocks which I examined, and which offer the least favourable condition for microscopical researches, did not yield any traces of Foraminifera.

Trochammina incerta, O.

This species is, as a rule, not common in the Swiss Jurassic formation; but it is the most remarkable from its wide geographical and geological distribution. It is present in every étage from the Bajocian up to the Kimmeridgian. It always presents very much the same appearance and the same typical varieties, not considering alterations of the shell through atmospheric action; while probably all the other species of *Trochammina* differ considerably when found in beds with entirely different constituents and organic remains.

According to the composition of the shell and the mode of growth, this species can be divided into two distinct varieties.

In the one, which, for convenience, we may call *Tr. incerta* reg., the test is thin, more or less transparent, built up of a generally siliceous cement and a minimum quantity of foreign sandy matter.

In the second (*T. incerta* irreg.) the test is thicker, not transparent, and built up of numerous small particles of quartz-sand imbedded in a whitish or ferruginous cement.

T. incerta reg. comprises almost invariably the more regularly convoluted larger specimens, with from six to eight convolutions lying in one plane, similar to *Spirillina arenacea*, Will.*; *T. incerta* irreg. the smaller irregular forms with few

* Williamson, Rec. Foram. Brit. p. 93, pl. vii. fig. 203.

convolutions (four or five) passing into the conical and *Quinqueloculina*-like species and *T. filum*.

Both varieties run into each other through numerous intermediate forms with regard to the mode of growth and the composition of the shell. The division is therefore entirely artificial, but so far quite justifiable as it prevents us from uniting the most heterogeneous forms under one name, and from making thus a clear description quite impossible.

T. incerta irreg. may be divided into several subvarieties, as the forms resembling *T. incerta* reg., or those differing from *T. gordialis* merely by the discoidal obvolution of the tube, corresponding to *Cornuspira variabilis*, K. & Z., or as those identical with *C. crassa*, K. & Z. It is, however, impossible to draw lines of separation—the more so as hardly two specimens are alike, the great number of these one-chambered *Trochamminæ* forming an unbroken chain of nearly-related individuals, passing from *T. incerta* typ. into the conical and even polythalamous species. As a rule, it may be said that the more the shell differs in its external appearance from the typical *T. incerta* reg. of this zone, the greater becomes the mass of sandy constituents compared with that of the siliceous or calcareous cement. Most of the specimens of this species answer the description of *Orbis*, *Involutina*, and *Ammodiscus* given by Strickland, Terquem, Reuss, and Bornemann; but many of the conical specimens consisting of a similarly built-up test, and the compact limestones of the Upper Argovian étage containing undoubtedly shells with calcareous cement, all these and some similar forms known as *Spirillina*, *Operculina*, *Cornuspira*, must be united to the genus *Trochammina*, as, indeed, was done long ago by English geologists.

A. *Trochammina incerta* reg.* (Pl. III. figs. 1–4.)

Test free, regularly convoluted or partly involuted, discoidal, formed of a simple non-constricted imperforate tube, regularly increasing in width.

Convolution six to eight in one plane, sometimes embracing; aperture large, at the non-constricted end of the tube; test thin, transparent, built up of almost hyaline siliceous shell-matter and a few very minute grains of sand. Surface smooth, sometimes brilliant, and with small more or less regularly distributed depressions, which, when examined with a low power, take the appearance of perforations, and give the shell a resemblance to *Spirillina*.

* The descriptions given only refer to the Foraminifera of the *transversarius*-zone of the Aargau, if not stated otherwise.

The rounded impressions on the outer surface, which are only present in the almost homogeneous glass-like specimens, are not visible in transmitted light when the object is mounted in balsam. On the contrary, the sandy grains (which when the shells are viewed as opaque seem to be absent) become thus plainly visible with the aid of a high power and the polariscope.

In none of the sections from the Upper Argovian limestones of the Geissberg, where the cement is calcareous, are any traces of this peculiar condition of the surface visible.

When found in material much changed through the action of atmospheric agencies, it becomes difficult to distinguish the shells from *Spirillina* without the use of a high power.

The condition of the siliceous tests differs widely from those changed by pseudomorphoses; so that it is evident that they represent their natural state. It can easily be accounted for by the great amount of silica, as may be judged from the immense accumulations of siliceous sponges in the same beds, whilst these are absent in the beds with calcareous *Trochammina*, although siliceous tubes are also met with in strata with hardly any siliceous substances, except grains of quartz-sand and argillaceous compounds, as some Liassic *Involutina* and the *Trochammina* of the Bathonian limestones of the Frickthal.

As typical specimens of this variety may be considered those resembling in the mode of growth the regularly convoluted recent variety, described as *Spirillina arenacea*, Will., but with a test resembling somewhat in its microscopical structure *Involutina silicea*, Terq.* A similar form was described by Gümbel† from the same zone at Streitberg as *Spirillina tenuissima*, and from the Eickberg by Kübler and Zwingli‡ (also from the Bathonian and Argovian II.). Similar regularly convoluted discoidal forms are known from many other formations; but the composition of the test is generally somewhat different, as in *Cornuspira Hærnesi*, Karrer§, from the Vienna basin, in *Serpula Ræssleri* Schmid||, from the German Zechstein, and in *T. incerta* from the English Permian rocks¶.

* Terquem, Second Mém. For. Lias, p. 450, pl. vi. fig. 11.

† Gümbel, Die Streitberger Schwammlager &c. p. 214, pl. iv. fig. 12.

‡ Kübler & Zwingli, Die Foraminiferen des Schweizer Jura, p. 19, pl. iii. fig. 2.

§ Karrer, "Ueber das Auftreten &c." (Sitzungsb. k. Akad. Wiss. Wien, vol. lii. p. 495, pl. i. fig. 10).

|| Schmid, Neues Jahrb. Min. 1867, p. 582, pl. vi. figs. 46, 47.

¶ Jones, Parker, & Kirkby, Ann. & Mag. Nat. Hist. ser. 4, vol. iv. p. 388, pl. xiii. fig. 1.

The same regular form is figured in Carpenter's Introd. Foram. (pl. x. fig. 2). Although the Carboniferous specimens are generally less regular, Brady * mentions a discoidal variety, the test of which, however, is much more sandy and calcareous than in those from the Lower Malm.

The usual diameter of the Argovian specimens is 0.35 millim.

Kübler and Zwingli† describe a constant elliptical variety (*Cornuspira elliptica*) from the Lower Bathonian, and a similar compressed variety‡ from the Lower Argovian (*C. concava*), and Karrer a corresponding form from the Vienna basin§.

In the beds A of the Frickthal I found several specimens with a somewhat similar mode of growth; but the first part of the shell is discoidal, as in the normally developed variety; the elliptical arrangement begins only with the third or fourth convolution. The microscopical structure is the same as in the typical *T. incerta* reg., as well as the total length and diameter of the tube (Pl. III. figs. 6, 7). In one specimen, length = 0.42 millim., diameter of tube (last convolution) = 0.04 millim., number of convolutions 6-7.

In another specimen the oldest part of the shell is elliptical and becomes gradually discoidal.

These deformed shells pass possibly into *T. pusilla*. Often the youngest part of the last convolution becomes embracing and leaves the plane, as in Pl. III. figs. 4, 5.

Distribution. In the beds A, B, and C of the Aargau, but also of the Cantons Schaffhausen and Solothurn, and the upper zones of the Malm (Argovian II. and III., Sequanian I., &c.). Not common.

B. *Trochammina incerta* irreg.

Test free, irregularly convoluted, composed of a non-septate cylindrical tube of almost invariable diameter. Convolution few, in one plane; aperture small circular, or large crescentic.

Test finely arenaceous, built up of numerous minute grains of quartz-sand, imbedded in a whitish or sometimes ferruginous cement.

This variety comprises a great number of forms, passing from *T. incerta* reg. to *T. gordialis* and *T. filum*. From the first they differ chiefly in their thick, more arenaceous, opaque or but slightly transparent test, and the small number of

* Brady, Monogr. Carb. & Perm. Foram. p. 71, pl. ii. fig. 13.

† Kübler & Zwingli, *l. c.* p. 17, pl. ii. fig. 3.

‡ *Loc. cit.* p. 24, pl. iii. fig. 3.

§ Karrer, *l. c.* p. 494, pl. i. fig. 10.

irregularly arranged convolutions, and in being almost invariably filled up with a black ferruginous compound, which is often found also in *T. gordialis* (Pl. III. fig. 18), while the shells of *T. incerta* reg., in spite of the wider aperture, are, as a rule, empty. The presence of this substance seems to be characteristic, as specimens from the Randen (Canton Schaffhausen), and even from older formations, contain it. It is perhaps due to a different chemical composition of the sarcode.

In a few instances the convolutions are partly embracing; but in others they hardly touch each other. According to the different mode of growth, the aperture is rounded, sometimes margined or crescentic. Forms resembling those figured pl. ii. figs. 10–14 in Brady's monograph of Carboniferous and Permian Foraminifera may be considered typical.

Distribution. In the lower and middle beds of the *transversarius*-zone with *T. incerta* reg., but also in the upper strata of the Argovian and in the Sequanian.

Trochammina gordialis, J. & P.*
(Pls. III. & IV. figs. 8–20.)

This species comprises a large number of different forms, consisting of a free, irregularly convoluted test, forming in its earlier stage a regular elevated conical spiral, to which the younger part, chiefly the last convolution, is attached in various manners. Width of the tube almost invariable; convolutions few, occasionally partly embracing; aperture large, sometimes margined, in other cases small, at the constricted end of the chamber.

Shell composed of numerous minute grains of sand imbedded in a colourless or brownish cement.

Specimens with septate tubes, as described by Jones and Parker, from the Indian and Arctic seas, appear to be wanting in the Upper Jurassic formation. As a rule this variety differs little from the *T. gordialis* of other formations; for instance, the *T. proteus*, Karrer†, fig. 3, from the Vienna basin, or those from the Permian‡.

Kübler and Zwingli§ describe as *Cornuspira variabilis* specimens from the Argovian II. (zone of *Terebratula impressa*),

* Jones & Parker, Quart. Journ. Geol. Soc. vol. xvi. p. 304; Carpenter, Introd. Foram. p. 141, pl. xi. fig. 4.

† Karrer, "Ueber das Auftreten &c.," Sitzungsber. k. Akad. Wien, vol. lii. p. 494, fig. 4.

‡ Jones, Parker, & Kirkby, Ann. & Mag. Nat. Hist. ser. 4, vol. iv. p. 390, pl. xiii.

§ Kübler & Zwingli, *l. c.* p. 33, pl. iv. fig. 4.

which may be considered passage forms from *T. incerta* to the typical *T. gordialis* *.

Analogous specimens to those figured by Brady † are occasionally met with.

Similar specimens to *Trochammina proteus* (fig. 8) ‡, with a regularly divided tube, which, according to Jones, Parker, and Kirkby §, are varieties of *T. gordialis*, occur also in the lower beds A of the Aargau.

Distribution. Almost everywhere with *T. incerta*, but chiefly in the beds A and B of Büren, Mönthal, Bözen (where, in the lowest banks cut by the road to the station, they are more common than anywhere else), and Hottwyl; also in the limestones of the Upper Argovian of the Kammerfels (Geissberg) and Remigen, and of the Sequanian I. of Lanffohr and Auenstein. Several specimens I obtained also from the same zones of the neighbourhood of Olten and Solothurn, &c.

Trochammina charoides, J. & P. (Pl. IV. fig. 21.)

The few microscopic shells belonging to this species agree fully with the descriptions given by Parker and Jones ||, Kirkby, Carpenter, Brady, Karrer, &c. ¶, although typical specimens are very rare. They are, as a rule, very small, never exceeding 0.3 millim., composed of a simple tube of invariable diameter coiled up in a conical spiral. Test finely arenaceous, resembling *T. incerta* irreg. and *T. gordialis*, from which they differ but very little.

Distribution. In the lowest beds A of Büren; very rare.

Trochammina pusilla, Gein.** (Pl. IV. figs. 27-30.)

In the beds A of the Frickthal I found several *Trochammina* which show, perhaps, the greatest resemblance to *T. pusilla*.

Shell free, irregularly convoluted, formed of a non-septate

* Jones on Swiss Jurassic Foraminifera, Geol. Mag. vol. x. no. 5, p. 211.

† Brady, *l. c.* p. 77, pl. iii. figs. 1-3.

‡ Karrer, *l. c.* p. 494, pl. i. fig. 8.

§ "Nomenclature of Foraminifera," Ann. & Mag. Nat. Hist. ser. 4, vol. iv. p. 388.

|| Jones & Parker, Quart. Journ. Geol. Soc. vol. xvi. p. 304.

¶ Carpenter, Introd. Foram. p. 141, pl. xi. fig. 3; Karrer, Sitzungsber. Akad. Wiss. Wien, vol. lii. p. 494, pl. i. fig. 4; Parker, Jones, & Brady, Monogr. Foram. Crag, p. 26; Jones, Parker, & Kirkby, Ann. & Mag. Nat. Hist. ser. 4, vol. iv. p. 390; Brady, Monogr. Carb. Perm. Foram. p. 77.

** Geinitz, Verst. deutsch. Zechstein, p. 6, pl. iii. figs. 3-6; Dyas, p. 39, pl. x. figs. 15-21.

cylindrical tube, convoluted nearly in one plane. Convolutions few, partly embracing. Aperture large, sometimes margined, at the non-constricted end of the tube.

Test finely arenaceous, the minute particles of sand imbedded in a colourless or ferruginous cement, which generally hides the older part of the shell or forms a narrow fringe. Diam. 0.2–0.5 millim.

The Swiss specimens approach the nearest to the subdiscoidal variety from the English Permian *, and resemble in the mode of growth of the last convolutions *T. incerta* (figs. 6 and 7).

A specimen with a fringe of shell-matter is also figured from the Carboniferous strata †.

Most of the specimens from the *transversarius*-beds may be considered transitional forms between *T. incerta* and *T. pusilla* typ.‡

Distribution. In the lower beds A overlying the Callovian marls at Bözen and Büren. Very rare.

Trochammmina filum, Schmid.§ (Pl. III. fig. 22.)

In the *varians*-beds of the Bathonian stage, and chiefly in the Lower and Upper Argovian group, there occur simple arenaceous tubes, sometimes partly coiled up, of a somewhat doubtful nature, but which may possibly be assigned to *T. filum*. They consist of a cylindrical, thin, irregularly bent, partly convoluted, often slightly constricted tube, with a large rounded aperture, differing but little from similarly-formed siliceous tubes of different origin, with which they are associated in the sponge-beds of the lower *transversarius*-zone.

Distribution. In the beds A of the Frickthal, the Upper Argovian rocks of the Geissberg, and the Upper Bathonian beds of Birmenstorf. Rare.

Trochammmina constricta, sp. nov. (Pl. IV. figs. 23–26.)

Test free, oblong, formed of a thin, regularly septate, and constricted tube of nearly uniform width. Convolutions few, sometimes slightly embracing, coiled up nearly in one plane. Aperture small, circular or crescentic, at the constricted end of the last chamber.

Shell-structure finely arenaceous, the numerous minute

* Jones, Parker, and Kirkby, Ann. & Mag. Nat. Hist. ser. 4, vol. iv. p. 386, pl. xiii. figs. 2–6.

† Brady, Monogr. Carb. Perm. Foram. pl. iii. fig. 4.

‡ Brady, *loc. cit.* p. 79.

§ Schmid, Neues Jahrb. Min. 1867, p. 582, tab. vi. fig. 48; Jones, Parker, & Kirkby, *loc. cit.* p. 389; Brady, *loc. cit.* p. 81.

grains of sand imbedded in a whitish or ferruginous subtransparent cement.

In the structure of the delicate shell this variety resembles *T. incerta* irreg., sometimes even *T. incerta* reg. The last chamber is sometimes straight.

As this variety is the most constant of all *Trochamminæ* of the zone, and so far found only in the lower *transversarius*-Schichten, it is a characteristic fossil for this division of the Upper Jurassic formation.

Distribution. In the Cephalopod-beds of Büren, Hottwyl, Bözen. Rare.

Trochammina jurassica, sp. nov. (Pl. IV. figs. 31-40.)

Test free, thin, composed of a regularly-constricted tube, with Agathistegian mode of growth. Convolutions few, embracing; sutural lines hardly visible. Aperture small, at the often projected end of the tube.

Test delicate, built up of coarse particles of sand and minute spicules of siliceous sponges imbedded in a constantly ferruginous dark brown cement.

Diameter variable. Length 0.4 millim., breadth 0.25 millim.

Through the coarsely arenaceous texture and the dark rusty cement this species forms an exception from all Jurassic *Trochamminæ*. In its general outlines it is very variable, sometimes compressed, the convolutions lying nearly in one plane, sometimes almost triangular. The last chamber is often straight, and bears the simple rounded aperture.

Its nearest relations are undoubtedly the *Miliola*-like *T. milioloides*, J., P. & Kirkby *, and *T. Robertsoni*, Br. †

In the relative position of the last convolutions the variable shells of *T. jurassica* imitate some *Quinqueloculina*, as *Miliola seminulum*, L., *Q. Chemnitziana*, O., *Q. Buchiana*, O.

True *Miliolæ* are very rare in the beds in which *T. jurassica* is most abundant, except an elongated variety of *Spiroloculina* which occurs in many other horizons, chiefly in the hard limestones with *Rhynchonella varians* of the Bathonian series. It is possibly the same form which Kübler and Zwingli described as *Ophthalmidium birmenstorffense* from the same beds. Near Mönthal I collected casts and fragments of another species of *Spiroloculina* in the same beds with *T. jurassica*.

Rotaline *Trochamminæ* with helicoid septate shells are

* Jones, Parker, & Kirkby, *loc. cit.* p. 390, pl. xiii. figs. 9-14; Brady, *loc. cit.* p. 79, pl. iii. figs. 11-15.

† Brady, *loc. cit.* p. 80, pl. iii. figs. 6, 7.

generally found with the ammodiscoidal forms, but, unfortunately, only in fragments not sufficient to determine the species. Some shells described as *Rotalia* and *Endothyra* may be associated with the polythalamous *Trochammina*. The tests are very variable in general shape, forming more or less elevated conical spirals, composed of numerous regularly-increasing chambers, finely arenaceous, the small particles of quartz or calcareous materials imbedded in a pure white, sometimes siliceous and transparent, but generally calcareous ochreous cement. These fossils belong probably to some already described species (*T. inflata*, *T. squamata*, *T. coronata*, *T. vesiculata*, *T. Reussi*). From the Bathonian rocks, where they appear for the first time in greater number, they range through the Upper Dogger and the Lower and Middle Malm.

Figs. 41 and 42 (Pl. III.) represent an interesting variety uniting the typical *T. constricta* with the regularly convoluted conical types and the polythalamous discoidal *Trochammina*, like a form figured by Karrer from the Vienna basin *.

Comparing the rhizopodal fauna of the Argovian Lower Malm with that of other countries, it surprises one to see that several of the most common Foraminifera of the Aargau have as yet not been discovered anywhere else, while *T. incerta* seems to be present everywhere.

The only species with almost equally wide distribution is a *Textilaria* or *Plecanium*, first described by Gümbel from the Streitberg sponge-beds as *Textilaria jurassica*, varieties of which (known as *T. franconica*, Güm., *T. Triggeri*, Schw., *T. flexa*, K. & Z., *T. helveto-jurassica*, K. & Z., *T. scyphiphila*, Uhl., *T. argoviensis*, Haeus., &c.) are met with in almost every zone of the Malm. The broader varieties unite the lanceolate *T. jurassica* with some from the Cretaceous formation.

Before concluding, a few remarks on the different families of Jurassic Foraminifera may be of interest.

As stated before, the rhizopodal fauna of the Swiss *transversarius*-beds is very rich in species and varieties compared with older zones of Liassic or Middle Jurassic age. Many of the widely-distributed types of *Lagena*, *Nodosaria*, *Dentalina*, and *Cristellaria* can be traced throughout the whole Jurassic series, beginning with the lowest Sinemurian limestones of the valley of the Reuss; while the oldest Liassic beds, the celebrated insect-marls of the Hettangian étage, were extremely poor, and yielded only a few fragments of Cristellarians and spiroloculine *Miliolæ*.

* Loc. cit. pl. i. fig. 8.

With the exception of small serpuloid bodies attached to a valve of *Lima* from the Muschelkalk of the Rhine valley, which are possibly remains of *Webbinæ*, no traces of Foraminifera have been detected in the Trias of the Canton Aargau. In the Sinemurian limestones with *Amm. Bucklandi* and *Gryphæa arcuata*, numerous genera (*Lagena*, *Nodosaria*, *Dentalina*, *Vaginulina*, *Marginulina*, *Cristellaria*, *Frondicularia*) are represented by many, *Cornuspira*, *Textilaria*, *Placopsilina*, and a small *Trochammina* or *Endothyra* by one very rare species.

Throughout the whole Lias this fauna remains almost unchanged, except that *Textilaria* and *Cornuspira* disappear towards the upper strata.

With the Dogger, *Trochammina*, *Valvulina*, *Endothyra*, *Plecanium*, and *Spirillina* appear. *Miliola* reaches its greatest development in the Jurassic formation, and several other genera, as *Lituola*, *Textilaria*, and some types of *Nodosaria*, become more abundant than in the Lias.

At the end of the Callovian period a great change in the general lithological and palæontological character of the sediments takes place, which is particularly remarkable from the sudden appearance of a rich fauna of siliceous sponges.

Here the Foraminifera with sandy or partly sandy shells form the greater part of the microscopic fauna. Only a few of the Liassic types of *Lagena*, *Nodosaria*, *Dentalina*, &c. are still traceable. The Textilarians are the most conspicuous through the great number of closely-allied varieties of the *Sagittula* group. Towards the younger zones several genera (*Frondicularia*, *Globigerina*, &c.) disappear, and others (*Nodosaria*, *Dentalina*, *Vaginulina*, *Marginulina*) become gradually scarcer; but the imperfect knowledge of the upper Sequanian and the Kimmeridgian sediments does not allow of giving a satisfactory list of the Upper Jurassic Rhizopods.

It is interesting to observe several widely distinct macroscopical faunas in the Malm, differently developed according to considerable changes in the nature of the sea-bottom; whilst the Foraminifera seem to have adapted themselves much more easily to the new conditions of life, thus giving birth to many interesting varieties, which, without numerous intermediate forms, it would be absolutely impossible to recognize as mere descendants of the typically-formed species of the Lower Malm.

The greatest impediment to Swiss geologists arises from the want of many of the most important works on Foraminifera, which makes a careful study of the many important microscopical species almost impossible, and which accounts

for the great faults occurring in the few papers on this part of Swiss palæontology.

The results of long researches on the Foraminifera of the Lower Malm shall be published in a short time. For the present I hope that these few remarks on the Jurassic *Trochammina* may be sufficient to furnish further proofs of the wide range and great variability of this interesting genus.

EXPLANATION OF PLATES III. & IV.

Figs. 1-3. *Trochammina incerta* reg.

Figs. 4, 5. *T. incerta* reg., passing into *T. incerta* irreg.

Figs. 6, 7. *T. incerta*, elliptical variety, showing the discoidal arrangement of the older convolutions.

Figs. 8-20. *T. gordialis*.

Fig. 10 a-d. Apertures of same.

Fig. 21. *T. charoides*.

Figs. 22, 22 a, b. *T. filum*.

Figs. 23, 24. *T. constricta*.

Fig. 25. Aperture of same.

Fig. 26. *T. constricta*, coiled up in the opposite manner, showing the last straight chamber with the small circular aperture.

Fig. 27. *T. pusilla*.

Figs. 28, 29. The same, the interior convolution hidden by finely arenaceous shell-matter.

Fig. 30. Ditto, aperture.

Fig. 30 a. Ditto, showing the fringe of hyaline cement.

Figs. 31-34. *T. jurassica*.

Figs. 35, 36. Ditto, with different development of the last chamber.

Figs. 37-39. Ditto.

Fig. 40. Ditto: portion of shell, with grains of sand and spicules. a = crystal of pyrites.

Figs. 41, 42. *Trochammina*, intermediate form between *T. constricta* and the rotaline varieties.

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THIS work, uniform in size and style with the Memoirs of the Palæontographical Society, will comprise a complete history of the British Palæozoic Cephalopoda, a group of Mollusca important to the geologist, which, from their distribution and varied forms, constitute a characteristic portion of the early fauna of the globe. By grants from the Government fund in aid of scientific research, the author has been able to collect materials from various museums



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