

THE HIGHER ZONES OF THE UPPER CHALK IN THE WESTERN PART OF THE LONDON BASIN.

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I.—INTRODUCTION.

THE following paper contains the results of an examination of the western part of the London Basin made, during the last two years, for the purpose of determining the zonal features of those divisions of the Chalk which immediately underlie the Tertiary Beds in that region, and also of throwing some light on the nature of the unconformity existing between the two series of strata. The sections to be described are in that part of the Chalk which occurs at the surface within a short distance of the main mass of the Tertiaries, and of the numerous outliers which border it, especially on the west and north sides. The area is limited on the east by a line drawn from near Farnham to near Henley-on-Thames, and extends to Savernake Forest in the west; the whole being comprised within Sheets 267, 268, 283, and 284 of the 1-inch Geological Survey Maps, New Series. [See Sketch Map, Pl. VII.] Owing to the great extent of country to be covered anything like a thorough investigation and comparison of the numerous sections and exposures it has been found necessary to examine would involve an amount of steady work which it has been quite beyond our power to undertake. Having regard, however, to the recent revival of interest in the Chalk we are inclined to think that the outline which we here present may prove useful to other workers in the same field. We hope at no distant date to deal with some of the more interesting districts separately and in greater detail. We accept Dr. Rowe's definition of the higher zones of the Chalk, and in following them up in the field have relied almost entirely on the zoological criteria which he has established for

their discrimination. The literature of the Chalk in this area is small, and most of the published works bearing on our subject are referred to in the body of the paper.

II.—THE SOUTHERN BORDER.

The greater part of the Chalk area south-east of Odiham, in Hampshire, is occupied by the zone of *Marsupites testudinarius*, which extends from the main Tertiary boundary southward, beneath the outliers of Horsedown Common and Well, nearly to the edge of the escarpment overlooking the valley of the Wey.

On White Hill, north-west of Well, are two roadside quarries a short distance apart, the lower of which is 15 ft. deep, but was so hidden by talus that the general character of the chalk could not well be made out. Such as could be seen *in situ* was soft and white, with few flints, and yielded a few plates of *Marsupites*, but on the talus were some blocks of very hard chalk containing fragments of *Inoceramus* and many small oysters. The other pit is at a level of about 30 ft. higher, at the top of the hill, and shows 12 ft. of chalk with lenticular jointing and of irregular hardness. Most of it is fairly soft, but near the base some of the blocks are quite firm and even rocky. Small flints are scattered plentifully throughout, and there are at least three layers of the solid nodular variety, of medium size, and with thin rinds. Fossils are scarce, with the exception of small oysters and fragments of *Inoceramus*, which are common. Green-coated flints occur in the surface-soil.

Similar chalk, with small oysters, can be seen close under the Reading Beds on the north-east side of the Well outlier, in a road-cutting near Stroud Farm. One-third of a mile north-east of this spot, on the north of the lane leading to Travers Farm, is a pit, 10 ft. deep, in rather firm chalk, irregularly jointed, with one course of solid nodular flints about half-way up, and many small ones scattered throughout. Small oysters abound, one specimen of *Echinocorys scutatus*, of an ovate form characteristic of beds at, or close below, the base of the *Actinocamax quadratus*-zone, was obtained here, and a flint cast of a similar form was found on the surface of a field close by. A little farther east, along the lane, at a level of about 20 ft. lower, an overgrown pit in a small valley west of Travers Farm yielded a few blocks of soft chalk in which plates of *Marsupites* were abundant.

One-third of a mile north of this pit, close under the Tertiary outlier of Horsedown Common, a farmyard pit between Swanthorpe Farm and High Croft Copse exposed 12 ft. of chalk of character similar to that of the higher beds at Well. Besides the small oysters, the only fossils found were *Micraster cor-anguinum*,

and one specimen of *Echinocorys scutatus*, the shape of which again suggests the proximity of the zone of *Actinocamax quadratus*. It is probable that the chalk in this pit, and in the higher pits at Well, belongs to the lower part of that zone, but in the absence of sufficient zoological evidence we hesitate to assign it definitely thereto, and prefer at present to regard it as the highest part of the zone of *Marsupites*.

Around the outlier of Horsedown Common are many old chalk-pits, mostly, however, now sloped over and difficult of access. On the north-west side, about half-a-mile from the boundary of the Reading Beds, on the east side of a lane north of Roke Farm, there is a good section, 18 ft. deep, of soft white chalk with lenticular jointing. One seam of tabular flint occurs at a sharp angle to the bedding planes, and there are also a few small, solid flints scattered throughout, some of which take the form of flattish cup-shaped sponges. Ferruginous casts of sponges also are not uncommon. Plates of *Marsupites* are plentiful at the base of the section, but become scarce towards the top.

Along the main Tertiary boundary the most easterly exposure noticed was in an old field-pit south-east of Byron's Farm, Crondall, where in one corner, at the top, a recent excavation showed 6 ft. of soft, blocky chalk with a few good-sized solid flints. *Echinocorys scutatus* var. *pyramidatus* and plates of *Marsupites* are common. One mile to the north-west, just inside the park east of Itchel House, is a large pit the face of which was much obscured by talus, only 6 or 8 ft. of the upper part being accessible. The chalk is very soft and much crushed, and plates of *Marsupites* and fragments of *Echinocorys* and *Micraster* are fairly common. As several green-coated flints were observed in the clayey surface-soil it is probable that this is near the upper limit of the chalk, although some little distance from the main mass of the Tertiaries.

One mile west-north-west of the above, and a little to the south of Rye Common, is a large quarry with a perpendicular face of over 30 ft. The chalk is soft and blocky with a few irregular bands of nodular flints and some tabular seams, the latter being at various angles to the bedding planes. This is the pit mentioned by Messrs. Bristow and Whitaker* as abounding in "*Echini* and other fossils," and as showing a dip of 3° nearly due north. The fossils found by us include plates of *Marsupites*, which occur in all parts of the section, and many specimens of *Echinocorys scutatus* var. *pyramidatus*, all more or less broken.

The pits formerly worked between Rye Common and Odiham appeared to be overgrown, and we were unable to obtain any satisfactory evidence of their zonal position, but somewhere in

* *Geol. Surv. Mem.* on Sheet 12, "Parts of Berks and Hants," p. 18 (1862).

this tract of country the *Marsupites*-band dies out, and its place as the topmost bed of the chalk is taken by the lower division of the zone, the *Uintacrinus*-band. Working westward, this was first noticed in a pit, 12 ft. deep, at the northern end of Wassel's Copse, one mile south-east of Odiham. Plates and brachials of the name-crinoid are common, but few other fossils were found. Flints of medium size occur both scattered and in irregular layers, and the chalk is somewhat firmer than that of the *Marsupites*-band in the pits last-mentioned.

The fine quarry on the south-west side of the town of Odiham appears to be all in the *Uintacrinus*-band, which we estimate to be here over 50 ft. in thickness. At the northern end of the pit, which alone is worked, we obtained a suite of fossils similar to that recorded by Mr. Jukes-Browne* as having been found at Odiham by Messrs. Griffith and Brydone. The chalk is of medium firmness, white and blocky, with few flints, and is much used for top-dressing the soil over the Tertiary country to the north.

The *Uintacrinus*-band is again exposed in a small field-pit on Adams' Farm, east of Greywell, on the northern slope of a hill overlooking the Tertiary country and not far from the boundary. There is also a good section of the same band in a roadside pit, 25 ft. deep, near the summit of Greywell Hill, on the west side. Fossils are fairly abundant, and the jointing of the chalk is very massive at the base of the section.

Remains of *Uintacrinus* were found in pieces of chalk from the talus of an old pit known as Cobbler's Dell, on Huish Farm, Mapledurwell, to the west of which the *Marsupites*-band comes on again. Its absence between this place and Odiham, or its restriction there to a very narrow belt close to the Tertiary boundary (for we have never met with the *Uintacrinus*-chalk in actual contact with the Eocene Beds in this district), may be due to a gentle anticline of late Cretaceous or early Eocene age, from the crest of which the upper part of the *Marsupites*-zone has been denuded.

Around Basing and north of Basingstoke the *Marsupites*-band is much in evidence. The chalk at the bottom of a large pit, or series of workings, the upper parts of which were hidden by talus, on the south side of Hatch Lane, yielded *Echinocorys scutatus*, var. *pyramidatus*, and a few plates of *Marsupites*. A little to the north-west of this pit, at the cross roads near Parker's Farm, about 10 ft. of chalk was visible at the top of an old quarry. The fossils, which are abundant, include *Echinocorys scutatus* var. *pyramidatus*, *Marsupites*, *Conulus* (*Galerites*) *albogalerus* (a small form, in a band, and always crushed), *Ostrea vesicularis*, etc.

* "Cretaceous Rocks of Britain" (*Mem. Geol. Survey*), vol. iii, pp. 190-192.

In a field on the north side of Oliver's Dell, Basing, and at about the same level as the higher beds in that now-disused quarry, is a small pit showing 8 ft. of firm chalk, finely jointed. Nodular flints are common, and there are some tabular seams. Green-coated flints are present in the surface soil, and there is a large pipe filled with stiff clay. The fossils observed were *Echinocorys scutatus*, of a form characteristic of the beds near the junction of *Marsupites* and *A. quadratus*-zones, *Ostrea vesicularis* (common), and two specimens of *Actinocamax granularis*. This chalk appears to be at about the same horizon as that of the higher beds at Well, and its incoming at Basing is probably due to a structural depression complementary to the Odiham-Greywell uplift noticed above.

At Chatham the *Marsupites*-band is well developed, and its soft, blocky chalk is exposed in several pits. To the list of fossils from this locality already published by Mr. Jukes-Browne,* on the authority of Messrs. Griffith and Brydone, we have nothing to add.

North-westward, by Sherborne St. John, the southern boundary of the *Marsupites*-band again recedes towards that of the Tertiary Beds, and at Monk Sherborne the outcrop of the whole zone is restricted to a very narrow belt of country. The large pit near Monk Sherborne Church is about 30 ft. deep, and shows 50 ft. of strata with a dip of 8 degrees north-east. The lower part is in rather firm chalk with scattered flints, many being small and globular, and there is one conspicuous tabular seam. Fossils are scarce, *Conulus* being the most common. Near the top is a course of nodular flints, above which the chalk becomes very rubbly, and contains remains of *Uintacrinus*. The chalk below this course of flints is probably all in the *Micraster cor-anguinum*-zone. A very large quarry in the fields about one-third of a mile west of Monk Sherborne is at its northern end sloped down and planted with trees, but at the southern end we obtained *Uintacrinus* on the talus which covers up most of the face.

Proceeding towards Ewhurst the *Marsupites*-band still keeps close to the Tertiary boundary, while the lower part of the zone spreads out some distance to the south, and is exposed in several field-pits. *Marsupites* and *Echinocorys scutatus* var. *pyramidatus* were found to be common in an old pit close to the Tertiaries, north-west of Ewhurst House.

Further to the north-west we come within the influence of the Kingsclere dome, and the increasing steepness of the northerly dip forces the outcrop of the *Marsupites*-zone within very narrow limits; in consequence of which most of the chalk pits in this part of the country are in lower zones. We were fortunate enough, however, to find a sufficient number to prove that the

* "Cretaceous Rocks of Britain" (*Mem. Geol. Sur.*), vol. iii, pp. 189-192.

Uintacrinus-band, at least, is continuous along the northern side of the dome.

A few yards south-east of Yew Tree Farm, Kingsclere, there is a good section showing the passage from the zone of *Micraster cor-anguinum* to the *Uintacrinus*-band. The beds have a strong northerly dip. The lowest part of the pit is in rather soft chalk with regular layers of solid nodular flints, and very few fossils. Above this comes about 10 ft. of similar chalk, with several seams of tabular flint, and a thin band of broken fossils, chiefly *Conulus* and a thin-shelled *Inoceramus*. The next 6 ft. is soft, blocky chalk, with a few scattered flints. At the top of the eastern face 6 or 8 ft. of very soft chalk yields many fossils, including *Uintacrinus*, *Hagenowia rostratus*, *Actinocamax verus*, etc.

Three-quarters of a mile west of Kingsclere, and a little to the south of Frobury Farm, a shallow pit on the north side of the road almost shows the junction with the Reading Beds. The chalk is much crushed and fossils are very scarce. One or two crinoid brachials, which may belong either to *Marsupites* or to *Uintacrinus*, were found. Half a mile farther west, on the south side of the road, near the top of the hill overlooking Ecchinswell, is a large pit divided into two by a close hedge. The chalk dips to the north at about 20 degrees, and a thickness of at least 40 ft. of beds is exposed. At the southern end flints are fairly numerous, and occasional specimens of *Conulus* were observed. In the middle of the section one *Echinocorys scutatus* var. *striatus* was found, and in the upper 6 ft. at the northern end *Uintacrinus* is common. Here again we have the passage-beds from the *Micraster cor-anguinum*-zone to the *Uintacrinus*-band.

Half a mile west of Ecchinswell, near Cowhouse Farm, in a space enclosed by three roads, is a large pit, or series of shallow workings, giving a discontinuous section from the upper part of the *Micraster cor-anguinum*-zone nearly up to the base of the Eocene Beds. At the southern end is an east and west section, 12 ft. deep, but much covered with talus, about half-way up which is a 6-in. band forming a sort of breccia, full of broken specimens of *Conulus* and other fossils, especially *Bryozoa*. Along the western side of the pit, and (measured at right-angles to the bedding planes) about 20 ft. above this fossiliferous band, is a course of pink flints, marking, approximately, the position of the junction of the zones of *Micraster cor-anguinum* and *Marsupites*. Remains of *Uintacrinus* occur very sparingly here, but they are abundant in a widely-jointed soft chalk exposed for a depth of 10 ft. in the next working northward. Still farther north is another little section in which *Echinocorys scutatus* var. *pyramidatus* is common. *Uintacrinus* occurs at its south end, and *Marsupites* at its north end, but both are scarce. From a shallow working along the northern side of the pit a few plates of *Marsupites* were obtained. The beds appear to be dipping north-

west at about 25 degrees. Owing to the irregular manner in which the pit is worked it is very difficult to take anything like exact measurements, but we estimate the thickness of the *Uintacrinus*-band at 20 to 25 ft., and the *Marsupites*-band at 25 to 30 ft., so far as it is exposed.

About one mile farther west is the Duncroft Farm cutting on the Didcot, Newbury, and Winchester Railway. When freshly dug, this must have shown a fine section of the whole of the Upper Chalk, and it is to be regretted that the opportunity was not taken to examine and measure the beds. The only fact recorded with reference to it is the finding of a plate of *Marsupites* by Mr. Rhodes, the collector to the Geological Survey.* At the present time the banks are so much covered by talus and grass that the zonal limits cannot be exactly located without undertaking small quarrying operations—to which the Railway Company might object.

In the accompanying diagram (Fig. 1), of the northern part of

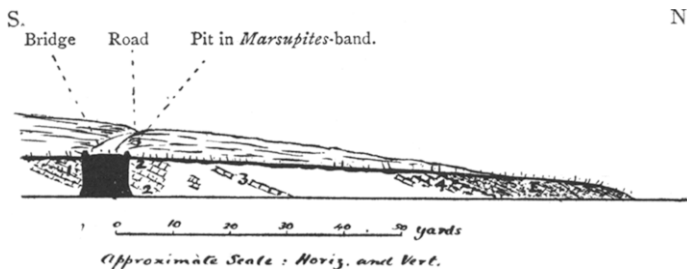


FIG. 1.—DIAGRAM OF SECTION IN CUTTING (ON THE DIDCOT, NEWBURY, AND WINCHESTER RAILWAY) NEAR DUNCROFT FARM, BURGHCLERE.

the cutting, the size of the exposures of solid chalk is greatly exaggerated so as to show the dip of the beds. The chalk exposed immediately to the south of the bridge contains many flint nodules, apparently in regular courses, and is probably in the zone of *Micraster cor-anguinum*. Fragments of *Conulus* are common at the spot marked (1). North of the bridge flints seem much scarcer and remains of *Uintacrinus* were found in two places (2). An example of the nipple-shaped *Bourgueticrinus* was obtained in the lower exposure of the *Uintacrinus*-beds.

Twenty-nine paces north of the bridge, a "reef" of blocky chalk (3), projecting through the talus, rises from the edge of the permanent way into the sides of the cutting. This resistant band yielded a plate of *Marsupites* and a few pieces of *Ostrea*. Thirty-six paces farther north the floor of the cutting intersects the junction of the Chalk and Eocene (Reading) beds (E). The

* "Cretaceous Rocks of Britain" (*Mem. Geol. Surv.*), vol. iii (1904), p. 189.

chalk (4) immediately below the junction is firm and slightly iron-stained, and seems to contain many flint nodules of elongate form. No trace of *Marsupites* could be found in the rubble; but many fragments of *Echinocorys scutatus* and a damaged guard of *Actinocamax granulatus* (?) were noticed.

At the base of the Reading Beds there is the usual band of green flint-nodules, and pebbles, with which are associated remains of *Ostrea bellovacina* and sharks' teeth.

The chalk referable to the *Marsupites*-zone is probably 65 to 70 ft. thick, and the base of the Eocene Beds must nearly coincide with the upper limit of that zone. The true dip of the Chalk and Eocene is about 20° north, as shown in the diagram, and considerably lower than the apparent dip on the sloped sides of the cutting.

In an old field-pit a little to the west of the bridge plates of *Marsupites* abound in blocks of chalk on the talus.

At Whitway, by the side of the main road from Newbury to Whitchurch, are two quarries adjoining each other. The southern one, which alone is worked, is mainly in the zone of *Micraster cor-anguinum*, but the *Uintacrinus*-band just comes in at the top of the face at the northern end. For some distance below it the chalk is soft and almost flintless and very poor in fossils, the only obtained being *Conulus albogalerus* and a fine specimen of *Echinocorys scutatus* var. *striatus*.* The northern pit is now grassed over, but, considering that the beds dip north at 25°, there seems to be room for as great a thickness of the *Marsupites*-zone as in the Railway Cutting.

On the western side of Highclere Park the Kingsclere dome, with its east and west axis, dies out, but the Kingsclere-Pewsey anticline, with high dips on its northern limb, follows the Tertiary boundary north-westward to Inkpen, where another dome—that of the Vale of Ham—is developed. All along this tract such pits as occur close to the Tertiaries were found to be hopelessly grassed over, while those farther out, and still open, are in the *Micraster cor-anguinum*, or lower zones, and not near enough to the boundary to be of any critical value. The only trace of the *Marsupites*-zone we could discover was in a lane-cutting south of Stargrove, East Woodhay. Here, from a piece of chalk dug out of the bank close under the "Bottom Bed" of the Reading Series, one plate of *Marsupites* was obtained.

Good sections in the highest beds of the chalk along the northern side of the Vale of Ham are also extremely scarce. From the talus of an old pit south-west of Kirby House we obtained a few small brachials, probably of *Uintacrinus*, and a fragment of the bryozoan *Eschara Danæe*. South of Werg's Barn, Inkpen, a field-pit showed 12 ft. of rather massive chalk with few flints and no distinctive fossils. This may be in the

* See Wright, *Cretaceous Echinocorys*, *Pal. Soc.*, 1882, Plate LXXVII, Fig. 7.

barren band which is sometimes found in the middle of the *Marsupites*-zone.

Such other pits as exist near Inkpen are in the *Micraster cor-anguinum* or lower zones; but at Prosperous Farm, a mile and a half north-west of the village there is a pit showing about 20 ft. of the *Uintacrinus*-chalk. Plates and brachials of the crinoid are abundant in a six-inch band half-way up the section. The beds dip north at 27° , and there is room for 20 or 30 ft. of higher chalk between them and the Tertiary strata.

III.—THE WESTERN END.

Beyond the Shalbourne-Hungerford valley, which marks the western end of the main mass of the Tertiaries, the Eocene Beds occur as a series of outliers separated by rather narrow, steep-sided valleys cut down into the underlying chalk, which is exposed in a fair number of pits. The Bedwyn valley, followed by the Great Western Railway and the Kennet and Avon Canal, divides the district into two parts.

(A.) Between it and the Shalbourne valley is a well-defined Chalk area, with three Tertiary outliers of unequal sizes. The two smaller ones, forming the wooded hills of Wilton Brail and Bedwyn Brail, on the south-west, seem to rest entirely on the *Marsupites*-band, but sections close to their boundaries are scarce. *Marsupites* occurs in several old and badly-obscured workings round the edge of the wood, especially on the east side. East of Castle Copse is a good pit showing the following section :—

		ft.	ins.
	(4) Soil		
READING BEDS.	(3) Mottled Clay	2	6
	(2) Greyish green sand with a few flint pebbles and concretions of iron oxide and "race"	2	6
CHALK.	(1) Soft blocky chalk, with a sharp, slightly waved junction with the overlying beds. <i>Marsupites</i> and other fossils, and a few scattered flints exposed	12	0

The *Uintacrinus*-band is exposed at the bottom of the Bedwyn valley near the third lock south-west of Great Bedwyn, and it may pass beneath the canal there.

The largest of the three outliers extends from Harding Farm on the south to North Standen Farm on the north, a distance of three miles, and rests for the most part on the *Marsupites*-band, but towards the north-west corner this thins off and perhaps disappears, all the sections close to the Eocene boundary at that end being in the *Uintacrinus*-band.

Working round the outlier from Shalbourne westward, we notice first a small overgrown field-pit, three-eighths of a mile

north-west of the Church, which has yielded plates of *Marsupites*. No other sections were seen along the south-east side, but in the small valley which runs from Harding Farm to Great Bedwyn there is a section of the *Uintacrinus*-band in a roadside pit south of Folly Farm, and another near the canal by the first lock south-west of Bedwyn. The *Marsupites*-band is exposed in several small pits close to the Tertiary boundary west of Folly Farm, and by the side of Foxbury Wood. Turning the corner of the wood and proceeding northward, we come to a small exposure of chalk close under the Tertiaries in Little Bonning's Copse, south-east of Little Bedwyn. The chalk here is very wet and dirty, the pit being, apparently, in a swallow-hole. It belongs to the *Uintacrinus*-band, but fossils are very scarce. Half a mile farther east, in a field on the north-east side of Barn Copse, are three grassed-over pits in the *Uintacrinus*-band. There is also a large pit, much talused, in the same chalk on the opposite side of the little valley west of Brickhouse Copse, Stype Wood. At the north end of this wood is another section showing 5 ft. of soft, clean chalk, massive at bottom and finely jointed at the top. There are a few scattered flints, and *Uintacrinus* is fairly common. On the east side of the outlier *Marsupites* is found in a pit near the mill, north-west of Slope End.

(B.) In the sub-district west of Bedwyn we have traced the zone of *Marsupites* as far as the depression which runs through Tottenham Park, on the east side of Savernake Forest from Durley northward towards the Froxfield valley at Knowle. It appears to be thickest at the south-east corner, near Crofton, and to thin off westward and northward. Some old grassed-over pits in Tottenham Park, between Durley and the Warren Farm, are in the *Uintacrinus*-band, but the presence of the upper part of the zone has not been proved west of the Eocene outlier of Bedwyn Common.

In the valley to the east of this outlier, running parallel to the depression above mentioned, the *Marsupites*-band is exposed in an old pit on the north-east side of the reservoir, and has there yielded plates of *Marsupites*, and one broken specimen of *Actinocamax granulatus*. Farther down the valley, a pit in a wood west of Stock House shows 12 ft. of soft chalk divided into lenticular masses by seams of crushed chalk. Flints are very few and fossils are scarce; plates of *Marsupites* and fragments of *Echinocorys* being the chief ones noted. A little farther north, to the west of Bewley Farm, is another pit in which fossils, including *Marsupites*, *Echinocorys scutatus* var. *pyramidatus* and *Ostrea vesicularis*, are unusually abundant. Two-thirds of a mile north of this, on the southern slope of Horsehall Hill, is a pit, 15 ft. deep, in the *Uintacrinus*-band. This section does not show quite the highest chalk in the hill, which may have a thin capping of the *Marsupites*-band. Such other pits as could be found to

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the north and west of Upper Horsehall Hill are in the zone of *Micraster cor-anguinum*.

On the west side of the Bedwyn valley, between the canal and the Tertiary boundary, good sections of the *Marsupites*-zone are scarce. The best is at Lower Barn, north-west of Crofton. This shows about 12 ft. of the *Marsupites*-band with many plates of the name-fossil. Nearer Great Bedwyn the chalk of this part of the zone at, or close to, its junction with the Tertiaries, has been converted into a very hard, fine-grained limestone with a conchoidal fracture. It contains fragments of *Inoceramus*-shell, occasional specimens of *Actinocamax granulatus* and, in a road-cutting up Chisbury Hill, numerous plates of *Marsupites*. Under the name of "roach," the occurrence of this rock was noticed, many years ago, by Mr. Whitaker* who described it as "a confused mass of pieces of hardened (? silicified) and somewhat flaggy chalk," overlying a bed of reconstructed chalk. At the present time the stone, which is much used for road-metal, is nowhere visible strictly *in situ*, as the detached blocks occurring in the soil or drift, rather below its outcrop, alone are worked. Although it contains a few small flints, its hardness is not due to silicification, as samples dissolve readily in weak mineral acid, leaving only a slight residue as fine brown mud. Mr. Jukes-Browne, who has kindly examined some samples, informs us that the induration is due to partial crystallisation.

IV.—THE NORTHERN SIDE.

(A.) On the northern side of the main mass of the Tertiaries, east of the Shalbourne Valley, and south of the Kennet, nearly the whole of the chalk area is occupied by the *Marsupites*-zone; the zone of *Micraster cor-anguinum* coming to the surface only along the Kennet Valley near Hungerford. The *Marsupites*-band occurs, as an almost flintless chalk, in a small pit near Slope End, on the east side of the road from Hungerford to Shalbourne. About a mile to the north-east of this pit there is a good section, 25 ft. deep, near Anville's Farm, and not many yards distant from the Tertiary boundary. Plates of *Marsupites* are found at all levels, and there is a band of *Echinocorys scutatus* var. *pyramidalis* about half-way up. The chalk is soft and blocky, with some layers of crushed chalk, and there are numerous small globular flints scattered throughout, in addition to the nodular forms. *Marsupites* was noticed also in fragments of chalk on the slope of a grassed-over pit in the park, at a point about one-third of a mile south-west of Inglewood House.

North of this most of the chalk appears to belong to the *Uintacrinus*-band. There is a pit 8 ft. deep in firm, finely-

* *Quart. Journ. Geol. Soc.*, vol. xvii (1861), p. 527.

jointed chalk by the roadside west of Little Templeton. One layer of large flints occurs near the top, but fossils are scarce. A large disused pit in the park, north of Inglewood House, showed, on the east side, 8 ft. of flaggy chalk with very few fossils. On the west side, at a slightly lower level, was a small exposure of soft, blocky chalk in which remains of *Uintacrinus* were extremely abundant, the plates and brachials occurring in bunches, much as in the Margate cliffs.

Farther east, in the immediate neighbourhood of Kintbury, is one of the most interesting districts in our area; containing, as it does, not only good exposures of both divisions of the *Marsupites*-zone, but also a fine section of the lower part of the zone of *Actinocamax quadratus*. In the large pit by the canal near Kintbury Mill, there is a section about 30 ft. deep in the *Uintacrinus*-band. The chalk is white, soft, and blocky, and is worked for the manufacture of whiting. Nodular flints are scattered sparsely throughout, and there are a few seams and oblique veins of the tabular variety. Fossils are scarce, but *Act. verus* was noted. In the village, at the higher level, small exposures in cottage gardens on the south side of the Newbury road give evidence of the presence of the *Marsupites*-band.

At Laylands Green, three-eighths of a mile south of the mill section, is the pit which was visited by the Geologists' Association on June 21st, 1902, and briefly described by one of us in the report of that excursion.* The few fossils then found suggested that the chalk belonged to a higher zone than that of *Micraster cor-anguinum*, but at the time its exact position was left undetermined. Further examination of the section under more favourable conditions (not the least of which is the recently-increased depth of the pit) has proved beyond doubt that it belongs to the zone of *Actinocamax quadratus*, part of which here occurs in an outlier of small extent, but of considerable thickness. The chalk in the Laylands Green pit dips S.W., at about 5°, and measured at right angles to the bedding, about 40 ft. is exposed. Its character varies from blocky to lumpy, and from firm to soft, in different parts of the section. In the lower part are several seams of tabular flint; nodular forms occur scattered throughout, and near the top there is a layer of the large cylindrical variety. In the upper part of the pit there are two bands of hard rocky chalk containing casts of sponges. *Offaster pillula* is most abundant in the lower part of the section, which was not exposed at the time of the excursion, but it is also found higher up and in the rock-bands. *Actinocamax quadratus* occurs sparingly in the higher beds. The usual zonal forms of Echinocorys are plentiful and frequently of very small size.

Half-a-mile west-south-west of the Laylands Green pit, a small

* *Proc. Geol. Assoc.*, vol. xvii, 1902, p. 388. "Cretaceous Rocks of Britain," vol. iii, p. 203. *Mem. Geol. Survey*, 1904.

exposure in a field showed 5 ft. of flaggy chalk with scattered flints, and one discontinuous layer of large cylindrical nodules at the top. Among the few fossils found were three specimens of *Actinocamax granulatus*. The section is probably about 20 ft. below the Tertiaries, which come on a short distance to the south.

The *Marsupites*-band is well shown less than half-a-mile south-east of Laylands Green in a pit 15 ft. deep, at Hampstead Holt Farm, only a few feet below the base of the Eocene Beds. The chalk is in blocks of medium size with stained joints. *Marsupites* is very abundant, four nearly complete tests having been observed, one containing a number of brachial and tegmenal ossicles. Unfortunately the condition of the chalk makes it impossible to extract the specimens unbroken.

At Irish Hill, rather more than half-a-mile east of the Laylands Green pit, is a much degraded section of the *Marsupites*-band. The chalk shown is finely jointed, and fossils are very scarce. This pit is some distance below the Tertiaries; 20 ft. at least.

About one mile and a quarter farther to the south-east, near the village of Hampstead Marshall, in a small inlier of Upper Chalk surrounded by clays of the Reading Beds, an old pit at the bottom of the valley shows 10 ft. of the *Marsupites*-band. The chalk is of a somewhat unusual character for this zone, being greyish and lumpy rather than white and blocky. The rock is much stained with clay, which has penetrated along the joint planes. Fossils are difficult to find, but a few plates of *Marsupites* were obtained after some search.

(B.) North of the Kennet, in and west of the Hungerford district, the Tertiary Beds appear to rest directly on chalk of the *Micraster cor-anguinum*-zone. At Hopgrass, one mile west-north-west of Hungerford, near the top of the ridge between the Kennet and the Bedwyn Valley, is a pit 25 ft. deep in chalk, with regular layers of solid nodular flints. About 15 ft. from the surface there is a band of yellow, rocky chalk, and fossils characteristic of this zone are fairly common throughout the section. A short distance to the north, at a slightly higher level, the pits in the brickyard show clay of the Reading Beds piped into the underlying chalk, which, where exposed, is in a crushed condition. No distinctive fossils were seen *in situ*, but in the surface soil close by we found a flint cast of *Echinocorys scutatus* var. *striatus*—a form which, throughout our area, seems to be restricted to the extreme upper part of the zone of *Micraster cor-anguinum*, and to the base of the *Uintacrinus*-band.

Nearly four miles east-north-east of Hungerford, near the hamlet of Elcot, the *Uintacrinus*-band is exposed in a small pit, 12 ft. deep, close to the Tertiary boundary. The chalk is soft and white, and flints are small and scarce. Both *Uintacrinus* and

Bourgueticrinus are common fossils here. In Benham Park, one and a half miles north-west of Newbury, there is a small pit at the edge of a copse, showing 12 ft. of soft chalk with scattered flints. *Uintacrinus* occurs sparingly.

The most easterly sections of the *Marsupites*-zone observed were in the two well-known pits at Shaw brickyard, north-east of Newbury, where a varying thickness of chalk is exposed beneath the Reading Beds. The topmost layers are discoloured and hardened in places, and riddled with curved tubular borings filled with the overlying pebbly green sand. The chalk between the borings abounds in plates and brachials of *Uintacrinus*. Two open courses of flints occur, the lower of which, about 10 ft. from the top, may be taken as the downward limit of the *Uintacrinus*-band, as below it no traces of the name-fossil have been observed, and the *Micraster cor-anguinum*-chalk immediately underlies the Reading Beds a little to the north.

The *Uintacrinus*-chalk appears to die out beneath the long Tertiary outlier which extends from Speen to beyond Wickham, along the west side of the Lambourn Valley, all the sections we have seen near its north-east border being in the zone of *Micraster cor-anguinum*.

Beneath the next Tertiary outlier on the east, between the valleys of the Lambourn and the Winterbourne, there exists a small outlier of the zones of *Marsupites* and *Actinocamax quadratus*. The chalk is of an unusual character, being in varying degrees phosphatic, and containing several rock-bands. Open sections are scarce and small, and for evidence of its lateral extension we have had to rely largely on small excavations made in the fields by ourselves for the purpose. Three sections may be noticed. The first is in a roadside pit in Hangmanstone Lane, about a quarter of a mile north of Boxford Church. The beds have a strong dip to the south-east, and they are all in the upper part of the *Micraster cor-anguinum*-zone, although the *Uintacrinus*-band must come on not far above the top of the pit. There are two rock-bands shown, the upper of which contains many small oysters; and the chalk is distinctly phosphatic in places. The *Uintacrinus*-band is exposed in a small roadside pit, one-eighth of a mile east of Boxford Rectory, where 8 ft. of soft, crushed chalk is shown, with few flints and very few fossils.

The most interesting exposure in the whole outlier is in a small pit in the middle of a field a quarter of a mile north-west of Winterbourne Church. This shows about 12 ft. of chalk belonging to the zones of *Marsupites* and *Actinocamax quadratus*. Both zones are more or less phosphatic, and very fossiliferous. No flints were seen *in situ*, but there are two rock bands, the higher of which marks the junction of the zones. In, and for an inch or two above, this band *Actinocamax granulatus* is extra-

ordinarily abundant, and is associated with many specimens of *Echinocorys scutatus*.

Besides the rock bands exposed in the pits many patches of rocky chalk have been detected cropping out at the surface on both sides of the hill. The beds down to the base of the *Uintacrinus*-band are overstepped by the Tertiaries near Wyfield Farm on the north, and under Basford Hill on the south, and are cut off on west and east by the valleys of the Lambourn and the Winterbourne, the extent of the whole outlier being less than one square mile.*

Along the border of the main mass of the Tertiaries north-east of Newbury, and around the numerous outliers which exist on the hill-tops at various distances from it, we have not observed any chalk belonging to a higher zone than that of *Micraster cor-anguinum*. At Yattendon, a small pit by the side of the road to Manstone Farm is close to the base of the Reading Beds, and shows 12 ft. of chalk with layers of solid flints. In the upper half of the section the chalk is crushed and the flints shattered. Fossils are numerous, especially spines of several species of *Cidaris*.

At Upper Basildon, chalk is obtained from a shaft sunk through the Reading Beds in the brickyard. The fossils found were similar to those from Yattendon, and indicate the upper part of the *Micraster cor-anguinum*-zone. There are pits also at Englefield and Stanford Dingley, at about the same horizon.

In a now disused brickyard on the east side of the village of Theale about 15 ft. of chalk is exposed beneath the Reading Beds. It is worked for lime-burning, and contains many regular layers of solid nodular flints. Fossils are fairly numerous, especially Echinoderms.

At Westwood, Tilehurst, to the north-east of Theale, there is a chalk pit 25 ft. deep, the top of which can be but little below the base of the Tertiaries. Fossils are common and flints are plentiful, both scattered and in regular layers. Many of them, especially the scattered ones, are of the cavernous variety, and contain "meal" rich in *Bryozoa*. Flints of this character are very rare in the upper part of the *M. cor-anguinum*-zone of our area, the only other place we have noticed them being at Winterbourne, just below the *Uintacrinus*-band, where, however, *Bryozoa* are by no means common.

The large quarries at Chazey Farm and near Caversham Church, described by Dr. Barrois† (the latter as being in his zone of *Marsupites*), are both clearly some distance below the upper limit of the zone of *Micraster cor-anguinum*. Cavernous flints occur at both places, and *Bryozoa* are fairly common in them at

* For a detailed account of this outlier see paper by the present writers in *Quart. Journ. Geol. Soc.*, vol. lxii, 1906, p. 499.

† "Recherches sur le Terr. Crét. Sup. de l'Angleterre, etc.," p. 148, 1876.

Chazey Farm: the species, however, do not altogether correspond with those from Westwood, Tilehurst, on the opposite side of the Thames. At Caversham these organisms are either absent or very rare.

Several sections exposed in temporary excavations for drainage and other purposes at the western end of the town of Reading have shown the ordinary flinty *M. cor-anguinum*-chalk immediately underlying the Eocene Beds.

Chalk was formerly exposed beneath the Reading Beds by the side of the Thames in Holme Park, Sonning. Some lumps taken from this locality, when rubbed down, yielded many fragments of *Bryozoa*, but few other fossils.

At Ruscombe Lake, on the north side of the Great Western Railway, about a mile east of Twyford Station, a small pit close to the old brickyard shows 10 ft. of finely-jointed, iron-stained chalk beneath the Reading Beds. Small finger-shaped flints are scattered throughout, and there are two thin tabular seams. The chalk is soft and fine-grained, and contains an unusually large proportion of perfect specimens of Foraminifera. Ferruginous casts of sponges are common, but other fossils are scarce. One broken guard of *Actinocamax verus* was found. Similar chalk is exposed in the railway cutting a mile or two farther east, where a flint cast of an Ammonite,* *Haploceras leptophyllus* (Sharpe), was found by a workman during the widening of the line in 1903. A list of the *Foraminifera* from this cutting has been published by Mr. E. Heron-Allen, F.L.S.†

The stratigraphical position of the Ruscombe Lake chalk would appear to be at the top of the *Micraster cor-anguinum*-zone, and immediately below the *Uintacrinus*-band, which probably comes in beneath the Tertiaries not very far to the south.

At Warren Row, two miles and a half north-east of Ruscombe, and just outside our area, is a small section showing the junction of the Chalk with the overlying Reading Beds.‡ The former is well down in the *Micraster cor-anguinum*-zone, the flints being large and solid and in frequent regular layers.

V. CONCLUSION.

As will be seen from the foregoing account, we have either determined, or confirmed the existence, in this area, of the following sub-divisions of the Upper Chalk above that part of the zone *M. cor-anguinum* which is characterised by regular courses of solid nodular flints:—

1. A group of beds, about 20 to 30 ft. thick, consisting of soft

* *Proc. Geol. Assoc.*, vol. xvii, p. 177.

† "Prolegomena towards the study of the Chalk Foraminifera," 8vo., London, 1894.

‡ *Proc. Geol. Assoc.*, vol. xvii, p. 179.

chalk with comparatively few and scattered flint-nodules and not infrequent seams and veins of tabular flint. These beds belong to the *M. cor-anguinum*-zone, but have many characters in common with the *Uintacrinus* chalk above. In them the large form of *Echinocorys scutatus* figured by Wright* as var. *striatus* seems fairly common, and remains of *Conulus albogalerus* are generally abundant. A pyramidal shape-variation of *Echinocorys*, like that occurring in the *Marsupites*-zone, has been noticed in two or three places.

2. The zone of *Marsupites*, divisible, as usual, into an *Uintacrinus*-band below and a *Marsupites*-band above. As in other places in the south of England, the *Marsupites*-band admits of sub-division into two parts. The upper part, which includes perhaps one fifth of the total thickness of the band, is, in this area, distinguished from the lower part chiefly by :

(a) the absence, or extreme scarcity, of *Marsupites testudinarius*.

(b) the presence of *Actinocamax granulatus*, a fossil we have rarely found in association with *Marsupites*; and by

(c) the presence of depressed pyramidal and sub-ovate shape-variations of *Echinocorys scutatus*.

With reference to the last-named species it may be mentioned that the angulation of the apex of the test in the pyramidal variety characteristic of the *Marsupites*-zone is most pronounced in the *Uintacrinus*-band. Further, that the average size of the variety is appreciably smaller in North Hants, Wilts, and Berks than in the Isle of Thanet.

In the western part of the London Basin the larger fossils of the *Marsupites*-zone have a somewhat sporadic distribution. Here and there we have encountered very barren beds, mostly in the *Uintacrinus*-band. Generally speaking, identifiable organic remains are far less common than in chalk of the same age occurring farther east.

We estimate the thickness of the zone to be at least 100 ft. near Crondall, Hants, at the south-eastern limit of the area; about 60 ft. at Kintbury, Berks, and Great Bedwyn, Wilts; and 30 to 40 ft. in the outlier between Boxford and Winterbourne, Berks. In the last case, however, the lithological conditions are abnormal. At Kintbury and Winterbourne the entire zone is represented, so that the northward and north-westward attenuation of this division of the Chalk formation, within the tract of country covered by the present paper, admits of no question. At Odiham, Hants, the *Uintacrinus*-band alone has a thickness greater than that of the whole zone at Winterbourne.

3. The zone of *Actinocamax quadratus*—the lower beds of which have been definitely recognised by us only in the two

* "Cretaceous Echinoderms," *Pal. Soc.*, 1882, plate 77, fig. 7.

small outliers of Kintbury and Winterbourne. At the former place, where there is at least 50 ft. of the zone, the lithological conditions differ but slightly from those obtaining in the *A. quadratus*-chalk of the Hampshire Basin. The Winterbourne patch is more or less phosphatic, and its maximum thickness is probably not more than half that provisionally assigned to the Kintbury development.

It is probable that some of this chalk occurs about Well and Horsedown, near Crondall; and there may be a little also at Old Basing and near Great Bedwyn, but we have not found the zonal fossil, *Offaster pillula*, at any of these places.

Superficial as much of it admittedly has been, our examination of the higher zones of the Chalk in the western part of the London Basin has yet thrown a good deal of light on the nature



FIG. 2.—DIAGRAM TO SHOW THE GENERAL RELATIONS OF THE CHALK AND EOCENE BEDS ON THE NORTH SLOPE OF THE LONDON BASIN, IN BERKSHIRE.

E.—Eocene Beds.
M.—*Marsupites*-band.
U.—*Uintacrinus*-band.
ca.—*M. cor-anginum* zone.

of the unconformity between the Cretaceous and Eocene strata in that area. To ascertain the structural relations of these rocks was, indeed, one of the main objects of this cursory survey.

One broad fact which we have established is the general overstepping of the higher beds of the Chalk by the Eocene strata in a northward direction. Thus, having traced the *Marsupites*-zone along the southern border of this tract from Crondall to Savernake, we entertain little doubt that its outcrop is continuous between those places, as Dr. Barrois* map indicates; but on the northern side of the area we find that most of the outliers and part of the main mass of the Eocene rocks rest upon divers portions of the older, *Micraster cor-anginum*-zone, the *Marsupites*-chalk not appearing to the east of Shaw, near Newbury. To the west of Shaw the chalk of the *Marsupites*-zone, capped in places by beds of *Act. quadratus* age, extends across the narrow belt of country to which the main body and larger western outliers of the Eocene formations are there restricted; and it is in this part of the country that the character of the overstep is most clearly shown (Fig. 2).

* "Recherches sur le Terr. Crét. Sup. de l'Angleterre, etc.," plate 1. It should be noted that the *Marsupites*-zone of Dr. Barrois generally included, with the modern zone of that name, an uncertain but very considerable thickness of Chalk presently assigned to the zones of *Actinocamax quadratus* and *Micraster cor-anginum*.

The northward range of the *Marsupites*-zone beneath the Eocene cover in the eastern half of our area has nowhere been determined. From the re-emergence of this chalk (probably in an outlier) at Taplow, in South Bucks, and from the varying character of the older chalk visible at the boundary of the main mass of the Reading Beds east of Theale, however, we infer that the northern limit of the zone follows a sinuous line having a general eastward and east-north-eastward trend from Newbury.

The transgressive relation of the Eocene to the Chalk, attributable to a gentle southward tilting and to subsequent planation of the latter in late Cretaceous or early Eocene times, is somewhat complicated by the effects of minor foldings which preceded or accompanied this regional disturbance. Planed across by erosion before the deposition of the Reading Beds, the small flexures have given rise to local unconformities and to the phenomenon of outliers. We have not recognised any inliers, although some no doubt exist. Good examples of this secondary or trivial sort of discordances occur in the vicinity of Kintbury, and of Winterbourne, in Berks. At the latter place we have ascertained that the Reading Beds pass from the *Uintacrinus*-band to the *Act. quadratus*-zone, and back again, in the space of little more than half a mile. Such local unconformities have been recognised in the north of France, and most probably occur in the more eastern parts of the London Basin (besides the Taplow district), and in the Hampshire Basin as well. We hope that those members of the Association who are examining the Chalk in their respective districts will look out for them, and describe any that they notice.

Our thanks are due to Dr. A. W. Rowe, Mr. A. J. Jukes-Browne, and Dr. G. J. Hinde for advice, especially at the commencement of our undertaking; to Mr. W. D. Lang for help in identifying the Cyclostomous Bryozoa; to Mr. H. L. Hawkins for assistance in field work; to various quarrymen, and to owners and occupiers of land, too numerous to mention individually, with all of whom our relations have been of an amicable nature.

VI.—LIST OF FOSSILS.

The list of fossils is divided into five columns, as follows:

1. From certain sections of the *Micraster cor-anguinum*-chalk with regular layers of solid nodular flints, which show either its actual contact with the Eocene Beds or its junction with the overlying chalk. Principal examples: Yew Tree Farm, Kingsclere, Ecchinswell, Whitway, Hopgrass, Boxford, Yattendon, Theale and Warren Row.

2. The passage-bed from the flinty part of the *Micraster cor-*

anguinum-zone to the *Uintacrinus*-band. Examples: Yew Tree Farm, Ecchinswell, Cowhouse Farm, Whitway, Shaw, Boxford, Ruscombe Lake and G.W.R. cutting.

3. The *Uintacrinus*-band.

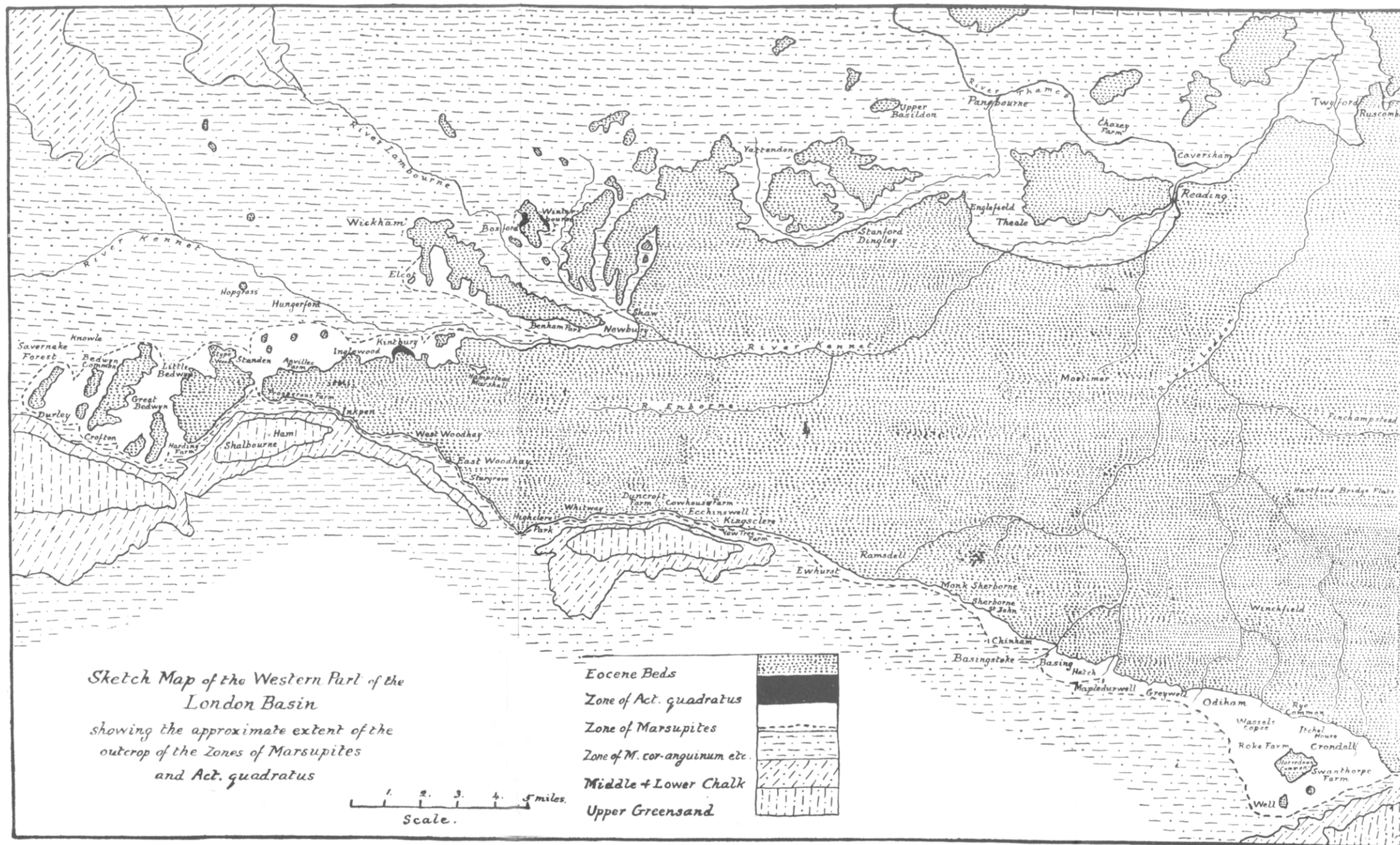
4. The *Marsupites*-band.

5. The *Actinocamax quadratus*-zone of Kintbury and Winterbourne.

	1	2	3	4	5
<i>Corax falcatus</i> , Ag. ... ..	...	...	...	X	...
<i>Corax pristodontus</i> , Ag.	X	...	...	...	X
<i>Lamna appendiculata</i> , Ag.	X	X	...	X	...
<i>Oxyrhina Mantelli</i> , Ag. ... ..	...	...	...	X	X
<i>Pollicipes glaber</i> , Römer... ..	...	...	X	...	...
<i>Scalpellum fossula</i> , Darw. ... ..	...	...	...	X	...
<i>Scalpellum maximum</i> , Sow.	X	X	X	...	...
<i>Ammonites (Haploceras) leptophyllus</i> , Sharpe ... ..	...	X	...	...	...
<i>Actinocamax granulatus</i> (Blainv.) ... ..	...	...	...	X	X
<i>Actinocamax quadratus</i> (Defr.) ... ..	...	...	...	...	X
<i>Actinocamax verus</i> , Miller ... ..	...	X	X	X	...
<i>Exogyra sigmoidea</i> , Reuss. ... ..	...	X	...	...	...
<i>Inoceramus Cuvieri</i> , Sow.	X	X	X	X	X
<i>Lima Hoperi</i> (Mant.)	X	...	...	...	...
<i>Ostrea hippopodium</i> , Nilss. ... ..	...	X	...	X	...
<i>Ostrea lateralis</i> , var. <i>striata</i> , Nilss. ... ..	...	?	...	...	X
<i>Ostrea normaniana</i> , d'Orb. ... ..	...	X	...	X	...
<i>Ostrea vesicularis</i> , Lam.	X	X	X	X	X
<i>Ostrea wegmanni</i> , d'Orb. ... ..	...	...	X	X	...
<i>Pecten cretosus</i> , Defr.	X	X	X	X	X
<i>Pecten quinquecostatus</i> , Sow.	X	X	...	X	...
<i>Plicatula sigillina</i> , S. P. Wdw.	X	X	X	X	X
<i>Spondylus latus</i> (Sow.) ... ..	...	X	X	...	X
<i>Spondylus spinosus</i> (Sow.)	X	...	...	X	X
<i>Teredo amphibæna</i> , Sow. ... ..	...	X	...	X	...
<i>Crania egnabergensis</i> , Retz.	X	...	...	...	X
<i>Crania Parisiensis</i> , Defr. ... ..	...	...	X	X	...
<i>Kingena lima</i> (Defr.) ... ..	...	X	X	X	...
<i>Rhynchonella limbata</i> (Schloth.) ... ..	...	...	X	...	...
<i>Rhynchonella plicatilis</i> (Sow.)	X	X	X	X	...
<i>Rhynchonella reedensis</i> , Eth. ... ..	...	X	X	X	X
<i>Terebratulina carnea</i> , Sow.	X	...	...	...	...
<i>Terebratulina semiglobosa</i> , Sow.	X	...	...	...	...
<i>Terebratulina Rowei</i> , Kitchin ... ..	...	...	X	...	...
<i>Terebratulina striata</i> (Wahl.)	X	X	X	X	...
<i>Thecidea Wetherelli</i> , Morris ... ..	...	X	...	...	X
<i>Berenicea papyracea</i> (d'Orb.) ... ..	...	...	X	...	...
<i>Berenicea polystoma</i> (Römer) ... ..	...	X	...	...	...
<i>Berenicea regularis</i> (d'Orb.) ... ..	...	...	...	...	X
<i>Clausia francgana</i> , d'Orb. ... ..	...	X	X	...	X
<i>Clausia globulosa</i> (d'Orb.)	X	X	X	...	...
<i>Crisina crenomana</i> , d'Orb.	X	...	X	...	X
<i>Crisina unipora</i> d'Orb. ... ..	...	X	X	...	X
<i>Entalophora Pergensi</i> , Greg. ... ..	...	...	...	...	X
<i>Entalophora virgula</i> (Hag.) ... ..	...	...	X	...	X
<i>Idmonea alipes</i> , Greg. ... ..	...	X	X	X	...

	I	2	3	4	5
<i>Lichenopora irregularis</i> , d'Orb.	X	...	...	...
<i>Melicerilites Lonsdalei</i> , Greg.	X	...	...
<i>Nodelea durobrivensis</i> , Greg. ...	X	...	...	...	...
<i>Proboscina angustata</i> (d'Orb.)	X	...	...	...
<i>Proboscina crassa</i> (Römer), var. <i>alectodes</i>	X
<i>Proboscina elevata</i> (d'Orb.)	X	...	...
<i>Proboscina radiolitorum</i> (d'Orb.)	X	X	...
<i>Spiropora verticillata</i> (Goldf.) ...	X	...	...	...	...
<i>Stomatopora gracilis</i> (M. Edw.)...	X	X	X
<i>Stomatopora granulata</i> (M. Edw.)	X	X	X
<i>Tervia Gamblei</i> , Greg.	X	...	...
<i>Tervia subgracilis</i> (d'Orb.)	X	X	...	...
<i>Truncatula aculeata</i> (Mich.)	X	...	...	...
<i>Cribilina pygmaea</i> (d'Orb.)	X	...	X
<i>Eschara cenomana</i> , d'Orb.	X	...
<i>Eschara Danae</i> , d'Orb.	X	...
<i>Eschara Lamarcki</i> , Hag.	X	X	X	X
<i>Membranipora argus</i> (d'Orb.)	X	...	...	...
<i>Membranipora dentata</i> (d'Orb.)...	...	X	...	...	...
<i>Membranipora echinata</i> (d'Orb.)	X	...
<i>Membranipora elliptica</i> , Reuss	X	X	X	...
<i>Membranipora grandis</i> (d'Orb.)...	X	X
<i>Membranipora monilifera</i> (d'Orb.)	X	...	...
<i>Micropora confuens</i> (Reuss.)	X	X
<i>Vincularia</i> (cf.) <i>longicella</i> , d'Orb.	X	...	X
<i>Serpula fluctuata</i> , S. Woodw.	X	X	...
<i>Serpula granulata</i> , Sow.	X	...	...	...
<i>Serpula ilium</i> , Sow.	X	...	...	...
<i>Serpula plana</i> , S. Woodw.	X	X	X	X
<i>Cidaris clavigera</i> , Koenig.	X	X	...	...
<i>Cidaris hirudo</i> , Sorig.	X	X	X	...
<i>Cidaris perornata</i> , Forbes	X	X	...	...
<i>Cidaris sceptrifera</i> , Mant.	X	X	X	...
<i>Cidaris serrifera</i> , Forbes	X	...	...	...
<i>Cyphosoma koenigi</i> (Mant.)	X	X	...	...
<i>Cyphosoma spatuliferum</i> , Forbes	X	...	...	...
<i>Echinocorys scutatus</i> , Leske	X	X	X	X
<i>Echinocorys scutatus</i> , var. <i>gibbus</i>	X
<i>Echinocorys scutatus</i> , var. (cf.) <i>pyramidatus</i>	X	X	...
<i>Echinocorys scutatus</i> , var. <i>ovatus</i>	...	X	...	...	X
<i>Echinocorys scutatus</i> , var. <i>striatus</i>	...	X	X	...	...
<i>Conulus</i> (<i>Galerites</i>) <i>albogalerus</i> , Leske...	X	X	X	X	...
<i>Epiaster gibbus</i> (Lam.)	X	...	...	...
<i>Helicodindema fragile</i> (Wilt.)	X	X	X	...
<i>Hagenowia</i> (<i>Infulaster</i>) <i>rostratus</i> (Forbes)	X	...	...
<i>Microaster cor-angulum</i> , Leske	X	X	X	X
<i>Microaster cor-angulum</i> , var. <i>rostratus</i>	X	X
<i>Offaster pillula</i> (Lam.)	X
<i>Calliderma latum</i> (Forbes)	X	...	...
<i>Metopaster Parkinsoni</i> (Forbes) ...	X	X	X	...	...
<i>Ophiura serrata</i> , Römer	X	...	...	...
<i>Pentaceros kulbiferus</i> (Forbes)	X	...	...	...
<i>Pentaceros piptilliferus</i> (Forbes)	X	...	...	...
<i>Pentagonaster megaloplax</i> , Sladen	X	X	...
<i>Bourgueticrinus</i>	X	X	X	X
<i>Bourgueticrinus</i> , nipple-headed var.	X	X	...
<i>Marsupites testudinarius</i> , Schloth	X	...

Illustrating Messrs. L. Treacher and H. J. Osborne White's paper on "The Higher Zones of the Upper Chalk in the Western Part of the London Basin."



	1	2	3	4	5
<i>Pentacrinus</i>	×	×	×	...	×
<i>Uintacrinus</i>	×
<i>Cœlosmia granulata</i> , Dunc.	×
<i>Cœlosmia laxa</i> , E. & H.	×
<i>Epiphaxum auloporoides</i> , Lonsd	×	...
<i>Parasmilia centralis</i> , Mant.	×	×	×	...	×
<i>Spinopora Dixoni</i> , Lonsd.	×	×	...	×	...
<i>Pharettospongia Strahani</i> , Sollas.	×	×
<i>Porosphæra globularis</i> (Phill.)	×	×	×	×	×
<i>Porosphæra nuciformis</i> (Hag.)	×	×	×
<i>Porosphæra patelliformis</i> , Hinde	×	×	×	×	...
<i>Porosphæra pileolus</i> (Lam.)	×
<i>Coscinopora infundibuliformis</i> , Goldf.	×	...	×	...
<i>Coscinopora quincuncialis</i> (T. Smith)	×	...	×	...
<i>Plinthosella squamosa</i> , Zittel	×	×	×
<i>Plocoscyphia convoluta</i> (T. Smith)	×	×
<i>Siphonia koenigi</i> (Mant.)	×	...
<i>Ventriculites infundibuliformis</i> , S. Woodw.	×	×
<i>Ventriculites radiatus</i> , Mant.	×	×