

the conclusion would fairly be drawn, that in Bohemia, as to the west of the Pennine chain in England, there exists a full Permian series, but with a different mineral-development from that of Northern Germany.

Throwing out this hypothesis as a caution, I would only add that the well-rounded pebbles of the coarse and fine conglomerates, which compose the lowest member of the group, seem to me to have been formed by the waves of a sea beating on the shore of an estuary, adjacent to which exuberant forests prevailed, with trees like the *Araucarites* and *Guglielmities*, which must have required a genial if not a warm climate to bring them to their large dimensions. When we also consider that these water-worn sediments are at intervals interlarded with outpourings of igneous matter, in the form of porphyries, basalts, tuffs, and amygdaloids, we have before us nearly all the material data for speculating upon the condition of large portions of the surface of the northern hemisphere at the close of the Palæozoic era, and antecedent to the origin of those new orders of Animals and Plants which began to prevail in Mesozoic times.

MARCH 18, 1863.

Samuel Baines, Esq., Holroyd House, Lightcliffe, near Halifax; Hilary Bauerman, Esq., Geologist of the North American Boundary Survey; Robert Muesett, Esq., Royal Mint, Tower Hill; and Frank McClean, Esq., B.A., C.E., late Scholar of Trinity College, Cambridge, 2 Park Street, Westminster, were elected Fellows.

The following communications were read:—

1. *On the CORRELATION of the several SUBDIVISIONS of the INFERIOR OOLITE in the MIDDLE and SOUTH of ENGLAND.* By HARVEY B. HOLL, M.D., F.G.S.

(Abridged.)

Introduction.—The Inferior Oolite in the South of England comprehends two well-defined subdivisions: namely, an upper member, consisting of light-coloured, coarse-grained, more or less thin-bedded or flaggy oolite, containing few fossils, and those chiefly in the form of casts; and a lower member of hard, brown, ferruginous lime-rock, often much speckled with ovoid grains of peroxide of iron, and abounding in fossil remains. The relationship which these two beds hold with respect to the other members of the Inferior Oolite has been differently viewed by geologists.

The late Mr. Strickland evidently regarded the lower brown fossiliferous limestone as the equivalent of the Cephalopoda-beds of Haresfield Hill*.

On the other hand, Dr. Lycett, referring to the same bed at Dundry, remarks that, “considering the position of the Mollusca-bed beneath the Freestones, and overlying the *Cynocephala*-stage, it

* Quart. Journ. Geol. Soc. vol. vi. p. 250 (1850), as quoted by Dr. Wright.

may approximately be placed upon the parallel of the Cheltenham ferruginous pisolite.”*

More recently, Dr. Wright communicated to the Geological Society a paper in which these lower beds at Dundry form the type of his “zone of *Ammonites Humphriesianus*,” while the white-oolite beds above constitute his “zone of *Ammonites Parkinsoni*.” The former he has referred to the horizon of the Upper Freestone of the Northern Cotteswolds, and the latter to that of the Trigonian- and Gryphite-grits†.

The result of my own investigations is at variance with each of these views; and, having followed the beds stratigraphically along the line of their outcrop, I shall endeavour to show that their true position is higher in the series than is stated by any of these geologists, and that they are, in fact, the southern extensions of the Upper and Lower Ragstones of Mr. Hull, the uppermost of which is not represented in the typical section at Leckhampton, having risen above the level of the country, and cropped out before reaching the brow of the hills.

Southern side of the Mendips.—On the southern side of the Mendips the Inferior Oolite nowhere exceeds 28 or 30 feet in thickness, of which from 8 to 10 feet belong to the lower subdivision. The upper subdivision immediately underlies the Fuller’s Earth; and its light colour, lithological structure, and general poverty in organic remains readily distinguish it from the hard, brown, more or less massive or rubbly limestone beneath, which is everywhere very fossiliferous.

Both members are well exposed in quarries and lane-side sections, along the whole length of the belt of oolite as it ranges through Dorsetshire and Somerset, but especially so in the neighbourhood of Bridport, Yeovil, Castle Cary, Bruton, and, further to the north, at Batcombe, and on the hills east of Shepton Mallet. At the “Halfway House,” between Yeovil and Sherborne, we find the following section, which fairly represents the general characters of both subdivisions:—

Section at the “Halfway House.”

	feet.
A. Upper Ragstone. Thin-bedded oolite, with partings of brown, sandy, laminated clay	13
B. Lower Ragstone:—	
1. Hard, ferruginous, thick-bedded limestone, divided near the middle by a soft, friable, light-coloured band	6
2. Hard, light-coloured, fine-grained, sandy limestone. . . .	3

The upper part of B contains many Ammonites; and the soft friable band which divides the bed contains several species of Gasteropods in a fine state of preservation, and also *Collyrites ringens*, *C. ovalis*, *Hyboclypus gibberulus*, *Terebratula Phillipsii*, *T. spheroidalis*, *Rhyn-*

* ‘Cotteswold Hills,’ p. 72, 1857. See also Proceedings of the Cotteswold Club, vol. i. (1853) p. 64.

† “On the Subdivisions of the Inferior Oolite of the South of England, compared with the equivalent beds of that Formation on the Yorkshire coast,” Quart. Journ. Geol. Soc. vol. xvi. pp. 17 & 24 (1859).

chonella spinosa, and, more rarely, *R. acuta*, Sow.*, *R. ringens*, and *R. Forbesii*, with many other shells. The fossils of the lower part of the bed are chiefly *Conchifera*.

Following the escarpment of the hills northward, past Blackford and Yarlinton, we meet with numerous exposures in one or both of these beds, and near Castle Cary and at Hadspen the lower one was formerly extensively quarried. In the former locality the Lower Ragstone contains *Clypeus Agassizii*, and in both *Clypeus altus* occurs, while in the latter, as also in the quarries near Bruton-Bradstock, *Terebratula sphaeroidalis* is met with in immense numbers. Ammonites are rare.

At Sunny Hill, near Pitcombe, between Castle Cary and Bruton, in a quarry above the Railway Station, we find the following section, which, as it is at some distance from the last, will serve to show the persistence with which these two subdivisions preserve their characters.

Section at Sunny Hill.

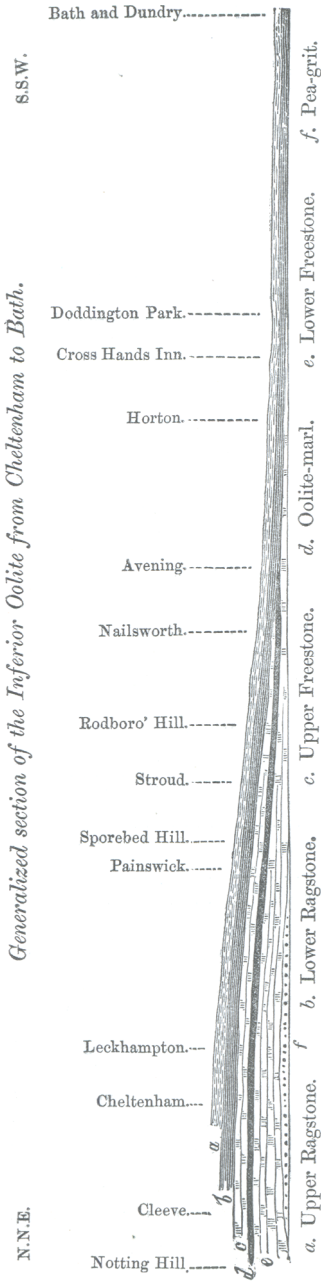
	feet.
A. Upper Ragstone. Coarse, white, flaggy oolite.....	6
B. Lower Ragstone:—	
1. Hard, brown, thick-bedded, highly fossiliferous limestone	12
2. Hard, sandy, compact, light-coloured limestone, with a few fossils.....	2

In this quarry the fossils of the Lower Ragstone are chiefly *Conchifera* and *Brachiopoda*. It is worthy of remark that the only Ammonite observed was *Ammonites Parkinsoni*. Among the fossils noticed were *Rhynchonella spinosa*, *R. angustata*, *Terebratula Philipsii*, *T. sphaeroidalis*, *Gryphæa subloba*, Desh., *Ostrea pixiformis*, Wr., *Lima gibbosa*, *Trigonia costata*, *Pholadomya Heraulti*, *Holctypus hemisphaericus*, &c. The bed No. 2, or basement-bed, contained a few fossils, very difficult to extract.

In the quarries around Bruton, and in the railway-cutting near the church, both series of beds are exposed, as also on the road through the Hedgestock turnpike-gate to Batcombe, and at Creech Hill. At the latter locality, ascending the hill from Lamyat, through a deep lane-cutting in the Ammonite-sands, to the brow of the hill, the lower fossiliferous limestone, not well exposed, is seen above the sands, and above this the Upper Ragstone, which is here about 15 feet in thickness, and is, in part, a tolerably thick and evenly bedded rock, while some of its beds exhibit lines of oblique lamination. About the middle of these upper beds there is a layer in which the fossils have the shell preserved.

The hard, pale-coloured, sandy limestone which formed the basement-bed of the Lower Ragstone in the sections at the "Halfway House" and at Sunny Hill does not appear to be continued much further to the north, as it was not observed at Creech Hill, and is absent at the Vallis Farm, 1½ mile north-west of Frome, where, in the quarry on the right bank of the stream, the Lower Ragstone is

* I am not aware that this fossil has hitherto been recorded as an Oolitic species.



seen separated from uptilted Carboniferous strata by alternate layers of more or less compacted clay, with pebbly bands, resting on a bed of conglomerate, beneath which Mr. C. Moore, of Bath, detected a thin stratum containing *Avicula contorta* *.

North side of the Mendips.—Between the Mendips and the valley of the Avon the same beds continue to represent the Inferior Oolite, and are well exposed in the railway-cuttings between Wells and Ammersdown, and, in a series of roadside-quarries, on to Radstoke, and further north, by the side of the canal near Dunkerton, at the foot of the Viaduct Bridge near Limpley Stoke, and at Widcombe Hill, near Bath. In all these localities they continue to preserve those general features which serve to distinguish the one from the other. In the neighbourhood of Dunkerton the Upper Ragstone is about 20 feet in thickness, and contains Corals of the genera *Anabacia*, *Stylina*, and *Isastrœa*.

The outlying patch of Inferior Oolite at Dundry Hill is connected with this portion of the main body of the range by the smaller patches of the Barrow Hills, Stanton Prior, and Timsbury. At Dundry the light-coloured, partly flaggy, partly thick-bedded oolite which caps the hill belongs to the upper subdivision, and in certain layers at the top of the hill contains Corals of the same genera and species as the similarly situated beds in the neighbourhood of Dunkerton and Bath. Beneath this we find beds of rubbly and ferruginous lime-

* This interesting section has been given in detail in Mr. T. R. Jones's recent Monograph of Fossil *Estheria* (p. 74), published by the Palæontographical Society.

stone belonging to the Lower Ragstone, and having a somewhat greater aggregate thickness than in other parts of the country; but this may possibly be more apparent than real, and owing to some slight settlement of the hard ragstones, around the flanks of the hill, upon the yielding sands and Upper Lias clays beneath.

The Cotteswolds.—Passing across the valley of the Avon, we are able to trace these beds past Dryham Park to the quarry half a mile east of Doddington Ash, where the junction of the two Ragstones is well exposed, the lower one abounding in fragments of *Trichites*.

But, two miles further to the north, in the lane leading from the 'Cross Hands' Inn to Old Sodbury, the Ragstones are seen underlain by about 6 or 8 feet of thin-bedded white oolite, the lower beds of which are made up, in part, of comminuted shells. It rests upon a yellowish sandy bed, 2 or 3 feet thick, containing casts of *Gresslya*; beneath this are the brown-coloured argillaceous Cephalopoda-beds, with Belemnites and casts of Ammonites. Nearly the whole thickness of this white oolite is seen in the lane-side cutting. The Lower Ragstone crops out in the field above the section, and is also seen a little further along the lane, while the Upper Ragstone and overlying Fuller's Earth are exposed in a quarry opposite the inn.

This white oolite, when followed northward, is seen gradually to increase in thickness, and its relationship to the Ragstones may be well studied in a quarry near Horton Rectory, while its basement-beds and its junction with the upper part of the Cephalopoda-beds are exposed in the lane half a mile south of the Rectory.

Section near Horton Rectory.

	feet.
A. Upper Ragstone. White, thin-bedded, friable oolite	12
B. Lower Ragstone. Massive, hard, brown limestone, in two or three beds, with many fossils	about 10
C. Freestone. Thick-bedded white oolite, used for building-stone	12
D. Yellow sandy rock, containing <i>Gresslya</i>	2 to 3
E. Cephalopoda-beds (Ammonite-sands or Upper Lias sands). Alternating beds of marly, more or less indurated, and rubbly rock, speckled with oolitic grains of peroxide of iron, and containing Belemnites and Ammonites; 8 feet exposed . .	8

The Lower Ragstone is here crowded with fossils, among which are *Trigonia costata* in great numbers, *Lima proboscidea*, *Ostrea Marshii*, *Trichites*, *Belemnites*, *Rhynchonella spinosa*, *Rhynchonella quadriplicata*, &c. The lower beds of the underlying Freestone contain a small *Pecten* in great abundance, which occurs also in the same position at Hawkesbury and Leckhampton.

A similar section exhibiting both the Ragstones, overlain by the Fuller's Earth, and resting upon the Freestone, which is probably 25 feet in thickness, is seen near Hawkesbury, on the road to Pool Farm.

The Freestone continues to increase in thickness as we proceed from the last section to Wotton Underedge, being 35 or 40 feet thick at Coneygore Wood, a mile north of the town. Continuing to thicken towards Frocester and Painswick Hills, it acquires its full development in the vicinity of Cheltenham, where it constitutes the "Building Freestone" of Leckhampton. The overlying Ragstones at the same time gradually rise to higher levels, and at Coneygore Wood crop out before reaching the brow of the hill, but may be found on higher ground half a mile further along the road, towards the Rushmire turnpike-gate.

From the section in Coneygore Wood and the sides of Symond's Hall Hill, the upper of the two Ragstones may be followed northward to Nymphsfield and Avening, and along the sides of the Vale of Nailsworth, where it becomes identified with the "Upper Ragstone" or "Clypeus-grit" of Mr. Hull*, and the "Pholadomya-grit" of Mr. Lycett†, the casts of *Pholadomya* and *Homomya* and the remains of *Clypeus (Nucleolites) Plotii* especially characterizing this highest zone in the northern part of the Cotteswolds, but being by no means common south of the Valley of Stroud.

In like manner the fossiliferous limestone immediately beneath it is continued onward to Rodborough Hill, where it becomes continuous with the Trigonia- and Gryphite-grits of Messrs. Wright, Lycett, and others, and the Lower Ragstone of Mr. Hull‡. In the neighbourhood of Nymphsfield this latter has associated with it a band of hard pale-coloured limestone, crowded with *Rhynchonella spinosa*.

In the vicinity of Wotton, as at Symond's Hall Hill, the Lower Ragstone rests directly on the Building Freestone; but, crossing the high ground on the east to the Vale of Nailsworth, we find, in the smaller tributaries of Horsley and Avening, a few inches of the Oolite-marl, with its characteristic *Terebratula fimbria*, underlying the base of the Ragstone, and resting upon 4 or 5 feet of pale-coloured argillaceous limestone, which graduates downwards into the Freestone. This is the earliest appearance of the Oolite-marl in the southerly direction, and a little further down the valley it begins to be separated from the base of the Ragstone by the interposition of some more or less sandy oolite belonging to the Upper or "Bastard" Freestone. This latter, at Nailsworth, is about 3 feet in thickness; but, passing along the valley to Stroud, both it and the underlying Oolite-marl gain in thickness and importance, and separate the Ragstones more and more widely from the Lower Freestone.

At Rodborough Hill the Lower Ragstone is about 10 or 12 feet in thickness. The basement-bed is crowded with *Conchifera*, and constitutes the Lower Trigonia-grit, or lowest of the three members into which it has been subdivided. As we proceed northward, however, both this and the middle, or Gryphite-grit division, increase in thickness. At White's Hill, near Randwick, Mr. Lycett has estimated it at 5 feet. At Kimmersley Castle it is somewhat more, and contains

* Memoirs of the Geological Survey, "Geology of parts of Wiltshire and Gloucestershire," p. 10.

† 'Cotteswold Hills,' p. 68.

‡ *Op. cit.* p. 10.

many *Conchifera* in a good state of preservation; but it attains its greatest development at Leckhampton Hill.

Over a considerable portion of the north-western part of the Cotteswolds, especially towards the verge of the hills, the Upper Ragstone has been denuded, and it is only beneath the isolated patches of Fuller's Earth, brought down by faults, that it occurs, and in these localities it is seldom well exposed. It may be seen, however, to the east of the fault at Cold Comfort, and still better on the hills beyond Andoversford.

The cropping-out of this bed before reaching the verge of the hills in the neighbourhood of Cheltenham appears to have led Dr. Wright to overlook it altogether*.

I quite agree with Dr. Wright in his suggestion that, away from the western escarpment of the hills, the Upper and Lower Trigonigriths have come into contact, as the great Oyster-bank which constitutes the Gryphite-grit extends only from the vicinity of Rodborough Hill to Cleeve Cloud, and eastward to the neighbourhood of Andoversford; but the Lower Ragstone, as seen in the quarries between the latter place and Hampen, consists chiefly of the *Upper* Trigonigrith, having at its base a bed, from 1 to 2 feet in thickness, of very hard, brownish limestone, pierced everywhere by small vertical tubes, probably the work of some species of Annelid. These Lower Ragstone-beds may be seen *in situ* on the Stow Road, a mile and a half east of Andoversford, and again half a mile beyond Naunton Inn, and on the top of a hill a mile south-west of Aylworth, where its junction with the Upper Freestone is exhibited.

But above this Lower Ragstone, and resting upon it, there is seen, over all the country around Naunton and Turk Dean, and west of North Leach, a higher bed, 15 or more feet in thickness, of very coarse-grained, rubbly, white oolite, containing fossils in abundance, but not in great variety. This is the northern extension of the Upper Ragstone, which has here become fossiliferous and more coarsely oolitic. The lower part of the bed is crowded with *Terebratulina globata*, and the central portion contains *Clypeus Plotii* in great numbers. In going from Naunton Inn to Harford Bridge, we cross in succession the outcrop of the Upper Freestone, the Lower Ragstone, and then the Upper Ragstone to the Fuller's Earth, and we again find the two latter, on the opposite side of the stream, in the lane above Harford.

The Upper Ragstone is well exposed at Aylworth, where it has been brought down to a lower level by faults, and also by the side of the road leading from Turk Dean to Aston, where an upper bed is exposed, made up of badly preserved fossils imbedded in coarse white oolite. *Clypeus Plotii* is most abundant in the middle portion of the bed.

The junction of the Upper Ragstone with what remains of the Lower Ragstone is well seen in a quarry by the side of the Roman Foss-way, near the fifth milestone from Stow, where we find the following section:—

* Quart. Journ. Geol. Soc. vol. xvi. pp. 38 & 43.

Section near Stow.

feet.

- A. Coarse, rubbly, white oolite, becoming darker-coloured towards the base, and containing in its lower portion great numbers of *Terebratulata globata*, *Lima gibbosa*, and *Pecten lens* 8
- B. Very hard, compact, brown limestone, covered on its upper surface with a large flat species of *Ostrea* 3
- C. Lower Freestone to the bottom of the section.

The Lower Ragstone is here reduced to 3 feet in thickness, and rests upon the Lower Freestone, the intervening members having thinned out between this place and Turk Dean. A mile further to the south-west, in the quarries above Clapton, this subdivision has nearly reached its extreme limit in this direction; some hard, brown, sandy rock, with fossils, and a mere trace of the basement-bed being all that remains to represent the Lower Ragstone. At Little Rissington both this and the underlying Freestone have entirely thinned out, and the Upper Ragstone rests directly on the Upper Lias clay; but north of Stow, on the road to Moreton, there is still some portion of the Lower Freestone remaining.

FOSSILS OF THE UPPER RAGSTONE.

- Nerinea*, sp. Little Rissington.
- Myacites*, casts of three species . . . Naunton, Aston, &c.
- Gresslya abducta*, *Phill.*? (cast) . . . Aston, Clapton.
- Homomya gibbosa*, *Sow.* (cast) . . . Aston, Naunton.
- Pholadomya Heraulti*, *Ag.* . . . Aston, Naunton, Little Rissington.
- *Dewalquei*, *Lyc.* Little Rissington.
- Isocardia* (cast) Stow, Aston.
- Astarte elegans*, *Sow.* Aston.
- , sp. Stow, Aston.
- Trigonia angulata*, *Lyc.*? Abundant around Naunton, Aston, &c.
- *costata*, *Park.* Little Rissington.
- Nucula variabilis*, *Phill.*? Aston.
- Lima duplicata*, *Sow.* Stow.
- *gibbosa*, *Sow.* Naunton, Stow, Aston, &c.
- Pecten lens*, *Sow.* Aston.
- *vagans*, *Sow.* Aston.
- Ostrea acuminata*, *Sow.* Stow, Naunton, Aston.
- Terebratulata globata*, *Sow.* Very abundant everywhere.
- Rhynchonella angulata*, *Sow.* . . . Naunton, Stow, Aston.
- *concinna*, *Sow.* Aston.
- Serpula*, sp. Clapton.
- Nucleolites* (*Clypeus*) *Plotii*, *Klein* . . . Abundant everywhere.
- Echinobrissus clunicularis*, *Lewyd* . . . Aston.
- Holactypus depressus*, *Lamk.* . . . Aston.
- Isastraea limitata*, *E. & H.* Aylworth.
- Anabacia orbulites*, *Lamk.* Naunton, Stow.
- , sp. Naunton.

The "Rolling Bank" Quarry.—Dr. Wright has referred all the fossils of the Rolling Bank Quarry to the Upper Freestone beds of Cleeve, and considers them to be the northern equivalents of the Conchiferous Lower Ragstone of Dundry, Yeovil, &c.* That this is

* Quart. Journ. Geol. Soc. vol. xvi. p. 18.

not so, however, is, I think, made manifest by a careful examination of all the beds which occupy the interval between the Oolite-marl and the base of the Ragstone, where they occur *in situ*. Leaving the Rolling Bank Quarry, which has been opened into "tumbled oolite" resting upon the Upper Lias Clay, and ascending the hill in an easterly direction, we come to two quarries situated in the Lower Freestone, and in the higher of the two, distant from the Rolling Bank Quarry about 200 paces, the Oolite-marl occurs, 9 or 10 feet thick, resting upon the Lower Freestone, and overlain by 5 feet of the Upper Freestone. The hill rises only a few feet above the top of the quarry, and a little further on, at the very summit of the hill, is a second quarry. The lowest beds on the western side of this quarry belong to the base of the Upper Freestone, and, formerly, a portion of the upper part of the Oolite-marl was also exposed. These beds, which dip slightly towards the east, pass upwards into a brown, calcareous, sandy rock, the uppermost stratum of which is, in parts, composed entirely of yellow and brownish sand. Resting upon this, and immediately under the turf, on the eastern side of the quarry, is the Lower Trigonina-grit, with *Terebratula impressa*, *Trigonina costata*, *Goniomya angulifera*, *Ceromya Bajociana*, *Myacites*, *Gresslya*, and many other fossils.

These beds are again seen in a third quarry, a little further on in the same direction. Eleven feet of rock are here exposed, the upper three feet of which are sandy and ferruginous, and similar to the top-beds in the last quarry. The lower eight feet consist of brown sandy oolite, moderately thick-bedded. Neither the uppermost nor the lowermost beds can be seen; but, close by, at only 3 or 4 feet higher elevation, the junction of the former with the Lower Trigonina-grit may be seen in some small superficial excavations which have been made in searching for the sand, which here and there occurs at the top of the Upper Freestone.

The junction of the Upper Freestone with the overlying Lower Trigonina-grit is, however, better seen in a number of small pits along the north side of the ravine which lies a little to the right.

From all these exposures the following section may be constructed:—

Section of the Rolling Bank Quarry.

A. Lower Trigonina-grit.	feet.
a. Rubbly limestone, with many fossils—Corals, &c.	
b. Brown and blue clay	1 to 2
B. Upper Freestone.	
a. Hard, brown, coarse-grained limestone, with frag- ments of Shells, not persistent	6 in. to 2
b. Yellow and brownish sand, with lenticular masses of sandstone	3
c. Ferruginous arenaceous limestone and sandy oolite, the lowest bed pierced by the vertical tubes of Annelids, about	14

C. Oolite-marl.	feet.
a. Pale-coloured, argillaceous limestone, with <i>Terebratula fimbria</i> , &c.	3 to 4
b. Cream-coloured marl, with <i>Terebratula fimbria</i> , Corals, &c.	6
D. Lower Freestone.	

The hill is capped by Gryphite-grit, with *Gryphæa subloba*, Desh. Thus, at Cleeve, a series of beds of very unstable character occupies the interval between the top of the Oolite-marl and the base of the Lower Ragstone, and represents the Upper Freestone of Leekhampton; but nowhere, in these beds *in situ*, do we find any of the fossils of the Rolling Bank Quarry. Apart, however, from this negative evidence that these beds are not on the same horizon as the Conchiferous limestones of Dundry, we have the fact that this Lower Ragstone may be traced continuously from Dorsetshire, through Somersetshire, and along the escarpment of the Southern Cotteswolds, up to the Trigonía-grits of Rodborough and Leekhampton Hills.

The Rolling Bank Quarry has been excavated into an accumulation of fallen débris which has collected at the foot of the oolitic cliffs, and consists chiefly of Lower Ragstone; and nearly all the fossils that are found there belong to this subdivision.

The Pea-grit.—The lowest member of the Inferior Oolite is the Pisolite, or Pea-grit, which immediately underlies the Lower Freestone. This bed has been generally stated to thin out at Notting Hill. Its southern limits have been somewhat more variously defined. Its northern attenuation at Notting Hill is true, however, only as regards its pisolitic structure, as the bed itself, although no longer pisolitic, appears to underlie the Lower Freestone of the Bredon outlier.

Below the brow of the eastern extremity of the hill, above Aston, *Rhynchonella cynocephala*, Rich., the small dwarfed variety similar to the one which occurs at Wotton Underedge*, is found in detached blocks of hard limestone; but I have not been able to find the bed *in situ*. This is the most northern locality at which this fossil has hitherto been met with in the Cotteswold district. Further round the hill, above Elmley Lodge, there is a bed of hard, yellow, sandy limestone, some layers of which are full of fragments of *Pentacrinus* and spines and plates of Echinoderms, with some fossils entire. *Terebratula plicata* is the dominant fossil, but the valves are usually separated. Still further on, beneath the ancient encampment of Bredon Tower, nearly 10 feet of this bed is exposed, having the Lower Freestone resting upon it. On the surface of the blocks, besides the fragments of *Crinoidea* and *Echinoidea*, are many specimens of *Cricopora verticillata*, Mich.?, and other *Bryozoa*.

To whatever position the grey and yellow limestone with *Rhynchonella cynocephala* may be assignable, the bed above referred to belongs, I think, to the Pea-grit.

Towards the south the Pea-grit ceases to be pisolitic, or is only

* The specimen, with part of the matrix, is in the author's cabinet.

very slightly so, at Painswick Hill. Beyond this it is represented by yellowish sandy limestone and ferruginous oolitic rock, which, near the Horseponds, are less than 20 feet, and at Haresfield Hill are about 12 feet in thickness. At Frocester Hill, the light-brown sandy rock, with casts of *Gresslya* and *Pholadomya*, overlying a hard fossiliferous bed, together about $7\frac{1}{2}$ feet in thickness, is all that remains to represent the Pea-grit of Crickley Hill; and the 2 or 3 feet of yellowish sandy rock, with *Gresslya*, which was seen underlying the Freestone in the sections at Horton, and near the Cross Hands Inn, probably belongs to the same zone, and indicates the approaching southern limits of the bed.

All these beds thin out in a south-easterly direction, as already shown by Mr. Hull*. The Upper Ragstone alone crosses the valley of the Evenlopd, and in Oxfordshire is the only representative of the Inferior Oolite, but finally it thins out in the vicinity of the Cherwell. The Lower Ragstone was seen to have nearly reached its eastern limits at the quarries above Clapton, and is absent at Stow, Seizincote, and Bourton-on-the-hill. The Upper Freestone and Oolite-marl are on the eve of disappearing at Condicote and Turk Dean, and do not extend southward further than Avening; while the Lower Freestone is seen thinning out at Stow, Sherborne, and near Doddington Park, ten miles north of Bath. The northern and southern limits of the Pea-grit have already been indicated. Eastward it ceases to be pisolitic before reaching Dowdeswell, beyond which the bed has not hitherto been recognized.

Geographical Distribution of the Fossils.—The fossils of the Upper Ragstone, as far as they are at present known to me, have been already enumerated. Those of the Lower Ragstone have been recorded by Dr. Wright, Mr. Lycett, and Mr. Hull. With respect to the lists given by Dr. Wright, however, it must be borne in mind that the Humphriesianus-zone of Dorsetshire and Somerset, and the Parkinsoni-zone of the Northern Cotteswolds, are on one and the same geological horizon.

The geographical distribution of the fossils of the Lower Ragstone is very unequal, and many of the species and even genera, although abundant, are altogether local. The Ammonites, for instance, are numerous only in a few localities in the southern part of the district; elsewhere only scattered individuals are met with, and not more frequently than they are in the northern part of the Cotteswolds †.

* "On the South-easterly Attenuation of the Lower Secondary Formations of England," Quart. Journ. Geol. Soc. vol. xvi. p. 71.

† With respect to *Ammonites Parkinsoni* and *Ammonites Murchisonæ*, these fossils are by no means so restricted in their range in time as some authors suppose. *A. Parkinsoni* is stated by Mr. Lycett to occur in the Pea-grit "but sparingly" (Cotteswold Hills, p. 37). It has been met with in the Lower Ragstone of Somersetshire, and occurs very generally in the Upper Trigonia-grit of the Northern Cotteswolds. *A. Murchisonæ* was found by the officers of the Geological Survey in the Lower Ragstone of Leckhampton and Stanley Hills (Hull, Geol. Cheltenham, p. 48), together with *A. Sowerbyi*, *A. concavus*, and *A. Dorsetensis*, and in the Upper Ragstone near Churchill, in Oxfordshire (Geol. of Country around Woodstock, p. 13). On the authority of Professor

Among the *Brachiopoda*, we find *Terebratula Buckmani*, Dav., in great abundance at Clevee, Leckhampton, and Sherdington. *Terebratula Wrightii* is equally gregarious, as in the Perna-bed at Cold Comfort; but it is only sporadically distributed elsewhere in the neighbourhood, and does not occur in the south. Near Andoversford, a small *Terebratula*, probably a dwarfed variety of *T. ornithocephala*, is met with in great abundance, and more sparingly so at Leckhampton, but I have not found it anywhere else. In the southern part of the district we find *Terebratula sphaeroidalis* occurring in the same great abundance at Hadspen and Bruton-Bradstock, while in neighbouring quarries they are by no means numerous. The Gasteropods are mostly southern forms, while the conditions of the sea-bottom upon which the calcareo-argillaceous beds of the Lower Trigonina-grit were deposited appear to have been favourable to the life of the *Anatinidæ*. Of the Echinoderms, most of the species of the northern part of the Cotteswolds are different from those of the southern side of the Mendips, and instead of *Clypeus (Nucleolites) Plotii*, *Hyboclypeus caudatus*, *Pedina rotata*, and *Holectypus depressus*, we find *Clypeus Agassizii* and *C. altus*, *Hyboclypeus gibberulus*, *Holectypus hemisphaericus*, *Collyrites ringens*, and *C. ovalis*, and others that are not, or only rarely, found in Gloucestershire. Omitting, however, these local and also the rarer forms, most of the more common and characteristic fossils on both sides of the Mendips are identical*.

In this communication I have endeavoured to show the relationship the several subdivisions of the Inferior Oolite hold with respect to each other,—and that the conclusions that have been arrived at by some writers on this point, based on the evidence of fossils only, are not borne out when the beds come to be traced stratigraphically from one end of the Oolitic range to the other.

2. On the OCCURRENCE of large Quantities of FOSSIL WOOD in the OXFORD CLAY, near PETERBOROUGH. By H. PORTER, M.D., F.G.S.

[Abstract.]

THE author gave a short description of the Oxford Clay area in the neighbourhood of Peterborough, and mentioned the properties which caused it to be worked, in the parishes of Eye, Thorney, Whittlesey, Stanground, Fletton, and Stilton, for the manufacture of bricks and tiles. The clay is very fossiliferous at all these places, the most abundant remains being those of *Belemnites Puzosianus*, *Gryphæa dilatata*, *Ammonites Elizabethæ*, *A. Duncani*, *A. convolutus*, *A. cordatus*, *A. fluctuosus*, *A. hecticus*, *A. Comptoni*, and a few other species of

Morris (Cat. Brit. Foss.), it occurs at Chideock, Sherborne, and Dundry, localities where the Ragstone is the lowest member. Both *A. Parkinsoni* and *A. Humphriesianus* have been found in Yorkshire in beds which are probably younger than the Inferior Oolite of Gloucestershire.

* Some of the Inferior Oolite forms of Somersetshire pass upwards into the Fuller's Earth—*Hyboclypeus gibberulus*, *Collyrites ovalis*, and *Holectypus depressus* being not uncommon in this bed near Bruton.