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THE INFERIOR OOLITE AND CONTIGUOUS DEPOSITS OF THE CHIPPING-NORTON DISTRICT OXFORDSHIRE

BY

L. RICHARDSON, F.R.S.E., F.L.S., F.G.S.

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I.—INTRODUCTION

In this paper it is purposed giving a detailed description of the Inferior Oolite and contiguous deposits of the Chipping Norton district. The extent of this district, for the purpose of the present communication, is shown in the map, fig. 1, page 196.

In this district the beds that are present between the Cornbrash and Upper Lias, are, in descending order :—

(1). The Forest-Marble series ;
(2). The Great Oolite, with
(3). The Stonesfield slate at the base ;
(4). The Neæran Beds ;
(5). The Chipping-Norton Limestone ; and
(6). Certain of the Top-Beds of the Inferior Oolite.

More minute subdivisions of these beds have been made, and those that have been recognised in groups 4, 5 and 6 are detailed in Table I., on page 201.

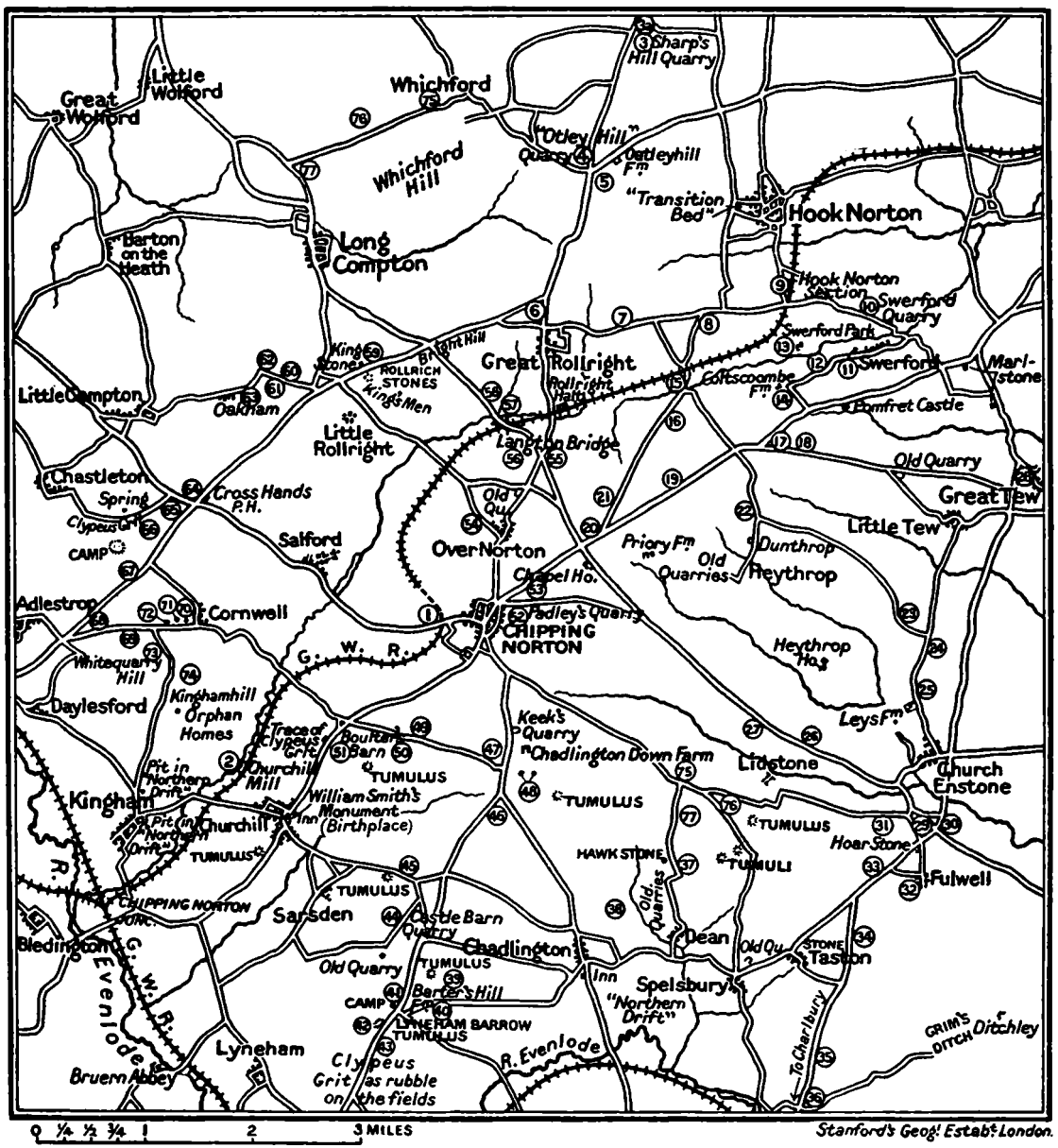


FIG. 1.—Map of the Chipping-Norton District. Scale: ½ inch = 1 mile.
(The numbers on the map correspond to those given in the text, and are intended to facilitate the location of the sections.)

As most workers in the Oolites are aware, the determination of the true sequence of deposits in the Chipping-Norton district,

and the question of their correct allocation, whether to the Great Oolite or to the Inferior Oolite, are matters that have engaged the attention of many geologists. A thick mass of limestone, called the "Chipping-Norton Limestone," is the most prominent rock-subdivision in the district, spreading over a wide extent of country. Attention has been mainly directed to this Limestone, and the desire to settle the question whether it should be grouped with the Inferior Oolite or with the Great Oolite, appears to have outweighed the inclination to study the sub- and super-jacent deposits, with a view to seeing how far they would contribute information towards arriving at a conclusion with regard to the precise date of the relatively-barren intervening deposit (*i.e.*, the Chipping-Norton Limestone).

PREVIOUS WORKERS.—Amongst those who have worked on the Oolites of this district are Prof. E. Hull,[1] A. H. Green,[2] Prof. J. W. Judd,[3] John Phillips,[4] W. H. Hudleston,[5] T. Beesley[6] J. Windoes,[7] Mr H. B. Woodward,[8] and Mr E. A. Walford;[9] but of these, Walford, Hudleston and Judd have made the most important contributions to our knowledge.

Mr H. B. Woodward has summarized very well indeed all the information that had been obtained up to and inclusive of the year 1894, and he inserted some additional observations. Since then, however, Mr E. A. Walford, F.G.S., has published a most valuable contribution, in which he has detailed the sequence of a number of most interesting, fossiliferous deposits, which he calls "Neæran Beds."[10] More recently, Mr J. A. Douglas has contributed an article, of the nature of a résumé, on the geology of the Oxford-Banbury district to the Jubilee Volume of the Geologists' Association;[11] but no new facts are recorded therein, and Mr E. A. Walford's latest contribution is unfortunately overlooked.

1 "The Geology of the Country around Cheltenham" (1857), pp. 47, 48, 59, 60. Mem. Geol. Surv.
2 "The Geology of the Country around Banbury" (1864), p. 12. Mem. Geol. Surv.
3 "The Geology of Rutland, etc." (1875), pp. 17-24. Mem. Geol. Surv.
4 "The Geology of Oxford, etc. (1871), pp. 144, 164, 245, etc.
5 Proc. Geol. Assoc., vol. v., No. 7 (1878), pp. 378-379: "Monogr. Brit. Jur. Gasteropoda—Part 1, Gasteropoda of the Inferior Oolite," pp. 70-71. Pal. Soc.
6 Proc. Geol. Assoc., vol. v., No. 4 (1877), pp. 165-185.
7 Mr Windoes was an active local collector. See Foss. Trig. (Pal. Soc.) Lycett, Appendix revised by E. A. Walford.
8 "The Jurassic Rocks of Britain—The Lower Oolitic Rocks of England (Yorkshire excepted)," vol. iv. (1894), pp. 146-164. Mem. Geol. Surv.
9 Foss Trig., Lycett, as above; Quart. Journ. Geol. Soc., vol. xxxix. (1883), pp. 224-245; *ibid.*, vol. xli. (1885), pp. 53-47; Rep. Brit. Assoc. (1895), p. 414; Proc. Geol. Assoc., vol. xiv., pt. 5 (1895), pp. 184-185.
10 "On some New Oolitic Strata in North Oxfordshire" (1906), pp. 1-32. Buckingham Advertiser Office.
11 "Geology in the Field." pt. 1 (1909), pp. 192-209.

GEOGRAPHICAL EXTENT OF THE ROCKS DESCRIBED.—The sketch-map given above (figure 1) does not show the geographical distribution of the several formations present in the district. It is only intended to indicate precisely the positions of the sections to which reference is made—the numbers in the text corresponding to those on the map. For the geology, and for seeing the approximate geographical distribution of the rocks, the Geological Survey Maps must be consulted ; but it should be noted that on the two quarter-sheets, 45 N.W. and 45 S.W., the equivalent beds between the *Clypeus*-Grit and typical Great Oolite are not similarly coloured, for reasons that need not be entered into here, as they have already been fully explained elsewhere.[1] Also, here and there, patches of higher beds than any originally suspected, such as of Forest Marble and Cornbrash, have been discovered ;[2] but considering the time at which the cartography was done, the small scale Ordnance Survey maps available, and the knowledge possessed, it is extraordinary that it was done as well as it was.

The LOWER LIAS floors the Vale of Moreton, the Evenlode Valley and the broad ends of the little valleys that run into the upland from the vale.

(1) The *Capricornus*-Beds were exposed when the tunnel at Chipping Norton (No. 1 on the map) was made :[3]
(2) In a temporary excavation near Churchill Mill (2—L.R., 1904) :
(3) The *Armatus*-Beds or thereabouts were seen in the railway-cutting near Charlbury :[4] while
(4) Lower Lias, of uncertain date, was laid bare in the railway-cutting at Ascott-under-Wychwood.[5]

The MIDDLE LIAS succeeds the Lower, and admits of the usual dual division into (*a*) a lower, sandy, shaly, clay portion, and (*b*) an upper or Rock-Bed (Marlstone) portion.

The sandy beds of the Middle Lias can be easily located by means of their usually-attendant gorse-bushes ; and the Marlstone, on the vale side, by the platforms—such as "Wichford Hill"—to which it gives rise. Around Hook Norton, the red, light level-land, and the numerous long workings, indicate clearly enough the presence and geographical extent of this Marlstone ; while its ferruginous character is emphasized by the presence of continuously smoking furnaces (figs. 2 and 3).

1 "The Jurassic Rocks of Britain, etc." vol. iv. (1894), pp. 146-147.
2 Proc. Geol. Assoc., vol. v., No. 4 (1877), p. 177.
3 *Ibid.*, pp. 180-185.
4 E. Hull, "The Geology of the Country around Woodstock" (1859), p. 9. Mem. Geol. Surv.
5 W. S. Horton, "The Geologist," vol. iii. (1860), p. 251.

It is unnecessary to say anything more in this paper about

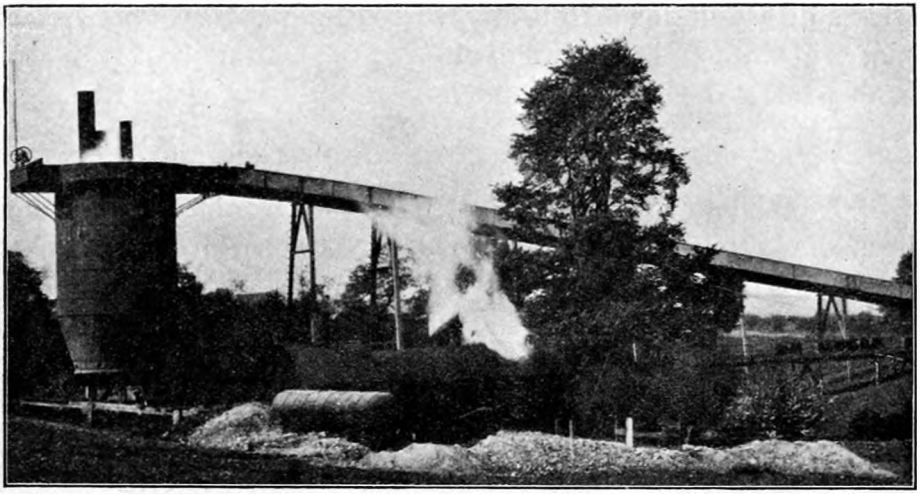


FIG. 1.—Blast Furnace at Hook Norton

the Marlstone beyond that it is of the usual Midland type, that is, it is rich red, ferruginous, and frequently replete with specimens of *Rhynchonella tetrahedra* (Sow.) and other fossils ;

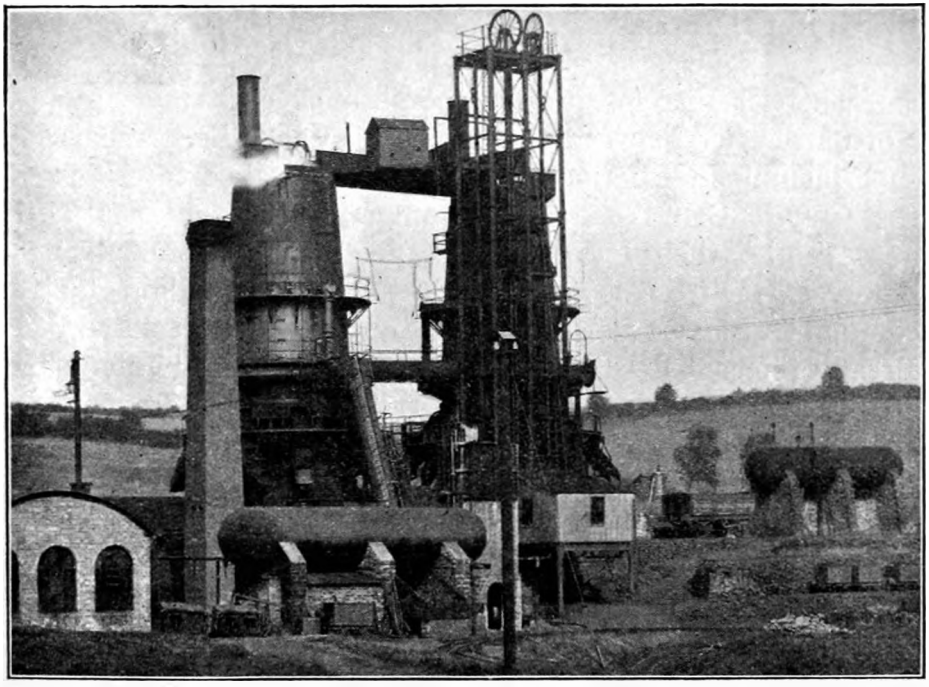


FIG. 2.—Another Blast Furnace at Hook Norton

but it may be as well to redirect attention to Prof. Hull's interesting discovery of conglomerate Marlstone "in a quarry south of Daylesford House," where the pebbles "consist of pieces of slate and sandstone, often of the character of trappean ash, while all the fragments have a Silurian aspect."[1] The quarry is now overgrown.

The UPPER LIAS in this district is clay from top to bottom. It is thickest in the railway-cutting at Hook Norton (30 to 40 feet), and thinnest in the south-eastern portion of the district, being at Fawler (just outside the area under consideration) only 12 feet thick. The clay in the Hook-Norton Cutting is mainly of *subcarinati*, *fibulati* and *brauniani* hemeræ; that at Fawler, Mr S. S. Buckman informs me "speaking from memory, of *fibulati* and perhaps *subcarinati* hemeræ: there are signs of *falciferi*, but they look like remanié." (*in litt.*, April 11th, 1911.)

Speaking approximately, the *Scissum*-Beds (*vide* Table I.) rest directly upon the Upper-Lias clay in the north-western half of the district, and the *Clypeus*-Grit—with or without the intervention of a thin layer of conglomerate—immediately thereon in the south-eastern portion.

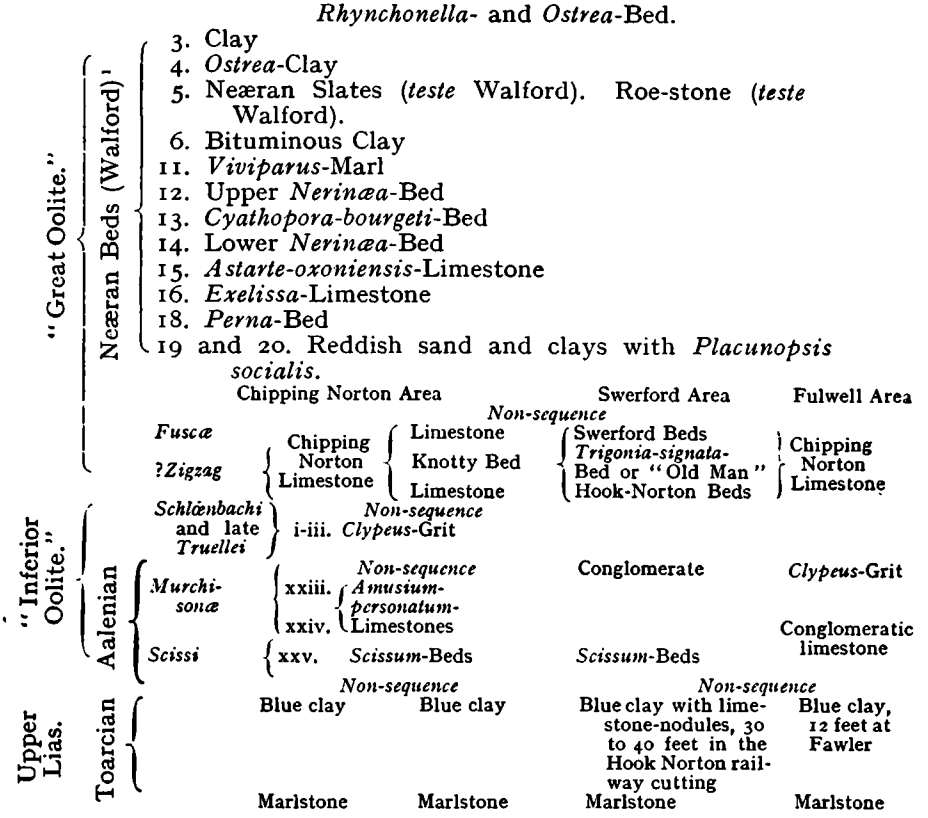
There is therefore a great non-sequence in the Chipping-Norton district between the Upper Lias and the immediately superincumbent Inferior-Oolite beds, and it is greatest where the *Clypeus*-Grit rests directly upon the Upper Lias. The lower limit of the Inferior Oolite is thus sharply-defined. Such, however, is not the case with regard to the upper limit, for the component layers of the Neæran Beds, which have been already referred to, have an irregular geographical extent and are overlaid by various members of the succeeding, unquestionable Great-Oolite beds. The line of demarcation between the Great Oolite proper and the Neæran Beds is therefore often none too definite, and the reason, doubtless, is—as Mr Woodward has remarked—mainly because the Chipping-Norton Limestone, Neæran Beds, etc., were flexured previous to the deposition of the higher beds.

1 "The Geology of the Country around Cheltenham" (1857), p. 20. Mem. Geol. Surv.

II.—Subdivisions recognizable in the Inferior Oolite and Contiguous Deposits of the District.

The subdivisions that are recognizable in the rocks under consideration are shown in the following table :—

TABLE I.—SUBDIVISIONS OF THE NEÆRAN BEDS, CHIPPING-NORTON LIMESTONE AND INFERIOR OOLITE SERIES IN THE CHIPPING-NORTON DISTRICT



[1](*The geographical distribution of these deposits is too complicated to indicate in this table.*)

(xxv.) *Scissum*-Beds (*scissi* hemera).—These beds precisely resemble, palæontologically and lithologically, their equivalents in the Cotteswold Hills, that is, they are, brown, sandy, calcareous limestones with the usual fossils, such as, *Rhynchonella cynocephala* (Rich.), *R. subdecorata* Dav., *Volsella sowerbyana* (d'Orb.), *Pholadomya fidicula* Sow., *Montlivaltia* cf. *lens* E. & H[1]., belemnites, and, in the Hook-Norton railway-cutting, ammonites—*Lioceras opalinum, L. thompsoni, Hammatoceras* aff. *newtoni*, etc.

1 The form referred to by R. F. Tomes as occurring in "the beds of the Inferior Oolite, near their junction with the Upper Lias." Proc. Geol. Assoc., vol. vi., No. 4 (1879), p. 154.

(xxiv.-xxiii) *Amusium-personatum*-Limestones (*Murchisonæ, s. l.*).—At Cornwell (70 on map), above the *Scissum*-Beds, are sandy limestones, frequently full of this noticeable little pecten, which must doubtless be correlated with the *A.-personatum*-containing limestones of the North Cotteswolds, Ebrington and Bredon Hills, etc.

Conglomerate-Beds.—The precise time of formation of a conglomerate-bed is often difficult to determine, and each example must be considered separately. Thus the Conglomerate-Bed at Fawler may be of *Truellei* date, and that in the Hook-Norton Cutting of late *Schlœnbachi*.

(iii-i.) *Clypeus*-Grit (late *Truellei* and *Schlœnbachi*).—Over the south-western half of the district, the *Clypeus*-Grit precisely resembles, both as regards faunal and lithic characters, its equivalent in the North Cotteswolds, but to the north-east, it attenuates, and in the Hook-Norton cutting the loose, shelly conglomerate referred to above, occupies its stratigraphical position.

Fullers' Earth.—Above the *Clypeus*-Grit is the stratigraphical position of the Fullers' Earth—in Dorset and Somerset a great mass of clay. A bed of rock called the " Fullers' Earth Rock " is prominent in the Fullers' Earth of Somerset, and separates the clay into two parts—an Upper Fullers' Earth and a Lower Fullers' Earth. The median rock-bed is of *subcontracti* hemera, and this is also the date of a portion of the Great Oolite at Minchinhampton Common ; of a portion of that exposed in the railway-cutting at Stony Furlong, near Chedworth, and of a portion of the Oxfordshire Great Oolite proper. Hence the deposit between the *Clypeus*-Grit or its equivalent and the rock of *subcontracti* date in the Cotteswold Hills and Oxfordshire corresponds, as regards stratigraphical position, to the Lower Fullers' Earth of Somerset.[1]

In Dorset and Somerset, portions of the Lower Fullers' Earth are sometimes clays, and at others limestones. In other words, limestones sometimes replace a greater or less portion of the clays of *zigzag* and *fuscæ* hemeræ. In the neighbourhood of Bath the deposit of *zigzag* hemera is clay and presumably so is that of *fuscæ* date. When the Fullers'-Earth clay is

1 Proc. Geol. Assoc., vol. xxii. (1911), pp. 111 and 115.

traced through the Cotteswold Hills, it is found to attenuate considerably as clay, and in the neighbourhood of Stow-on-the-Wold to be largely replaced by limestone again.

As far as can be seen, this replacement is effected in the local Fullers' Earth of the Stow district, from near the base, upwards. Thus, in the railway-cutting about half-a-mile to the south-west of Harford Bridge, between Notgrove and Stow, there is the following section :[1]—

SECTION IN RAILWAY-CUTTING NEAR HARFORD BRIDGE, BETWEEN NOTGROVE AND BOURTON

		Thickness in feet	ins.
Gt. Oolite.	Limestone, generally white, rather coarsely-oolitic : seen about	8	0
"Fullers' Earth"	1. Clay, greenish, yellow-streaked, with buff-coloured layers of marl	0	5
	1. Marls, buff-coloured, with a harder layer at 6 inches from the top	2	0
	2. Marls, bluish	1	2
	3. Marls, buff-coloured and yellowish, with layers of clay and a number of limestone-bands, some of which are fissile and sandy, finely-micaceous, with annelid tracks and a bed about the middle full of specimens of *Ostrea*, sp. : about	3	9
	4. Clay, very tough, yellowish : perhaps about ..	1	0
	5. Clays, bluish, marly : about .. .. .. (At the base of these clays is a course of water-worn pebbles, often coated with *Serpulæ*, *Ostrea* and Polyzoa).	15	0
	6. "Red sand, derived from the decomposition of [the top-portion of] bed 4 [*i.e.*, my bed 7]."[2] ..	1	2
C. N. L.	7. Limestones, brownish sandy, with numerous specimens of *Ostrea* sp., plant-remains : about ..	6	6
	8. Layer of marly material, with crushed oyster-shells, described by Walford as 'a dark blue clay,' and given by him as	1	0
Inf. Oolite.	*Clypeus*-Grit. Usual type : seen	5	0

From this section it will be seen that limestones have developed in the lower portion of the Fullers' Earth. There is clay below them, and I presume that it is this bed which is represented at Great Rissington, where it contains an *Ostrea*-Limestone.[3]

1 This section was first described and accurately interpreted by Mr E. A. Walford (Q. J. G. S., vol. xxxix. 1883, pp. 225-226). Subsequently, in 1887, it was noticed in greater detail by Mr S. S. Buckman (Proc. Cotteswold Nat. F.C., vol. ix., pt. 2, pp. 123 and 128). See also Mr Walford's paper "On Some New Oolitic Strata in North Oxfordshire" (1906), pp. 6 and 7.

2 Walford. "On Some New Oolitic Strata, etc." p. 6

3 Quart. Journ. Geol. Soc., vol. lxiii. (1907), pp. 440-441.

In a quarry near Lower Swell[1] bed 5 of the railway-cutting section appears to have become replaced by limestone; while above are marls that weather into a tough greenish-brown clay, which seem to represent bed 1 in the railway-cutting, but may be beds 2, 3 and 4 as well. In the marls exposed in this quarry is a limestone-band, sometimes crowded with gastropods which, I think, is correlative with the Lower *Nerinæa*-Bed in the Neæran Beds of the Chipping-Norton district. If this is the case, then by the test of relative stratigraphical position, the lower two-thirds of the Lower Fullers' Earth would appear to be equivalent to the Chipping-Norton Limestone, and the upper third to the Neæran Beds. This, of course, is speaking approximately, and in the light of the knowledge at present possessed.

I once noticed in the quarry near Lower Swell a peculiar deposit of sand, which I assigned to a position between the Chipping-Norton Limestone and the clay-beds. Mr Walford noticed a similar deposit on top of the Limestones (bed 7) in the railway-cutting. A similar deposit occupies a like stratigraphical position in many of the quarries in the Chipping-Norton district.

Thus on stratigraphical grounds, it would appear that the Lower Fullers' Earth in the Chipping-Norton district is mainly represented by the Chipping-Norton Limestone, and the fact that this limestone at the Oakham Quarry (page 228) has yielded a specimen of *Oppelia*, probably *O. fusca*, shows that this is so.

Chipping-Norton Limestone.—This limestone spreads far and wide over the Chipping-Norton District, and has long been known for the occurrence in it, or in the immediately superincumbent clay-beds of the remains of the giant saurians of the genus *Cetiosaurus*.[2]

The name "Chipping-Norton Limestone" was first used by the late W. H. Hudleston in 1878,[3] and he evidently intended it to apply to the *whole* of the limestone that intervenes between the *Clypeus*-Grit and the present Neæran Beds, or Great Oolite deposits, as the case may be, in the neighbourhood of Chipping Norton, where it is extensively quarried for dry-walling or for mending the local roads.[4]

1 Proc. Cotteswold Nat. F.C., vol. xvi., pt. 1 (1907), pp. 24 and 25.
2 Phillips, "Geology of Oxford, etc." (1871), pp. 164, 245: Proc. Geol. Assoc., vol. v., No. 4 (1877), p. 185.
3 Proc. Geol. Assoc., vol. v., No. 7 (1878), p. 384.
4 "The Jurassic Rocks of Britain, etc." vol. iv. (1894), p. 149.

Lithically, the Chipping-Norton Limestone varies considerably. In the south-western half of the district it is a black-speckled, although otherwise pure white, limestone, only slightly arenaceous; but eastwards it passes into much more arenaceous limestones and in places into actual sand-deposits.

About the middle of the Chipping-Norton Limestone, *in the south-western half of the district,* is a peculiar bed best described as a "Knotty-Bed."[1] This Knotty-Bed becomes very hard indeed and often replete with specimens of *Trigonia,* especially of *Trigonia signata, in the north-eastern portion of the district,* on which account Mr Walford has termed it the "*Trigonia-signata*-Bed."[2]

The limestone above the *Trigonia-signata*-Bed may pass, as in the Hook-Norton Cutting, into a white sand similar to that of the Lower Estuarines at Stow-nine-Churches and Duston, near Northampton; while in the sandy-limestone portion, larger fragments of plants occur than further west. For these beds, which are equivalent to the Chipping-Norton Limestone, *above* the Knotty Bed, the term "Swerford Beds" will be useful.

The limestones *below* the Knotty Bed are usually more massive than those above, have often waterworn, "wavy" surfaces, and when traced in an easterly direction, are found to become very sandy, and, in appearance, when soft, not unlike the Harford Sands on Cleeve Hill, near Cheltenham, or the sands associated with the beds about the horizon of the Collyweston Slates at Collyweston, in North Northamptonshire. For these beds, Mr Walford has employed the term "Hook-Norton Limestones,"[3] but latterly he has dropped it, and has used the term "*Trigonia-signata*-Sands and Limestones"[4] for these beds, *plus* the overlying *T.-signata*-Bed.

The Chipping-Norton Limestone, in its more sandy development, gives rise to a light, very sandy soil. Percolating, carbonated waters dissolve up the calcareous cement, and in the process cause considerable settling, slipping and faulting of the beds. The carbonate of lime is often deposited

1 Called the "Old Man" by the quarrymen at Sharp's Hill. This bed in its "knotty" development is excellently seen in a quarry opposite the Merry-Mouth Inn, Fyfield, where there is the usual kind of limestone above and below.

2 Quart. Journ. Geol. Soc., vol. xxxix. (1883), p. 238.

3 Quart. Journ. Geol. Soc., vol. xxxix. (1883), p. 238.

4 "On Some New Oolitic Strata in North Oxfordshire" (1906), pp. 4, 5 and 27.

in the form of massive travertine, called " lac lunæ " by the early mineralogists. All this dissolution naturally encouraged fissuring, and into many of the cracks the clay of the immediately superincumbent deposit has often found its way. On this account, Mr Walford has termed the clay-bed immediately on top of the Chipping-Norton Limestone, the " Rift Bed."[1]

Neæran Beds.—To Mr Walford, practically alone, are we indebted for our knowledge of these beds. He gave them their name ; worked out the sequence of their component layers, and to no small extent, their palæontology, at Sharp's Hill ; and proceeded a considerable way towards indicating their geographical extent in North Oxfordshire. As will be seen shortly, they comprise a most interesting collection of dark-coloured tough clays of various tints, and marls and limestones —the marls sometimes ultra-limy, and the limestones often considerably arenaceous ; while fossils, mostly of novel form to Cotteswold workers, abound. The mutual relations of the component layers of the Neæran Beds are difficult to determine, and so are their relations to the overlying Great-Oolite beds.

Very similar deposits to these Neæran Beds have been described in the department of L'Indre, France, by MM. Cossman and Benoist.[2]

II.—Local Details.—Descriptions of Sections.

The best section in the district whereat to commence a detailed investigation, is that at Sharp's Hill (3 on map), two miles north-west by west of Hook-Norton Church. It has been described in some detail by Mr Walford (pp. 7-15),[3] and is extremely instructive as demonstrating the variability of the beds between the black clay (" Rift-Bed ") and the *Rhynchonella*- and *Ostrea*-Bed of the Great Oolite proper.

1 *Vide* H. B. Woodward, " The Jurassic Rocks of Britain—The Lower Oolitic Rocks of England and Wales (Yorkshire excepted)," vol. iv. (1894), p. 159.

2 Bull. Soc. Géol. de France, 3ième ser., tome xxvii. (1899), pp. 136-143 and 543-585, pls. xiv.-xvii.

3 References, such as this one in brackets after Mr Walford's name refer to his pamphlet " On Some New Oolitic Strata in North Oxfordshire," Buckingham, 1906.

No. 3. SHARP'S HILL QUARRY[1]

		Thickness in ft.	ins.
	1. Reddish soil: 6 ins. to 1 ft...	1	0
	2. *Rhynchonella*- and *Ostrea*-Bed. Marls, yellowish, clayey, crowded with oysters and specimens of *Rhynchonella: Camptonectes annulatus* (Sow.)	1	0
Neæran Beds	3. Clay, brown and dirty greenish-grey at the top, darker towards the base[2]: about ..	1	0
	4. *Ostrea*-Clay. Marly clay crowded with whitened oysters	0	6
	5. *a*. Clay, tough, dark-brown and greenish: 6 ins. *b*. Intermittent bed of brown sandstone: 0 to 2 ins. *c*. Clay, tough, bluish, passing down into greenish-blue and yellow-streaked clay, and this again into bed 6: 1 ft. 10 ins.	2	6
	[*Position of beds* [2] *to* [6] *of Langton Bridge* (*teste Walford*)]		
	6. Bituminous Clay. Clay, black (in places almost a coal-seam), constituting a particularly noticeable horizon and usually overlying a seam of rich-brown clay: 2 to 8 ins.	0	6
	(*Beds 7 to 10 of Walford should come here, but Mr Paris and I did not detect them*).		
	11. *Viviparus*-Marl. Marl, pale-purplish, with numerous pebbles and concretions, some ochreous, others phosphatic—the whole deposit having an appearance best colloquially described as "like an ash-heap." *Viviparus langtonensis* (Hudl.),[3] *Ataphrus labadyei* (d'Arch.), *Nerinæa* spp., etc: 0 to 1 ft. 4 ins.	0	8
	(*This deposit rests, where present, upon an uneven surface of bed* 12).		
	12. Upper *Nerinæa*-Bed. Limestone, generally a hard bed, but more rubbly in places and sometimes passes into a whitish-grey marl. Also appears to be a lenticular deposit in the quarry-face (Aug., 1910), but re-appears at the extreme western end as an intermittent limestone-bed. Large *Nerinæa* of *eudesi*-type common, *N.* cf. *voltzi* Desl., *Nerita minuta* Sow. at the base, *Corbula buckmani* Lyc., *Arctica loweana* (M. and L.) dwarfed form, *Gervillia waltoni* Lyc., *Ostrea*, *Volsella imbricata* (Sow.), etc. 1ft. 2 ins. to 2 ft.	1	9

1 Near Temple Mill, quite close to Sharp's Hill, is a quarry in which the sequence of beds displayed is similar to that at Sharp's Hill. At the top is the *Rhynchonella*- and *Ostrea*-Bed. About 6 inches of clay separate this from the *Ostrea*-Clay, while below this are clays black at the top and bottom and of a tea-green hue in the middle. The clays above and below those of tea-green colour contain iron and weather a rusty colour. Below come similar beds to those at Sharp's Hill, only the Upper *Nerinæa*-Bed is not nearly so prominent (often only lumps of limestone embedded in marl) and the *Cyathopora-bourgeti*-Bed is thinner and contains fewer concretions.

2 At Temple-Mill Quarry an irregular limestone-band is present in the middle of bed 3.

3 *V. langtonensis* was recorded by Hudleston in his Monograph from Sharp's Hill, Castle Barn and Langton Bridge. He remarks that it resembles *Paludina scotica* Tate (Q. J. G. S., vol. xxix., pl. xii., fig. 3). The species resembles *V. aurelianus* Crossman (Bull. Soc. Géol. France, 3ième série, vol. xxvii. (1899) p. 141, fig. 4 and page 565, pl. xvii., figs. 2-7), but the spire is more produced than in that species. *V. aurelianus* is from the "Bradfordian."

		Thickness in ft.	ins.
Neæran Beds	13. *Cyathopora-bourgeti*-Bed. Marl of a greenish-grey colour with numerous peculiar white concretions (and irregular limestone-layers) and therefore an easily-found bed; *Nerinæa voltzi, Gervillia waltoni, Perna mytiloides* Lamarck, *Placunopsis socialis* M. and L. *Nucula menkei* (Roemer), *Ostrea, Volsella imbricata* (Sow.), etc: *Cyathopora bourgeti* occurs principally at the base: o ins. to	2	1
	Lower *Nerinæa*-Bed.[1] Limestone, pale-green when freshly-fractured and readily-recognised by innumerable specimens of *Nerinææ*. At the western end represented only by an occasional nodule; *Cyathopora bourgeti* (Defr.) near the top, *Arctica loweana* (dwarfed form), *Rhynchonella concinna*, auctt., *Astarte, Nerinæa*, etc.: o ins. to 1 ft.	o	8
	Irregular parting of clayey marl: o to ..	o	2
	15. *Astarte-oxoniensis*-Limestone.[2] Limestone, very variable in thickness and mixed with marl. When freshly fractured is pale-green, with a tendency to become "rotten," while the harder portions are blue and shelly; *Perna* cf. *mytiloides, Nucula menkei* auctt., *Volsella imbricata, Exelissa* spp., etc.: o to 8 ins.	o	5
	Fairly persistent parting of greenish clayey marl: 1 to 3 ins.	o	3
	16. *Exelissa*-Limestone. Limestone with pale-yellow or whitish exterior, blue-hearted. The weathered surfaces show innumerable specimens of *Exelissa*. The nether surface is very irregular; *Amberleya* aff. *nodosa* M. & L., *"Phasianella" pontonis* Lyc., *Protocardia buckmani* (M. & L.), *Nucula menkei*, etc.: o to 10 ins.	o	6
	(17. *Limestone, according to Walford, 5 inches thick*).		
	18. *Perna*-Bed. Pale-yellow and greenish and bluish marl and stone. *Perna oxoniensis* Paris, *P. mytiloides, Gervillia waltoni*, [*G. richardsoni* Paris[3]] *Protocardia lingulata* (Lyc.), *Pleuromya* cf. *unioniformis* (M. and L.), *Vol. imbricata, Ataphrus labadyei*: [*A. discoideus* M.& L., *Delphinula benoisti* Cosmann[4]], *Exelissa* spp., etc.: 1 ft. to ..	1	6
	19. Reddish-brown sandy layer with nodules and masses of a blue shelly limestone on its horizon; *Perna, Placunopsis socialis, Gervillia, Volsella, Exelissa*, numerous ostracods (in the limestone-band): o to ..	o	8
	20. Clay, black with a reddish-brown seam (20*a*) at the base	1	11

1 This bed might be called the Lower *Nerinæa*- and *Volsella*-Bed in this area; and
2 This bed the *A.-oxoniensis*- and *N. menkei*-Bed.
3 Not found *in situ*. See page 234, and Pl. xxvii., figs.. 3*a* and *b*.
4 Not found *in situ*. *D. benoisti* is figured in the Bull.Soc. Géol. France, vol. xxvii., 3ième série, 1899, pl. xv., figs. 12-14.

		Thickness in ft.	ins.
Swerford Beds	21. [=2 of Hook-Norton Section, p. 213]. Plant-Bed. Limestone, perforated with tubular holes, into which black clay has infiltrated: 1 ft. 6 ins. to 2 ft. 8 ins.	1	6
	21*a*. Clay, tough: 0 to 2 ins.: average.. ..	0	1
	22. Limestones, fine-grained, siliceous, fawn-coloured, but blue-hearted, with numerous fragments of black lignite: according to Walford 2 to 8 ft. thick	4	8
Hook-Norton Beds — *T.-signata* Bed	23. [Bed 12 of Hook Norton]. *Trigonia-signata*-Bed of Walford, the "Old Man" of the quarrymen. This bed is a fawn-coloured, blue-hearted limestone, joined on to the bed above; *Trigonia* spp. abundant. The bed is extremely hard	1	4
Hook-Norton Beds	24*a*. Limestone, fine-grained, siliceous, blue, weathering brown, with numerous fragments of lignite	2	4
	b. Conspicuous layer of ironstone: 0 to 4 ins.	0	2
	c. Limestone, similar to 24*a*, but more ferruginous: seen 2 ft., but according to Walford	9	0
	(*The following beds, not exposed at the time of my visit, have been noted by Mr Walford*).		
Inf. Oolite — *Clypeus*-Grit	25. "Rubbly, earthy limestone with nodules; *Gervillia prælonga*, *Trigonia* sp., *T. producta*, *Gresslya abducta*, *Avicula braamburiensis*, *Lima ovalis*. Thickness not determined.		
	26. Compact, fine-grained yellow limestone, with yellow sand at base (thickness not determined.)"		

It is important to obtain first a general idea of this fine section, and then to investigate its many beds in detail.

It should be first of all noticed that there are groups of various-coloured clays near the top of the section and immediately above the Swerford Beds. The deposits in between are principally limestones, all of which, *Exelissa*-Limestone, *Astarte*-Bed and Lower and Upper *Nerinæa*-Beds, are important. Scarcely less so are the associated deposits, the *Perna*-Bed and *Cyathopora-bourgeti*-Bed.

The Upper *Nerinæa*-Bed varies considerably as regards lithic structure. In places it is a hard limestone, in others a marl.

Previous to the deposition of the *Viviparus*-Marl, there was an erosion. The non-sequential relation of the purplish *Viviparus*-Marl to the whitish Upper *Nerinaea*-Bed (in its marly condition) is very obvious.

The *Viviparus*-Marl, however, is not continuous throughout the section. It indicates a change, and in places the nonsequence between it and the underlying deposits is far greater than at Sharp's Hill. At Castle Barn (44), for example, it rests directly upon the Chipping-Norton Limestone.

The *Ostrea*-Clay and *Rhynchonella*- and *Ostrea*-Bed are difficult deposits to deal with. When, as is usually the case, the clays with oysters are close to the top of a section, it is difficult to say if they represent the *Ostrea*-Clay or the *Rhynchonella*- and *Ostrea*-Bed. The presence or absence of specimens of *Rhynchonella* constitute the main guidance. In some sections the *Rhynchonellæ* are seen to be associated with specimens of *Terebratulæ* of the group colloquially spoken of as the " *T.-globata*-Group."

Near Whichford is a quarry (75), in which such a *Rhynchonella*- and *Ostrea*-Bed, containing specimens of " *T. globata*," is close down upon the Swerford Beds ; only deposits comparable with those numbered 19 and 20 at Sharp's Hill separate them. The limestones in this quarry are very much disturbed. Sometimes in large blocks and sometimes flaggy, they are at others reduced to a yellowish sand. Also in places they are highly ferruginous—especially the top-layer, which is probably on the horizon of the Plant-Bed of Sharp's Hill.

The quarry numbered 76 is in limestones, which are, however, less ferruginous.

LONG-COMPTON QUARRY.—The Chipping-Norton Limestone is worked in a quarry (77) on the hill to the north of Long Compton. The upper portion of the limestone has been reduced to a sand ; but on top of it, the extremely ferruginous equivalent to the Plant-Bed may be descried. Waters, rendered chalybeate from this stratum, have percolated the " sands," and have imparted to them a rich rouge colour. Above the Plant-Bed equivalent is reddish-brown sand, then a tough, dark clay (4 ins.), with pieces of limestone rich in specimens of *Placunopsis*, and next reddish-brown sand again : the three layers being equivalent to beds 19 and 20 of Sharp's Hill.

OATLEY HILL.—A little over a mile south-south-west of the Sharp's Hill Quarry is Oatley Hill or "Otley Hill," as it is more generally known amongst geologists (No. 4).

The locality has long been famous as an interesting collecting-ground, and Prof. J. W. Judd, Mr E. A. Walford and others have obtained and listed therefrom a considerable number of specimens. Now, however, the classic section is quite overgrown, and the highest beds at present visible are on the same stratigraphical horizon as those seen in the quarry (No. 5), near Oatley-Hill Farm. However, it is easy to see from the lists of fossils given by Judd[1] and Walford[2] that the Chipping-Norton Limestone, *Trigonia-signata*-Bed and Hook-Norton Beds, part of the Pea-Grit-Series equivalent and *Scissum*-Beds are represented. Mr H. B. Woodward has listed a few of the more noteworthy fossils from the "lower beds" of Oatley Hill,[3] and of them it may be remarked that the *Montlivaltia lens* is probably the *Scissum*-Bed variety, which is so commonly associated with *Rhyn. cynocephala* and *Pholadomya fidicula* in the Cotteswold Hills, as it is here also at Oatley Hill; the *Acrosalenia* is probably the *A. lycetti*, which at the Edge, near Painswick,[4] occurs abundantly in association with huge specimens of *Nautilus*; while *Nerinæa cingenda* and *N. pisolitica*, are common in the Dogger of Blea Wyke and in the top-portion of the Pea-Grit[5] in the Cotteswold Hills respectively.

OATLEY-HILL-FARM QUARRY.—In a field belonging to Oatley-Hill Farm is a quarry (5) in which about 8 feet of Chipping-Norton Limestone is exposed. The beds are brown and sandy, and give rise to a very sandy soil. They contain numerous pieces of brown lignite, occasional specimens of *Lima? cardiiformis* (Sow.), *Lucina* (fairly common); whilst on certain of the weathered slabs can be distinguished fragments of an *Acanthothyris, Gervillia, Ostrea, Syncyclonema, Serpula* and Polyzoa. There also appears to be evidence of Mr Walford's *Trigonia-signata*-Bed, for certain pieces of shelly limestone that were lying about contained numerous specimens of *Trigoniæ, Ostreæ* and a large *Camptonectes lens* (Sow.).

1 "The Geology of Rutland, etc." (1875), pp. 21-23. Mem. Geol. Surv.
2 Quart. Journ. Geol. Soc., vol. xxxix. (1883), pp. 232-233 and 242.
3 "The Jurassic Rocks of Britain—The Lower Oolitic Rocks of England (Yorkshire excepted)," vol. iv. (1894), p. 157. Mem. Geol. Surv.
4 Proc. Cotteswold Nat. F.C., vol. xvi., pt. 2 (1908), p. 164.
5 Slatter collected a specimen of *Terebratula simplex*, J. Buckman, at Oatley Hill.

In a quarry (6), which is becoming rapidly overgrown, situated a mile and a quarter to the south-south-west of the above, siliceous Chipping-Norton Limestone is exposed that is weathering at the top into a white sand. Two or three feet of similar sandy limestones are to be seen in an old quarry near Rollright-Heath Farm (7) and about 8 feet were exposed in a temporary excavation marked 8.

HOOK-NORTON RAILWAY-CUTTING SECTION (No. 9.)—Three quarters of a mile still further east is the Hook-Norton Tunnel, which is approached at both ends by means of deep cuttings. In both cuttings excellent sections have been available showing the junction of the Upper-Lias clay with the succeeding Oolite, and also the sequence as far up as the *Exelissa*-Limestones of the Neæran-Beds. Hence the sections are very important, and have, therefore, been studied by several geologists, while several palæontologists have investigated certain members of the fauna.

The banks of the approach-cutting to the southern (or Duckpool-Farm) end of the tunnel are, for the most part, overgrown; but in the northern approach-cutting there is still a very good section. This is mainly due to the fact that huge masses of Oolite are continually becoming detached from the parent mass, and slipping forward, occasion much concern to those responsible for the safety of the travellers on the railway below.

T. Beesley, the first to describe the sections, thought that the whole of the Oolite in this northern approach-cutting belonged to the *Murchisonæ*-Zone of the Inferior Oolite, and that it was comparable with the development that obtains at Ebrington and Bredon Hills.[1] He gives a long list of fossils, and, in his account of the cutting on the south side of the tunnel, notes that the sequence there is from the Upper Lias to the Great Oolite.[2]

Mr Walford published a more detailed record in 1883,[3] and so closely does it agree with the present one, that I have retained his numbers for the beds. The beds about those numbered 22-24 vary considerably, as might be expected in the neighbourhood of a Conglomerate-Bed that marks an important non-sequence.

1 Proc. Geol. Assoc., vol. v., No. 4 (1877), p. 170.
2 *Ibid.*, p. 172.
3 Quart. Journ. Geol. Soc., vol. xxxix. (1883), pp. 228-231 and 239-242.

Towards the tunnel-end of the western bank the Coral-Bed becomes well-defined and therefrom the late R. F. Tomes collected a number of corals.[1]

The record given by Mr H. B. Woodward is based upon those published by Beesley and Walford. This section also agrees in general with the present one, and the beds numbered 25 and 26a, b and c in my section correspond to those that are bracketed together by Mr Woodward as equivalent to the "Northampton Beds." Mr Woodward observes that[2]

> "the Chipping Norton Limestone is, no doubt, represented in the upper strata, while lower down, the *Clypeus*-Grit and the *Trigonia*-Grit of the Cotteswolds may be represented in point of time."

The *Clypeus*-Grit is probably represented by the Conglomerate-Bed, and it may be that the Coral-Bed is on the horizon of the Upper Coral-Bed of the Cotteswolds and Bath-Doulting district; but I did not notice any representative of the Upper *Trigonia*-Grit.

No. 9. THE HOOK-NORTON RAILWAY-CUTTING SECTION

(*West side of the Cutting*)

					Thickness in feet	ins.
Great Oolite	Bathonian (*pars*)	Neaeran Beds		1. Soil, with here and there, according to Walford,[3] pieces of the *Exelissa*- and *Astarte*-Limestones;[5] *Cyathopora pratti*, E. & H., *C. luciensis*, E. & H.,[6] etc...	0	6[4]
				Non-sequence		
		Swerford Beds		2[7] Horizon of Plant-Bed. Limestone, flaggy, white, oolitic	2	0
				3. Sand, weathering white and very conspicuous	3	6
				4. Limestone, bored in places by annelids	1	9
				5. Sand, brown and yellow } With *Ostrea cal-*	0	11
				6. Limestone, sandy } *ceola* and *Lima*,	0	4
				7. Sand, brown and yellow } (*teste* Walford)	0	5
				8. Limestone, sandy, with incipient "pot-lid" structure at the base: 2 ft. 3 ins. to 3 ft.	2	3
				9. Sand, yellow and brown; *Serpula* & *Ostrea*	0	1
				10. Limestone, sandy. The top-surface of this bed is often well waterworn and pitted and covered with oysters	1	10
				11. Sand, coarse, gritty	0	2
		T-signata Bed		12. "Old Man." Limestone, hard, brown, sandy, with a waterworn surface covered with oysters and pebbly at the base	1	3
		Hook-Norton Beds		13. Sand, brown and yellow, with occasional "knots."	0	2
				14. Limestone, brown, shelly; *Pteria inæquivalvis*, auctt., and shell-fragments: about	1	11
				15. Clay, dark, with a brown layer	0	7
				16. Limestone, shelly	0	5
				17. Clay, arenaceous	0	2
				18. Limestone, hard, sandy, brown but blue-centred, with numerous pieces of lignite	1	0
				19. "Plant-Bed" (of Walford). Limestone, brown, sandy, full of brown fragments of lignite. This bed is really the bottom-portion of 18	0	4
				20. Clay	0	2½
				21. Limestone, brown, shaly, and marl	2	0

1 Proc. Geol. Assoc., vol. vi., No. 4 (1879), pp. 152-165.
2 "The Jurassic Rocks of Britain, etc." vol. iv. (1894), p. 155.
3 Quart. Journ. Geol. Soc., vol. xxxix. (1883), p. 230.
4 The thicknesses of beds 1 to 9 are extracted from Mr Walford's record, but were checked as far as was possible.
5 And probably of the Lower *Nerinæa*-Bed as well.
6 Proc. Geol. Assoc., vol. vi., No. 4 (1879), p. 161.
7 Beds 2 to 13 = Block E of Walford; beds 14 to 21 = his Block D; and 22*a* and *b* (Walford's beds 22-24) = his Block C.

				Thickness in feet	ins.
Oolite		Upper Coral-Bed and *Clypeus*-Grit Equivalent	These beds 22-24 of Walford vary considerably.	22*a*. Limestone, very hard, somewhat ferruginous, with a very irregular under surface, forming a kind of cap to the Conglomerate-Bed; *Astarte minima*, Phil., *Trigoniæ*, *Acanthothyris* sp.: about	0	6
				22*b*. Conglomerate-Bed. Pebbles, water-worn, bored by *Lithophagi* and often covered with oysters, and *Serpulæ*, in a brown, rather sandy, marl with bleached oysters and well-rolled shells. Where this bed is thicker and less conglomeratic, the Coral-Bed[4] comes in at the base; *Rhynchonella* cf. *subtetrahedra*, Dav., common, *Gresslya abducta* (Phil.), *Pleuromya* cf. *goldfussi* (Lyc.) and other species, *Pholadomya* sp., *Myoconcha*, *Cucullæa*, *Alectryonia*, *Pteria inæquivalvis*, auctt., *Serpulæ*, etc: average	0	5
				Limestone, very hard	0	5
				Limestone, hard, iron-speckled, with irregular under surface	0	4
Inferior	Aalenian (*pars*)	*Scissum*-Beds		*Non-sequence*		
				25[1] "Ammonite-Bed." Limestone; *Lioceras opalinum* (Reinecke), *L. thomsoni*, S. Buckman, *Hammatoceras* aff. *newtoni*, S. Buckman,[3] *Volsella sowerbyana* (d'Orb.), *Pleuromya* sp., *Gresslya abducta* (Phil.), etc ..	1	6
				26*a*.[2] Limestone, massive, often joined on to the bed below; *Trigonia brodiei* Lyc., *Rhyn. cynocephala* (Rich.), *Astarte elegans* Sow., *Belemnites* spp., *Isocrinus*-ossicles, etc. ..	1	5
				26*b*. Limestone, massive	1	8
				26*c*. Limestone, massive	2	2
				27. Seam of sand, not very conspicuous	0	3
Upper Lias	Toarcian			Hemera *Non-sequence*		
				28. Clay, blue, with curiosly-shaped, hard grey-blue limestone-nodules; *Peronoceras fibulatum* (J. de C. Sow.), *Harpoceras subplanatum* (Oppel.) *Nuculana ovum* (Sow.), *Inoceramus dubius*, Sow., *Orbiculoidea reflexa* (Sow.), etc.: 30 to	40	0
				[*acuti* 29. Position of "Transition-Bed"].		
Middle Lias	Pliensbachian			*spinati* Marlstone.		

brauniani *fibulati* *subcarinati* and *falciferi*

1 Bed 25 = Block B of Walford, and
2 Beds 26*a*, *b*, *c* and 27 = his Block A.
3 "Monogr. Inf. Ool. Amm. Brit. Isles," pt. 2 (1888), pp. 52 and 53; Suppl., p. xxxv. Pal. Soc.
4 R. F. Tomes recorded from the Coral-Bed (Proc. Geol. Assoc., vol. vi., No. 4 (1879), pp. 156, etc.), *Clausastræa conybeari* (E. & H.), *Isastræa beesleyi*, Tomes, *I. limitata* (Lamx.), *I. serialis*, E. & H., *Latimeandra lotharinga* (Michelin), *Thamnastræa defranciana* (Mich.), *Thamnastræa* sp., etc.

The *Scissum*-Beds are typical and quite easy to locate and date.

The Conglomerate-Bed is a most interesting deposit, and, it should be particularly noticed, contains " dark pebbles," which serve to differentiate it from other conglomerate-beds in higher subdivisions. Also, it should be observed, that if this deposit were absent, it would be difficult on a cursory inspection to separate the *Scissum*-Beds from the Hook-Norton Beds.

The beds *below* the Conglomerate-Bed contain plant-remains only rarely; but those above, not infrequently, and at certain horizons, as in bed 19, even abundantly.

Mr Walford did not identify any stratum in this section with his *Trigonia-signata*-Bed, but Mr Paris and I are of opinion that bed 12 is on its horizon.

SWERFORD QUARRY.—This quarry (10) is known locally as " Bennet's Quarry " and has been briefly described by Mr Walford.[1]

No. 10. SWERFORD QUARRY

		Thickness in feet	ins.
Neæran Beds	4. *Ostrea*-Clay (in pockets). Clay, dirty-yellow; *Ostrea* abundant		
	5. Clay, stiff, dirty-brown, passing down into bed 6. [*?Horizon of "Neæran Slates"* (Walford) *of Langton Bridge*].		
	6. Bituminous Clay. Clay, black and bluish-grey, tough, brownish at the base: 6 ins. to 2 ft.	1	3
	(*Beds 7 to 12, incl., absent*).		
	13 [2].[2] *Cyathopora-bourgeti*-Bed. Dirty grey-white marl with bluish-grey (weathering white) concretions; *Perna mytiloides*: 6 ins. to	2	0
	14. *Lower Nerinæa-Bed.* Limestone, grey, sandy, with specimens of *Nerinæa*, *Ostrea* and *Perna mytiloides* common on the nether surface, which is irregular; *Protocardia buckmani* (M. & L.): 11 ins. to	1	3
	(*Bed 15, the Astarte-Bed, absent*).		
	16. [? Bottom-portion of Walford's bed 4]. *Exelissa*-Limestone. Limestone (similar to that at Sharp's Hill), very shelly ..	0	6
	(*Beds 17 and 18, bed 18 being the Perna-Bed, absent*)		
	19 and 20. [5], Clay, brown and yellow: 1 to 6 ins.	0	3
	20*a*. [6], Rubbly, sandy rock and reddish-brown sand passing down into the bed below: 3 ins. to 1 ft.	0	7

1 Quart. Journ. Geol. Soc., vol. xxxix. (1883), p. 231.
2 The numbers in square brackets refer to Mr Walford's record.

			Thickness in feet	ins.
Swerford Beds	2.[1]	Plant-bed equivalent. Limestone, siliceous, weathering flaggy	2	0
	3 & 4	Limestones, very siliceous, with a particularly shelly-bed (comparable with a similar bed in sections 12, 17, 22, 28 and 33) at 2 to 3 feet down. At the south-eastern end of the quarry, these beds have been reduced to a white sand, in which the "*shelly-bed*" is conspicuous as a yellower band[2] ..	4	2
	5 to 11	Limestones, more massive, with oysters very abundant (especially in the top-bed) and noticeable	6	0
T.-signata Bed	12	Conglomerate-Bed, with well-rolled pebbles of oolite (some of them bored and encrusted with oysters and Serpulæ) at 6 feet down. Associated with the pebbles are waterworn oysters, *Lima ?cardiiformis*[3] and echinoid-radioles	1	0
Hook-Norton Beds	13 to 18.	Limestones: seen:	3	0

The principal non-sequence in the Swerford Quarry occurs at the same horizon as that at Sharp's Hill, that is, immediately below bed 6. The *Exelissa*-Limestone is readily-recognised, being identical, as regards faunal and lithic characters, with its equivalent at Sharp's Hill.

The following are notes on sections of minor importance:

QUARRY 11.—In this old circular quarry there are traces of black clay (? bed 6) and of the flaggy limestone, bed 2.

QUARRY 12.—In this quarry there is seen, in descending order, the flaggy limestone (bed 2); yellow sand and sandy rock (with a 4-inch "*shelly-bed*," full of *Trigoniæ*, at 2 feet from the top); and then massive limestones.

QUARRY 13.—This quarry is in Chipping-Norton Limestone.

QUARRY 14.—This section is now quite overgrown; but Mr Walford[4] observed traces of black clay on top of the limestone.

QUARRY 17.—In this quarry a 12-foot face of Chipping-Norton Limestone is seen, with the "*shelly-bed*" (which contains specimens of *Isastræa*, *Astarte*, *Trigonia*, etc.) about the middle.

QUARRY 18.—This quarry is in similar beds to the preceding (17).

QUARRY 19.—Here slightly higher beds are exposed. They comprise four beds of limestone (with *Ostreæ*) with intervening "sand-beds," the top one of which is more marly than the others, and full of *Nerinææ*.

QUARRY 20.—In this quarry there is a marl, rich in *Nerinææ*, similar to the *Nerinæa*-Marl in quarry 19; but in this case it occurs in a marl and "sand"—the whole deposit being not unlike that which is numbered 3 in the Hook-Norton Railway-Cutting Section.

1 These numbers correspond to those used in dealing with the Swerford, *Trigonia-signata*- and Hook-Norton Beds in the Hook-Norton Railway-cutting.

2 In fissures in this limestone were observed, in places, little black concretions similar to those seen in a quarry near Lower Swell, near Stow-on-the-Wold (*vide* Proc. Cotteswold Nat. F.C., vol. xvi., pt. 1 (1907), pp. 24 and 25).

3 In this paper a query refers to the word it precedes.

4 Quart. Journ. Geol. Soc., vol. xxxix. (1883), p. 232.

DUNTHROP.—Mr H. B. Woodward has published some notes on this section (22) and queried all the limestones below the " shelly-bed " as being equivalent to the Oolite Marl'.

No. 22. DUNTHROP QUARRY

			Thickness in feet	ins.
Neæran Beds		Reddish, sandy and clayey soil and subsoil.		
Swerford Beds	2.	Limestone, weathering into flaggy pieces ..	2	0
	3 & 4	Limestone, also weathering flaggy. At the top it often breaks up into a yellowish, oolitic, rubbly and seemingly " sandy marl " [= the *Clypeus*-Grit of Mr Woodward[2]), and at 2 feet 2 inches below bed 2 is an irregular shelly-bed (sometimes pebbly)[3] in which *Trigoniæ* abound, and occasional specimens of *Ostrea*, *Lima ?cardiiformis*, *Perna* and *Isastræa* occur	4	4
	5 to 11	Limestones, more massive-bedded, iron-stained along the joints	5	0
T. signata Bed	12	Limestone, hard, average	1	0
Hook Norton Beds	13 etc.	Limestones, with irregular runnelled surfaces similar to those in quarry number 33 : seen ..	3	0

The following sections are of less importance :

WEST-WOOD QUARRY (23).—At the top are white " sandy " marls and rubble, similar to the deposit seen in the quarry north of Chapel House (20), then a marl-bed similar to that seen in the Dunthrop Quarry (22), with brown oolitic limestones, which pass down into more-than-usually-ferruginous limestones, below.

LEYS-FARM QUARRY (24).—In this quarry, the highest bed seen is the equivalent of bed 2 in the Dunthrop Quarry. At its base is the equivalent to the rubbly marl of that section and of the sandy marl of the West-Wood Quarry. Then comes a conspicuous bed of limestone, under which is oolitic rubbly marl, about on the horizon of the " shelly-bed " of Dunthrop, with below, the ordinary limestones. Another quarry (25), nearer the farm, is in similar limestones.

THE DOWNS QUARRY.—In this quarry about 15 feet of Chipping-Norton Limestone is exposed. As a rule, the limestone is well oolitic, and has a tendency to become sandy in the upper portion and black speckled in places. In one part of the quarry a considerable number of pieces of a greyish limestone were found, which were literally crowded with gastropods—mostly *Nerinææ*. The bed was not detected *in situ* ; but there is little doubt that it is on the horizon of the Lower *Nerinæa*-Bed and is comparable with the Gastropod-Bed seen in a quarry near Lower Swell, near Stow-on-the-Wold.[4]

1 " The Jurassic Rocks of Britain," vol. iv. (1894), p. 161.
2 Mr Woodward queries this suggestion.
3 When this layer is pebbly, it is not unlike that in Boulter's-Barn Quarry, near Churchill (51)
4 Proc. Cotteswold Nat. F.C., vol. xvi., pt. 1 (1907), p. 24.

Quarry number 27 is also in the Chipping-Norton Limestone.

GREAT TEW.—This section is an important one (28) and should be visited by anyone working the district.

No. 28. QUARRY AT GREAT TEW

			Thickness in feet	ins.
Swerford Beds	2.	Limestone, pale-brown, hard, rubbly: seen (in the eastern side of the quarry)	1	9
	3 & 4.	Limestone, similar, rubbly mixed with sand, in the southern face becoming a white and yellow sand with the "shelly-bed" about the middle	4	6
	5 to 11	Limestone, hard, massive, with an extremely shelly bed (with *Trigoniæ*, *Lucinæ*, etc.) joined on to the bottom limestone	3	2
		Limestone, sandy, rubbly, mixed with sand ..	1	6
"Old Man"	12.	Limestone, massive, sandy, in three layers, ferruginous and shelly. Pebbles waterworn, bored by *Lithophagi* and with oysters on them, are embedded in the top-portion of the bed, which has a very irregular nether surface..	2	3
Hook-Norton Beds	13.	Sand, brown and grey-streaked	0	10
	14.	Hard calcareous sand-rock passing into soft brown sand	0	9
	16.	Brown sandy rock; *Syncyclonema demissum* auctt.	0	7
	18.	Somewhat hard, bluish-grey centred shelly sandy rock: seen	0	4

Tomes records *Cryptocœnia luciensis* E. & H. and *Isastraea beesleyi* Tomes, from Great Tew.[1] They would come from higher beds than any now exposed in this quarry, the main feature of which is the tendency for the beds *above* 12 to become rubbly and sandy, and for those *below* (which all contain plant-remains in the form of black lignite with occasional fern-fronds) to become noticeable soft brown sand.

BELL-INN QUARRY.—This quarry (29) is fast becoming filled up with refuse. This is unfortunate, for some of the beds are extraordinarily fossiliferous and the majority of the specimens excellently preserved.

Mr Walford has given a brief record of this section,[2] which has otherwise escaped attention.

1 Proc. Geol. Assoc., vol. vi., pt. 4 (1879), pp. 157 and 160.
2 "On Some New Oolitic Strata in North Oxfordshire" (1906), pp. 24-25.

No. 29. BELL-INN QUARRY, ENSTONE

		Thickness in feet	ins.
Nearan Beds	2. Clay, dirty-yellow, marly; *Ostrea* (common), *Terebratula globata* auctt., passing down into ..	0	7
	3. Clay, dirty-green .. .. (*Bed 4, the Ostrea-Clay, absent*).	0	2
	a. Upper Placunopsis-Bed. Marl, dirty-yellow and greenish-grey, crowded with *Placunopsis socialis* M. & L., and containing occasional pieces of shelly stone	0	6
	b. Sand, reddish-brown intimately associated here with bed 14 .. .. (*Beds 5c to 13 incl. absent*).	0	2
	14.[4 of Walford]. *Lower Nerinæa*-Bed. *a.* Sandstone, very hard, calcareous, passing down into the *b.* "*Fossil-Bed.*" Limestone, yellowish, very fossiliferous; *Arctica loweana* (M. & L.), *Astarte minima* Phil., *Corbula buckmani* Lyc., *Gervillia enstonensis* Paris, *Grammatodon* sp., *Perna oxoniensis* Paris, *Ostrea* aff. *acuminata* Sow., *Placunopsis socialis* M. & L., *Volsella imbricata* (Sow.), *Alaria* sp., *Nerinæa eudesi* M. & L. and other species, "*Phasianella*" *elegans* M. & L., etc.	0	8
	(*Beds 15, i.e. the Astarte-Bed, 16, the Exelissa-Limestone, and 17 absent*).		
	18 [and 19 = 5 of Walford]. *Perna*-Bed. Marly limestone; *Perna oxoniensis* Paris, *Ostrea* and many of the shells of the bed above, common. Passes down into		
	19. Clay, greenish-grey marly	0	9
	20 [6]. Clay, black	0	6
	20*a*. [7]. Sand, reddish, and ferruginous sandy stone	0	1
Chipping-Norton Limestone	Limestones, compact: seen:	11	0

It is unnecessary to add any remarks to the above record.

Traces of black clay (bed 20), white marl and fossiliferous limestone, are seen (all very much intermingled) on top of the Chipping-Norton Limestone in quarry 30, that is, the section referred to by Mr H. B. Woodward as "south of Enstone (east of the 69th milestone)."[1] In the same quarry are fine masses of travertine.

The Chipping-Norton Limestone is exposed in the quarry numbered 31; while 32 is Walford's "Fulwell Quarry."

1 "The Jurassic Rocks of Britain, etc." vol. iv. (1894), p. 161.

No. 32. FULWELL QUARRY

			Thickness in feet	ins.
		Dark green clayey subsoil with numerous *Ostreæ*: seen	1	0
Neæran Beds	5.	*a.* Upper *Placunopsis*-Bed. Clay, bluish-grey, shelly, with occasional pieces of bluish limestone full of *P. socialis*..	0	6
		b. Reddish-brown, sandy and *c.* Greenish-grey sandy clay 3 to 6 ins. ..	0	4
	6.	Bituminous Clay .. .. (*Beds 7 to 13, incl., absent*).		
	14.	Lower *Nerinæa*-Bed. *a.* Sandstone, very hard, calcareous; *Perna oxoniensis* Paris, *P. mytiloides*, *Mytilus*, *Camptonectes lens* (Sow.), *Volsella imbricata* (Sow.), *Nerinæa* spp., *Rhynchonella concinna*, *Cyathopora bourgeti* (Defr.), etc.: 0 to	0	3
		b. Limestone, greyish-white, rubbly, mixed with some marl; *Perna oxoniensis*, *Grammatodon* sp., *Tancredia* cf. *angulata* Lyc., *Ataphrus labadyei* (d'Arch), etc.	0	6
		(*Beds 15, the Astarte-Bed, 16, the Exelissa-Limestone, 17, 18 the Perna-Bed, and 19 absent*).		
	19.	Clay, greenish-grey, marly with small concretions that weather into soft calcium carbonate, passing down into	0	6
	20.	Clay, black (weathering bluish-grey): about..	0	8
Swerford Beds	2.	[?Horizon of Plant-Bed]. Limestone-layers graduating into brown sandstones with intervening layers of marly sand and clay, weathering to a cream colour on the surface	1	6
	3 to 11	Limestones, massive, sandy	7	0
"Old Man"	12.	Limestone, massive	1	4
Hook-Norton Beds	13 to 18.	Limestones, fairly well bedded, brown and sandy, with a tendency to become reduced to a yellow sand: seen	4	0

CHARLBURY-ROAD QUARRY, ENSTONE.—In this quarry (33) the pale-coloured marls 19 and black clay 20 are seen at the top with the Lower *Nerinæa*-Bed puzzlingly intermingled. Below are the Chipping-Norton Limestones with at from 2 to 3 feet down a "shelly-bed," and at 9 feet down a fairly massive bed, one foot thick, which is probably on the horizon of the "Old Man." Below are limestones with "wavy" surfaces. Large stretches of these were exposed in the floor of the quarry, and are reminiscent of the waterworn surfaces of the Sully Beds at Lavernock, near Cardiff. The beds probably correspond to the Hook-Norton Beds, which at Great Tew are so sandy.

Chipping-Norton Limestone is exposed in the quarries numbered 34 and 35.

DITCHLEY-ROAD QUARRY, CHARLBURY.—This quarry (36) has been considerably worked since Mr Walford published his brief description of it (pages 23 and 24 of his paper). The Upper and Lower *Placunopsis*-Beds (*i.e.*, beds 5 and 19-20 respectively) can be made out, but at the time of my visit, there was only a 4-inch bed of black and brown clay parting them. An *Ostrea*-Clay occurs above the Upper *Placunopsis*-Bed, and is succeeded by limestone, which is several feet in thickness. According to Mr Walford " black clays with [an] oyster bed at [their] base " and 1 ft. 5½ ins, thick come above this limestone and are succeeded by the *Rhynchonella*-Bed of the Great Oolite.

HAWK-STONE QUARRY, DEAN.—This quarry (37) displays some most interesting beds, full of large gastropods. As far as can be seen they constitute a local modification of the top-portion of the Chipping-Norton Limestone.

HAWK-STONE QUARRY, DEAN

			Thickness in feet	ins
Neæran Beds	19 & 20	Clay, dirty greenish and brown at the base, with inclusions of " sooty " clay : *Placunopsis socialis* ..		
Chipping Norton Limestone	*a.*	Upper Gastropod Limestone. Limestone very hard, white ; large gastropods (? *Pseudomelaniæ*) : about	1	0
	b.	Limestone, hard, white, with numerous small specks of calcite which weather in relief : 6 ins. to 1 ft...	0	9
	c.	Marl, bluish-grey : 4 to 8 ins.	0	8
	d.	Limestone, white	0	8
	e.	Lower Gastropod Limestone. Limestone, hard, brownish ; large gastropods	1	7
		Limestone, fairly massive : seen	8	0

EAST-END QUARRY, CHADLINGTON.—The following is the succession in this quarry (38) :

EAST-END QUARRY, CHADLINGTON

			Thickness in feet	ins.
Great Oolite		Limestones		
	2.	Clay, dirty-yellow and greenish-grey ; *Ostrea* (common), [*Rhyn. concinna* not found *in situ*] ..		
	Cf.S.S.	Limestone, hard, greyish brown, fissile in places ; nether surface very level : about..	4	8
		(*Beds* 3 *to* 18, *incl., absent*).		

EAST-END QUARRY, CHADLINGTON—*continued.*

		Thickness in feet	ins.
Neæran Beds	19. Yellow sand with some "films" of greenish clay: 0 to	0	3
	20. Reddish-brown sand: 0 to 2 ins.	0	1
	Black sooty clay: 0 to 2 ins.	0	1
	Lower *Placunopsis*-Bed. Reddish-brown or chocolate-coloured marly clay, with occasional seams of sand; *P. socialis* very abundant: 0 to 6 ins. ..	0	3
	(*These Neæran Beds rest upon a very uneven surface of the underlying limestones, and in places are absent, the bed marked "Cf. S.S. [Compare Stonesfield Slate]" then resting directly upon the Chipping-Norton Limestone*).		
Chipping-Norton Limestone	*a.* Upper Gastropod Limestone. Limestone, creamy-white and brown, full of large gastropods as at the Hawk-Stone Quarry. Very irregularly-developed: about	1	0
	(*Beds b, c, d and e of the Hawk-Stone Quarry absent*). Limestones, very much disturbed	8	0

The Upper Gastropod Limestone may be on the horizon of the Plant-Bed.

The two quarries (39) and (40) near Barter's-Hill Farm are in the Chipping-Norton Limestone.

BARTER'S-HILL-CAMP QUARRY.— Here (41) about 15 feet of limestone is exposed. At the base are massive limestones, then comes the "Knotty-Bed" (="Old Man"), and this is followed by less-massive limestones that have a shelly-bed at 2 feet above the top of the Knotty-Bed.

LYNEHAM-BARROW QUARRY.—Beds similar to those seen in the last quarry are exposed here (42). The limestones *below* the Knotty-Bed are very massive, and have a tendency to fissure vertically. Those *above* comprise false-bedded and flaggy limestones, which may be on the horizon of the Gastropod Limestones and associated deposits of the Hawk-Stone and East-End Quarries, with a rather white limestone on top. Upon this stratum rests all that represents the Neæran Beds—a layer of clay (bed 19) overlaying reddish-brown sand (bed 20), which together measure 4 inches in thickness. Above these deposits come 5 feet of Great-Oolite limestones, which contain not infrequently fish-teeth, such as *Mesodon*, which are not uncommon in the true Stonesfield Slate at Stonesfield.

LYNEHAM-BARROW QUARRY 2.—In the quarry numbered (43), most of the limestone exposed is Chipping-Norton Limestone. At the extreme north-west corner, however, are later beds. They comprise, in ascending order, marl with *Placunopsis socialis* M. & L. abundant, overlain by brown and bluish clays with sandy patches and "sooty" (wood) inclusions (beds 19 and 20), and then pale yellow marl and stone 8 inches thick (bed 18), which adheres to the base of Great-Oolite limestones similar to those exposed in the preceding section (42).

The 8-inch bed is important. It is in part of remanié nature, containing *Strophodus magnus* Ag., *Homomya*, *Ostrea*, *Trigonia*, *Perna*, *Rhynchonella*, etc. The occurrence of specimens of *Perna* is important, because it shows that the marls with *Placunopsis* below are on the horizon of the Lower *Placunopsis*-Bed.

CASTLE-BARN QUARRY.—This section (44) is best known in connection with the *Viviparus*-Marl[1] which is replete with specimens of *Viviparus langtonensis* (Hudleston).

No. 44. CASTLE-BARN QUARRY

			Thickness in feet	ins.
		Prominent bed of irregularly-fissile, oolitic, shelly limestone: seen	2	0
		Ostrea-Bed. Marl, dirty yellow, and dark clay: *Ostrea*	0	6
		Limestone, sparsely-oolitic, flaggy-bedded, except at the bottom where there is a massive bed (1 ft. 3 ins.) splitting on exposure into a rough tilestone (*cf.* Stonesfield Slate). The under surface is irregular and has pebbles embedded in it	5	6
		(*Non-sequence*).		
Neæran Beds	11.	*Viviparus*-Marl. Marl, white, indurated, sparsely-oolitic; full of specimens of *Viviparus langtonensis* (Hudl.), passing down into a brownish-white marl (8 ins.) with which is associated greenish clay	1	8
		(*Beds 12 to 20, incl., absent*).		
Chipping-Norton Limestone	2 to 11	Limestone, brown oolitic, more massive at the base	6	6
	12.	Limestone, very hard, "knotty"	1	0
	13 to ?	Limestones, massive, with sandy partings: seen ..	6	0

In quarry 45 there is a trace of greenish clay belonging to the Neæran Beds, as at Padley's Quarry, resting upon oolite, whose granules have been separated by dissolution to resemble a marl-deposit at a distance, and soft enough for rabbits to burrow in. Below are more massive limestones.

1 H. B. Woodward "The Jurassic Rocks of Britain," vol. iv. (1894), p. 153.

QUARRY EAST OF SARSGROVE.—In this quarry (46), as Mr Woodward has remarked, "some of the layers [of the Chipping-Norton Limestone]. . are remarkably false-bedded."[1]

QUARRY WEST OF CHADLINGTON-DOWN FARM.—The section in this quarry (47) has been referred to by Mr Woodward, who has given a sketch of a portion of the quarry-face and a brief record of the beds exposed.[2]

QUARRY SOUTH-WEST OF CHADLINGTON-DOWN FARM

			Thickness in feet	ins.
Neæran Beds.		19 & 20. Brown clayey subsoil at the western end	0	9
Chipping-Norton Limestone	*a.*	Limestone, close-grained, flaggy, sparsely-oolitic	2	0[3]
	b.	Limestone, hard, white, with specks of calcite weathering in relief	0	8[3]
	c.	Marl, whitish-grey,[4] passing down into hard brownish clays with yellow sand, and lumps of hard sandy limestone (= Bed 3 of Mr Woodward's record) intimately associated with the top-bed of..	1	2
		Limestones: seen	10	0[5]

A quarter of a mile south of Chadlington-Down Farm are two quarries (48) in which much the same beds are exposed as in quarry 47. In the western one of the two, about 4 feet of Chipping-Norton Limestone is exposed, then a marly zone to poorly represent bed *c* in the preceding section, with a dense white limestone with numerous specks of calcite, which weather in relief (1 ft. 6 ins.) to represent bed *b* of that section; while on top comes 2 feet of whitish limestone.

About a mile due west of Chadlington-Down Farm are two quarries. The first (49) is abandoned; but the second (50) is in work. In it about 18 feet of Chipping-Norton Limestone is exposed, and here and there at the top, and often filling in large fissures, are remains of the same type of Neæran Beds as at Padley's Quarry, pieces of the *Placunopsis*-Marl being especially noticeable; while here and there pieces of marl with oysters—indicative of the *Ostrea*-Marl of that section—occur.

1 "The Jurassic Rocks of Britain, etc." vol. iv. (1894), p. 153.
2 *Ibid*, pp. 152-153. 3 = Bed 6 of Woodward. 4 = Bed 4 of H. B. W.
5 = Beds 1 and 2 of H. B. W.

BOULTER'S-BARN QUARRY, CHURCHILL.—In this quarry the Chipping-Norton Limestones differ somewhat from their usual aspect.

No. 51. BOULTER'S-BARN QUARRY

		Thickness in feet	ins.
	Soil in places clayey, with a few *Ostreæ*.		
Chipping-Norton Limestone	Limestone more or less flaggy as in the sections in the north-eastern portion of the district: seen	2	0
	Limestones, hard, with numerous pebbles of oolite and occasionally of quartz; *Nerinæa* spp.	1	0
	Limestones	10	0
	Brownish rubbly stone and marl; *Ostrea sowerbyi* M. & L., *O.* cf. *subrugulosa* M. & L. and *Alectryonia costata* (Sow.)	0	6
	Limestone: seen	2	0

Typical *Clypeus*-Grit is occasionally seen in the road-banks between this quarry and Churchill (*vide* map, figure 1).

PADLEY'S OR THE CETIOSAURUS QUARRY, CHIPPING NORTON.—This classic quarry (52) is situated in the part of Chipping Norton called "Tite's End"; but now the once vast quarry is practically abandoned, and cottage-gardens are sheltered in its welcome depression. Now, this part of Chipping Norton is better known as "The Quarry."

The following details were obtained at the extreme southern end of the quarry.

No. 52. PADLEY'S QUARRY, CHIPPING NORTON

		Thickness in feet	ins.
Neæran Beds	Limestone, coarse, oolitic, shelly with a tendency to become flaggy at the base. The bottom-layer, as at the Ditchley-Road Quarry, Charlbury, has an irregular under surface, is intermittent and is mixed up with some chocolate-coloured clay in places. The top-portion of this irregular limestone has occasional gastropods in it, and in the bottom-portion, numerous oysters; *Trigonia pullus* M. & L.: seen 4 to	5	0
	4. & 5. *Ostrea*-Clay. Clay, dirty greenish-grey and pale-yellow, crowded with oysters: more clayey at the top and marly below; *Placunopsis socialis* M. & L., *Serpula*, pentacrinoid ossicles and echinoid-radioles	1	6
	Clay, tough, greenish, irregular; bones of *Cetiosaurus*: 0 to 9 ins.	0	4
	[*Position of bed* 11 *of Castle-Barn Quarry*]		
	Marl, pale-yellow, with "race"; *P. socialis* M. & L., abundant: 0 to 6 ins.	0	3
	19 & 20. Shaly, dirty-green, reddish-brown clay with crowds of *Placunopsis socialis* M. & L. ..	0	3
	Clay, tough, greenish-brown	0	4
	Limestone, rotten, often reduced to white carbonate of lime: 0 to 2 ins.	0	2
	Yellowish sand and clay, intimately associated with the irregular sandy limestone-top of the beds below	0	8
Chipping-Norton Limestone	Limestones: seen	12	0

This section has been briefly described by Hudleston[1] and the top-bed of the above record corresponds to his bed A; 19 and 20 to his bed B, together with his "variable line of loose reddish sand"; and the top-layer of the Chipping-Norton Limestone to his bed C. Mr H. B. Woodward has also given a record,[2] which in the main, agrees with the above; but he records the remains of *Cetiosaurus*[3] from the deposit in his section that corresponds to beds 19 and 20 in the above record.

The Chipping-Norton Limestone is well displayed in a quarry near the Workhouse (53) and has been worked at Over Norton and other places in the immediate neighbourhood. It is poorly exposed at the top of the bank in the deep cutting (55) on the way to Langton Bridge, where Windoes identified the *Clypeus*-Grit "and the probable equivalents of [Walford's blocks] C and D" below it.[4]

LANGTON-BRIDGE RAILWAY CUTTING.—The section here (56) has been described in detail by T. Beesley;[5] a somewhat clearer record has been published by Hudleston;[6] and additional details have been given by Mr Walford (pp. 15-16).[7]

No. 56. LANGTON-BRIDGE RAILWAY-CUTTING

			Thickness in feet	ins.
	[1].	Great Oolite marls and limestones with a bed of fissile sandy limestone at the base .. .. T. Beesley records that the lowest of these beds is a pale grey clay with *Ostrea sowerbyi* and *Rhynchonella concinna*, 2 feet	74	0
	[2].	Limestone, compact grey crystalline and shelly ..	3	8
	[3].	Grey marl with *Pteroperna*, oysters and gastropods ..	1	8
	[4].	Neæran Slate. A fissile limestone with *Neæra ibbetsoni*	0	4
	[5].	Marl, shelly and sandy	0	2
	[6].	Clay, grey, rather sandy at the base, with *Ataphrus*, *Isastræa* sp.	0	6
6	[7].	Bituminous Clay. Black, but lighter in the lower part: 3 feet thick according to Hudleston: average .. (*Beds 7 to 10 incl. absent*).	1	6
11	[8]	*Viviparus*-Marl. Grey mortar-like limestone(= sticky, marly clay with small *Ostrea*, etc. of Hudleston's record, 2 ft. 7 ins.); *Nerinæa*, *Viviparus langtonensis* (Hudl.)	3	0
20	[9].	Red Sand	4	0
C.N.L.	[10-13].	Limestones, fawn-coloured, siliceous: seen ..	16	6

1 Proc. Geol. Assoc., vol. v., No. 7 (1878), pp. 384-385.
2 "The Jurassic Rocks of Britain, etc.," vol. iv. (1894), p. 327.
3 See also Owen, Proc. Geol. Soc., vol. iii., p. 457.
4 Quart. Journ. Geol. Soc., vol. xxxix. (1883), p. 236.
5 Proc. Geol. Assoc., vol. v., No. 4 (1877), pp. 178-180.
6 *Ibid.*, No. 7 (1878), pp. 379-381.
7 Also Quart. Journ. Geol. Soc., vol. xxxix (1883), p. 234.

The numbers in square brackets refer to Mr Walford's record (pp. 15-17). Beds 2 to 6 = beds 14 and 15 of Beesley's record; bed 7, his bed 16; and beds 8 and 9, Beesley's bed 17, but the measurements and descriptions vary considerably. Beesley thought that the red sand [9] passed horizontally into the *Viviparus*-Marl [8]; but I have little doubt that Mr Walford's arrangement is right, as the beds then come into line with similar deposits elsewhere. Hudleston's record agrees generally with Mr Walford's; but he would regard bed [2] as more closely related to the overlying Great Oolite than to what Mr Walford calls the Neæran Beds. Mr Walford regards the *Viviparus* [*Paludina*] -Marl here as equivalent to the *Viviparus*-Marl of Sharp's Hill, and therefore assigns beds [2] to [7], inclusive, to a position between the *Viviparus*-Marl and Bituminous Clay at Sharp's Hill.

The irregular thickness of the red sand at Langton Bridge reminds one of the similar and yet more irregular deposit in the quarry near Stow-on-the-Wold.[1] The Oxfordshire sections might give the impression that the deposit was mainly derived from the dissolution of the immediate subjacent sandy Chipping-Norton Limestones; but that near Stow shows that it was an independent irregular accumulation, as it there rests directly upon ordinary oolitic limestones.

The quarry numbered 58 is in Chipping-Norton Limestone. The upper beds are much shattered; the lower are black-speckled and somewhat iron-stained. Other quarries in this Limestone are those numbered 59, 60, 61 and 62.

OAKHAM QUARRY.— In this quarry (63) the Chipping-Norton Limestone is an oölitic, somewhat sandy limestone, with occasional oysters and shell-fragments and pebbles. Some very large blocks of stone can be obtained; but the beds are generally much fissured, and into these large openings clay has been introduced from above.

A greenish clay is the most noticeable bed in the quarry. Below it are, here and there, masses of soft calcareous and extremely shelly marl, crowded with specimens of *Placunopsis socialis* M. & L. These deposits are best seen in a kind of trough fault at the south-western corner of the quarry. Here,

1 Proc. Cotteswold Nat. F.C., vol. xvi., pt. 1 (1907), p. 25.

above the green clay, come two beds of very fossiliferous limestone with a median band of brown marl, and above these again, green clay and rubble—the green clay containing whitened oysters.

No. 63. OAKHAM QUARRY

			Thickness in feet	ins.
Neæran Beds	?4. & 5.	Dark purple clayey subsoil .. .. .. Clay, dirty green and yellowish-blotched, with fragments of whitened oysters: seen.. ..	1	0
	12.	Limestone, weathers rubbly, very shelly; *Ostrea, Quenstedtia, Volsella imbricata* (Sow.) very common, *Pholadomya, Nerinæa* spp., *Nerita pseudocostata* d'Orb., at the base, *Turbo ?burtonensis* Lyc., *Ataphrus labadyei* (d'Arch.) ..		
	?13.	Marl, brownish; *Ostrea, Placunopsis socialis*: 6 to 8 ins.	0	5
	14.	Limestone, rubbly shelly; *Pleuromya, Chlamys vagans* (Sow.), *Grammatodon, Volsella imbricata* (Sow), *Nerinæa, Clypeus müllleri, Strophodus* (tooth), lignite, etc.: average.. .. .. (*Beds 15 to 18 incl. absent*).	1	10
	19. & 20.	Clay, tough, greenish: average .. .. .. Marl, brown, shelly, and stiff chocolate-coloured clay, often enclosing irregular masses of rotten shelly (*P. socialis*) marl. In places near the base, are masses of brown gritty limestone: 0 to 3 ft.	0 2	4 0
C.N.L.		Limestones: plant-remains, *Oppelia fusca* (Qu.)	12	0

This section was first noticed by Hull,[1] who referred all the beds to the Great Oolite. In connection with the deposits numbered 19 and 20, he wrote:

> "The thick bed of marl is very constant over the district, and may again be observed in the quarries in the Moreton Road, as also in a quarry [now overgrown, 69 on map], near the gate of Daylesford Park, which opens into the Cornwell Road, where it is associated with thin bands of sand and gravel."

In the neighbourhood of the Cross-Hands Inn (64, 65, etc.) there are extensive workings in the Chipping-Norton Limestone.

CHASTLETON-HILL QUARRY.—This quarry (66) is on the golf-course, and has been extended in a south-westerly direction in two workings. If the observer enters this quarry and the right-hand extension, he will notice the best section of the beds in the quarry-face on the left; but, as usual, the beds are very much disturbed. The beds correspond very well with those at the Oakham Quarry and it should be especially noticed that, in the top bed, specimens of *Rhynchonella* and *Terebratula* are common.

1 "The Geology of the Country around Cheltenham" (1857), p. 59; see also H. B. Woodward, "The Jurassic Rocks of Britain," vol. iv. (1894), p. 328.

No. 66. CHASTLETON-HILL QUARRY

		Thickness in feet	ins.
	2. *Ostrea*- and *Rhynchonella-Bed*. Greenish-grey clayey marl with *Ostrea*, *Terebratula*, *Rhynchonella concinna* auctt. very common, *Trapezium*, *Pholadomya*, *Neri-næa*, etc. : about	0	6
	(*Beds* 3 *to* 11, *incl.*, *absent*).		
Neæran Beds	12. Limestone, pale-yellow, rubbly, oolitic ; *Ostrea*, *Tra-pezium*, etc., and *Nerita pseudocostata* d'Orb., at the base	1	0
	?13. Clay, dark greenish-grey ; *Ostrea*	0	3
	14. Limestone, hard, brownish, in two layers. Rather a waterworn top..	2	2
	(*Beds* 15 *to* 18, *incl.*, *absent*).		
	a. Marl, pale-yellow : about	0	5
	b. Clay, tough	0	2
	19 & 20 *c*. Sand, brownish, with limy inclusions at the top. In the other working, in the north-westerly face, the clay-beds (*b* and *d*) are seen enclosing a mass of marl (with *P. socialis*) and conjointly measuring 1 ft. 6 ins across (vertical). The sand is 6 ins. thick in places and is occasionally replaced by chunks of hard brown limestone : 2 to 18 ins.	0	10
	d. Clay, tough, dark : 0 to 2 ins.	0	2
C.N.L.	Limestones ; top-bed (? = Plant-Bed) very hard and gritty : seen	12	0

FREEBENCH QUARRY.—In this quarry (67) about 15 feet of black-speckled Chipping-Norton Limestone is exposed, and while some of the beds are close-grained and non-oolitic, others are decidedly oolitic.

POINTED-HEATH QUARRY.—The beds above the Chipping-Norton Limestone in this quarry (68) are very much disturbed.

No. 68. POINTED-HEATH QUARRY

		Thickness in feet	ins.
Neæran Beds	14. Lower *Nerinæa*-Bed. Limestone, pale pinkish-brown, shelly, rather fissile and ofttimes sandy ; *Nerinæa* spp. common *Gervillia ornata* Lyc. non Moore : seen about	1	0
	Marl, pale-green ; *Nerinaeæ* not uncommon, *Ostrea acuminata* Sow., *Perna mytiloides*	0	6
	Clay, very tough, dark-brown..	0	3
	19 & 20. Limestone very hard, gritty, pinkish-brown and blu-ish, shelly. On top of it, and separated therefrom by a thin layer of clay, is a band of limestone, large-ly composed of specimens of *P. socialis* (1 inch) ..	0	6
	Sand, yellow	0	1
	Clay, tough, dark-brown	0	5
	Marl, greenish-grey mixed with white rubble ..	0	6
C.N.L.	Limestones, with black-specks and more definite plant-remains : seen	10	0

The prominent bed of limestone in 19-20 and the richness of bed 14 in gastropods are the most noteworthy features of this section. The faunal and lithic characters of the Lower *Nerinaea*-Bed are precisely the same as those of the equivalent bed in the quarry near Lower Swell, near Stow-on-the-Wold.

WHITEQUARRY-HILL QUARRY.—This quarry (73) is now abandoned, but the Chipping-Norton Limestone and marly oolites and clays of the Neæran Beds are exposed, although often puzzlingly intermingled.

No. 73. WHITEQUARRY-HILL QUARRY

			Thickness in feet	ins.
Neæran Beds		Limestone, white, well-oolitic, with occasional pieces of lignite and tubular infillings ; *Ostrea* : seen ..	3	0
	2	*Rhynchonella*- and *Ostrea-Bed.* Marl and marly stone, pale-yellow ; *Ostrea, Rhyn. concinna*, auctt., *Terebratula, Trapezium*, etc. : average	0	6
	? parts of 3,4 and 5	*Ostrea-Clay.* Clay, tough, dark-brown ; *Ostrea* very abundant in the upper portion	0	5
		(*Beds 6 to 11, incl., absent*).		
	12.	Marl, brown, sandy, intimately associated with the bed below , *Ostrea* very common : 4 to 6 ins.	0	5
		Limestone, rubbly ; *Homomya vezelayi* (Lajoye), *Ostrea, Trigonia costata, Volsella sowerbyana* (d'Orb.) ..	0	10
	? 13.	Similarly-coloured shaly marl and rubble ; *Ostrea* ..	0	5
	14.	Limestone, often massive-bedded ; *Clypeus mülleri* Wr.	2	0
	19 & 20.	Greenish clayey marl, often preponderating, passing down into	1	0
		Brown clayey, sandy marl, and this into		
		Brown sand		
		Purplish clay, with *Placunopsis socialis*		
		Brown sand with lumps of limestone		
C.N.L.		Limestone (with waterworn surface) flaggy, oolitic : seen	8	0

Below the Chipping-Norton Limestone is the *Clypeus*-Grit. Typical pieces of rock of this subdivision can be picked up at the spring near Hill Farm, Chastleton, and at the top of the bank above that at Cornwell (70).

Below the *Clypeus*-Grit at Cornwell is a thin representative of the *Amusium-personatum*-Limestones of the Pea-Grit Series, and below these again, the *Scissum*-Beds. The *Scissum*-Beds are best seen in a small way-side section near the spring (at 72), and have yielded the usual fossils—*Rhyn. subdecorata*, Dav., *Pholadomya fidicula*, Sow., *Volsella sowerbyana* (d'Orb.), etc.

ODDINGTON STONE QUARRIES

On the hill between Oddington and Stow are several quarries, but only one " in work," and this is situated a little to the south-west of the old windmill. The beds are extraordinarily disturbed, and this, combined with quarrying operations, renders it impossible to identify the same section at two consecutive visits if they are separated by any length of time.

The following record, I have little doubt, sets forth the true sequence of the beds :

ODDINGTON STONE QUARRY

		Thickness in feet	inches
	Reddish soil with small Northern-Drift Pebbles		
	Limestones, hard, sparsely-oolitic, somewhat flaggy, brownish, shelly, *Ostrea* being the most abundant fossil	*Several feet*	
Rhyn.-Isast. Bed	*Rhynchonella-Terebratula-Isastræa*-Bed. Greenish yellow, clayey oolitic marl, passing into almost a shell-bank, and in other places into a shingle. *Isastræa limitata* common, *Rhyn. concinna* auctt., *Terebratula, Ostrea, Chlamys vagans, Exogyra lingulata* (Walton MS.), *Serpula*, etc. Some of the pebbles have oysters and polyzoa attached to them : 1 foot to 1 ft. 6 ins ..	1	3
cf. S.S.	Limestones, brownish, oolitic ; *Ostrea* and shell-fragments : about	5	0
Neæran Beds	Dirty-green, chocolate and yellow and brown clay, with pebbles of dense brown limestone and reddish-brown sand at the base. Some of the pebbles are in the process of being converted into rotten white carbonate of lime. Lignite : up to	1	4
C. N. L.	Limestone, brownish, oolitic with oysters in places and brownish lignite. Thickness not ascertainable ..	6	0+
"Fullers' Earth"	Clay, blackish, tough	0	6
Clypeus-Grit	Limestone, rubbly, coarsely-oolitic to pisolitic, with typical specimens of *Ter. globata* auctt., *Clypeus ploti, Grammatodon hirsonensis*, etc. At the top, in places, is a finer-grained bed, in which specimens of *Perna* are extremely abundant along with a large *Camptonectes* : seen, about	4	0

There is no doubt about the identity of the *Clypeus*-Grit ; the " Fullers' Earth " is comparable with that at Great Rissington ; and the Chipping-Norton Limestone is unmistakable. How thick it is, Mr Paris and I were unable to ascertain, but in the Rissington-Burford district, it occurs over a considerable area and is readily recognised by its black specks.