The question, however, has lately been again agitated, and a proposal has been made to form a new company to recommence operations from the bottom of the old shaft. In view of this circumstance, it may not be without interest or utility to consider what thickness of beds possibly intervene between the bottom of the shaft and the horizon of workable Coal. The Coal-field of Warwickshire is the nearest Coal-field to this locality, and as no important change from the thinning-out or denudation of intermediate beds, or from a great fault, is known to occur in the space lying between this locality and that, it will not be unreasonable to apply the data furnished by sections in Warwickshire to an approximate calculation of the probable thickness of the same beds in this district. Mr. Hull, in *The Coal-fields of Great Britain*, quoting from Mr. Howell's Memoir "On the Geology of the Warwickshire Coal-field, etc.," gives the following thicknesses:—Trias, 780 feet; Lower Permian, 2,000 feet; Sandstones, Shales, etc., of the Coal-measures before workable Coal is reached, 1,500 feet. So that, if these beds extend into the adjoining county of Northampton without material alteration, we shall have underlying the bottom of the Kingsthorpe shaft, and above the horizon of the Warwickshire Coal, beds of the aggregate thickness of 4,200 feet; which, added to the depth of the old shaft, would give a total depth of some 5,000 feet, or about twice the depth of the deepest Coal-mine in this country.

Moreover, according to the views of Mr. Hull, as stated by him in a paper read in the Geological Section of the British Association at Liverpool last year, Northamptonshire is quite without the area of the original Coal-field of this country, as it existed before denudation took place; and in such case no Coal could possibly be found at any depth.

The faith of the projectors of the proposed new company, however, is not based upon any geological considerations, but upon the opinions of *practical men*; indeed, one prominent mover in the matter, a man of means, having large connexion with the iron-producing trade in the country, declares his utter lack of faith in geologists, and bases his belief that Coal will be found in Northamptonshire upon his conviction "that where God has sent iron-ore, he has also sent Coal to smelt it!"

DALLINGTON HALL, Oct. 20, 1871.

IV.—ON THE FORAMINIFERA OF THE CHALK OF GRAVESEND AND MEUDON, FIGURED BY PROF. DR. CHR. G. EHRENBURG.

By Prof. T. RUPERT JONES, F.G.S., and W. K. PARKER, F.R.S.

THE Second Edition of Prof. Morris's "Catalogue of British Fossils" appeared in 1854, and in the same year was published Dr. Chr. G. Ehrenberg's "Mikrogeologie," containing the figures of numerous Foraminifera found by that eminent German microscopist, in specimens of Chalk from Gravesend, Kent. A preliminary notice, indeed, of these had been given in the Transactions of the Berlin Academy of Sciences for 1838 (1839), pp. 92, 133—135, 146, pl. iv.,

fig. iv. ; and some of the species were quoted in the "Catalogue;" but a more matured consideration was subsequently given them; and, together with many others from other sources, recent and fossil, they were most carefully figured and enumerated in the above-mentioned magnificent work on Microzoa. In its fine folio plates, so richly illustrating the Foraminiferal faunæ of many localities, and of many geological horizons, the artistic work is of high order in the zoologist's eyes; it is faithfully correct as to form, aspect, ornamentation, colour, and all details, modified, however, by the specimens being mostly seen as transparent objects, with the thickness of the walls rather too much pronounced at the edges; the objects, too, are somewhat in perspective. It being difficult to combine transparency and perspective in a drawing, especially with the attending minutiae of pores, tubercles, ridges, internal septa, septal apertures, and other characteristics of Foraminifera, the result is that the task of recognizing the real zoological place of the figured forms is difficult, or impossible, except to those who have long studied similar hosts of microzoa, similarly mounted in Canada-balsam. Having had such advantages, we feel called on to add to the list of British fossils, with our own nomenclature, the Cretaceous Foraminifera of Gravesend, figured by Ehrenberg.

Though we differ very considerably in our estimation of generic and specific distinctions and arrangement from this veteran naturalist, as shown by the different appellations we decide to annex to his figured specimens, yet we must remark that the divisions and collocations of the figures on his plates in the "Mikrogeologie" are generally quite *natural*, according to some characters, which Dr. Ehrenberg has recognized, but not clearly elaborated, and which agree to a very great extent with our own basis of generic arrangement.

In plate xxviii. of the *Mikrogeologie* are figured numerous Foraminifera from the soft Chalk of Gravesend, England. They are magnified 300 times in linear dimensions. These are referred to in the "Monatsberichte" of the Berlin Academy for 1838, pages 193, 194, where some of them are stated to have been found in the Chalk of Brighton also, and in the "Abhandlungen" for 1838, as stated above. An able abstract of this and another memoir in the "Abhandlungen" was made by the late T. Weaver, F.R.S., F.G.S., in 1841, and published in the "Phil Mag.," Nos. 118 and 119, and in "Annals and Mag. Nat. Hist.," vol. vii., pp. 296, 374, etc.; and in Taylor's "Scientific Memoirs," vol. iii. is a full translation, with plates, of Ehrenberg's memoir "on the numerous animals of the Chalk Formation which are still found living." Berlin Acad. Transact. for 1840.

The results of our careful examination of Ehrenberg's figures are as follows:—

Fig. 1. *Miliola lævis* is probably a single joint or a detached chamber of a *Nodosaria*. Ehrenberg's *Miliola* is the same as *Lagena* of other authors. 2. *Nodosaria Anglica* is *N. ovicula*, D'Orb., with a rather excentric aperture. 3. *N. monile* is a variety

of *N. ovicula*, D'Orb., with rather short chambers. 4. *Vaginulina nodulosa* is a variety of Roemer's *V. lævigata*, with a peculiar (concretionary?) shell-structure. 5. *V. cretæ* (*brachyarthra*) seems to be (if really flat, as is probable) *V. longa*, Cornuel sp. 6. *Textilaria striata*, Ehr. 1838. More fully illustrated in pl. xxxii., I., figs. 4a, 4b, 7, and II., 6, 18, from the Missouri and Mississippi Chalk. 7. A broad individual of *T. striata*. 8. *Text. ampliata* (*T. aspera*, 1838) is a young *T. gibbosa*, D'Orb., with roughish shell. 9 and 10. *Text. globulosa* (1838). 11. *T. leptotheca*, and 12. *T. globulosa ampliata*, are individuals of *T. gibbosa*. 13. *Loxostomum curvatum* is an arcuate *T. agglutinans*, the later chambers of which have the aperture higher and higher up; thus passing, in its quasi-generic character, from *Textilaria* proper into *Grammostomum*. Indeed, it may be the young of Ehrenberg's *Lox. Anglicum* (fig. 19 of the same plate), which is a rather narrow and neat *Gram. pennatula*, Batsch sp. 14. *Grammostomum scabrum* seems to be only a small coarse-shelled *Text. agglutinans*, D'Orb. 15, 16. *Gr. polytrema* is *Virgulina Schreibersii*, D'Orb. 17. *Gr. aculeatum* is a variety of *Verneuilina triquetra*, Münster sp., with aculeate edges: it is seen from one of its three flat sides. 18. *Textilaria aculeata* is a small rough *T. agglutinans*, with flattish chambers. 19. See above. 20. *Proroporus cretæ* is *Polymorphina Thouini*, D'Orb. See the "Monograph on Polymorphina" by Brady, Parker, and Jones, Linn. Soc. Trans., 1870, vol. xxvii., p. 232. 21. *Bigennerina cretæ*, and 22. *B. acanthopora*, are also *P. Thouini* (*loc. cit.*). 23. *B. apiculata* is *P. compressa*, "Mon. Polym." p. 227. 24. *Loxostomum vorax* is also *Polym. compressa*, and should be added to the synonyms in the "Monograph Polym.," p. 227. 27. *Lox. tumens*, and 26. *Lox. aculeatum*, however, are slightly differing individuals of *Heterostomella aculeata*, Ehr. sp. This may be described as a prickly loose-grown *Textilaria*, which, having ceased to grow in the typical manner (with a double row of alternating chambers), has continued with a single row (as a *Bigennerina*), and these have not only got terminal, instead of lateral, apertures, but have become lipped, as in *Sagrina rugosa*, D'Orb. (1840). D'Orbigny, however, had applied the name "*Sagrina*" to a Uvigerine Foraminifer (*S. pulchella*) in 1839. In 1866 Reuss published the name *Heterostomella* as distinctive of the "*Textilarian*" *Sagrina* (Sitzungsb. Akad. Wien, vol. lii.). Ehrenberg's "*Loxostomum*," though older (1854), is so misapplied by him (to *Polymorphina*, *Grammostomum*, and a transitional form between the latter and *Textilaria* proper), that naturalists may well hesitate to use it. *H. aculeata* is figured also in pl. xxvii., figs. 21, 22. 27. *Polymorphina turio* is a narrow and typical specimen of *Virgulina Schreibersii*, D'Orb., which is subgenerically related to *Bulimina*. 28 and 29. *Pleurites? calciparus*, 30. *Sphæroidina cretacea*, and 32. *Grammobotrys Anglica*, are broad and flattish individuals of *Virgulina Hemprichii*, Ehr. sp. This species is well figured (under many different names) in the "Mikrogeologie." It is very variable in form, but constant in

¹ Some of Ehrenberg's figures quoted in this Monograph as *Polymorphina*, we find, on fuller consideration, to be *Virgulinae*, etc.

the cloudy, or seemingly muddy, opacity of its shell,—a structure beautifully engraved in pl. xxix., fig. 38, and elsewhere. This species is very common in the Indian seas, with its misty, dull shell, of variable growth, sometimes regularly Virguline, with alternate chambers, sometimes passing into *Bulimina* proper, sometimes short and nearly round, like *Cassidulina*, and in other subvarietal shapes. It is the only *Virgulina* that takes on a sandy condition, becoming subarenaceous, and thereby very delicately rugose. Ehrenberg appears to have first noticed it in the Tertiary Limestone from Thebes, Egypt. In pl. xxiv., illustrating the Foraminifera from that rich rock, he gives the name *Strophoconus Hemprichii* to a fine complanate specimen (fig. 32); some smaller individuals, figs. 29, 30, 31, he puts under the same genus, and another as "*Textilaria* ? or *Grammobotrys*." His "*Strophoconi*" are all either *Virgulinæ* or *Buliminæ*; therefore the name is not required. Other instances of *V. Hemprichii* (fossil) occur at pl. xix., fig. 86 (?), Ægina; xxi. fig. 88, Oran; xxiii., fig. 19, Mokattam; xxv., fig. 15 (?), Antilibanon; xxvi., figs. 19—24, 26, 27, Cattolica; xxix., figs. 32—36, Moen Chalk; xxx., figs. 18, 19, 21, Rügen Chalk; xxxii., II., figs. 18, 20, Mississippi Chalk; xxxiii., XIII., fig. 27 (?), San Francisco. Of these some are remarkable; for instance, the *Vaginulina* ? *paradoxa* and *V. obscura* (xxvi., 26, 27) are nearly cylindrical and subarcuate, such as occur in the Jurassic Clays, in the Gault, and in the Chalk; they are old "Secondary" *Virgulinæ*. A variety, xxx., fig. 18, termed "*Polymorphina nucleus*," shows a passage into *Cassidulina*. An outspread, rhomboidal, and suboblong Textilariform variety is seen in xxxii., II., figs. 18 and 20, termed "*Grammostomum tessera*," and "*Pleurites* ? *Americanus*."

Pl. xxviii., fig. 31, *Heterostomum cyclostomum*, and 33, *Grammostomum platytheca* are young, broad, coarse-shelled *Textularia gibbosa*. 32. See above. 34—42a., variously named "*Rotalia*" (including *R. globulosa*, 1838, figs. 40, 41), are so many individuals of *Globigerina cretacea*, D'Orb., an outspread, flattish variety of *Gl. bulloides*, D'Orb., smooth in the youngest (41, 42), coarser and prickly in older specimens.

43. *Planulina omphalolepta* (*Pl. turgida*, 1838) is a small and somewhat complanate *Cristellaria rotulata*, Lamarck sp., or feebly keeled *Cr. cultrata*, Montf. sp. 44. *Pl. annulosa* is a still smaller specimen. 45a, b. *Pl. odontophæna* is *Crist. cultrata*, Montf. sp. Fig. 45a has tear-like and ridgy exogenous growths of shell-matter near the umbilicus, but no umbo. 46. *Pl. hexas* (*Rosalina globularis* ? 1838) is *Cr. cultrata* with a small keel. 47. *Rotalia prætexta* is a produced suboval individual of *Crist. cultrata*. 48. *Planulina adspersa* is probably a small *Cr. cultrata* or *rotulata*. In fact, figs. 43—48 show various stages and conditions of growth of the common *Cristellaria* of the Chalk, in its umbilicate condition, and with more or less of a keel or crest. 49. *Pl. umbilicata*, also 54, *Cristellaria megalomphala*, and 55, *Cr. Anglica*, are limbate specimens of *Cr. cultrata*, that is, having the shell thickened over the septal lines. 50. *Rotalia lenticulina*, 51. *R. Londinensis*, and 52. *R. lepida*, are

small individuals of *Planorbulina ammonoides*. 53. *R. picta*? This is *Pulvinulina Micheliniana*, D'Orb. sp., seen from its flat (upper) spiral face. The same species is represented in pl. xxvii, fig. 52, by a rather larger specimen ("*Planulina picta*") from the Chalk of Meudon, viewed through the vertical thickness of the shell from its high umbilical (lower) face. This belongs to a large family of Rotaline Foraminifera, which group themselves around *Pulvinulina repanda*, Fichtel and Moll, sp. It belongs more especially to the subgroup of which *P. Menardii* is the type. This attains its best growth at about 100 fathoms in the existing seas, but lives well at abyssal depths, even at more than two miles depth; whilst, on the contrary, in shallow water it degenerates into *bizarre* varieties. D'Orbigny's *Rotalia crassa*, figured on the same plate (Mém. Soc. Géol. Fr., iv. pl. 3, f. 7, 8), is also a variety of *Pulvinulina Menardii*. These are found in existing seas under the conditions mentioned above, and are abundant in the Gault, Chalk-marl, and Chalk.

The other objects from the Chalk shown in this interesting plate are some siliceous and calcareous Sponge Spicula, some Morpholites, including Coccoliths, possibly a variety of Cyatholith without its centrum, and two Diatoms, *Fragilaria rhabdosoma*, 1838, and *Fr. pinnata*, 1844 (*Fr. striolata*, 1838).

According to our views, as explained above, and in our papers on the Nomenclature of the Foraminifera in the Ann. Nat. Hist., and in other memoirs, we regard Dr. Ehrenberg's figures of the Foraminifera from the Chalk of Gravesend as referable to—

Nodosaria ovicula, D'Orb.
Vaginulina lavigata Roemer.
 ——— *longa*, Cornuel sp.
Textilaria striata, Ehr.
 ——— *gibbosa*, D'Orb.
 ——— *agglutinans*, D'Orb.
Heterostomella aculeata, Ehr. sp.
Verneuiliina triquetra, Münster sp.

Grammostomum pennatula. Batsch sp.
Virgulina Schreidersii, D'Orb.
 ——— *Hemprichii*, Ehr. sp.
Polymorphina Thouini, D'Orb.
Globigerina cretacea, D'Orb.
Cristellaria cultrata, Montfort sp.
Planorbulina ammonoides, Reuss sp.
Pulvinulina Micheliniana, D'Orb. sp.

Those of Ehrenberg's species that are mentioned in Morris's "Cat. Brit. Foss.," second edition, are:—

1. *Planulina* (? *Cristellaria*) *turgida* = *Cristellaria cultrata*, small (*Pl. omphalolepta*, 1854). 2. *Rosalina globularis* = *Cr. cultrata*, feeble (*Pl. hexas*, 1854). 3. *Rotalia globulosa* = *Globigerina cretacea*. 4. *Rotalia ornata* = ? Not figured in 1838, nor in 1854. 5. *Rotalia perforata* = *Globigerina cretacea*. 6. *Textilaria aciculata* = ? Not figured in 1854: the figure given in 1838 is like that of a small *Virgulina*. 7. *Textilaria aspera* = *T. gibbosa* (*T. ampliata*, 1854). 8. *T. globulosa* = *T. gibbosa*, small. 9. *T. perforata* (= *T. gibbosa*) should not have been inserted, as Ehrenberg does not refer to it as occurring in the English Chalk.

It will add to the interest of these notes on Cretaceous Foraminifera, if we allude to Pl. xxvii. of the "Mikrogeologie," illustrating the species and varieties that Dr. Ehrenberg discovered in the Chalk of Meudon, France. These are similarly treated, and are also referred to in the same papers in the Journal and Transactions of the

Berlin Academy, as the English specimens. Studied in the same manner as the latter, these French forms appear to us to belong to the following species and notable varieties:—

<i>Lagena globosa</i> , Montagu.	<i>Verneuilina pygmaea</i> , Egger.
<i>Nodosaria ovicula</i> , D'Orb.	<i>Polymorphina Thouini</i> , D'Orb.
<i>Bolivina punctata</i> , D'Orb.	<i>Sphaeroidina bulloides</i> , D'Orb. sp.
<i>Virgulina squamosa</i> , D'Orb.	<i>Cristellaria cultrata</i> , Montf. sp.
— <i>Schreibersii</i> , D'Orb.	<i>Globigerina cretacea</i> , D'Orb.
<i>Textilaria striata</i> , Ehr.	<i>Planorbulina ammonoides</i> , Rss. sp.
— <i>gibbosa</i> , D'Orb.	<i>Planorbulina fareta</i> , F. & M. sp.; small varieties.
— <i>aculeata</i> , Ehr.	<i>Pulvinulina truncatulinoides</i> , D'Orb. sp.
— <i>sagittula</i> , Defrance.	— <i>Micheliniana</i> , D'Orb. sp.
— <i>agglutinans</i> , D'Orb.	(See above, page 510.)
<i>Heterostomella aculeata</i> , Ehr. sp.	

These may be with advantage compared with the Foraminifera from the Chalk near Paris, described and figured by Alcide D'Orbigny, in 1840, "Mém. Soc. Géol. France," vol. iv., part 1, pl. 1-4. We must, however, premise that, to bring all to the same terms of comparison, some of the generic terms used for these Foraminifera in 1840 have now to be altered, thus:—

<i>Rotalina Voltziana</i> = <i>Planorbulina</i> .	<i>Rosalina Lorneiana</i> }	= <i>Planorbulina</i> .
— <i>Micheliniana</i> = <i>Pulvinulina</i> .	— <i>Olementiana</i> }	
— <i>umbilicata</i> = <i>Rotalia</i> .	<i>Uvigerina tricarinata</i> = <i>Tritaxia</i> (near	
— <i>crassa</i> }	<i>Verneuilina</i>).	
— <i>Corcieriana</i> }	<i>Pyruclina acuminata</i> = <i>Polymorphina</i> .	
	<i>Sagrina rugosa</i> = <i>Heterostomella</i> .	

A full list of D'Orbigny's species from the Chalk is given in Mr. Weaver's Appendix to his Abstract of Ehrenberg's Memoirs, Ann. Nat. Hist., vii., p. 395, etc.; together with notes on their localities and distribution in France, England, and elsewhere.

Lastly, we must not lose sight of the fact that the specimens figured in the "Mikrogeologie" are for the most part very minute, such as lie among the finer débris of washed Chalk; whilst those treated of by D'Orbigny were larger individuals picked out by means of hand-lenses from the coarser dust of the disintegrated material. The great difference of size, however, among individual Foraminifera carries but little weight in the determination of species; for the conditions, not only of growth, but of feeding-ground, depth of water, and climate affect them so greatly, that a form which may be gigantic in one *habitat*, will be arrested or dwarfed in another, retaining all the essential characteristics of shape and structure which are required for its specific identification.

NOTICES OF MEMOIRS.

ON THE GEOLOGY OF THE KINGSCLEERE VALLEY.

A Lecture addressed to Newbury District Field Club, during an Excursion, on September 19, 1871.

PROFESSOR RUPERT JONES, who took his stand on the northern edge of Ladel Hill, from which an extensive view of the country was obtained, proceeded to deliver a lecture "On the