A HISTORY

OF THE

FOSSIL INSECTS

IN THE

SECONDARY ROCKS OF ENGLAND.

ACCOMPANIED BY

A PARTICULAR ACCOUNT OF THE STRATA IN WHICH THEY OCCUR,
AND OF THE CIRCUMSTANCES CONNECTED WITH THEIR PRESERVATION.

BY THE

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TO THE

REV. ADAM SEDGWICK, M.A., F.R.S., & L.S.;

VICE-PRESIDENT OF THE GEOLOGICAL SOCIETY OF LONDON,

FELLOW OF TRINITY COLLEGE,

AND

WOODWARDIAN PROFESSOR OF GEOLOGY IN THE UNIVERSITY OF CAMBRIDGE.

My dear Sir,

You have added another instance of your kindness and friendly regard, in allowing me to dedicate this little Work to you. I feel the greatest pleasure and pride in being thus permitted to associate my name with yours, not only because you stand in the foremost rank of men of genius and science, but because you have also been my friend and instructor, from whose eloquent reasonings in the lecture-room, and in the field, I have imbibed in a great degree that taste for Geology, of which this memoir is one of the early fruits. It is, therefore, with peculiar propriety I dedicate it to you, in the hope that it may be acceptable to the Public, and more especially meet with your approbation.

Believe me, my dear Sir,

Your much obliged and faithful servant,

Peter Bellinger Brodie.

TABLE OF CONTENTS.

PREFACE.

The intention of this Work is to give some account of the existence of Insects in a fossil state in a more detailed and definite manner than has hitherto been done respecting those which have been discovered in this country; and also to describe in detail the strata in which they are deposited, and the circumstances connected with their preservation. For although a few have been previously observed in other formations in the British Isles, as well as in the Wealden and Lias, still the number is very small, when compared with the great variety of other fossils which those strata afford. Certain beds in the Secondary series are now found to contain the remains of Insects in abundance, so much so, that they may be fairly considered as highly characteristic of those limestones in which they occur; and hence a greater degree of interest is attached to such ancient relics of a former world. Perhaps future discoveries may bring to light a much larger collection from other deposits; and it is not improbable that they may lead us to modify some of the opinions already formed, and may even ultimately prove of importance in our conclusions with regard to the physical features and conditions of the ancient Globe. The rarity of such fossils in general, and more especially in England, has caused us to overlook their value in answering these ends; but, from the additional facts lately made known, the subject must, as a matter of course,

prove highly interesting to Geologists, and for other reasons equally so to the majority of Naturalists.

The value of the organic contents of rocks is now universally allowed, not only in determining the age of different formations, and in comparing them with each other, but also in helping us to decipher the nature and characters of the various animals and plants which mark the different geological epochs of former ages. Independently, then, of those nobler and higher considerations which teach us to regard every portion of the universe as a proof of design and an evidence of creative wisdom and omnipotence, it would be most unphilosophical to overlook or disregard *even one* of those creatures, however minute, which once performed the task allotted to them by their great Creator.

The discoveries of Ehrenberg have also pointed out the importance of minute investigations, and have shown that such examinations and labours are not altogether thrown away, inasmuch as every addition to the stock of general knowledge enables us by degrees to arrive at more correct and logical conclusions upon any given matter of inquiry. These considerations, added to the suggestions of some eminent scientific friends, have induced me to detail in this memoir the results of my researches in this interesting subject.

I must here acknowledge the kindness of Professor Sedgwick and Mr. Strickland in giving me many useful hints while preparing the manuscript for the press, and for the friendly interest which they have taken in it. At the same time, I am indebted to Sir Philip Grey Egerton for the kind manner in which he has given me the benefit of his sound knowledge of Ichthyology in determining the characters of several new species of fossil fish from the Wealden.

Owing to the kindness and liberality of the Rev. F. W. Hope, the eminent Entomologist, I am able to add another Plate, in which some new and remarkable specimens are figured from his collection.

My best thanks also are due to Mr. Westwood for his beautiful and accurate engravings, which must have occasioned him more than ordinary trouble from the extreme minuteness of most of the originals.

I cannot conclude without expressing the hope that those at present but little acquainted with Geology may be encouraged to examine and search for themselves amidst the treasures and wonders which the earth still hides: for the studies of the closet can only be rendered really useful by practical application in the field, and by a personal inspection of every disputed theory or undoubted fact. Thus they will learn to value and appreciate a Science which, while it demands a wide and extended sphere of general knowledge, has been justly declared by one of our first philosophers to be secondary only to Astronomy itself, the greatest of all the physical sciences.

INTRODUCTORY OBSERVATIONS.

By Mr. WESTWOOD.

Wealden Insects.

The seventy-four Insects, or parts of Insects, represented in Plates ii., iii., iv., (except fig. 13,) v., and vi., (figs. 1 to 14,) have been selected from a series of two hundred and thirty-nine specimens forwarded by the Rev. P. B. Brodie from the Wealden formation, as being the best defined and most interesting individuals in the collection. They may, in fact, be considered as affording a tolerably correct average indication of the state of Insect life as exhibited by the series; although it would be very far from correct to regard them as sufficient to enable us to form a correct general view of the articulated winged animals in existence at the period when these specimens were destroyed, because the discovery of the remains of this great division of the animal kingdom in this stratum has been made too recently, and, indeed, the investigation of the fossilized remains of ennulose creatures has been too much neglected to induce us to suppose, that we have as yet obtained more than a very slight insight into the ante-diluvian annulosa.

The minute size of very many of these specimens, especially amongst the Diptera and Coleoptera, will not fail to be noticed, and this remark is of importance, as appearing to point out a low temperature, as it is well known that the lower the temperature the smaller are the Insects which inhabit that particular region. At the same

time, there are certain individuals which, judging from present insect-life, must have been inhabitants of a warm, if not a tropical climate, as for instance the Ricania, pl. iv. fig. 12, and two or three of the wings represented in pl. v. (figs. 10, 12, 13.) With these trifling exceptions, there seems nothing to warrant the supposition that these Insects were inhabitants of a climate very different from that of our own country. For although the fact of so many small Insects being discovered amongst the Wealden fossils is not of itself a proof of their not inhabiting warm climates (inasmuch as the tropics produce minute insects enough), yet the general character of these insect remains, and the want of larger ones among them seems to determine them to a temperate clime. The little Aphis is an especial proof of the correctness of this opinion; because, in the present day, there are no Aphides in the tropics, their place being occupied by much larger Insects, which are consequently able to perform the part of Aphides in nature in a more effectual manner. These are the Cuckoo-spit Insects, of which our Cercopis spumaria is a smaller type. We find, moreover, the minute Curculionidæ (vegetable feeders); Silvanus (?) (xylophagous, or rather feeders on dry seeds, meal, &c.); vast numbers of minute Tipulidæ of various genera (for the most part inhabitants of moist or wet situations); the terrestrial Cricket (pl. ii. fig. 4) and omnivorous Cockroach (pl. iii. figs. 7, and pl. iv. fig. 11); the plant-sucking Aphides (pl. iv. fig. 3) and Delphax (pl. iv. figs. 7 and 8); Cuckoo-spit Insects (Cercopidæ and Cicadellinæ) (pl. iv. fig. 6; pl. v. fig. 4) and Dragon-flies, inhabitants of the water in their first, and of the air in their last state, some of a gigantic size, with wings of insects nearly allied to the almost equally voracious insect-feeding genera Panorpidæ.

It is scarcely to be supposed that a state of things could have existed in which we should find such a collection of Insects as the Wealden series exhibits without there being parts of the world inhabited by giant Cicadæ, immense Beetles, Locusts, and Grasshoppers, with wings expanding little less than a foot, and other Insects of the size at least of those in the present creation.

It is proper to observe that, with the exception of the wings, the solid parts of most of these specimens are often very indistinctly to be traced, a slight difference in the colour or texture of the plates of stone often indicating the leg or body of the Insect; the minute size of many, and mutilated state of most of the individuals, must also be taken into consideration as having prevented me from giving more defined representations of these objects, or from attempting to decide upon the genera of many of them. I have endeavoured to put down only what I have seen; but fear that in several instances I may have mistaken delicate fractures or irregularities on the surface of the stone for shadings of limbs or outlines of form.

From the preceding observations it will be easily perceived that it has been impossible to arrive at any certain conclusion as to the identity of many of these remains with existing species; in the few instances in which the state of the specimens would allow a positive comparison (as pl. iv. fig. 12; pl. v. fig. 12, &c.), the contrary appears to be the case.

It is to be observed that many of the figures are more or less highly magnified: when this is the case, the natural size is indicated either by a drawing of the specimen of the real dimensions close to the magnified figure, or by a slender line, as in all the figures in plate v.

Stonesfield Slate Insects.

The collection of fossil Insects from the Stonesfield Slate which I have examined, (namely, those of Dr. Buckland, Mr. Witts, Mr. Hope, and Mr. Brodie,) are not numerous in specimens, and with a single exception they consist of the elytra of Beetles, either single or in pairs. The single exception alluded to is a portion of the wing of a very large Neuropterous Insect, allied to Hemerobius, from the collection of Dr. Buckland, figured in pl. vi. fig. 22, and described by that author in the Proceedings of the Geological Society for July 1838, that gentleman having previously submitted it to my examination, and having incorporated my notes thereon in his notice.

It is rather remarkable that the elytra only of Beetles should have been preserved, the other outer portions of the bodies being equally hard, and of a similar material. The seven specimens represented in pl. vi. figs. 15 to 21, have been selected as the most remarkable and characteristic from the collections which I have examined.

The perfect Insects must have varied in size from one and a half to half an inch in length, so that the specimens before us do not indicate a tropical temperature. It is impossible from these relics to form any precise idea as to the habits of the Insects; some of the larger elytra, however, evidently belonged to Beetles which are lignivorous in their economy.

Lias Insects.

The collection of Insects submitted to my inspection from the Lias is, on the whole, not so entomologically interesting as that from the Wealden, the specimens being for the most part in a less perfect state, and even these

being much fewer in number than in the latter. We find, in fact, none of the minute Diptera and Trichoptera, which occur so plentifully in the Wealden; and even when the body of the Insect is preserved, it is extremely rare to find the limbs present. Of nearly three hundred specimens which I have examined, two only had the legs still attached to the body and sufficiently defined for delineation.

The Coleoptera appear to have been extremely abundant; for considerably more than one third of the collection consisted either of Beetles, for the most part rudely preserved (of which a series is given in the upper part of plate vii.) or of elytra, nearly ninety of the specimens consisting of single, or the two elytra detached from the body. A series of the most interesting is given in the lower part of plate vi. Even in this large collection of elytra, we do not find any equalling in size those of the Stonesfield Slate; nor are they, except in a few instances, so well defined, so as to exhibit the characters of the surface, as those of the Wealden. Although very difficult from a single elytron, preserved as these are, to define the condition of the imago, it is evident that most of the species were not aquatic in their habits: many of them, indeed, would appear to have belonged to lignivorous or herbivorous species, some being evidently Elaterideous, as pl. vii. figs. 1 and 2; while others, as pl. vi. fig. 28, and pl. x. fig. 2, may be Carabideous. There are in the collection two or three instances of legs, all of which seem to have belonged to the slender-footed family of Grasshoppers (Gryllidæ veræ,) as is also the case with pl. vii. fig. 16.

There are also in the collection a considerable number of specimens (about thirty) of the detached abdomens of

various beetles, all of comparatively small size, having belonged to beetles not more than one third of an inch in length; so that, in fact, the elytra and bodies are small in comparison with existing tropical forms, and also with those in the Stonesfield Slate (pl. vi. fig. 15).

Of detached wings we have a collection of about eighty specimens, which are the most interesting portion of the series. Here we find Libellulidæ, Ephemeridæ, Hemærobiidæ, Panorpidæ (?), as well as a considerable number of specimens belonging to the same group as the unknown wings found in the Wealden formation. It is very interesting to find this new form of wing (as distinguished by the arrangement of its wing-veins) in this formation, equally numerous and equally perfect as in the Wealden.

Our plate vi. (figs. 23 to 34), and the whole of plates vii., viii., ix., x., consist entirely of figures of the most interesting of the specimens from the Lias. The whole of those in pl. x. (with the exception of figs. 4 and 6 furnished by Mr. Gibbs, and fig. 13,) being contained in the collection of the Rev. F. W. Hope, by whom this Plate has been presented to the work.

With the very badly preserved remains of most of the Lias Insects, it is impossible to say that they are, or are not, identical with existing genera. However, they resemble forms of ordinary occurrence and of temperate climes, more like North America than Europe.

The remaining figures in pl. ix. are from Aust Cliff.

The specimens from Aust, although but few in number, are interesting as exhibiting one or two peculiarities distinct from those of the other Lias Insects figured in the other plates, and which seem to indicate a different process in their destruction. Here we have masses of beetles scarcely more than two-thirds of an inch in extent, consisting of between

thirty and forty specimens, apparently of the same small species.* Again, we have masses of larger and smaller beetles mingled together; and, in others, beetles and a small Neuropterous Insect allied to Hemerobius, which has been preserved entire and intelligible. There are also elytra of large and small size, portions of legs, abdomens, &c. Of the nature of the Insects themselves there is nothing in the collection to warrant the supposition of any distinction in their states of existence, and those of the other Lias or Wealden Insects, all of which, I may again observe, bear an absolute analogy to existing forms.

The different degrees of preservation in which the Insects of these different formations occur, is suggestive of the different modes in which they were destroyed and fossilized; but this is a question peculiarly within the province of the Geologist.

Insect from the Coal Formation.

Pl. i. fig. 11 is drawn from a specimen in the collection of the Rev. F. W. Hope from Coalbrook Dale, of the natural size, and which has very much the appearance of some large Caterpillar, furnished with rows of tubercles, to which setæ or bristles were attached, as in the case of the Caterpillar of our common English Emperor Moth (Saturnia Pavonia—minor): unfortunately the specimen is imperfect at each end, and therefore it is impossible

* Practical entomologists are well aware of the advantage of collecting and examining the masses of floating weeds, &c. brought down by rivers during the spring floods; but a circumstance has been recently communicated to me by T. Vernon Wollaston, Esq., of Jesus College, Cambridge, which he had observed during the past winter, which bears strongly on the origin of these masses of fossilized insects of the same species. In one of his excursions in the fens during flood-time, he secured a mass of small beetles, which, upon examination, proved to consist of at least a thousand specimens of a very rare species of Haltica. In like manner during such floods the rare Odacantha melanura may be taken by myriads.

to judge of the appendages of the head or tail. It will be seen that there appear to be distensions of the membrane connecting several of the segments of the body together, as between the first and second, second and third, fourth and fifth (on the right hand side), and seventh and eighth. Now this could not, I think, occur to so visible an extent in a Lepidopterous larva, because it seems to intimate that the broader parts of the body (or the true segments) are of a firmer texture than the connecting distendable membrane. The lateral series of long, slender, and *evidently articulated* appendages seem also to throw a doubt on the Insect being a Lepidopterous larva. These appendages have some remote analogy to those of a portion of the segments of a Squilla, but this is only in appearnce, and not a real relationship. The dark line which runs down the back seems quite analogous to the great dorsal vessel or heart of caterpillars.

Addenda.

Pl. iv. fig. 13, p. 36. M. Milne Edwards, to whom I have shown this figure, considers that it is not the remains of a Pagurus, but more like the larva of some Insect. The legs seem too robust for the larva of a Libellula.

Pl. x. fig. 3, p. 71. M. Milne Edwards has suggested to me that this may be a portion of a larva of some unknown Insect, the dilated portion being the anterior part of the body and the two oval plates portions of the oral and not anal appendages, as I had surmised.

There are some dipterous larvæ, such as Syrphus and Stratiomys, which seem to favour such an opinion, but they are comparative pigmies, and have none of the lateral margins so distinct in this specimen, of which Mr. Hope fortunately possesses both the fossil and its cast.

ERRATA.

Page 59, *note*, line 4, *omit* "as well as fig. 12, pl. x."
„ 61, „ „ 2, *for* "No. 2, for May," *read* "No. 3, for August."

FOSSIL INSECTS

IN THE

SECONDARY ROCKS OF ENGLAND.

CHAPTER I.

WEALDEN.

Vale of Wardour—Its general structure.—Fossil Insects, Crustacea, and Fish of the Wiltshire Wealden.—Purbeck strata in the Vale of Aylesbury, compared with the Vale of Wardour.—General remarks and conclusions on the Wealden.

The vale of Wardour, situated between the towns of Wilton and Mere in Wiltshire, is a somewhat narrow valley, extending for nearly twenty miles from east to west, and expanding gradually in breadth towards the west, the hills on one side ranging north, and on the other south. The country is undulating and diversified, and generally striking and picturesque. It is partially bounded on the north and south, by the range of the chalk downs, which extend in a horse-shoe curve on the east, and there shut in the vale, forming part of that vast extension of the chalk formation called Salisbury Plain. In crossing the vale from north to south, the formations traversed are the Chalk, Upper Green sand, Galt, traces of the Lower Green sand, (in a few places only,) Purbeck, and Portland series. These strata are repeated on the southern or opposite side,

the Kimmeridge Clay being seen only at its western limit. Towards the eastern extremity of the valley, the Green sand hills rise on each side, and continue in a somewhat irregular course, following the line of the chalk escarpment.

The Galt is occasionally exposed beneath this formation, and follows the same direction as the Green sand beds above it. These strata are more distinctly seen at the sides of the valley, on the north, south, and east, while the interior exhibits in considerable detail, the Purbeck and Portland series, which are there rich in fossils, and well deserve a careful and attentive examination; I shall not, however, dwell upon all of these, because the chief object of the present chapter is to examine and describe the general characters and organic contents of the Purbeck beds. These belong to the lower division of the Wealden formation, and occupy the greater part of the middle of the valley, where they are largely developed, and extend in a westerly direction, from the point where they commence near Dinton.

In general throughout this district, the Purbeck strata are seen resting upon the Portland Oolite, but this is not always the case, because the former are irregularly distributed, and have apparently been subject to considerable denudation since their original deposition.

The two sections, plate xi. figs. I and II, will explain the geological structure of part of this valley.

The first point where the Purbeck series are exposed, is at a quarry not far from the village of Dinton, at the eastern end of the vale.

This yielded to my researches many new and interesting fossils, the chief of which are the *Crustacea*, *Fish*, and *Insects* about to be described. The quarry not having been worked for some years renders it extremely difficult

to obtain an accurate section of the beds, which are nearly horizontal, but the following in descending order, is as near an approximation as can at present be made.

	FEET.	INCHES.
1. Clay forming the surface a few inches		
2. White Limestone	0	3
3. Clay	0	2 to 3
4. White limestone, similar to No. 2, containing shells (chiefly Cyclas), a few Unios and Cypris	0	3 to 4
5. Crystalline grit with Cyclas major	0	2
6. Clay	0	3
7. Clay with layers of grit	0	3
8. Clay	0	2 to 3
9. Light brown sandstone full of small Cypris and Cyclas, consisting in the lower part of comminuted shells	1	6
10. Blue and brown clay with innumerable fragments of shells	0	3 to 4
11. Thin-bedded grit	0	2
12. Fibrous carbonate of lime 13. Grit 14. Fibrous carbonate of lime	0	6
15. Soft shelly sandstone	0	2
16. Light brown and blue limestone abounding in the Isopodous Crustacean (*Archæoniscus*, pl. i. fig. 6), in the lower part laminated with numerous Cyclades and Ostreæ	0	6 to 8
17. Blue compact grit full of impressions of Cyclas and Ostreæ	0	2 to 3
18. White laminated crystalline limestone very different from Nos. 2 and 4—probably	2	0
Total	7	4

It is very difficult to distinguish the beds below this, as the pit was full of water, but they in all probability consist of a series of grits, coarse blue limestone, and fine white slaty limestone, containing the remains of Fish, Cypris, and Insects. I have little doubt that this limestone, which I propose to denominate *Insect Limestone*, is inferior to that of No. 18. It is generally of a coarser texture, softer, and less compact than the stratum (No. 16) containing the *Archæoniscus*, (plate i. fig. 6,) being often white at the edges, but of a blue colour towards the centre,

where it becomes fine grained and harder. It passes into a thin white slaty limestone, (resembling the stone of Monte Bolca and Solenhofen,) very fine grained, and having a laminated structure. These slabs also abound in Fish, Insects, impressions of Plants, Cypris, *Archæoniscus*, and rarely shells, most of which belong to the genus Cyclas, and one species of Paludina. A very few species of Cyclas occur in the coarse blue "Insect Limestone," nor are there any traces of the above-mentioned Crustacean. There are also numerous specimens of Cypris granulosa, which differ from those in the upper strata. Associated with these, there are many fragments of carbonized vegetable matter, and impressions of small plants, a list of which is given at page 31.

A thin bed of grit gradually passing into the "Insect Limestone" forms one of its surfaces, and contains bones, scales, and palates (Bufonites) of fish, probably belonging to a species of Lepidotus, and the tooth of a Saurian. This grit is very like one which marks some of the upper members of the Sussex Wealden, especially in the abundance of rounded pebbles which it encloses. It differs in this respect from No. 17, but is very similar to No. 7 in the previous section.

The white limestone (No. 4) and the brown sandstone (No. 9) as well as the "Insect Limestone," afford frequent remains of at least three species of Cypris, namely, Cypris Valdensis, C. granulosa, and another smaller variety. The shells although numerous as to individuals, present but few genera—Cyclas media, C. major, C. parva, Paludina elongata, and a species of Unio, being the most characteristic.

The true *Insect Limestone* is easily distinguished from the *Isopod Limestone* No. 16, not only by its texture and

position, but also by the absence of these peculiar Crustaceans, although the thin slaty stone into which it passes does contain them. Insects are found in all these beds, but they are very rare in the *Isopod Limestone*, though abundant in, and characteristic of, the coarser blue and fine slaty limestone subjacent to it. The "Insect Limestone" is generally about a foot and a half in thickness. A partial excavation since filled up, about two hundred yards to the east, enabled me to determine the true position of this bed.

The strata are all inclined at a very considerable angle, dipping rapidly to the south, and gradually thinning out towards that point. Indeed, they have been upraised and fractured to a great extent, which is most likely the result of a fault; and it is singular that this upheaving has not taken place in the same strata only a little further to the west, as they are there almost horizontal; (see section page 3;) and since the "Isopod Limestone" approaches the surface, most of the overlying beds must have been previously denuded. In descending order we have

	FEET.	INCHES.
1. *Isopod Limestone*	0	3 to 4
2. Slaty stone, upper part of "Insect Limestone" much reduced in thickness	0	2
3. Brown gritty sandstone	0	3
4. Very hard grey crystalline limestone without fossils . .	1	0
5. Purbeck stone, full of Cyclas; a hard grey slaty stone, like that at Teffont and Lady Down	2	0
Total	3	9

The position therefore of the *Insect Limestone* is evidently *below* the *Isopod Limestone*. The calcareous beds at Teffont and Lady Down above the tiling stone (sections pages 19 and 20) are most likely the equivalents of the

Isopod and Insect Limestone combined, as they contain both Archæoniscus and Insects, and are superior to the Tilestone itself. The whole of these may be likewise considered as representatives of *the Slate* and *the Cap* on the coast of Dorsetshire. Dr. Mantell conceived that No. 4 resembled a limestone in Sussex, which is characterized by the same species of Unio ; and he also recognized the grit (No. 17) full of Cyclas, as identical in external appearance with some of the Tilgate beds near Cuckfield. The beds from 1 to 8 inclusive in the section page 3, seem to have been very much denuded, since the sandstone (No. 9) lies almost immediately beneath the surface in part of the adjoining country, the edges of this bed being exposed on the banks of the river Nadder which flows through it. The Limestone (No. 16) is a hard blue stratum, locally called " Lias" by the workmen, and abounding in specimens of Archæoniscus, which often lie together in clusters. (Pl. i. fig. 6.) These Crustacea and a few Cyclades are the most predominant and remarkable fossils. A very few fragments of Insects, and one more perfect specimen, have been detected in this bed : these consist of some single and attached Elytra of Coleoptera ; the other is a very fine and perfect specimen belonging to the genus Acheta, one of the Cricket tribe (pl. ii. fig. 4), which I propose to denominate *Acheta Sedgwicki*, in honour of Professor Sedgwick. It exhibits the attached wings, legs, and one of the antennæ.

With these exceptions, the Insects are confined to the coarser and the slaty limestones inferior to No. 18 of the section page 3.

These fossils are so numerous and interesting that I shall endeavour at once to describe them, before I proceed to a further examination and comparison of the strata

elsewhere. Detached portions of plants are common, but, being generally imperfect and ill-defined, it is almost impossible to determine their characters. One or two species apparently belong to the genera Sphenopteris and Louchopteris, with fragments of Lycopodites and Mosses, a few small seed-vessels and Fucoids. There is besides much decomposed and charred vegetable matter, very similar to some which prevails in the Sussex Wealden.

The remains of Insects are so abundant, and present such a variety of genera, that we are in this instance forcibly reminded of the rich collection of these beautiful fossils in the more modern deposits at Aix and Œningen. Thus an additional interest is given to the important facts brought to light in Kent and Sussex; for although there are in Wiltshire none of those gigantic reptiles which characterize the upper members of the series in the south-east of England, yet there are many smaller forms of animal life equally curious and instructive. The existence of Insects too, while it increases our knowledge of the fauna which flourished at the commencement of the Wealden group, may help us to give a more accurate opinion respecting the physical conditions and climate of that particular epoch.

INSECTS.

Mr. Westwood states (see Introductory Observations), that the collection which he had examined from this formation contains types of many well-known forms of different orders. The Coleoptera seem to have been very abundant; yet it is surprising how extremely scarce perfect Beetles are, single elytra being of most frequent occurrence. In a few instances both elytra are present, but they are generally crushed out of form and

otherwise injured, apparently the result of great pressure. Judging from the detached elytra, the Beetles varied from one and a half line to an inch in length ; and they appear, from the form and texture of the specimens, to have belonged to many and very different families. Among these are Buprestidæ, Carabidæ, Curculionidæ, Chrysomelidæ, Elateridæ, Cantharidæ, Tenebrionidæ, and Helophoridæ, so that the species were terrestrial and aquatic, herbivorous and carnivorous in their habits. Among the more perfect specimens, which, however, as might be anticipated, are often deficient in those distinctive characters by which alone their precise affinities can be determined, Mr. Westwood detected Cercopidæ, Cimicidæ, Tipulidæ (which are very numerous), Simulium, Blatta, Aphis, and a perfect Acheta. The wings are perhaps the most interesting, because the veins are often perfectly preserved and beautifully defined. Among these there are several which cannot be precisely referred to any known Neuropterous genus, and a portion of a gigantic Libellulideous wing, twice the size of any recent species. One specimen agrees exactly with the wings of Panorpa : there are also many Blattideous and Achetideous wings. These Insects belong to many different orders, among the chief of which are Coleoptera, Orthoptera, Neuroptera, Hemiptera, and Diptera.

Now it will be seen that a large proportion of these are herbivorous ; and this we might naturally expect to be the case, as the Wealden beds abound in the remains of plants, and there is therefore every reason to conclude that the neighbouring land was clothed with a rank and luxuriant vegetation on which these Insects fed, and amongst which they lived. The Achetidæ, Blattidæ, and Libellulidæ are certainly not herbivorous ; but as a fertile

flora implies swarms of Insects which feed on vegetables, so the abundance of such genera also implies an equal number of predaceous ones. Others again belong to those tribes which are generally met with in damp marshy places, and which, like our common May-fly, hover over the surface of streams and rivers. This is especially observable in the remains of the minute Tipulidæ which mostly prevail near running water and stagnant pools.

From the fragmented and imperfect state in which many of them occur, it seems probable that they were carried for some distance down the streams which fell into the Wealden estuary. Even the more perfect ones have this appearance, the wings where attached, lying close to the body, and very rarely in an expanded state. The conclusion at which Mr. Westwood arrives, after a careful examination of a large series of fossil Insects from the Wealden, amounting to nearly two hundred and forty specimens, is particularly interesting, because it shows that this class of animals are (with a very few exceptions) closely allied to forms now in existence, a result upon the whole quite the reverse of that which we are led to infer from the rest of the fossils in the Secondary rocks. Thus, while we have in the Wealden many strange and extinct races among other divisions of the animal kingdom, the Insecta which accompany them are more nearly related to existing genera, and present upon the whole a decidedly European character; indeed, the greater part must have been the inhabitants of a temperate climate, although some few were adapted to a much higher temperature. This is the more remarkable, because the colossal Saurians, Palms, and Tree-ferns in these strata evidently belonged to a hot country. It is true that these are chiefly confined to the upper division of this deposit; but many of the fossils in

the lower or Purbeck beds are equally conclusive in the matter, as the remains of the Megalosaurus, Crocodiles, Turtles, and Cycas clearly prove. In the present instance those kinds of Insects which are confined to warm latitudes are rare, while those which are indigenous in Europe are very abundant. How these facts can be reconciled with the tropical analogies presented by contemporary organisms, may afford an interesting matter for speculation on the general distribution of land and sea, and the climatal influences at that era. One thing, however, must be borne in mind, that the climate in the ancient world was probably much more equally distributed, and subject to less variations over large areas, than it is now.

ISOPODS.

The term Isopoda is the name given by Latreille for the fifth order of Crustaceans, and they are so called from the feet being equal, which always amount to fourteen in number. The body is composed of a head, tail, and crustaceous carapace, divided into lobes or segments. The under part of the tail is furnished with appendages, which are very apparent, and in the form of leaflets, which will be seen in the fossil Isopod, plate i. fig. 8. The Limestone (No. 16, page 3) contains remains of a new genus of this order, named *Archæoniscus Brodiei* (pl. i. fig. 6), in great abundance. These Crustaceans are generally found lying together in clusters, and so beautifully preserved that there can be little doubt that they lived and died upon the spot where they now appear. On one slab, measuring about seven inches broad and nine inches long, there are from fifty to sixty individuals. This mode of grouping agrees with the habits of existing animals of the same tribe, which are often found associated together in a similar manner.

Darwin mentions an instance on the coast of South America, where he observed certain Isopodous Crustaceans in such numbers, that the shore was literally alive with these little animals. His account is so interesting, that I may be excused if I insert it here: "Near Terra del Fuego on the sea-coast, under every stone, numerous crawling creatures swarmed, and especially Crustacea of the family of Cymothoides. The number of Sphæroma was truly wonderful; as these animals when curled up have some resemblance to Trilobites, they were an interesting sight to a geologist." (Darwin, Journal, p. 303.)

Pl. i. figs. 6, 7, 8, will give some idea of the nature of the fossil Isopod, which resembles the common Wood-louse in form, but is distinct from any living genus. I have in a few instances detected traces of Crustaceous legs which are small and delicate, but very rarely found attached. (Pl. i. fig. 8.)

It is rather singular that amongst the numerous specimens in my collection, I should never yet have discovered one in a reversed position, lying on its back, which would at once have enabled me to define the legs with greater distinctness. This fact also proves that they lived tranquilly at the bottom of the water which they inhabited, and that the limestone in which they were imbedded was a slow and gradual deposit, though sufficiently rapid to envelope them as they were crawling along the mud of the estuary. But perhaps the most curious part of this fresh-water Crustacean is the eye, which, like that of the Trilobite, is composed of a series of separate lenses, and forms a beautiful object when magnified. (Pl. i. fig. 10.) Two of these eyes were attached to the head, in which state they are occasionally found, and sometimes they occur loose in the limestone. The eye of the Wood-

louse, and indeed that of most Crustaceans and Insects is very similar.

Fossils of this kind are so rare, that this is the first instance of their discovery in England, and only a few specimens have been detected on the Continent. The approximation of the Isopods of the Wealden in their external form to Trilobites of the older formations, and the possibility of their forming a sort of connecting link between these latter Crustaceans and their nearest living representative Bopyrus or Serolis, is worthy of notice, and renders their occurrence in a secondary deposit of greater interest.* The body of Trilobites is divided into three lobes or segments, while the Isopods are single lobed. (Pl. i. fig. 8.) The latter possess legs, and probably antennæ; while in the former no traces of either have hitherto been discovered, although perhaps they may have possessed them in a living state.

This comparison between these two extinct animals of a former creation is the more interesting, because a great lapse of time must have taken place between the deposition of the Wenlock and Purbeck series, during which numerous other strata were in process of formation, and yet in none of these (the Solenhofen Slate excepted) has the least trace of any animals at all similar been hitherto detected.

The Isopods are by no means confined to the particular spot above described, although most abundant there, but occur as will be seen, in other and more distant portions

* This idea must be expressed with some caution, for although the apparent affinity of Trilobites with *Serolis* and other *Isopoda* has been commonly maintained, still it seems doubtful how far this view may be correct. Indeed, Dr. Burmeister in his late work on "the organisation of Trilobites," places them between the *Phyllopoda* and the *Pœcilopoda*; and also infers that they bear no relation whatever to the *Isopoda*.

of the same formation. They all appear to belong to one and the same species, but several are much more elongated than others. They also vary considerably in size, seldom exceeding half an inch long, and a quarter of an inch broad. In some rare cases the Crustaceous covering is preserved. The largest fossil of this kind is represented in plate i. fig. 7.

M. Milne Edwards has been kind enough to determine the character of these interesting fossils, and I shall conclude this imperfect sketch, by his account of them, translated from the "Annales des Sciences Naturelles," (series 2. vol. xx. page 326,) a notice of which has also been given in Taylor's Annals of Natural History, for February 1844, page 110.

"Fossil Crustacea of the great division of *Edriophthalmia* have been but recently discovered by geologists, a very small number only being yet known, and that in a very imperfect manner. It appeared to me, therefore, to be desirable to indicate here the existence of a new species, by which the museum of the Jardin des Plantes has been recently enriched. The specimens sent me by Mr. Brodie are about twelve centi-metres long, and nine broad, but that gentleman has found some which are considerably larger, and which have, he says, nearly the dimensions of a small Trilobite. The body of these Crustaceans is very flat, and is composed of a series of segments terminated posteriorly by a sort of rounded buckler. Unfortunately the head is much injured in all the individuals which I have seen. I have not been able to perceive any traces of feet, but Mr. Brodie has detected them on other specimens, and I believe I can distinguish vestiges of the impressions left by the antennæ. I have no doubt then as to the order to which this fossil belongs; it is evidently

an Isopod, and judging from its general conformation, it ought to be ranged in the family of the *Cymothoidæ*. I cannot, however, refer it to any of the genera hitherto established, and it appears to me that it cannot even be classed in any of the tribes of which this great division of the *Edriophthalmia* is composed. It seems to be intermediate between the genus *Serolis* and the erratic *Cymothoidæ*. It approaches the former in the enlargement of its body, and the great development of the lateral or *epimeral* pieces compared to the medial or *tergal* lobe of the thoracic and abdominal rings, as well as in the lamellar form of the *epimera*, and the structure of the terminal buckler of the body: but it is essentially distinguished from *Serolis* by the considerable development and evident mobility of the first rings of the abdomen, a character which connects it with the *Ægæ* and other erratic *Cymothoidæ*. The several segments comprised between the head and the caudal buckler scarcely differ among themselves, so that there is no visible limit between the thorax and the abdomen; but they are twelve in number, and as the thoracic segments never exceed seven throughout the division of *Edriophthalmia*, we must conclude that the five hindmost ones belong to the abdominal portion of the body, which would consequently consist of six moveable segments, as in the genera *Ægæ*, *Nelocira*, &c. The sixth segment of the abdomen, which composes the terminal buckler already mentioned, is almost semi-circular, and exhibits in its medial and anterior portion a tubercular swelling, somewhat analogous to that observed in the same part in various *Sphæromatidæ*. It appears to me also, that the margin of this piece is notched laterally, to give insertion to an appendical portion placed in the same manner as in *Serolis*. We may also infer, from the ar-

rangement of the lateral pieces of the other abdominal and thoracic segments, that the animal possessed the power of rolling itself into a ball like the *Sphæromatidæ*. Lastly, the structure of the head appears intermediate between that of the last mentioned Crustaceans and that which is exemplified in *Serolis*, for the cephalic segment is widened like that of *Sphæroma*, whilst the eyes approach the median line as in *Serolis*. From the facts thus indicated it appears that this fossil Crustacean is probably distinct from the Isopods hitherto known, and ought to be classed in a separate generic division. I purpose then to designate it by the name of *Archæoniscus Brodiei*."

It is well known, that the recent animals belonging to this order are both aquatic and terrestrial. The genus *Armadillo* and *Oniscus*, of which the common Woodlouse is an example, being truly terrestrial Isopoda. With regard to their distribution, the Amphipod and Isopod Crustacea seem to be more peculiarly the inhabitants of the colder regions of the globe, while the Decapods are more common between the tropics. Most of them have eyes and antennæ, but some are destitute of both these organs, especially the parasitic Isopoda. The eyes are of two sorts, either simple or compound, as in the case of the Archæoniscus and Trilobite, for in both these animals they are composed of a number of different lenses, or facets, to each of which a thread of the optic nerve corresponds.

FISH.

In the "Insect Limestone" and the bed immediately subjacent to it, there are four new species and two new genera of small fish; *Leptolepis Brodiei* (Agass.) pl. i. figs. 1, 3; *Leptolepis nanus* (Sir P. Egerton), pl. i. fig. 5; *Oxygonius tenuis* (Agass.) pl. i. fig. 4; *Ceramurus*

macrocephalus (Sir P. Egerton), pl. i. fig. 2; the two last being considered by Professor Agassiz and Sir Philip Grey Egerton to belong to new genera, and, as all the specimens in my collection have not yet been carefully examined, it is probable that one or two more species may be added to the number. I have great pleasure in subjoining the following remarks of M. Agassiz, comprised in a letter to Sir P. G. Egerton, who has kindly consulted that eminent naturalist upon the subject.

"Les desseins des poissons des Wealden de Monsieur Brodie, que vous m'avez communiqués m'ont vivement interessés. Ils me paroissent prover que cette formation est plus intimément liée aux terrains jurassiques, comme je l'ai toujours pensé, qu' à la série des terrains crétacées avec lesquels on a voulu les réunir en deça du Canal. Comme vous l'avez très bien reconnu, plate i. figs. 1, 3, est une espèce de Leptolepis que me paroit nouvelle et que je proposerais d'appeler *Leptolepis Brodiei*. Plate i. fig. 5, appartient à la section des Thrissops qui comprend le *Thrissops cephalus* autant qu'on peut juger d'un aussi petit poisson d'après un dessein. Si ma supposition est correcte, on pourrait appeler cette espèce Thrissops minutus. Comme vous possedez le *Thrissops cephalus* il vous sera facile de les comparer d'une manière plus directe. Pl. i. fig. 4, est vraisemblablement encore un poisson de la même famille, seulement sa longue caudale fourchue me le fait considérer, comme le type de nouveau genre au quel le nom de *Oxygonius* conviendroit assez bien; on pourrait baptiser l'espèce *O. tenuis*.—Il faudroit chercher les caractères des écailles avec une forte loupe; j'ai beau y voir sur le dessein, je ne les trouve pas! pas même l'épine dorsale."

Sir P. Egerton has since been good enough to examine

and compare two of these fish with Agassiz's descriptions and figures, and with the splendid series in his own cabinet, and has proposed the names above given, which are only adopted provisionally, as the originals are not sufficiently well preserved to form a decided opinion about them. On examining the one figured at pl. i. fig. 5, he detected the position of the dorsal fin, which inclined him to refer it to the genus *Leptolepis*, rather than Thrissops. This is the most diminutive fossil fish with which he is acquainted. The other (*Ceramurus*) "presents the nearest affinity to the remarkable genus *Megalurus*, but differs in its slender form, and the large proportional size of the head. The vertebræ seem to be fewer in number, and of smaller diameter. The most characteristic feature is the tail, which is strengthened above and below by broad, elongated, fulcral scales. This interesting specimen may be designated by the name of *Ceramurus*, or tile-tail, from the character of the fulcral scales supporting the lobes of the caudal fin. The species may be called *Macrocephalus*."

The genus Leptolepis is new in the Wealden, and it is worthy of remark that this is very abundant in the Solenhofen Slate, with which in many respects the Wealden would seem to be closely connected. I understand from Sir P. Egerton that the genus *Megalurus* to which the *Ceramurus* (pl. i. fig 2) is most intimately allied, is confined to the newest Jura beds of Solenhofen and Kilheim, associated with Thrissops and Leptolepis. This tends still more to confirm M. Agassiz's opinion respecting the approximation of the Wealden to the age of the Jurassic system. These fish differ both generically and specifically from those obtained at Lady Down and Chicksgrove. The largest is about two inches in length, and the smaller ones average from half an inch to one

inch. In most cases the eye is distinctly seen and well-preserved, pl. i. figs. 3, 4. 5.

They are almost entirely confined to the "Insect Limestone," and the white slaty limestone into which it passes, and with one exception have hitherto only been found at this particular locality. A thin bed of grit which accompanies it, contains numerous scales, bones, and palates of fish; and in the "Insect Limestone" also, there are detached teeth, scales, and coprolites. A single tooth of a Saurian from the same grit is the only fossil of the kind which I have met with in this district, but I believe Miss Benett's valuable collection contains a series of Sauroid Vertebræ from the quarries on Lady Down near Tisbury.

Having thus pointed out the nature and varieties of the different organic remains in one important quarry, we will now proceed to consider and compare in detail the fossils and strata of the same series in other parts of the valley, where the general variation of the strata in their lithological character at comparatively small intervals is remarkable, while they are all more or less marked by the occurrence of the same peculiar fossils, though the Archæoniscus and Insects are rare, and sparingly dispersed throughout the series.

A quarry situated about two miles south-east of Dinton presents the following section in descending order:

	FEET.	INCHES.
1. Upper beds, consisting of a debris of other rocks, namely, rounded fragments of Green sand and Portland stone, with their usual fossils,—a few inches.		
2. Layer of Chert full of Cyclas, and occasionally Bufonites	1	6
3. Hard, brownish white limestone with Ostrea, and casts of other shells, some resembling Cyclas major. The upper beds of this limestone are much disturbed . .	2	0
4. Black earthy clay	0	2
5. Purbeck stone, hard, light brown, very crystalline, slaty stone, containing Cyclades	3	0
Carried forward	6	8

	FEET.	INCHES.
Brought forward	6	8
6. Fissile, soft sandy stone (locally called *scales*), full of Modiola, palates, vertebræ, dorsal spines, and other bones of Fishes, also some flat bones of a species of Tortoise	1	0
7. Hard white limestone (*Lias*), rather softer at the top, contains "Archæoniscus," wings of Libellulidæ, and elytra of Coleoptera, one or two species of Cyclas (C. Membranacea, and others), and Cypris granulosa in great abundance	3	0
8. Tiling stone, like that on Lady Down	1	3
Total	11	11

The beds here have a slight dip to the south. The limestone No. 7, is whiter and coarser grained than that with Isopods near Dinton, nor is there any distinct limestone marked and characterised by the remains of Insects only, although it is probably the equivalent of the "Isopod and Insect Limestones." (See p. 5.) It is generally laminated, but often possesses a transverse and very irregular fracture, and runs in beds divided by thin partings of clay: at one end of the quarry this limestone is upwards of twelve feet in thickness.

In an escarpment on the banks of the adjoining river there are two bands of limestone, the upper yielding a few Cyclas and plants, with small elytra of Coleoptera: it is of a greyish white colour and about two feet thick. The lower limestone is of a bluer cast, and full of Cypris, Cyclas, and carbonized wood. These rest upon a very oolitic limestone continued downward to the depth of two feet, where the section ends. This contained the cast of a small Melanopis, and the seed-vessel of some plant. I could discover no indications of "Archæoniscus" at this spot, nor do the limestones at all resemble those in either of the other localities above-mentioned.

About a mile beyond this quarry, a partial excavation afforded the section subjoined, in descending order:

	FEET.	INCHES.
1. Clay intermingled with fragments of Green sand and the Purbeck beds	1	0
2. Fibrous carbonate of lime	0	4
3. Clay	0	3
4. Thin bedded limestone	0	5
5. Clay	0	2
6. Purbeck stone continued downwards	2	0
Total	4	2

The beds below this were not exposed.

No. 4 closely resembles the thin slaty slabs of limestone near Dinton, more especially as there were a few specimens of *Archæoniscus*, Cyclas, and small fish (*Leptolepis Brodiei*) belonging to the same species as those at the above quarry, but no Insects were observed. Several bones of a species of Tortoise were found in one of the strata of clay. In the quarries on Lady Down there are beds of a crystalline limestone which much resembles the white limestone of the other quarries already described. Cypris and Cyclas are rare, and as I could not perceive any traces of Insects or Isopoda; it is probably a distinct bed of limestone. The same stratum is also exposed on the side of the lane leading from Chilmark to Lady Down. This spot commands a very extensive view of the vale, and a good idea may be formed from this hill of the general extension of the whole series of strata in the neighbourhood, from the Portland and Purbeck formations, to the upper Green sand and Chalk inclusive.

The Portland Oolite is more largely developed at this point, and passing thence eastwards, the whole of the Purbeck group is seen to emerge gradually from beneath the Green sand, where it may be well studied up to its extreme limit in the vicinity of Dinton. (See sections I. and II. pl. xi.

In many of the quarries in the valley near Tisbury there

is a soft, gritty stone, slightly oolitic, and of a yellowish white colour, from which I procured the remains of "Archæoniscus" of considerable size, and much larger than any others hitherto met with, (pl. i. fig. 7,) and also one elytron of a Coleopterous Insect. Several large specimens of silicified wood have lately been found in a field close to Chicksgrove quarry, nearly on a level with the upper part of it, and with the beds of clay (No. 8, in Dr. Fitton's section,) which he considers to be the representative of one of the *Dirt Beds* at Portland and Lulworth (page 252). The size and perfect state of some of these fossils, which present no indications of having been rolled or bouldered, shews that they once occurred *in situ* near the same place, although it is probable that the bed (*Dirt Bed?*) which contained them has undergone great denudation, for the surface is very irregular, and unfortunately so overgrown with bushes that I was unable to search more minutely.

The fish found here differ from those at Lady Down and Dinton, the former being famous for the large and perfect specimens of *Lepidotus minor*, which are now and then discovered there.

In this part of the vale, there are few of those beds of limestone so predominant in other portions of it; but, upon the whole, the fossils are nearly identical with those above noticed; from which it appears that both *Insects* and *Isopoda* are the most characteristic organic remains throughout the greater part of the Wealden in this district, though they are comparatively speaking of rare occurrence, except at one particular spot, while *Cypris*, *Cyclas*, and *Ostrea*, the usual and characteristic fossils of estuarine formations, are generally abundant. The lithological agreement, however, of these strata, is in many

cases very indistinct and ill defined; for, even the limestones vary much in character, colour, and general appearance, while the whole series of strata, in one quarry, differ greatly from those in another not far distant. The two points in which the beds more nearly resemble each other, both in the sections and lithological characters, are near Dinton and Ham Cross, Lady Down, and around Chilmark.

The strata above described consist chiefly of limestones (often fissile, slaty, and slightly oolitic), sandstones, shales, and grits, differing much in thickness and mineralogical texture, yet often sufficiently similar even in this respect to identify them as a whole with each other. Any difficulties, however, which arise in such identification owing to variations in structure, may readily be removed by the aid of certain fossils, such as *Cypris*, *Ostrea*, and *Cyclas*, which prevail indiscriminately throughout the whole group. And this is only one of the many instances which prove the value of organic remains in identifying the same strata in different and often very distant localities.

One characteristic test of fresh-water deposits is the abundance of species and the comparative rarity of distinct genera, and this is fully illustrated in the tract under consideration. Generally speaking, any set of deposits which have been formed by a lake, river, or estuary, present certain peculiar appearances and characters which the eye of an experienced geologist can readily detect, and which often afford a very fair presumptive evidence of their origin. But of course it would not be safe to rest our conclusions on these grounds alone, without the aid of fossils and other connecting circumstances.

In the present instance we have decisive proof, from the

abundance of fresh-water fossils, as to the source of the Purbeck formation; whilst the frequent intermixture of *Ostrea* and *Modiola* leads to the inference, that the beds were deposited beneath the waters of an estuary, which produced considerable changes in the nature of the sediment accumulated, and of the animals by which it was inhabited.

VALE OF AYLESBURY.

Having thus far considered the general nature of the Purbeck strata and their fossil contents in Wiltshire, we will now proceed to examine briefly the analogous beds in Buckinghamshire. The Purbeck formation occupies a considerable area in the Vale of Aylesbury and its immediate neighbourhood, and presents throughout the same predominant characters, and the same lithological variations which have been observed in the Vale of Wardour. There is a certain degree of similarity in both cases, with local differences as clearly marked in each.

The Vale of Aylesbury, which extends from Thame on the south-west to Leighton on the north-east, is bounded on the north and west by the Kimmeridge clay, with occasional patches of the Lower Green sand, and detached outliers of the Purbeck and Portland formations; and on the south and east by the Green sands (upper and lower), Galt, and Chalk. In crossing the Vale from north to south, the formations traversed and seen in the whole denudation are, 1. Chalk; 2. Upper Green sand; 3. Galt; 4. Lower Green sand; 5. Purbeck; 6. Portland stone and sand; 7. Kimmeridge clay. A reference to page 1 will shew the difference between the structure of this district and that of the Wiltshire Wealden; for in this case the

strata, from No. 1 to 6 inclusive, are not repeated on the opposite side, as in the Vale of Wardour.

The heights at Whitchurch on the north are capped by the Purbeck beds, which are seen in several quarries near that village resting upon the Portland stone and sand. The town of Aylesbury stands partly upon the Portland Oolite and Kimmeridge Clay; but, towards Stone and Dinton on the south-west, the Purbeck strata are again exposed, and are generally found to occupy numerous higher ridges in the neighbourhood. At Dinton on the south-west, and Quainton Hill on the north-west, and elsewhere, these beds rest upon the Portland series, as at Chicksgrove and Wockley in the Vale of Wardour. The Pendle at Quainton and Bishopstone is instanced by Dr. Fitton as identical with certain beds at Dinton and Wockley in the Vale of Wardour, the whole group belonging to the lower part of the Purbeck formation, and being the equivalent of the *Slate*, *Cap*, and *Dirt*, and the other inferior beds on the coast of Dorsetshire. (Fitton, Geol. Trans., vol. iv. p. 288.) At Hartwell the Purbeck stone lies in the valley, which is not usually the case in this tract of country.

The Vale of Aylesbury, like that of the Vale of Wardour, appears to have been denuded by the action of water, and consequently the Purbeck series is seen in the same detached and irregular manner as it is in Wiltshire. A reference to Greenough's Geological Map, or to Dr. Fitton's Map of part of the south-east of England (Geol. Trans., 2nd series, vol. iv.) will shew, that in Buckinghamshire the Chalk, Upper Green sand, Galt, and Lower Green sand (both of which are here largely developed on the east, and far more so than round the Vale of Wardour) occupy only the eastern side of the valley; while

on the west, the Kimmeridge clay crops out beneath these formations with only occasional patches of the Lower Green sand. The Vale of Aylesbury thus differs considerably from the geological outline of the district immediately surrounding the Vale of Wardour; indeed, the aspect of the country in general is less varied and picturesque, though equally interesting to the scientific observer. The distance of the two valleys from each other in a straight line is about seventy miles.

The Sandstone of Quainton Hill, ten miles north-west of Aylesbury, and which closely resembles the Hastings sand, is rich in Cypris, Paludina, and Planorbis; above this is a thin band of hard crystalline limestone, not distinguishable from that on Lady Down, which seemed to be altogether destitute of fossils; and although I found slabs of a limestone much like one of the slaty beds in the vicinity of Dinton, I could not perceive any traces of Fish, Insects, or Isopodous Crustacea. The summit of the hill is capped with Lower Green sand, which is highly ferruginous, and in this I detected the dermal bones of a species of Crocodile. In the vale of Aylesbury, however, in a quarry between Stone and Hartwell, I discovered a few *wings* and one *elytron* of a Coleopterous Insect (pl. vi. fig. 7), similar to some in Wiltshire, but I could not meet with any vestiges of the Archæoniscus. The following is a section of the pit in descending order, the beds being horizontal:

	FEET.	INCHES.
1. Rubble,—several feet.		
2. Hard, white stone without fossils	3	0
3. Greenish stone with Cypris, about	2	0
4. Black clay containing bones of Tortoise	1	0
5. White and blue fissile limestone, locally termed *Pendle* .	0	0
Total	6	0

This has a laminated structure, and abounds in Modiola, a few Cypris and Cyclas, with bones, coprolites, and palates of Fish (Lepidotus). The remains of Insects are very scarce and imperfect. This stratum is also full of fragments of lignite; and, more rarely, specimens of *Sphenopteris*, resembling *S. Mantelli*, and another minute species of Fern. The pits in the Vale of Wardour include thin layers of limestone, with a profusion of carbonized plants in a comminuted state, as in the Sussex Wealden (page 7).

The Limestone (No. 5) in this section, bears a close analogy to the thin white slaty limestone near Dinton in Wiltshire, (page 5,) and while there is in this instance a great agreement in lithological character, it is highly interesting to find a similar agreement as regards the fossils, especially in the existence of *Insects* in two distant portions of the same formation.

There are many other quarries at Whitchurch, Dinton, and Stone, which I was unable to examine, but as the Pendle occurs at all, it is not improbable that Insects may be found there also.

GENERAL REMARKS AND CONCLUSIONS ON THE WEALDEN.

The whole of the Wealden formation is supposed to have been deposited beneath the waters of an estuary, (or more probably as Dr. Fitton suggests, it may have originated in a series of local estuaries,) as it contains some fossils such as *Ostrea*, *Modiola*, and others, which never live exclusively in fresh water, but are capable of living in estuaries, or at the mouths of rivers near the sea. In the Purbeck beds, (which as previously stated, form the lower part of this group,) these estuarine shells, are very abundant, associated, however, with many fresh-water genera, *Insects*, Fish, Crustacea, a few land and

fresh-water plants, together with other and higher orders of the animal creation. As might be expected, the Wealden generally is a partial deposit and of moderate extent, but presenting the same characters, and many of the same peculiar fossils, throughout its range. The upper series is best developed in Sussex, Kent, and the Isle of Wight, and the lower in Wiltshire, Dorsetshire, and Buckinghamshire. Traces of the Wealden have also been discovered in France and Germany, as well as in Scotland, although there is reason to doubt whether the supposed Wealden beds of the latter country are strictly equivalent to those in England.

Those who are interested in the subject, will find ample details in Dr. Fitton's admirable and interesting memoir on the strata below the Chalk, published in the "Transactions of the Geological Society of London, vol. iv. 2nd Series."

Whether the upper members of the Wealden will afford *Insects* and *Isopoda* so abundant in portions of the lower ones has yet to be proved; but their existence in that part of the series is rendered more probable, because the same causes were in operation during the formation of the whole group, and from which they all derived their origin. If the beds in the neighbourhood of Battle in Sussex represent the Purbeck division, or a portion of it, such fossils might be sought for among the limestones there with some chance of success. Dr. Mantell has lately informed me that he has hitherto searched in vain for them in many parts of Sussex, so that their occurrence there is still uncertain.

I have stated that the Vale of Wardour is nearly surrounded by the Chalk and Upper Green sand, and a reference to Greenough's Geological Map, will shew that the

general outline of the country enclosing the Sussex Wealden is precisely similar.

Now in both these cases, there can be little doubt that the strata were at one time continuous, and spread over the whole of the inferior and earlier formations, which is easily proved by sections taken across the district, as section II. pl. xi. will explain.

Subsequently, however, as in the instance of the Vale of Wardour, these upper beds must have suffered great denudation from the action of water, and disruption of the strata, by which the subjacent Purbeck and Portland series have been exposed, and thus the Vale itself, in course of time, has acquired the same general outline which it now presents.

It is probable that there was a gradual expansion or upheaving of the Purbeck beds, anterior to the destruction and denudation of the Chalk and Green Sand above; this would both tend to fracture the latter, and to disturb and incline the Purbeck series; and this we find to be the case, for an anticlinal line or ridge, caused by this upheaving, traverses the valley from east to west, and the strata in consequence are inclined in opposite directions, at a greater or less angle, on the north and south of this line. But the disturbing forces appear to have acted with a greater degree of intensity on the north side of the line, for the beds have a greater dip to the north than the south. See section II. pl. xi., and Fitton, page 244.

It is a singular fact noticed by Dr. Fitton, "that this anticlinal line coincides in direction with that of the great Wealden denudation in Hampshire, Surrey, and Sussex, and is parallel to the line of upthrow on the coast of Dorsetshire and the Isle of Wight." This seems to shew that the same elevating causes which produced the one set

of disturbances, also produced the other, and that in fact they all have a common origin.

Thus we have a number of similar phenomena in the same strata throughout their range in different parts of England, while there is also a general uniformity in the organic contents and lithological structure of the whole group.

The Vale of Wardour itself presents an excellent example of a valley of denudation. There are other valleys in the Wiltshire Downs of a similar nature. The vales of Pewsey and Warminster, for instance, are of the same character, though on a smaller scale. Dr. Buckland, on the other hand, considers these to be valleys of elevation "formed by the elevation of the strata which enclose them;" (Geol. Trans. 2nd Series, vol. ii.;) and it is not unlikely that some of them may be attributed to the agency of both these causes.

With regard to the deposits coeval with the Wealden, it is fair to suppose that different strata were in process of formation in other parts of the globe during the same period. Some geologists conceive that the Solenhofen Slate (which forms the upper part of the Oolitic system in Germany) was deposited contemporaneously with the Wealden. This slate is exclusively of marine origin, and is remarkable for the number and extreme beauty of its fossils. It is rich in Fish, Insects, and Crustacea, and in some cases the stone itself is much alike. The Saurians also found in the Sussex Wealden, are more nearly allied to those in the Oolitic or Jurassic, than to those of the Cretaceous epoch, and Agassiz states that the Wealden Fishes* are entirely distinct from those of the Chalk.

* Among these we now have the genus Leptolepis (vide p. 15) which is common in the Solenhofen Slate.

But of course these coincidences, however interesting, are by no means proofs of contemporaneous origin. Indeed, at present the existence of any marine equivalent of the Wealden is hardly decided, although the Solenhofen Slate undoubtedly belongs to the upper part of the Oolitic formation, and our Wealden is also referrible to the same date, to which it is much more naturally allied than to the Cretaceous series.

Certain strata of the Neocomian period of Continental geologists, have lately been considered to be contemporary with the Wealden, but Dr. Fitton in his paper on the Lower Green sand of the Isle of Wight (Geol. Proc. vol. iv. pt. i, for 1843, No. 95, page 203) doubts this supposition, and considers it untenable and inconsistent with the facts there stated. Mr. Murchison is also of the same opinion. (Geol. Proc. vol. iv. pt. i. No. 94, page 175.) For further details respecting marine deposits coeval with the Wealden, I refer the reader to Dr. Fitton's Memoir on the strata below the Chalk. (Geol. Trans. 2nd series, vol. iv. page 328.)

I may here remark the great similarity in lithological composition and general appearance between the Purbeck beds, and some of the fresh-water Tertiaries of the Isle of Wight. Many of the slabs of fissile limestone, near Cowes, containing embedded Cyclades, were hardly distinguishable from certain limestones in the Vale of Wardour. The thin white slaty limestone, so replete with Insects and Fish at its eastern extremity, also bears a close analogy to the stone of Monte Bolca, and to some of the beds at Aix in Provence. These facts added to the proofs in other instances shew that an agreement in mineralogical character however great, between strata of different ages, affords no criterion of their identity, and

also the value and importance of fossils in determining the age of distinct formations, widely separated from each other in point of time.

With regard to fresh-water deposits in general, (as I have before observed,) whether they owe their origin to lakes or rivers, or partake of a mixed and estuarine character, there is a great uniformity and lithological resemblance betweeen them in most cases. The fossils of course will be seen to vary according to the different circumstances attending their original deposition arising from local causes, but even then, there will be a certain degree of similarity far more remarkable in this instance, than in that of other formations entirely marine. We shall perceive, for example, a great quantity and variety of land and fresh-water plants, and a far larger assemblage of the different terrestrial inhabitants which existed at that period. In most marine deposits, on the contrary, except in a few particular cases, as in the London Clay, and Stonesfield Slate, these terrestrial and fluviatile productions will be generally of rare occurrence, while marine exuviæ will of course be more or less abundant.

TABLE OF ORGANIC REMAINS FROM THE PURBECK STRATA IN THE VALE OF WARDOUR.

SPECIES.	REFERENCES.
PLANTÆ.	
Licopodites, (portions of,)	
Louchopteris Mantelli? . . .	Mant. Geol. Trans. 2. ser. 1. t. 46. fig.
Sphenopteris Phillipsii, and two other genera	5. Mant. Geol. S. E. England, p. 239.
Musci? (traces of,)	
Thuytes	
Fucoides	
A large cone in Miss Benett's collection	
Seed vessels	

TABLE OF ORGANIC REMAINS, ETC., *continued.*

INSECTA.*

COLEOPTERA.

SPECIES.	REFERENCES.
Carabidæ, (a doubtful species of this family,)	Pl. ii. fig. 1.
Carabus elongatus, (Brodie,) . . .	Pl. ii. fig. 1.
Staphylinidæ ? (remains of,) . . .	Pl. ii. figs. 2, 3.
Cerylon striatum, (Brod.) . . .	Pl. iii. fig. 1.
Helophorus ?	Pl. iii. fig. 2.
Cyphon, (Beetle resembling,) . .	Pl. iii. fig. 3.
Rhyncophora, (resembles one of the short-snouted,)	Pl. iii. fig. 4.
Pupa, (of some minute Coleopterous Insect,)	Pl. iii. fig. 6.
Buprestidæ? (elytra of,) . . .	Pl. vi. figs. 1, 10.
Tenebrionidæ? (elytron of one of the,) .	Pl. vi. fig. 2.
Harpalidæ, (*id.*)	Pl. vi. fig. 3.†
Colymbetes? (elytron of,) . . .	Pl. vi. fig. 5.
Elateridæ ? (elytra of,) . . .	Pl. vi. fig. 6, 7.‡
Curculionidæ ? (*id.*)	Pl. vi. fig. 4, 8, 14.†
Limnius ? (elytron of,) . . .	Pl. vi. fig. 9.
Cantharidæ ? (elytron of one of the,) .	Pl. vi. fig. 11.
Hydrophilidæ ? (*id.*)	Pl. vi. fig. 12.†
Helophoridæ, (elytra of,) . . .	Pl. vi. fig 13.

ORTHOPTERA.

Acheta Sedgwicki, (Brodie,) . . .	Pl. ii. fig. 4.
Blatta, (abdomen of,)	Pl. iii. fig. 7.
Blatta Stricklandi, (Brod.) . . .	Pl. iv. fig. 11.

* The number of families and genera determined, as far as the condition of the specimens would allow, amounts to *forty-eight*. In the few specimens to which I have ventured to attach specific names, in the absence of true specific identity (which can rarely be established), I have proposed certain general terms, which, for want of better characters, will sufficiently serve to distinguish the fossils ; for I conceived it would be better to adopt, than to omit them altogether, although Mr. Westwood was unable to determine them more definitely. I have named some in honour of individuals whose high scientific attainments and researches are too well known to need any further comment. I have also pursued the same plan with reference to the Lias.

† Pl. vi. figs. 3, 12, 14, may be Chrysomelidæ (Westwood).

‡ Pl. vi. fig. 7, is from the Vale of Aylesbury.

TABLE OF ORGANIC REMAINS, ETC., *continued*.

HEMIPTERA.*

SPECIES.	REFERENCES.
Kleidocerys, or Pachymeria . . .	Pl. ii. fig. 11.
Cixius ? maculatus, (Brod.) . . .	Pl. ii. fig. 8.
Ricania ? fulgens, (Brod.) . . .	Pl. iv. fig. 12.
Asiraca ? Egertoni, (*id.*) . . .	Pl. iv. figs. 7, 8.
Aphis Valdensis, (Brod.) . . .	Pl. iv. fig. 3.
Aphis ? plana, (*id.*)	Pl. ii. fig. 10.
Cimicidæ (an Insect belonging to one of the family,)	Pl. iv. fig. 6.
Cercopis, (larva of,)	Pl. ii. fig. 12, and pl. iv. fig. 9.
Cicada punctata, (Brod.) (wing of,)	Pl. v. fig. 4.
Delphax pulcher, (Brod.) (*id.*) . .	Pl. v. fig. 17.
Velia, Hydrometra, { Unfigured wings, which probably belong to these genera. }	

NEUROPTERA.

Leptoceridæ, (an Insect belonging to this sub-family,)	Pl. ii. fig. 6.
Phryganeidæ,†	Pl. ii. fig. 7.
Termes ? grandævus, (Brod.) . .	Pl. ii. fig. 5.
Corydalis, (wings allied to a family of which this genus is the type,) .	Pl. v. figs. 2, 3, 13, 14, and 16.
Æshna perampla, (Brod.) . . .	Pl. v. fig. 7.
Lindeniæ	Pl. v. figs. 8, 9.
Libellula (proper) antiqua (Brod.) (this agrees not only in the form of triangular cell, but also in coloration of basal part of the wing.—Westwood,)	Pl. v. fig. 10.

DIPTERA.

Simulium ? humidum, (Brod.) . .	Pl. iii. fig. 8.
Platyura ? Fittoni, (*id.*) . . .	Pl. iii. fig. 9.
Tanypus ? dubius (*id.*) . . .	Pl. iii. fig. 10.

* Many Entomologists divide the Hemiptera into two orders, Hemiptera and Homoptera. The Cicada and Aphis for example, are Homoptera, or Homopterous Hemiptera.

† The Phryganeida are placed in the order Trichoptera by Leach and Kirby.

TABLE OF ORGANIC REMAINS, ETC., *continued*.

SPECIES.	REFERENCES.
Empidæ, (one of the,)	Pl. iii. fig. 11.
Sciophila ? defossa, (Brod.)	Pl. iii. fig. 12.
Macrocera ? rustica, (*id.*)	Pl. iii. fig. 13.
Chironomi, (one of the,)	Pl. iii. fig. 14.
Culex ? fossilis, (Brod.)	Pl. iii. fig. 15.
Chironomus ? extinctus, (*id.*)	Pl. iv. fig. 5.
Rhyphus ? priscus, (*id.*)	Pl. iv. fig. 10.
Macropeza, or Chenesia, { wing allied to one of these genera, }	Pl. v. fig. 15.
Tipulidæ, (there are several unfigured specimens, which belong to this family, besides many of the above,)	
Larva, (vermiform of a sub-aquatic dipterous Insect,)	Pl. iv. fig. 1.

CRUSTACEA.

Archæoniscus Brodiei	(M. Edwards, Ann. des Sciences, Nat. 2nd series, vol. xx. page 326,) also, pl. i. fig. 6, 7, 8, pages 10 to 15.
Cypris granulosa	Fitton, Geol. Trans., pl. xxi. fig. 4.
„ Valdensis	*Id.* „ fig. 1.

And another undescribed species.

CONCHIFERA.

The following list is given in Dr. Fitton's Memoir, Geol. Trans. 2nd series, vol. iv. page 259 :

Cardium ?	
Corbula ?	
Cyclas angulata	Geol. Trans. pl. xxi. fig. 12.
„ elongata	„ fig. 9.
„ major	„ fig. 13.
„ media	„ fig. 11.
„ parva	„ fig. 7.
„ membranacea	M. C., 527, fig. 3.
Modiola	
Ostrea distorta	Geol. Trans. vol. iv. pl. xxii. fig. 2.

GASTEROPODA.

Paludina elongata	M. C., 509, fig. 2.

TABLE OF ORGANIC REMAINS, ETC., *continued*.

PISCES.

SPECIES.	REFERENCES.	
Leptolepis Brodiei, (Agass.) new species,	Pl. i. figs. 1, 3,	pages 15 to 18.
Leptolepis ? nanus, (Sir P. Egerton,) new species,	Pl. i. fig. 5,	
Ceramurus ? macrocephalus, (Sir P. Egerton,) new genus	Pl. i. fig. 2,	
Oxygonius tenuis, (Agass.) new genus	Pl. i. fig. 4,	
Lepidotus minor, (Agass.)	Fitton, Geol. Trans. page 260.	
Pholidophorus ornatus (Agass.)	*Id.*	

REPTILIA.

Testudo, (remains of, vide page 20,)
Tooth of a Saurian (p. 18).

CHAPTER II.

OXFORD CLAY. FOREST MARBLE. STONESFIELD SLATE.

Supposed larva of an Insect in the Oxford Clay in Wiltshire.—Traces of Insects in the Forest Marble near Bath.—Stonesfield Slate in Gloucestershire and Oxfordshire.—Remains of Insects in this formation, with numerous other Fossils.—Proofs of neighbouring land.—General observations.

The Oxford Clay is a formation belonging to the Middle Oolite, and consists for the most part of thick beds of laminated blue clay, including in some places subordinate courses of limestone called Kelloway Rock. These are the lowest strata in this division of the Oolitic group, and are very rich in organic remains. Among these my friend, Mr. J. C. Pearce has lately discovered the larva apparently of an Insect, near Christian Malford, and he has kindly permitted me to have an engraving made of it. (Pl. iv. fig. 13.) Mr. Westwood considers that the feet are too thick for the larva of a Dytiscus, but that it may possibly be a Libellula larva, though it has quite as much the appearance of a portion of a Pagurus, one of the long soft-tailed hermit Crabs. Either of its supposed names are related to forms which inhabit temperate climates. (See Addenda.)

This is the first instance of the occurrence of any Insect (?) in this formation, although many other rare and interesting fossils have been met with. Mr. Pearce's choice collection contains a fine selection from this bed,

an account of which is given in the Geological Proceedings, vol. iii. part ii. page 592. The abundance of Cephalopodous Mollusca, such as Ammonites, Belemnites, and Sepia in the Oxford Clay at this spot, evidently shews that it was deposited in a deep sea; and therefore it is to be expected that the remains of Insects would be sparingly distributed.

FOREST MARBLE.

The Forest Marble succeeds the Cornbrash, and belongs to the upper part of the Lower Oolite: the proper position of the whole of these will be seen in the Table at page 51. This series is chiefly composed of thin, fissile, and slaty oolitic limestones divided by clays, and sometimes by sand and grit, varying in thickness and full of fossils. No vestiges of Insects have, I believe, been hitherto detected in it; but, from the abundance of embedded plants, they might naturally be expected to occur. In some of the quarries near Bath, I lately found a few elytra of small Coleoptera, which Mr. Westwood states must have been of an oval form, and about one quarter or one third of an inch long; but it is quite impossible, from their imperfect state, to judge even of the group to which they belong. One is plain, another slightly striated, and the third punctate-striate. The following is a section in descending order of a quarry between Farley and Bath:

	FEET.	INCHES.
1. Hard rock, building stone. This is a compact Oolite .	5	0
2. Laminated clay and marl of a green, white, and yellow colour, full of plants, chiefly Thuytes, small seed vessels, and rarely *elytra*	8	0
Carried forward	13	0

	FEET.	INCHES.
Brought forward	13	0
3. Tiling and paving stone ; these are the usual slaty bed of the Forest Marble divided by clays, full of carbonized wood and other decomposed vegetable matter, with numerous shells (among which Pectens are abundant, and especially Pecten *lens*). Palates and teeth of Fish and Saurians	12	0
4. Marly clay, same as No. 2, abounding in plants, chiefly Thuytes, and a portion apparently of some Cycadaceous plant, with a few leaves of Ferns, *elytra*, and wings of Insects, Ostrea, and other small bivalves . .	9	0
5. Blocks, rough, yellow, and brown Oolite containing numerous shells, chiefly casts	5	0
The beds are horizontal.		
Total	39	0

The laminated marls, Nos. 2 and 4, are not unlike some of our tertiary fresh-water marls, and their surface is often covered with fragments of small plants. These marls do not seem to be so largely developed in other places, though they are seen near Atworth between Bradford and Melksham, but I could not discover any remains of Insects in that neighbourhood. The beds of Great Oolite at Atworth are, to all appearance, identical with those about to be described at Naunton in Gloucestershire (page 42). The Forest Marble often bears a very close resemblance to the Stonesfield Slate, both lithologically and zoologically ; and the great number of land plants, in addition to the presence of Insects, would tend to the supposition that analogous causes were in operation during their formation, especially as the Forest Marble is as intimately connected with the *upper* division of the Great Oolite, as the Stonesfield Slate is with the *lower* part of it. Indeed, the Forest Marble, Great Oolite, and Stonesfield Slate are, in many respects, so nearly related, that the whole forms *one* great Oolitic series, and naturally belongs to one and the same period.

STONESFIELD SLATE.

Our notice of the Stonesfield Slate will be very brief, as the remains of Insects are comparatively scarce, and are neither so numerous nor diversified as those in the Wealden and Lias. The Stonesfield Slate (so called from the village of Stonesfield near Oxford) is a formation belonging to the lower division of the Oolitic group. In parts of Gloucestershire it is intermingled with, and hardly separable from, certain beds (*Ragstone*), which appear to be a partial representative of a portion of the Great Oolite, as they contain many of the same fossils, and in all respects are evidently of contemporaneous origin. The Slate itself is an Oolitic limestone, averaging from five to eight feet in thickness, possessing a slaty structure, and very rich in organic remains. I shall dwell more in detail upon the Slate beds of the Cotteswold Hills in Gloucestershire, because they are less known, and are in most respects similar to those in Oxfordshire. In order that the reader may compare those in each county, it will be necessary to examine the annexed Section in descending order, of one of the quarries at Stonesfield, copied from Dr. Fitton's paper, Zoological Journal, vol. iii. p. 412.

1. Rubbly Limestone (Cornbrash).
2. Clay with Terebratula. Pecten fibrosus.
3. Rocky limestone.
4. Blue clay.
5. Oolite rock.
6 Blue clay.
7. Rag. Oolitic limestone.
8. Sandy bed, containing the Slate.

A deep shaft is made to the depth of 68 feet, and the Slate is got out from the bottom. The bed No. 7 is about 25 feet thick, and is a fine-grained Oolite, with

casts of Univalves and Bivalves of the genera Turritella, Venus, Tellina, Pecten vagans, &c. No. 1 to No. 6 consist of various beds of clay and limestone, probably belonging to the Cornbrash, rubbly at the top, and oolitic at the bottom. The Slate occurs in irregular masses in a bed of sand.

The Slate beds are largely developed in the north-east of Gloucestershire, and have been traced by Mr. Lonsdale from Wooton-under-Edge to the neighbourhood of Burford, where their lithological and zoological characters are nearly identical with those at Stonesfield. From thence they may be followed in a more northerly direction, and are well exhibited near Bourton-on-the-Water, Upper Slaughter, Stow-on-the-Wold; and on the west, at Eyeford and Naunton, to their farthest limit in this direction at Sevenhampton, six miles east of Cheltenham. There is a considerable uniformity of character in the sections at these different points, and a very general resemblance to the Slate of Stonesfield; the fossils too are in almost every respect precisely similar, so that there can be little doubt respecting the age and relations of this portion of the Oolitic series.

The succeeding Section in descending order, of one of the quarries nearest to the village of Sevenhampton, will give some idea of those at the other quarries in the immediate neighbourhood, which it in most respects fairly represents.

	FEET.	INCHES.
1. Yellowish clay with numerous shells, viz., Echinus excavatus, Ostrea acuminata, Natica, Pecten vagans, Pinna ampla, Cardium gibberulum, Modiola plicata, Cidaris; Terebratula obsoleta and globata, being the most characteristic. There are also several Corals (Cyclolites being the most abundant	6	0
Carried forward	6	0

	FEET.	INCHES.
Brought forward	6	0
2. Ragstone, a hard, coarse, oolitic limestone with Ostrea acuminata, and other species; Terebratula, and numerous small branching Corals on its upper surface . .	0	4 to 6
3. Thin seam of soft oolitic stone with Ostrea acuminata, and arm-joints of *Apiocrinites*, cemented by calcareous matter	0	3
4. Sandy marl of a light brown colour, containing but few shells of which Pinna ampla is the most characteristic	8	0
5. Ragstone, of a more slaty nature than the first bed, No. 2. This is a very hard stone, often of a grey colour at the edges, but becoming blue towards the centre. Sometimes it is quite blue, and externally resembles certain beds of the Cornbrash. It contains a few casts of shells, Plagiostoma Cardiiforme, Ammonites triplicatus being characteristic; and occasionally fruits and leaves of plants, with teeth and palates of Fish	14	0
6. Slate.—This is the regular bed used for tiles: it has a laminated structure and readily splits on exposure to the frost. The colour varies from light to dark brown, and it is generally hard, but sometimes soft and sandy. Shells are scarce, but a species of Ammonite (probably new) is not uncommon	4	0
Total	32	9

No. 6 is rich in the remains of plants, chiefly monocotyledonous fruits and leaves, a few Ferns, some Liliaceæ, and others which resemble the genus Potamogeton. A large cone and some smaller ones, which probably belong to a species of Thuytes, have been found.

Teeth of Sharks and small palates (Bufonites) are abundant, and more rarely those of Saurians: elytra of Beetles of various sizes also occur. (Pl. vi. figs. 15 to 21.)

This bed is the lowest reached by quarrying at this spot, but elsewhere the quarries are much deeper, and consequently the thickness of some of these inferior beds is better seen. In one, for example, about a mile to the west, we have in descending order,

	FEET.	INCHES.
1. Clay, same as No. 3. above referred to, and containing similar fossils	4	0
2. Ragstone, same as No. 5	16	0
3. Fine Slate, same as No. 6	4	0
Total	24	0

The beds Nos. 2 and 3 might not be improperly combined, for they are frequently intermixed, although the best Slate is perhaps fairly separable from the Ragstone. There is a slight difference in the section here, when compared with that at the first quarry, in the absence of the sandy Marl, and the greater thickness of the Ragstone; lithologically and zoologically, however, the beds are precisely alike.

The occurrence of the remains of a species of *Apiocrinite*, both in the Clay No. 3, and the Ragstone below, in addition to that of several shells and other fossils (palates and teeth) identical with those which abound in the Great Oolite, seems to shew that these strata form a reduced equivalent of a portion at least of that formation; and while they are hereabouts greatly lessened in volume, they pass directly and often insensibly into the inferior Slate beds. In many places, especially near Naunton, the Ragstone is much thicker, and bears a still closer resemblance to the Great Oolite in the neighbourhood of Bath and Bradford, containing a great abundance and variety of the small but beautiful shells for which Avon Cliff is so justly celebrated.

There are no beds of the upper division of the Great Oolite seen in this part of the country represented by the Cornbrash in Oxfordshire. (See section, page 39.) The Slate too appears to be a more regular and continuous stratum, than that which occurs in irregular masses in the sandy bed at Stonesfield. But these differences

are such as might naturally be expected in a more distant portion of the same series; while, as before indicated, the general conformity is sufficiently marked and distinct for all purposes of comparison and identification.

The whole of this district is affected by several faults, which are exposed at Brockhampton (section v. pl. xi.), Lower Swell near Stow on the Wold, and elsewhere. Section v. pl. xi. will give some idea of the general bearing of the Oolitic strata in the Cotteswolds, and of the relative position of the Stonesfield Slate. (No. 1.)

At Eyeford, where the fossils are very numerous and interesting, (especially as there are among them a new species of Asterias, and portion of a Pterodactyle,) we find in descending order,

	FEET.	INCHES.
1. Rubble, the remains of old quarries	4	0
2. Ragstone. This bed differs from that at Sevenhampton in forming thick blocks and not possessing a slaty structure	14	0
3. Fine slate. A sandy stone splitting into layers, from .	3 to 6	0
Total	21	0

Here the Slate is separable from the Ragstone. I learn from my friend, the Rev. E. F. Witts, (who has the finest collection of Slate fossils from this neighbourhood, and who has lately made many important discoveries there,) that the strata lying between Burford and Charlbury in Oxfordshire, are all coarser in their texture than those in Gloucestershire, but contain the same fossils. Above the Ragstone and Slate are the two beds of clay, divided by a thin layer with Ostrea, as in the section at Sevenhampton (page 40); and the whole of these immediately overlie the "Clypeus bed," belonging to the upper part of the Inferior Oolite, of which it forms the first stratum.

The Stonesfield Slate is chiefly confined to parts of

Oxfordshire and Gloucestershire, though there are similar beds at Kettering, in Northamptonshire, and at Collyweston, near Stamford, in Lincolnshire. At the latter place Dr. Buckland informs me, that the bed is only four feet thick, and lies between the Great and Inferior Oolite as near Woodstock, but many of the shells differ from those at Stonesfield. The stone itself also is less calcareous than the Slate in Oxfordshire,

The remains of Insects in this formation are confined to a few genera only, and from their imperfect state are very difficult to determine. Pl. vi. fig. 15, represents one of the largest elytra found in the Slate which is also constantly met with at Stonesfield. (See Bridg. Treat. vol. ii. pl. xlvi. figs. 4 to 9, and vol. i. p. 409, where the leg of a Curculio is figured from the same spot.) These elytra have been generally considered to belong to the Buprestidæ, but Mr. Westwood (vid. notes,) thinks they are more nearly allied to the Prioniidæ; for which I propose to adopt the name Prionus (?) Ooliticus until more decisive characters can be made out.

Figs. 15 to 21, inclusive are from the Stonesfield Slate in Gloucestershire, and according to Mr. Westwood may possibly belong to the families Prioniidæ, Buprestidæ, Pimeliidæ, Blapsidæ, and Coccinellidæ. He remarks that none of these absolutely indicate a tropical temperature,* which the large elytra (fig. 15, pl. vi.) have been usually supposed to do; and some of these were evidently portions of xylophagous Coleoptera. This conclusion is quite to be anticipated from the preponderance of vegetable remains throughout this deposit.

In the second volume of the Geological Proceedings

* The recent genus Pimelia, for example, is peculiar to southern Europe, northern Africa, and Egypt.

(p. 688,) Dr. Buckland describes the wing of a large Neuropterous Insect (*Hemerobioides giganteus*) which he more lately discovered at Stonesfield, and I am indebted to the kindness of that eminent author for an opportunity of figuring this beautiful fossil, pl. vi. fig. 22. This is the first instance of a Neuropterous wing in the lower division of the British Oolites.

Mr. R. C. Taylor (in Loudon's Mag. Nat. History, vol. iii. p. 361) states, that elytra of Beetles occur in the Oolitic Shale at Danby in Yorkshire, which is also noticed by Messrs. Young and Bird in their "Geology of Yorkshire," but I have not been able to obtain any further information respecting them. The fact is however an interesting one, because, "this Shale occupies nearly the same place in the Oolitic series as the Stonesfield Slate." (See Buckland's Bridg. Treatise, vol. ii. p. 78, note.) The number and variety of the fossils at Stonesfield have been long and justly celebrated, but the author believes that those of the district under review, have not been hitherto described in any detail.*

The brief notice given in this chapter will still be sufficient to point out the general extent and zoological importance of this group.†

With regard to the conditions which prevailed when this portion of the Oolite was formed, the great abundance of terrestrial remains evidently proves that land was not far distant, and the character of the fossil flora especially of that period, points to an exuberant vegetation, which may have flourished on some neighbouring coast,

* A paper upon this subject, by Mr. Buckman and myself, will be found in the Proc. of the Geological Society for June 26th, 1844.

† Some valuable communications on the Oolitic formations of Gloucestershire, are given by Mr. Murchison and Mr. Lonsdale in the Geological Proceedings, vol. i. page 388, and vol. i. page 413.

inhabited by various tribes of plants and animals. Or, possibly, these various fossils may have been derived from a series of Islands with which the seas of that early period were perhaps largely interspersed; a case, in many respects, very similar to that which attended the deposition of the London Clay in the Island of Sheppey and elsewhere. The contiguity of land is likewise evident from the relics of the Phascolotherium (a Marsupial animal resembling the Didelphis) and Pterodactylus, which occasionally, though rarely, accompany them. The occurrence also of the Amphitherium, which is supposed to have been an insectivorous animal, may like the Spiders at Aix and Solenhofen be used as an argument in favour of the contemporaneous existence of Insects, even if no fossils of that class had been previously met with.

The following is a list of the fossils from the whole of the district (in Gloucestershire) referred to in this chapter:

TABLE OF ORGANIC REMAINS FROM THE STONESFIELD SLATE IN GLOUCESTERSHIRE.

PLANTÆ.

SPECIES.	REFERENCES.	LOCALITIES.
Bensonia ovata, (Buckman,)	. . . . .	Sevenhampton.
Cycadites ? . . .	Murchison's, Geol. Chelt. pl. i. fig. 2. . .	*Id.*
Carpolithus conicus, and two other unnamed species .	Foss. Flora, pl. cix. figs. 1, 2, 4. . .	*Id.*, and Eyeford.
Thuytes cupressiformis .	Sternb. pt. iii. pl. 33. fig. 3. . . .	*Id.*
T. expansus, (fine fruits of,)	Phill. York, pl. x. fig. 11.	Sevenhampton.
Pinites? or other Coniferæ two species	. . . .	*Id.*
Calamites ? . . .	. . . . .	*Id.*
Lila lanceolata, (Buckman,)	Geol. Chelt. pl. ii. fig. 3.	Eyeford.
Naiadea obtusa.	„ pl. i. fig. 2.	Sevenhampton.
„ ovata.	„ pl. ii. fig. 1.	*Id.*

TABLE OF ORGANIC REMAINS ETC., *continued.*

SPECIES.	REFERENCES.	LOCALITIES.
Næggerathia?		Eyeford.
Stricklandia acuminata, (Buckman,) . .	Geol. Chelt. pl. ii. fig. 2.	Sevenhampton.
Salicites longifolius.	„ pl. i. fig. 1.	Eyeford.
ZOOPHYTA.		
Fungia lævis.	Gold. Pet. pl. xiv. fig. 2.	Clay, Sevenhampton.
Turbinolaria mitrata.	„ pl. xv. fig. 5.	S.S. Stow Road.
Astrea oculata.	„ pl. xxii. fig. 2.	Clay.
„ concinna.	„ „ fig. 1.	*Id.*
Meandrina agaricites.	„ pl. xxxviii. fig. 2.	*Id.*
Lithodendron elegans.	„ pl. xxxvii. fig. 10.	S.S. Wagboro' Bush.
ECHINODERMATA.		
Cidarites subangularis.	Gold. Pet. pl. xl. fig. 8.	Clay, Sevenhampton.
„ propinquus.	„ „ fig. 1.	S.S. Eyeford.
Galerites depressus.	„ pl. xli. fig. 3.	Clay, Sevenhampton.
Apiocrinus, (arm joints of,) .	. . . . .	Clay, *Id.*
Asterias Cotteswoldia, (Buckman,) . .	Geol. Chelt. pl. iii. fig. 5.	S.S. Eyeford.
Pentacrinus, (joints of,)	. . . . .	Sevenhampton.
Id. (head with attached arms) . . .	. . . . .	Eyeford.
ANNELIDA.		
Serpula ilium.	Gold. Pet. pl. lxix. fig. 10.	Sevenhampton and Eyeford.
„ plicatilis.	„ pl. lxviii. fig. 2.	Clay, Sevenhampton.
„ quinquangularis.	„ „ fig. 8.	*Id.*
CIRRIPEDA.		
Pollicipes? ooliticus, (Buck.) . . .	Geol. Chelt. pl. iii. fig. 7.	Sevenhampton and Eyeford.

These are single valves resembling those of Pollicipes, but it is doubtful to what they really belong.

INSECTA.		
Coleoptera.		
Prioniidæ, (an elytron possibly belonging to the,)	Pl. vi. fig. 15. . .	Sevenhampton and Eyeford.
Prionus? ooliticus, (Brodie,)	*Id.* . . .	*Id.*

TABLE OF ORGANIC REMAINS, ETC., *continued*.

SPECIES.	REFERENCES.	LOCALITIES.
Blapsidæ, (elytra which approach in form to,)	Pl. vi. fig. 16.	Sevenhampton.
Buprestidæ, (elytra probably belonging to the,)	Pl. vi. figs. 17, 18, 19.	*Id.*, and Eyeford.
Pimeliidæ ? or Chrysomelidæ ? (*id.*) . .	Pl. vi. fig. 20.	Eyeford.
Coccinellidæ ?	Pl. vi. fig. 21.	Sevenhampton.
Coccinella ? Wittsii (Brodie)	*Id.*	*Id.*
CRUSTACEA.		
Remains of, ...		Clay, and S.S.
CONCHIFERA.		
Arca lævis. (Buck.)		Clay, S.S. Sevenhampton, and Wagboro' Bush.
Astarte elegans.	M.C. pl. cxxxvii. fig. 3.	Clay, Sevenhampton.
„ lævis.	Gold. pl. cxxxiv. fig. 20.	*Id.*
Avicula Munsteri.	„ pl. cxviii. fig. 2.	Sevenhampton, Eyeford.
„ ovata.	M.C. pl. DXII. fig. 2	*Id.*
Corbula striata, (Buck.)	Geol. Chelt. pl. iii. fig. 4.	*Id.*
Cucullæa ?		*Id.*, Clay.
Cardita V. Costata (Buck.)		*Id.*
Cardium gibberulum.	Phill. Yorks. pl. xi. fig. 8.	*Id.*
„ striatum, (Buck.)		*Id.*, S.S.
Exogyra auriformis.	Gold. pl. lxxxvi. fig. 5.	*Id.*
Gervillia lanceolata.	„ pl. cxv. fig. 9.	*Id.*
Isocardia concentrica.	M.C. pl. ccccxci. fig. 1.	*Id.*, Clay.
Lima elongata.	Gold. pl. cii. fig. 13.	Sevenhampton.
„ gibbosa.	M.C. pl. cliii.	Clay, *Id.*
„ minuta.	Gold. pl. civ. fig. 6.	S S. Sevenhampton.
„ duplicata.	„ pl. cvii. fig. 9.	*Id.*
Modiola gibbosa.	M.C. pl. ccxi. fig. 2.	*Id.*, and Eyeford.
„ inclusa.	Phill. Yorks. pl. iii. fig. 20.	
„ tenuistriatus.	Gold. pl. cxxxi. fig. 5.	Clay, Sevenhampton.
Mya æquata.	Phill. Yorks. pl. xi. fig. 12.	S.S. Naunton.
Mytilus pectinatus.	M.C. pl. cclxxxii.	Clay, Sevenhampton.
„ pulcher.	Gold. pl. cxxxi. fig. 8.	S.S. *Id.*, and Eyeford.
Nucula mucronata.	M.C. pl. cccclxxvi. fig. 4.	Wagboro' Bush.
„ axiniformis.	Phill. Yorks. pl. xi. fig. 13.	*Id.*
„ lachryma.	M.C. pl. cccclxxvi. fig. 3.	S.S., Eyeford.

TABLE OF ORGANIC REMAINS, ETC., *continued.*

SPECIES.	REFERENCES.	LOCALITIES.
Pecten annulatus.	M.C. pl. DXLII. fig. 1.	*Id.*
„ lens.	„ pl. CCV. fig. 2, 3.	*Id.*
„ obscurus.	„ pl. CCV. fig. 1.	*Id.*
„ vagans.	„ pl. DXLIII. figs. 3, 5.	Clay, Sevenhampton.
Pholadomya lyrata.	„ pl. CXCVII.	S.S., *Id.*
„ truncata (Buck.)	. . . .	Clay, *Id.*
Pinna ampla.	„ pl. VII.	*Id.*
Plagiostoma cardiiforme.	„ pl. CXIII. fig. 3.	S.S., *Id.*
Plicatula ventricosa.	Gold. pl. CVII. fig. 3.	Clay, *Id.*
Ostrea accuminata.	M.C. pl. CXXXV.	*Id.*
„ costata.	„ pl. CCCCLXXXVIII.	*Id.*
„ gregaria.	„ pl. CXI. figs. 1, 3.	*Id.*, and Eyeford.
„ sandalina.	Gold. pl. LXXIX. fig. 9.	*Id.*
Sanguinolaria obtusa (Buck.)	. . . .	*Id.*
Tellina ?	. . . .	S.S., Sevenhampton.
Terebratula globata.	M.C. pl. CCCCXXXVI. fig. 1.	Clay, rare in S.S., *Id.*
„ obsoleta.	„ pl. LXXXII. fig. 7.	*Id.*
Trigonia clarellata.	„ pl. LXXXVII.	S.S., Sevenhampton, Eyeford.
„ impressa.	Sow. Zool. Jour. 3. pl. xi.	*Id.*
„ pullus.	M.C. pl. DVIII. fig. 2.	Clay, Sevenhampton.
Unio Lavateri.	Gold. pl. CXXXII. fig. 6.	S.S., *Id.*
Two other species.	. . . . .	Clay, *Id.*
Venus nuculiformis.	Roemer Verst. pl. vii. fig. 11.	*Id.*
	GASTEROPODA.	
Actæon cuspidatus.	M.C. pl. CCCCLV. fig. 1.	S.S., Wagboro' Bush.
Buccinum subcarinatum.	Roemer Verst. pl. xi. fig. 33.	*Id.*
Cerithium.	. . . . .	*Id.*
Delphinula.	. . . . .	*Id.*
Fusus carinatus.	„ pl. ix. fig. 24.	Clay, Sevenhampton.
ittorina concinna.	*Id.*	S.S., Wagboro' Bush.
Nucula variabilis.*	M.C. pl. CCCCLXXV. fig. 2.	Eyeford.
Melania lineata.	„ pl. CCXVIII. fig. 1.	Clay, Sevenhampton.
„ striata.	„ pl. XLVII.	*Id.*
Nerinæa striata, (Buck.)		Clay, Sevenhampton.
Nerita minuta.*	„ pl. CCCCLXIII. fig. 3, 4.	S.S. Eyeford.
„ costata.*	„ pl. CCCCLXIII. figs. 5, 6.	*Id.*

* These shell also occurs in the *Great Oolite* at Ancliff.

TABLE OF ORGANIC REMAINS, ETC., *continued.*

SPECIES.	REFERENCES.	LOCALITIES.
Natica macrostoma.	Roem. Verst. pl. x. fig. 11.	Wagboro' Bush.
„ alta, (Buck.)	. . . .	Clay, Sevenhampton.
„ inflata, (*Id.*)	. . . .	Wagboro' Bush.
Trochus obsoletus.	„ pl. xi. fig. 5.	S.S. rare.
Turbo ornatus.	M.C. pl. cccccxl. fig. 2.	Eyeford, and Sevenhampton.
Patella rugosa.	„ pl. cxxxix. fig. 6.	Wagboro' Bush, rare.
„ nana.	„ pl. cccclxxxiv. fig. 3.	*Id.*
	CEPHALOPODA.	
Ammonites elegans.	M.C. pl. xciv. fig. 1.	Eyeford.
„ gracilis, (Buck.)	Geol. Chelt. pl. iii. fig. 7.	Sevenhampton.
„ triplex.	M.C. pl. ccxcii. fig. 4.	*Id.*
Belemnites canaliculatus d'Orbigny Terrains. Jur.	„ pl. xiii. fig. 1.	*Id.* Eyeford.
Fleuriausus.	„ pl. xiii. fig. 14.	*Id.*, rare.
Nautilus, (casts of,)		
	PISCES.	
Palates, Teeth, Scales, &c. of Shark, Psammodus, Pycnodus, and others.	. . .	Sevenhampton and Eyeford.
	REPTILIA.	
Ichthyosaurus, (Bones of,)	. . . .	*Id.*
Megalosaurus, (Tooth of,)	. . . .	Eyeford.
Pterodactylus.	. . . .	*Id.*

CHAPTER III.

Enormous lapse of time* between the deposition of the Purbeck and Lias formations.—Range and extent of the Lias through Gloucestershire into Worcestershire, Warwickshire, and parts of Somersetshire and Monmouthshire.—General uniformity of character.—Abundance of Insects, conclusions to be formed from their occurrence.—Condition of the lower Lias at that period.

From what has been said, it will be seen that at present no Insects have been found in England, with the exception of the Oxford Clay, Forest Marble, and Stonesfield Slate in any of the numerous and extensive formations which come between the Purbeck and Lias series.

The following table arranged in descending order of geological succession, is intended to shew these, beginning with the newest or uppermost:

UPPER OOLITE.	MIDDLE OOLITE.	LOWER OOLITE.
Portland Stone and Sand. Kimmeridge Clay.	Calcareous Grit. Coral Rag. *Oxford Clay?* † Kelloway Rock.	Cornbrash. *Forest Marble.*† Great Oolite and *Stonesfield Slate.*† Fuller's Earth, Inferior Oolite.

* In addition to the many facts which may be brought forward to prove the lengthened periods which must have taken place, not only during the formation of one group of strata, but also in some cases previous to their deposition; a very striking instance may be observed at Vallas, near Frome, in Somersetshire. A thin bed of Fuller's Earth rock rests unconformably on highly inclined strata of Mountain limestone; and a lithodomous Modiola (*M. inclusa*) has bored into the upper part of this limestone to the depth of several feet, and the shell itself frequently occurs *in situ* in the rock. This same genus is met with in the Inferior Oolite near Cheltenham, and has penetrated the Oolite there in a similar manner. Now it is quite clear that this Mollusk must have required time to form these cavities, and that it continued to do so long before the Fuller's Earth entombed it.

† The formations marked in italics contain Insects, but they are inserted here in their proper place, in order to mark their true geological position. At present only one doubtful specimen of this class is known in the Oxford Clay (page 36); a very few elytra in the Forest Marble (page 37); while the Stonesfield Slate presents a much greater variety, but less than the Wealden and Lias.

It is evident then, that there is a great geological distance between the Purbeck and Lias, and that a considerable lapse of time must have taken place whilst the intermediate strata were deposited. It would not of course be right to infer that, because no Insects have as yet been detected in any of the other deposits, they did not inhabit the globe at the different geological epochs above referred to. But as the greater part of the various intervening groups were formed at the bottom of deep seas, and therefore at a considerable distance from land, it seems more probable that the circumstances which prevailed at the time were unfavourable to the preservation of any Insects which may have lived at that period.

The Lias is a very extensive formation in this country, and generally rich in organic remains; until lately, however, no trace of Insects had been detected in it, although they are now found to be abundantly distributed, chiefly throughout the lower division of this deposit in Gloucestershire, Worcestershire, Warwickshire, Somersetshire, and on the borders of Monmouthshire. I first discovered these interesting fossils in the immediate neighbourhood of Gloucester, but more recent investigations have shewn, that they are by no means limited to this district. My object therefore, is to shew by the help of sections and fossils, the general relation which these strata bear to each other, in the different counties above mentioned, and to describe in detail, those peculiar fossils which now may be fairly considered as characteristic of certain portions of the Lias series. (See Plates 7, 8, 9, 10.)

The Lias in Gloucestershire is divided into 1. Upper Lias shales. 2. Lias Marlstone. 3. Lower Lias shales. 4. Lower Lias limestones and shales. The Upper beds (No. 1.) are not well or extensively developed in the

neighbourhood of Cheltenham, but they may be best studied in the Liassic outliers at Dumbleton and Alderton, about twelve miles north of that town. These consist of thick beds of blue shales and clays traversed by a thin stratum of limestone, which will shortly be described (page 55). This shale contains numerous fossils, among a few of which the following may be enumerated: Ammonites Walcotii, M. C. t. 106, A. undulatus, Belemnites acutus, Mill. G. T. 2. ser. 2. t. 8. fig. 9, Plicatula spinosa, M. C. t. 245, Nucula claviformis, M. C. t. 476, Inoceramus dubius, M. C. t. 584, Gervillia, &c. The total thickness of the upper Lias shale is from 60 to 100 feet. The Marlstone on which it rests is a very hard rough stone of a blue colour internally, and of a brown colour externally; there are numerous beds divided by sand and clay. It abounds in fossil shells, viz., Nautilus obesus, M. C. t. 124, Ammonites heterophyllus, M. C. t. 266, A. Sedgwicki (Buckman) and others; Belemnites pencillatus, M. C. t. 590, Pecten æquivalvis, M. C. t. 136, Pholadomya, Gryphæa gigantea, M. C. t. 391, Cardium truncatum M. C. 553, f. 3, Pinna affinis, M. C. 313, f. 2, Terebratula tetrahedra, M. C. t. 83. f. 4, Pleurotomaria, Spirifer, and many other shells; a fir cone, Fucoids, stems of Pentacrinite, and the humerus of a *Pterodactyle* which was lately discovered by my friend the Rev. R. L. Benson.

The Marlstone is about twenty feet thick. In some localities, a thin bed of yellow clay containing nodules of ironstone is seen below the Marlstone, which abounds in shells; among a few of which the most characteristic are, Belemnites elongatus, M. C. t. 590, Modiola cuneata, M. C. t. 248, f. 2, Cardinia. Stutch. Ann. Nat. Hist. t. 10. f. 13, Pinna lanceolata, M. C. t. 281, Arca pulchra, M. C. t. 473, f. 3, A. Buckmani, Spirifer punctatus, and some others.

The next bed consisting of laminated clay, twelve feet in thickness, is considered by Mr. Buckman to be the first true bed of the lower Lias shales, and is characterized by Ammonites Conybeari, M. C. t. 131, Crenatula ventricosa, M. C. t. 443, Ammonites Henleyi, M. C. t. 173, A. Taylori, M. C. t. 514, Unio, and a few other shells. These two beds chiefly occur on the lower escarpments of the Cotteswolds. These are succeeded by about ten feet of slate-coloured clay, which is divided by a thin layer of yellow clay two feet thick, in both of which there are many species of Ammonites and Belemnites; the former being most abundant in the yellow clay, and the latter in the slaty clay. The fossils in the lower bed differ from those in the upper one. Among these may be mentioned, Hippopodium ponderosum, M. C. t. 250, Corbula cardioides, Phil. G. Y. i. t. 14, f. 12, Spirifer Walcotii, M. C. t. 377, f. 2, &c., &c.— A thin band of clay, four feet thick, containing Ammonites obtusus, M. C. t. 167, Nautilus striatus, M. C. t. 182, Cardinia Listeri, Gold. t. 132, f. 1, Pleurotomaria anglica, M. C. t. 142, Astarte lurida, M. C. t. 137, &c. Beds of blue limestone each averaging about four inches thick, divided by partings of clay and shale, affording Pentacrinites briareus, Crustacea, *Insects*, (elytra of Coleoptera pl. vi. fig. 26,) Fucoids, Gervillia, Pectens, Plagiostoma giganteum, M. C. t. 77, Gryphæa incurva, M. C. t. 112, G. Macullochii, M. C. t. 547, Ostrea, &c. This part of the series is well developed, in a quarry near Churchdown Hill, and described at page 56. We next have alternating strata of compact limestones, shales and clay: the lower beds are blue, and the upper of a dingy white colour. These yield Arca Branderi, M. C. t. 276, f. 1, Pinna, Ammonites planorbis, M. C. t. 448, (abundant in the shales) Ostrea, and Modiola minima, M. C. t. 210,

f. 5. This part of the lower Lias is very rich in the remains of Saurians. These four last divisions are largely developed in different parts of the Vale of Gloucester. The lowest division which forms the base of the Lias system, consists of only a few beds of limestone, some of which abound in *Insects*, and contain but few shells. These superimpose a thick series of shales and stone, which include the well-known "Bone bed," and finally rest upon the Red Marls, averaging about forty feet in thickness.*

These sections of course are taken at different localities, as the whole series of beds above detailed are never developed in any one consecutive section. Having made these few brief prefatory remarks respecting the Lias in Gloucestershire, which serves as a very good type of that formation in the other counties about to be described, it will be necessary to proceed with the more immediate object of this memoir.

Some beautiful specimens of *Insect remains*, chiefly elytra and wings (see pl. viii. figs. 1, 2,) have been found in the upper Lias at Dumbleton, where thin layers of nodular limestone occur at irregular intervals in the lower part of the upper Lias shales, which rest upon a thick bed of Marlstone. With these are associated a few plants, crustacea, shells, (chiefly Ammonites and Inoceramus dubius,) and a Sepia with the attached ink-bag. The remains of Fishes are so numerous that this stratum has been locally denominated the "Fish-bed." This limestone is generally of a yellow colour externally, often soft

* My friend Mr. Buckman's valuable chart of the Cotteswold Hills has furnished me with many of the fossils in the preceding list, and with other information respecting some of the lower Lias beds in this district. Those who are interested in the Geology of the immediate neighbourhood of Cheltenham, will find ample and very interesting details in the second edition of the "Geology of Cheltenham," by Messrs. Murchison, Buckman, and Strickland, lately published.

and slaty, but becoming harder towards the centre, where it has a bluish tinge. Its average thickness is about seven or eight inches, but sometimes it does not exceed two or three. I have detected the same species of fish and shells in the equivalent limestone in the other Lias outliers at Churchdown and Robinhood's Hill, near Gloucester, but I could not find there any trace of Insects. The upper Lias and its included "Fish-bed" are, however, much reduced in thickness at both these places.

At Bredon Hill, in Worcestershire, there is a thick bed of Marlstone abounding in fossil shells, capped by the upper Lias as it is in Gloucestershire, which there averages from eighty to a hundred feet thick. It is worthy of remark that this band of limestone occupies the same relative position with regard to the *upper* Lias, that the "Insect Limestone" does with reference to the *lower* part of this formation. See pl. xi. section iv. where the summit of Churchdown Hill is capped by upper Lias and its included "Fish-bed."

The upper and middle portions of the lower Lias are extensively developed in the neighbourhood of Gloucester and Cheltenham, and occupy the greater part of the vale, but remains of Insects are exceedingly scarce in this portion of the series. A quarry on the line of the Gloucester and Birmingham Railway, which afforded a few of my earlier discovered specimens, presents the following section in descending order:

	FEET.	INCHES.
1. Soil	2	0
2. Thin bed of gravel	1	0
3. White clay	1	0
4. White limestone, a soft sandy bed full of minute shells, and a bivalve apparently belonging to some Crustacean not unlike Cytherina	1	0
Carried forward	5	0

	FEET.	INCHES.
Brought forward	5	0
5. White clay, with Fucoids and small shells . . .	1	2
6. Limestone, white at the top and blue in the interior, contains Pentacrinites Briareus, chiefly stems ; but I found a tolerably perfect one with the head, stem, and arms attached. Plagiostoma giganteum, Ammonites, Ostrea, Terebratula, and a few other shells	0	5
7. White clay	0	5
8. Blue limestone	0	11
9. Bluish clay tending to white, passing into blue shale, with irregular layers of limestone. The shale contains small Pectens, Ammonites, Gervillia, &c	2	0
10. Blue limestone	0	5
11. Blue clay, full of Fucoids, small shells, some of which are undescribed, scales of Fish, and one small *elytron* .	1	6
12. Blue limestone, like No. 10	0	4
13. Blue Clay	1	3
Total	13	5

The beds have a slight dip to the S. E..

This section fairly represents that of the few other quarries in the more immediate neighbourhood of Gloucester.

The bands of limestone, Nos. 8, 10, 12, are exactly alike lithologically, and are not distinguishable from each other. In one of these, probably No. 10, I detected two *elytra* of *Coleoptera* apparently belonging either to the family Buprestidæ or Elateridæ, pl. vi. fig. 26.

These are the only fossils of the kind hitherto met with in this portion of the Lias, after a careful examination of many other places where the same strata occur. With this exception, the numerous remains of Insects prevail in the bottom part of the lower beds near the base of the Lias, which are seen at many points in the neighbourhood of Gloucester. The first place worthy of notice is at Wainlode Cliff on the banks of the Severn, where these inferior strata rest on Red Marl, and form a bold escarpment on the south side of the river, which the annexed section in descending order will illustrate :

	FEET.	INCHES.
1. Black Clay	3	0
2. Hard blue limestone ("bottom bed,") with Ostrea, Modiola minima, and other shells	0	4
3. Yellow shale with traces of Fucoids	0	10
4. Grey and blue limestone, which, for distinction's sake, I have termed *Insect Limestone*, because these are the most interesting and characteristic fossils	0	5
5. Marly clay	5	3
6. Hard yellow nodular limestone with small shells like *Cyclas*, a species of Unio, Plants (Naiades), *Cypris*, and very rarely scales of Fish	0	6 to 8
7. Yellow clay	9	0
8. Black shale	3	0
9. Hard grey stone with impressions of Fucoids on the upper surface, with scales and teeth of Fish, viz., Gyrolepis, Hybodus, Acrodus, and Saurichthys, which also occur in the true "Bone bed"	0	1
10. Black slaty clay	1	6
11. "Pecten bed" a very hard stone of a dingy brown colour, containing abundance of pyrites, with Pectens and one or two other shells	0	4
12. Black shale	8	0
13. "Bone bed," here a hard thin stratum full of pyrites, and composed of bones, scales, and teeth of Fishes; connected with this is a white and yellow sandstone full of casts of Pullastra arenicola	0	3
14. Black shale	2	0
Total	34	8

This reposes on green and red angular marls, forming the upper part of the New Red sandstone, exposed to the depth of about sixty-five feet.

The total height of the cliff is nearly one hundred feet, and the beds dip gradually to the S.E.

I have found it necessary to make a few corrections in this section, which therefore differs slightly from the one formerly given in the Geological Proceedings, vol. iv. part i. No. 92, page 15. As my object at present is to call attention to the new features presented by the fossil contents of the beds Nos. 4 and 6, I shall refer the reader for further details respecting the inferior strata to

Mr. Strickland's interesting papers in the Geol. Proc. vol. iii. p. 586, and vol. iv. part i. No. 92, p. 16.

The "Insect Limestone," has a laminated structure, and presents lithologically the aspect of a fresh-water limestone. It passes in its upper part into a blue and yellowish white shale, which is full of a supposed species of minute *Cypris*, apparently identical with that which marks the yellow limestone (No. 6) below. It now and then contains portions of Insects and Fucoids. The "Insect Limestone" lies about twenty-seven feet eleven inches above the "Bone bed," and five feet three inches, above that with *Cypris* and *Cyclas*.

The Insect remains consist chiefly of elytra belonging to several genera of Coleoptera, which are by no means uncommon, (those figured in pl. vi. figs. 30, 31, which Mr. Westwood thinks may have belonged to an aquatic beetle, are very numerous and characteristic,) and a few wings bearing a close resemblance to some I have previously detected in the Wealden,* pl. v. figs. 12, 18. There are others also which are stated by Mr. Westwood to be allied to Chauliodes (pl. viii. figs. 6, 14, and pl. x. figs. 6, 9, 10,) one of the Neuroptera, and referable to the same group as the Wealden wings pl. v. figs. 13, 16.

Shells are not common, but Ostrea, Unio, and a small species of Modiola are the most abundant; there are also, though rarely, a few specimens belonging to the genus Monotis. Small fragments of carbonized wood, and one

* Dr. Mantell in his late work (*Medals of Creation*) has figured one of these wings, which he has denominated *Panorpa liassica*, from specimens which I had presented to the Geological Society. But Mr. Westwood informs me that, although figs. 7 and 8, 9, pl. viii., as well as fig. 12, pl. x., are very near Panorpa, yet they differ in the third vein emitting four branches, and in entirely wanting transverse veins, so that they are *not* Panorpa. It is, therefore, to be regretted that the above name was so hastily applied, especially as it has long been known that a special work was about to appear upon the subject.

or two leaves of Ferns (Otopteris obtusa) have been met with. The yellow "Cypris Limestone" (No. 6), which lies about twenty feet above the "Bone bed," is a hard nodular stratum, and bears a strong mineralogical resemblance to the Muschelkalk. It has a very uneven and irregular fracture, and is waved and variegated like the "Landscape stone" of Somersetshire, which it very probably represents. This bed is described at a future page; where I have entered into some details respecting its position, structure, and organic contents in the more immediate neighbourhood of Bristol, where it is largely developed.

The fossils from this bed are the more interesting from their supposed resemblance to some which occur in the Wealden. Mr. Sowerby having examined them, thought that the bivalve shell *might* be a *Cyclas;* and as he saw nothing to distinguish the *Cypris* from those in that formation, he concluded that in all probability it was of fresh-water origin. This opinion seems to be confirmed by the apparently fluviatile character of the Plants which accompany them.

This supposed Cyclas also bears a close resemblance to the genus Posidonomya, which characterizes the Keuper sandstone; and Mr. Strickland has observed a bivalve in the Lias of Worcestershire, which is identical with the one in the yellow "Cypris Limestone" (No. 6 of section, page 58); its real genus therefore at present is somewhat doubtful. This shell is generally found singly, but sometimes in masses sufficiently thick to shew that it lived and died on, or at any rate near, the spot. The *Cypris* are by no means abundant here; but I have detected them at Westbury in the same stratum, lying together in clusters, as they do in many of our fresh-water

deposits. This is exactly the case with the beds of shale (page 58), which form the upper part of the "Insect Limestone," and also in the "Cypris and Plant bed," near Bristol.

I shall not here enter into any details respecting the nature and origin of the Plants, because I have elsewhere stated my reasons for supposing that they are more probably allied to fresh-water Plants than marine ones, although the family to which they belong includes a genus which inhabits salt water.

Above the black clay and Ostrea bed (Nos. 1 and 2 of the section, page 58), there are other strata of the lower Lias; although they are so covered up and concealed that it is impossible to obtain an accurate section. In a band of brown-coloured, hard, and somewhat sandy limestone, which lies several feet above the black clay, I have detected numerous minute Foraminifera (not unlike Nummulites in form), often much rubbed and injured. A few small scales of fish are intermingled with them, but I could not observe any other fossils. There is a similar bed in Warwickshire, where it affords the same and another species of Foraminifera.*

At Apperley, the "Ostrea bed" and the "Insect Limestone" were seen in a small quarry on the Grey Hill near Apperley Court, about a mile from Wainlode Cliff. The lower part of the hill is composed of Red Marl, and the fossils in the "Insect Limestone" are alike, but the stone assumes a more sandy character. The remains of Insects are very plentiful, many small slabs three or four inches square exhibiting several elytra and wings, and a few small Beetles.

* These are described and figured by Mr. Strickland in the Journal of the Geological Society, No. 2, for May, 1845.

There are many other localities in this neighbourhood where in all probability the "Insect Limestone" might be traced, if there were any escarpments to expose it. At some former period it must have been more extensively and uniformly distributed, for I have found numerous scattered fragments with similar fossils in the adjoining fields, especially at the Leigh, a village two miles north-east of Wainlode. On the Newent road, four miles from Gloucester on the north-west, there are many portions of the same stratum more or less bouldered, but I could not perceive the bed anywhere in situ.

This portion of the lower Lias appears to have suffered considerable denudation from the action of water and other causes; indeed, it is probable that many of these now isolated beds were formerly continuous, and filled a much larger area than they do at present. (Vide section iv. pl. xi.) The transverse section (pl. xi. fig. 4) marks the position of the lower Lias, especially with reference to the *Insect Limestone*, and shews its outcrop at Wainlode and Coreswood Hills. It also illustrates the geological structure of part of the Vale of Gloucester from Churchdown Hill on the south-east to Eldersfield on the north-west, where the Keuper Sandstone first makes its appearance.

Generally speaking, the lower Lias in this district occupies elevated ridges resting upon the upper part of the New Red sandstone, and commands fine views over the extensive and fertile valley of the Severn. It now and then takes its course along the valleys, and follows a much lower level: which is usually the case with the upper division of the inferior beds.

The "Insect Limestone" may be traced at Wainlode along the escarpment on the west, for some distance from

the point where it is exposed at the top of the cliff, until it appears again at Ashelworth on the other side of the river, where it is quarried for lime and other purposes. The following is a section in descending order of a quarry there, since filled up:

	FEET.	INCHES.
1. Red coloured soil	2	0
2. Clay	0	3
3. Thin bedded, hard, blue limestone	0	4
4. Clay	0	2
5. Hard blue limestone with Ostrea ("bottom bed,") the equivalent of No. 2. in the Wainlode Cliff section, (page 58.)	0	6
6. Clay	1	0
7. *Insect Limestone*	1	0
8. Clay, a few inches.		
Total	5	3

The beds are horizontal. No. 7 contains traces of Plants, leaves of Ferns (Otopteris obtusa), elytra of Coleoptera, and a portion of the wing of a Libellula.

Ascending the hill on which the village of Hasfield stands, the same strata are largely developed. There appear to be two beds of "Insect Limestone" lying within a few feet of each other, which present a large assemblage of fossil Insects. One of these is very hard and of a blue colour, while the other is softer, sandy, and nearly white; but their organic contents are in all respects identical. The limestone with Oysters, and spines and teeth of Echini, here forms as usual the upper stratum. I could not trace the yellow "Cypris Limestone," (No. 6 of the section at Wainlode, page 58), nor could I perceive any clear indications of the "Bone bed," (described at page 58, No. 13,) which is probably wanting at this spot, although the whole repose conformably on the Red Marl. The best section is seen on the road from Hasfield to Glou-

cester, where the Lias crops out above the Marl, and dips away from it about ten degrees to the south-east.

	FEET.	INCHES.
1. Shale	10	3
2. *Insect Limestone*, about, ...	1	0
3. Black shale	0	2
4. *Insect Limestone*	1	6
5. Shale and hard stone continued downwards		
Total	12	11

A little more to the north these strata pass upwards into shale and hard limestone, with *Ostrea*, which rests upon these lower beds in all the localities in this direction. This limestone is called by the workmen the "bottom bed," being generally the lowest reached in most of the large quarries in the neighbourhood; but the subjacent beds, though not seen in situ, are most probably coextensive with it. In some cases, as at Ashelworth and Forthampton, there are two or three bands of hard blue limestone, containing the same Ostrea immediately above that with Insects.

On the Gloucester and Hasfield road the beds in contact with the Red Marl, which have been much disturbed, incline at a considerable angle, while the superior strata become gradually horizontal. A few miles to the west there are quarries in the middle and upper part of the lower Lias yielding the usual fossils, divided by courses of shale with Ammonites planorbis, &c., &c. The "Insect Limestone" has a foliated structure, and is often marked with innumerable black impressions, most likely derived from some species of Fucus. The Insects, as at Wainlode Cliff, consist of various elytra of Coleoptera mostly of small size, and a few Beetles, in some of which the eyes are distinctly visible. (Pl. vii. figs. 5, 10, 12.) For further descriptions I refer to Mr. Westwood's ex-

planation of the plates, and to Plate vii. figs. 1 to 14; and Pl. vi. figs. 23 to 31.

There are besides, some singular impressions of a doubtful nature, many of which may have been produced by the partially decomposed bodies of different Insects. With these are associated a variety of small plants, some resembling Mosses (one of which is undoubtedly the capsule of a Moss, but very different from those in the yellow "Cypris Limestone"); a few seed-vessels, and leaves of Fern. Modiola minima is very abundant; but this, with two rare exceptions, is the only shell I have detected in the "Insect Limestone" at this spot. The other shells resemble Nucula and Unio, but they are too imperfect to determine the genus correctly.

There are also remains of a peculiar species of Crustacean (a *Macrurous decapod*), which is highly characteristic of this limestone throughout its range. It is very rarely well preserved, detached claws and other portions being of most frequent occurrence.* There are fragments of another species of Crustacean, but these are very scarce. A minute species of Cypris may be occasionally observed in the limestone.

At Coombe Hill, a few miles to the east, a small escarpment exposes a band of "Insect Limestone," though neither extensively developed nor rich in fossils. The yellow limestone (No. 6 of the Wainlode section, page 58) underlies it, with the same small plants and bivalves. The upper limestone here is at least twenty feet above the Bone bed.

* In my paper in the Geol. Proc. (Vol. iv. Part i. page 16), I stated that this Crustacean resembled the genus Eryon from the Solenhofen slate; at that time I had only very imperfect specimens, chiefly portions of the tail; but since then, some better preserved ones have enabled Mr. Strickland to determine that it belongs to the genus *Coleia*, allied to, but specifically distinct from, C. antiqua, described by Mr. Broderip, Geol. Trans. vol. v., &c. . . . . The Coleia is related to the shrimp family.

Passing thence northwards, we find the same bed of "Insect Limestone" in the neighbourhood of Forthampton near Tewkesbury, according to this section in descending order.

	FEET.	INCHES.
1. Red soil and clay	2	0
2. Beds of whitish clay and shale with thin layers of grit	6	0
3. Grit	0	2
4. Three beds of blue limestone divided by thin layers of clay, containing Ostrea and Modiola. (Nos. 9, 10, 11, 12, 13, 14, of the section at Strensham page 70)	3	0
5. Dark brown shale, with casts of bivalves and scales of Fish, (No. 15 at Strensham.)	0	6
6. Hard blue limestone, with Ostrea and Modiola like the beds No. 4. (No. 16 at Strensham)	0	5
7. Brown laminated shale like No. 5. (No. 17 at Strensham)	1	2
8. *Insect Limestone*, blue, and very hard. (No. 18 at Strensham)	1	0
Total	14	3

These strata, with a slight variation in the relative thickness, agree precisely with those in the *lower* part of the sections at Brockeridge (page 67), and Strensham (page 70). The dip is nearly seventeen degrees to the east.

The beds hereabouts have been much disturbed by a fault which intersects them at right angles to their dip, and which appears to be parallel to the one at Ripple (vide page 69).

The quarry from which this section is taken is situated at the lowest part of a sloping field; and at the upper end, a few yards distant, beds of limestone, with Ostrea identical with No. 4 in the foregoing section, were exposed by draining about eight feet from the surface. A thin parting of clay separated this from a stratum of "Insect Limestone," retaining the same fossils as No. 8 above. It is here and there white and earthy (probably from the

action of the weather), but it passes into hard blue limestone exactly like No. 8, which forms the bottom of the quarry. Hence there can be no doubt as to their identity, and their original continuity must have been broken by a fault, which either caused a depression or upheaving on one side of the line of separation.

The elytra, Beetles, and wings do not differ at all from those found in the other localities above mentioned. The Plants and Crustacea are also alike. The "Insect Limestone" generally has a foliated structure; but the weather acts upon it in such a way that it is rendered useless for all building purposes.

Pl. vii. fig. 19 represents the portion of a large insect with the wings attached, from this spot, which Mr. Westwood thinks may possibly be dipterous, allied to Asilus.

There are also remains of the same *Macrurous decapod*, as in the "Insect Limestone" elsewhere. A few Modiola (M. minima), Monotis decussata, and the cast of an apparent Nucula, are the only shells associated with them.

From Forthampton these beds extend to Brockeridge Common, about two miles to the north, where numerous Saurians have been met with. Here there is a greater development of the strata above the "Insect Limestone," but in other respects they are identical with those elsewhere. This will be readily explained by the ensuing section in descending order:

	FEET.	INCHES.
1. Soil	2	0
2. White clay	3	0
3. White laminated limestone, somewhat resembling the "Insect Limestone," called by the workmen *first rub*	0	4
Carried forward	5	4

	FEET.	INCHES.
Brought forward	5	4
4. Brown shaly clay; abounds in Ammonites planorbis with the internal nacreous coat, which retains its bright pearly lustre	3	0
5. Blue limestone	0	3
6. Brown clay and shale *Double rub*	0	2
7. Blue limestone	0	3
8. Black clay with Saurians	3	0
9. Blue limestone, (*Ostrea bed,*) called *Red nurf* . . .	1	0
10. Black clay	1	6
11. Beds of limestone divided by clay, at the bottom of which being the lowest point dug is the *Insect Limestone*, making nine layers in all. These are fully detailed in their equivalents at Strensham, (page 70) . .	4	6
Total	19	0

A comparison of the two sections will shew the general agreement which they have to each other. The limestones in No. 11 average about three or four inches in thickness, and the intervening clays about two inches. The "Insect Limestone" is blue and crystalline like No. 8 at Forthampton (page 66), and nearly a foot and a half thick. It contains many small elytra, generally of a black colour, and a few wings (but they are not very abundant); the same species of Coleia and minute plants. The fossils in fact are similar to those at Wainlode and other places. Remains of Icthyosaurus and Plesiosaurus prevail in all the superior strata, but more especially in the black clay No. 8, and sometimes, though very rarely in the "Insect Limestone." The series named *double rub* yields various shells, viz., Ammonites planorbis, Arca, Pinna, Cardium, and the genus Meleagrina, a bivalve resembling Inoceramus.

Near Ripple, about a mile and a half west of Brockeridge, I observed the same band of yellow limestone containing plants (*Naiades*) and *Cypris*, identical with that at Wainlode (see section No. 6, page 58), and Westbury

(page 79). It occurs in situ on each side of the lane leading to the village, and has in all probability been brought up by a fault which runs in this direction.

The Sections at Boughton (where many fine Saurians have likewise been found) a few miles to the north of Brockeridge, are similar to those at that place and Strensham about to be described (page 70). There are beds of shale equivalent to one of the layers in the divided beds No. 11 at Brockeridge, affording teeth, scales, and small jaws of a species of Dapedium, two species of Cidaris, leaves of Ferns (Otopteris obtusa) and bones of Saurians. It can hardly be doubted, therefore, that the "Insect Limestone" would be exposed here, if the quarries were worked to a greater depth. Brockeridge is at present the farthest point north in Gloucestershire, where I have traced the "Insect Limestone."

In following its course from Gloucester northwards, we perceive that it presents a general uniformity of character both lithologically and zoologically; and this is usually the case throughout its range.

Tracing this limestone still farther into Worcestershire and Warwickshire in a north-easterly direction, we have nearly the same series of beds, but with a very large developement in the latter county. In every instance there is a great similarity in mineralogical structure, by which the whole may be connected together and identified with each other. In fact, there is sufficient evidence to shew that they all resulted from the same causes, which appear to have operated with great regularity, throughout a large area, extending at least seventy miles from north-east to south-west.

The Lias, perhaps, presents a greater persistency of character as a whole, and in detail, than any other forma-

tion in the British Isles, and this remark applies with equal force to some parts of the Continent.

Thus far at least, our examination of even a small portion of this group fully verifies this assertion, which is very clearly illustrated and explained by that peculiar limestone now under review. Its appearance is, without exception, so remarkable and distinct, that it may generally be identified, even without the aid of fossils to determine it.

There are several localities in Worcestershire, where this limestone may be observed. At Strensham, two miles from the Defford station, and nine from Evesham, a bed of "Insect Limestone" forms the bottom of a large quarry, containing the same fossils, and occupying the same position as at Brockeridge and other places, which the annexed section in descending order will explain:

	FEET.	INCHES.
1. Soil 2. Clay (Nos. 1 and 2 of the Brockeridge section page 67	1 3	0 0
3. White limestone. *Chance rub.* (No. 3, *First rub*, at Brockeridge, ...	0	4
4. Clay, full of Ammonites planorbis, (No. 4 at Brockeridge)	2	0
5. Stone 2 In. 6. Clay 2 In. 7. Stone 2 In. *Double nurf.* (Nos. 5, 6, 7. *Double rub* at Brockeridge')	0	6
8. Yard clay. (No. 8 at Brockeridge)	3	0
9. OSTREA BED. *King's nurf.* (No. 9. *Red nurf* at Brockeridge	0	3
10. Second bed of yard, black clay. (No. 10. at Brockeridge.)	3	0
11. *Queen's nurf*	0	3
12. Blue clay	0	3
13. Hard blue limestone full of Modiola minima . .	0	6
14. Paving stone, 3 in. divided by clay 1 in. . . .	0	4
15. Black shale, which separates into layers, and contains fish-scales, two species of Cidaris, and some bivalves .	0	6
16. *Brick bed*, square blocks of hard stone	0	5
17. Shale, similar to No. 14	0	3
Carried forward	15	7

	FEET.	INCHES.
Brought forward	15	7
18. Insect Limestone, generally blue and very hard. The beds dip 15° to the east, where this stratum lies deep in the quarry; but a little to the west, it crops out, and appears within four feet of the surface where it is softer, and of a white colour . . .	0	6
19. Blue shale, about	1	3
20. A somewhat soft, light blue limestone, with casts of shells, chiefly Cardinia cyprina, Arca, Cardium, and some others	0	4
Total	17	8

This limestone (No. 20) does not appear to be the "Cypris bed" described at page 58, but more closely resembles one of those in the Bristol sections, which are there subordinate to the "Insect Limestone." The beds, Nos. 9 to 18 inclusive, are the same as Nos. 9, 10, and 11 at Brockeridge (page 67), and No. 4 to 8 inclusive, at Forthampton (page 66).

Insects are not uncommon; one remarkable specimen belonging to the Rev. F. W. Hope is figured at Pl. x. fig. 3. This according to Mr. Westwood appears to be part of the abdomen of a gigantic species of Libellula? which I propose to designate (provisionally) *Libellula Hopei*. (See Addenda.)

There are many portions, and sometimes tolerably perfect specimens of the same species of Coleia, (page 65 note,) the characteristic Crustacean of this bed. Modiola minima abounds, with a few species of Monotis decussata (as at Westbury, page 79), an Avicula, Nucula? and leaves of Fern (Otopteris obtusa). The section here differs in one respect from those in Gloucestershire, in having a stratum of limestone *below* the "Insect Limestone," distinct from that containing Plants and *Cypris*.

Mr. Strickland has found the Yellow "*Cypris* limestone" with *Cyclas?* the Pecten and Bone beds, (affording a nearly similar section to the one at Wainlode Cliff,) at Dunhamstead, on the line of the Gloucester and Birmingham Railway, near the Droitwitch station. These beds immediately overlie the Red Marl. The "Insect Limestone" is here, however, concealed, although it would probably be detected in its proper place. If so, this would be the farthest northern limit at present, carrying these lower beds of Lias into the centre of Worcestershire, beyond which, this formation does not extend in that direction, as it follows a more north-easterly course into the extremity of Yorkshire.

In the neighbourhood of Evesham, the "Insect Limestone" and the superior and inferior beds, occupy various higher ridges and escarpments as in Gloucestershire, and form the greater portion of the Cracombe Hills, the lower parts of which are composed of Red Marl. There are traces of the *Ostrea bed* above, and the *Cypris and Plant bed* below, (see section page 58, Nos. 2, 4, and 6,) identical in all respects, both in fossils and position with these strata in Gloucestershire. Occasionally these are seen in situ, when exposed on the sides of the hills, and in several places the Bone bed crops out with its subjacent shales and clays.

The "Insect Limestone" contains numerous remains of Insects, many of which, especially the wings and even the elytra are beautifully preserved. There are several varieties of the former, all of which probably belong to the same genera as those in Gloucestershire. Modiola and Ostrea are plentiful in this limestone, which averages from one to two feet in thickness. In a quarry near Chadbury, unfortunately filled up at the time when I visited it, other

and higher courses of limestone are quarried, and the shale now and then presents specimens of Avicula longicostata with its attached spines. A fragment of a Fern was obtained in the "Insect Limestone."

Passing into the adjoining county of Warwickshire, there is a large extension of the lower Lias in the neighbourhood of Bidford and Binton. The quarries hereabouts afford some of the finest sections in this part of the series. The Insects are not confined to one or two comparatively thin seams of limestones, but occur in several distinct beds, the whole being developed to a much greater extent than in any part of Gloucestershire hitherto examined.

From the general conformity of these to each other, both zoologically and lithologically, it may be concluded that they do not represent the various limestones and clays superior to the "Insect Limestone" in other places, but simply form a greater developement of this particular portion of the lower Lias; being, in fact, enlarged equivalents of the "Insect Limestone" itself. This is rendered more probable by the existence of certain strata, both *above* and *below* the "Insect Limestone" in the immediate neighbourhood, for Mr. Strickland (with whom I had the pleasure of examining this country,) discovered the "Bone-bed" in situ at Temple Grafton, two miles from Bidford, the farthest limit on the north-east where it has been hitherto found. It is hardly possible to determine here how far the "Bone bed" lies below the "Insect Limestone," but it is probably somewhere between thirty and fifty feet. Some of the overlying Binton quarries belong to the upper and middle parts of the lower Lias, so that the Insect beds occupy their *proper* and *intermediate* position in this district.

In order to explain this more fully, it will be necessary

to examine the following sections in descending order from different quarries near Bidford, in Warwickshire.

1. Nook quarry, Bickmarsh, a mile and a half south of Bidford.

		FEET.	INCHES.
	1. Clay	14	0
A.	2. Top rock: best flooring bed	0	8
	3. Clay	3	1
B.	4. Thick rock	0	7
	5. Clay	2	3
C.	6. Gravestone bed	0	4
	7. Clay	1	2
D.	8. Bottom flooring bed	0	4
	9. Clay	3	7
E.	10. White bed	0	4
F.	11. Second white bed	0	4
	12. Limestone and dirt	1	5
G.	13. Blocks	0	9
H.	14. Headstone	0	6
	15. Clay	4	8
I.	16. Firestone		
	Total	34	0

The beds have a slight dip to the south-east.

2. Mr. Harwood's quarry near Temple Grafton, two miles north-east of Bidford.

		FEET.	INCHES.
	1. Clay	4	0
A.	2. Top rock	0	6
	3. Clay	3	8
B.	4. Thick rock	0	6
	5. Clay	3	0
C.	6. Gravestone bed	0	5
	7. Clay	1	0
	8. Middle bed, (sometimes wanting,)	0	2
	9. Clay	0	4
D.	10. Bottom paving rock	0	4
	11. Clay	5	0
E.	12. White bed	0	3
	13. Clay	1	6
	14. Potstone	0	5 to 10
	15. Dirt	0	9
	Carried forward	22	3

		FEET.	INCHES.
	Brought forward	22	3
G. 16.	Blocks	0	8
17.	Clay	0	5
H. 18.	Headstone	0	7
19.	Stone	0	2
20.	Bottom rock	0	3
21.	Clay	5	6
I. 22.	Firestone	0	7
	Total	30	5

The names of the different beds are given according to those used by the workmen, and the letters A to I refer to their equivalents in the two sections. On comparing these sections it will be seen that the corresponding strata in the two quarries, two or three miles apart, are nearly identical, presenting about the same average thickness, and lithologically similar. In the Nook quarry there are only sixteen beds in all, while in the latter there are twenty-two, owing to the addition of some beds in the one which are wanting in the other. The strata Nos. 8, 14, 19, and 20, at Temple Grafton, do not occur at the Nook. The addition also of two layers of clay gives an excess of six beds in the former over those of the latter. But although there are fewer divisions at the Nook, yet the total thickness is greater than at Temple Grafton by four feet.

Various seams of clay separate the different limestones from each other, which latter consist of white and blue limestones, varying in thickness, but seldom very hard. Indeed most of them, especially the middle courses, used for flooring and gravestones are easily worked, being finely laminated, and readily splitting in the planes of stratification. Many of the blocks raised are of great size.

There is here a much larger developement of the "Insect Limestone" than in any of the previous sections in Gloucestershire and adjoining counties, but as they *all* have a

strong lithological and zoological resemblance to each other, they are evidently connected together, and belong to the same series, partially represented in other places by only one or two beds of "Insect Limestone." In a few instances near Bristol, (which are described hereafter) there are three beds of this limestone, but the inferior strata are very different from those in the Warwickshire sections.

There are other quarries near Bidford, but the sections above given are the most illustrative, and with slight exceptions represent the rest. No. 11, F, at the Nook, though wanting at Temple Grafton, occurs nevertheless at three other different quarries near there; it is a thin-bedded limestone, of a whitish colour, and softer than the rest. The strata marked C, D, E, are the chief repositories of the Insects, especially the bed D, where they are the most prevalent. Still they are sparingly distributed through the upper rocks, Nos. 2 A, and 4 B. Wings of Libellula, which are so scarce elsewhere, are more frequent here, particularly at the Nook, where that remarkably fine and beautiful specimen (described and figured by Mr. Strickland in the Magazine of Natural History, vol. iv. page 301, new series,) was discovered some years ago. A figure of this is given Pl. x, fig. 4, for which, as well as fig. 6, Pl. x. I have to thank Mr. Gibbs, to whom they belong.

On one large slab which had been split open, I observed two or three perfect wings, one small fly, portions of Crustacea, (*Coleia*,) and a few elytra. In the other quarries the remains of Insects are much rarer, but I obtained the two specimens engraved at Pl. vii. figs. 16 and 18. The former is pronounced by Mr. Westwood to be a small species of the family Gryllidæ, which I propose to call *Gryllus Bucklandi*, in honour of Professor Buckland;

and the latter apparently belongs to one of the Trichoptera. With these are associated the same *Macrurous decapod*, (described at page 65,) which characterises the "Insect Limestone" of Worcestershire and Gloucestershire, but it is far better preserved at Bidford and Binton. This Crustacean accompanies this stratum through its range from south-west to north-east.

There are also at least two species of Fish, Pholidophorus Stricklandi, (Agass.) and another. Some fine specimens of Tetragonolepis angulifer (Agass. T. 23,) are met with in some of the upper beds. A few Ferns (Otopteris acuminata, O. obtusa,) and another smaller species are occasionally found. In these particular limestones, shells are very scarce, but in some of the upper shales we have Ammonites planorbis, and a species resembling A. Conybeari, with a few small undetermined bivalves. In these limestones, but especially in No. 11 of the Nook section, there are some small semicircular corneo-calcareous bodies, the nature of which is very doubtful. They are generally of a black colour, and have a thin external coating of carbonaceous matter. In some cases they are not unlike carbonized seed-vessels; but others resemble *Opercula*, or seem to have belonged to some sepiaceous animal. They occur in all the beds of "Insect Limestone" hereabouts. Professor Owen was unable to make out their character, but thought that they might be allied to Trigonellites, (*Aptychus*,) the nature of which is not altogether known, although some Geologists have imagined that they are the opercula of Ammonites. The specimens from Binton at first sight seem to have had some connexion with the animal of the Ammonite, for Mr. Strickland has lately found one within the shell, which a fortunate fracture exposed to view. But still, as they may have been acciden-

tally introduced into the chambers, nothing certain can at present be decided respecting their nature or origin. I may refer for further descriptions of these curious bodies to Mr. Strickland's Paper in the Geol. Proc. for June, 1844. He observes that "they are semicircular, very thin, slightly concave plates, usually corneous, sometimes more or less calcareous;" and he considers that they formed laminar appendages to the animals of the Ammonites, adapted to discharge some unascertained function. They resemble the two expanded valves of Aptychus soldered together; and probably were allied to that fossil, which he thinks had a similar origin.

The beds subordinate to No. 11 F. at the Nook, and No. 12, E. at Temple Grafton, are of a different character from the superincumbent limestones containing Insects. They have few or no fossils, and are generally much harder and more crystalline. Though these beds are wanting in Gloucestershire, the "Firestone," from its position and character may perhaps represent the *Cypris and Cyclas Limestone* (page 58), for it also affords the remains of this Crustacean. It is the lowest bed worked in Warwickshire, has a hard splintery fracture, and, as it takes a tolerable polish, is generally used for chimney pieces and other purposes of a similar nature.

The quarries in this neighbourhood are at present the farthest point in a north-easterly direction, in which the insectiferous beds of the lower Lias have been observed; still it is not unlikely that they might be detected in its more northern course, through parts of Leicestershire and Lincolnshire, especially where the bottom beds are exposed to view; though there are large tracts of land both in Yorkshire and Lincolnshire, where this is not the case.

It is worthy of remark that in all the country described in this memoir the lower beds of the Lias usually occupy lines of low undulating hills, which forms a prominent and characteristic feature in their junction with the upper beds of the New Red sandstone.

Having thus traced the "Insect Limestone," and associated beds from the central part of Gloucestershire into the southern division of Warwickshire, we will follow it along its south-western range below Gloucester.

The well-known Garden Cliff near Westbury on Severn, eight miles from Gloucester, gives a similar section to Wainlode Cliff (page 58). As the strata dip here at an angle of at least 15° to the south, and disappear under the river, it is very easy to examine the upper part of this deposit, and to obtain a clear section. At the extreme south end we have in descending order:

	FEET.	INCHES.
1. "Bottom bed" with *Ostrea* equivalent to that at Wainlode, and other localities, pages 58, 68, 70 . .	0	4
2. *Insect Limestone*, containing Monotis decussata in profusion	2	0
3. Beds of shale and clay	1	0
4. Hard yellow, and grey limestone, often slaty and sandy, the centre beds closely resemble the Muschelkalk, (as in No. 6, at Wainlode,) with supposed *Cyclas*, plants, (Naiades,) *Cypris*, and scales of fish identical with those at Wainlode	1	6
5. Shale and clay	10	0
6. Hard grit. "Bone bed"	4	0
Total	18	10

A little further to the north the beds are more developed, and are seen resting upon the Red Marl. No. 4, lies nearly twelve feet above the Bone bed. The "Insect Limestone," like its representative at Wainlode in its upper part, passes into thin layers of light brown shale, with *Insects* and *Cypris*. The limestone contains numerous

elytra of Coleoptera, similar to those in other localities, with traces of wings, abdomens, and small plants resembling reeds. These lie in the centre of the slabs of limestone, intermingled with the shells.

The abundance of Monotis is very remarkable; but rare as this bivalve is elsewhere, the position of this limestone, and its other fossils, shew that it is equivalent to the "Insect Limestone" at Wainlode and other places. No. 4, is clearly identical with the hard yellow limestone at that cliff. (No. 6, page 58.) It has the same peculiar appearance, and is often striped and waved like the "Cottam, or Landscape Marble." Here and there it has a slaty structure, and the colour changes to a dingy blue. The Plants (*Naiadita lanceolata*) and *Cypris*, are here much more abundant, the surface of the slaty portions being covered with remains of the latter Crustacean, which are collected together in masses of some thickness, just as we find them in many fresh-water deposits. The occurrence of numerous bivalve shells of a Crustaceous animal, so closely resembling the common *Wealden* "Cypris" that it cannot be distinguished from it, is certainly deserving of notice, and if it really be of fresh-water origin (to say nothing of the supposed *Cyclas*) we have a new and highly interesting feature in the history of this deposit.* The Plants, which are very small and never perfect, except near Bristol, are yet in some respects sufficiently well preserved to enable some opinion to be formed about them.

We must now resume our investigation of these lower beds of Lias in their course southwards. I have not been able to examine all the other escarpments on the Severn,

* I propose to call the Cypris, *Cypris liassica*, as it is the only one of the kind at present known in that formation.

below Westbury, except at Aust, where the Lias reposes on Red Marl, but from the appearance of the "Insect Limestone" between Berkley and Tortworth, it is highly probable that the same stratum would be traced in many other places. On the line of the Gloucester and Bristol railway, near Huntingford, a very thin band of this limestone is seen in its usual position above the Red Marl which there forms a steep escarpment facing the west. Most of the old walls and buildings in the neighbourhood are built of this stone, and it contains remains of *Insects*, Plants, Crustacea, (*Coleia*, page 65,) scales of Fish, and the peculiar, black, "corneo-calcareous bodies," previously mentioned (page 78). In all respects the organic remains are like those in other places. The limestone is thin bedded, moderately hard, of a dingy white colour, and splits into thin laminæ. I could not hear of any quarries in this direction; but, from all the information I could collect on the spot, it is probably extensively worked at Wick, not far from Newport, and thence towards Berkley. From the thin stratum of "Insect Limestone" exposed on the railway, it may be inferred that it expands more in that direction towards the north and north-west. In its course hitherto, the "Bone bed" has often accompanied it, or has been found near it; and such is the case here, for it has been noticed by Mr. Murchison at Charfield Green, and near Wotton Underedge. (Silurian Sys. pages 449, 450.) I observed one peculiarity in the Bone bed" at this spot, thin masses of bones, scales, and teeth being embedded in a hard blue limestone, six or eight inches thick. I am obliged to my friend Mr. E. T. Higgins for much information respecting the lower Lias in the more southern parts of Gloucestershire and the adjoining county of Somersetshire, near Bristol, where he first detected the

remains of Insects, and he has since worked the subject out with great care and accuracy. I afterwards examined several of the more interesting localities, but in so short a visit could not obtain many fossils, as they are much rarer than in other places previously described.

The cliff at Aust Passage on the banks of the Severn, about thirty miles south-west of Tortworth, and twelve from Bristol, is very high and perpendicular, which renders it extremely difficult to obtain an accurate section; but the one here given, in descending order, is perhaps a tolerably close approximation to the truth, although some of the minor details may not be quite so correct as could be wished:

	FEET.	INCHES.
1. Rubble, nearly	6	0
2. Five beds of stone, one of which contains Oysters, and appears to be the representative of the "Ostrea" or "bottom bed."	4	0
3. "Landscape stone." The upper part is of a brown colour, has a laminated structure, and contains Plants, *elytra* of *Insects*, and the same *Macrurous decapod*, described at page 65. The lower part is a hard, crystalline limestone, having an irregular fracture, and possessing the character of the "Landscape stone," or "Cotham marble." It contains Plants, Fish, *Insects*, Modiola, Ostrea, and Monotis	5	0
4. Clay	0	2
5. White stone. *Cypris and Plant bed* with *Cyclas?* This appears to be identical with the true *Cypris bed* elsewhere, (see pages 58, 79, &c.) There are two beds divided by clay—one is soft, and of a yellowish white colour: the other harder, and having a *landscape* character and irregular fracture	6	0
6. Clay	0	3
	21	5

Below this are the "Pecten bed" and "Bone bed" (Nos. 11 and 13 of the Wainlode section, page 58), divided by partings of clay, resting conformably upon the Red Marl, including which, the depth to the base of the

cliff is apparently not more than one hundred feet. In the "Pecten bed" there are some very large and well-preserved specimens of that shell. The "Bone bed" consists of very large blocks, nearly five feet square, and exceeding a foot in thickness. It contains some fine palates of Ceratodus, with numerous coprolites, bones, and teeth of Saurians and Fishes. There are also thin slabs with Pullastra arenicola, and the peculiar markings described by Mr. Strickland (Geol. Proc., vol. iv. part i. page 15,) which are not unfrequent at Wainlode Clift (page 58). The total height of the cliff is from eighty to one hundred feet, and the true dip about 12° to the south east. It is traversed by five nearly vertical faults, one of which, at the southern extremity, has altered the dip, and inclined the beds at a considerable angle to the W.N.W. The cliff is nearly half a mile long, and the above section is taken towards the centre.

On the other side of the river in Monmouthshire, three miles from Chepstow, a little to the west of Aust, there is another escarpment called Sudbury Cliff, which I was unable to examine, but Mr. Higgins informs me that it is in most respects nearly similar, as far as regards the beds subordinate to the "Landscape stone." There is, however, this difference, that there is a developement of *true* "Insect Limestone" *above* the "Landscape stone;" for at the eastern end they are separated from each other by about four feet of shale, and thus form distinct beds; while at the western extremity they thin out and blend as at Aust. The "Insect Limestone" averages about five inches, and the "Landscape stone" about eight or nine; where they blend, the thickness does not exceed a foot. There are inferior shales and clays as at Aust, dividing the "Landscape stone" from the "*Cypris* and Plant bed."

In the centre of the cliff there are Ostrea and other beds exposed, which form the summit.

In this case then, as in the other sections in the vicinity of Bristol (page 86, &c.,) we have a true bed of "Insect Limestone," identical both in fossils and mineralogical character, with the same stratum elsewhere: but there is another band of subjacent limestone possessing that peculiar construction which has given it the name of "Landscape stone," and here affording a great variety of Insects, some of which are tolerably perfect. Indeed, this limestone appears to be confined to this spot and the more immediate neighbourhood of Bristol. At this cliff as well as Aust, and on Bedminster Down, the "Cypris and Plant bed" is seen in its proper position, and in every case possesses a true "Landscape" character. This, in addition to its position and fossils, serves to identify it with the same bed at Wainlode (No. 6 of section, page 58), Westbury (No. 4, page 79), &c., &c., and also with the "firestone" of Warwickshire. Thus far the resemblance is clear, but the intervening stratum between the "Insect Limestone" and "Cypris bed" is evidently wanting in other places. The "Landscape stone," from its peculiar mineralogical aspect, is in all probability more closely connected with the "Cypris and Plant bed," than with the Insect Limestone," with which it only blends when the clays which separate the two are absent. The "Landscape stone" encloses many *Cypris* and fragments of minute Plants, and a few small Fish. The height and the dip of Sudbury Cliff are the same as at Aust Passage; but the former is not affected by the numerous faults which intersect the latter. In both localities the "Landscape stone" is nodular and uneven on the upper side, and the Insects are found on the convex surface, gene-

rally embedded *en masse*, clustered together. (Pl. ix. figs. 8, 9.)

Mr. Higgins has detected as many as *thirty* small Beetles on one slab of limestone, with remains of other Insects having the wings attached. These fossils are better preserved in this stratum, owing partly to the peculiar character of the stone, and partly perhaps to the more immediate contiguity of some ancient coast line, which may very possibly have been formed by the high and bold range of the mountain limestone in Monmouthshire. The whole of the Insects from Aust are represented in pl. ix. figs. 7 to 17, and for these I have to thank Mr. Higgins, to whom they belong.

Passing from thence to Bristol, the country is exceedingly flat for more than five miles, when the ground rises, and the Lias is seen at intervals, but not sufficiently well-defined to admit of a section. Crossing the Mountain limestone and Red Marl, we again perceive a considerable developement of the lower Lias at Stoke and Horfield, the former six and the latter two miles north of Bristol. (See Section iii. pl. xi.) This exhibits the outcrop of the lower Lias, which is prominently exposed at Horfield and Bedminster Down near Bristol. I was unable to examine the quarry at Stoke, and I am therefore indebted to Mr. Higgins for the following section taken near Stoke Church, in descending order :

	FEET.	INCHES.
1. Light coloured limestone	0	0½
2. Two beds of light grey limestone, with large Modiola .	0	1
3. *Insect Limestone* similar to the bed at Wainlode, . . with Insects, Fish scales, Plants, Modiola minima .	0	4
4. Dark grey limestone with Modiola	0	3
5. Clay	0	8
Carried forward	1	4½

	FEET.	INCHES.
Brought forward	1	4½
6. *Landscape stone* or *Cotham marble* in detached blocks, yielding *Insects*	0	2 to 3
7. Clay	0	3
8. Mottled limestone and clay	0	1½
9. Dark grey limestone with Modiola, Ostrea, and other shells	0	7
10. Clay and light grey limestone	0	1
	3	1

This section is intended to show the relative position of the *Insect Limestone* and *Landscape stone* in situ (Nos. 3 and 6), which are rarely seen in the same section. Single leaves and fronds of Zamia have been met with at this quarry.

At Horfield there are numerous courses of limestone and clay overlying the "Insect Limestone," and there is a much larger developement of beds subjacent to it than at Stoke. A band of blue marly clay, nine feet four inches below, contains Avicula longicostata, and when I visited the quarry this was the lowest stratum worked; but Mr. Higgins has detected nearly eight inches of marl and clay still lower, resting upon the "Cotham marble," from four to five inches thick, which is probably the bottom of the pit. Descending the hill on which the quarry stands, the course of the Red Marl may be traced on the sides of a rivulet which runs at its base. The opposite hill on the west, going towards Cotham, is almost entirely composed of Red Marl, for a well was sunk to a great depth through the upper beds of this formation, which were exposed within a few feet of the surface. From the contiguity of the Red Marl, it is probable that there is no great thickness of Lias beneath the "Landscape stone" in the Horfield section.

The Lias is again visible on the south at a quarry called

the Nubbers near Lock's Mill, one mile and a half east of Bristol, which presents the annexed section in descending order:

	FEET.	INCHES
1. Rubble	1	0
2. Impure white limestone, with Ostrea, Plagiostoma rusticum, &c.	0	4
3. Four beds of rubbly grey limestone, divided by partings of clay with Ostrea, and Modiola	1	6
4. Coarse grey limestone, with Astarte, Ostrea, and Modiola.	1	5
5. Brown clay, with Ostrea	0	3
6. Bluish grey limestone, affording Ostrea, Modiola, Cardium, and Plagiostoma	0	4
7. Clay, with many shells, chiefly Ostrea, intermixed with rubbly limestone	0	4
8. *Insect Limestone*, of a brownish colour, and laminated structure, identical both lithologically, and zoologically, with that elsewhere. It contains *Insects*, Plants, the same Macrurous decapod, (*Coleia*, page 65,) Modiola, and scales of Fish	0	6
9. Brown clay	1	6
10. Coarse blue limestone, with Ostrea and Modiola	0	8
11. Brown clay	0	1
12. Monotis limestone: this is a hard, light brown limestone, whiter and softer in its upper part, where it contains several shells, viz. large Modiola and Unios? It is very hard and crystalline in its lower part, and abounds in a species of Monotis	0	6
13. Nodular bed of stone with a small Turbo	0	0
	8	5

This is the lowest stratum worked.

The quarry stands on a hill, and at its base the Red Marl is exposed on the road-side about two hundred yards to the south. In this section, and in the two following ones on Bedminster Down, the beds subordinate to the "Insect Limestone" differ from those in other parts of Gloucestershire, Worcestershire, and Warwickshire.

As the adjoining quarries present considerable variations from the above, I shall add two more sections from the pits on Bedminster Down. The first is situated a mile to the

south of the Nubbers on the borders of Somersetshire, where we have in descending order :

	FEET.	INCHES.
1. Rubble	5	0
2. Four beds of rubbly whitish limestone, of a coarse texture, divided by clays, with Modiola, Ostrea, Ammonites, and Plagiostoma	2	4
3. Brown clay, with fragments of Ostrea	1	2
4. Whitish shale, including a band of limestone	1	6
5. Four beds of nodular light blue limestone, divided by clay.	1	8
6. Thin layer of shale, passing into a thin bed of limestone, containing wings, elytra, and abdomens of *Insects*, Plants, Fish scales, and the corneo-calcareous semicircular bodies described at page 78, and portions of Coleia.	0	7
7. Slaty clay with Ostrea	0	5
8. Compact blue limestone, generally divided into two beds, ferruginous at top and bottom, resembles the true *Insect Limestone*, and affords a few remains of *Insects*	0	7
9. Two beds of nodular limestone, separated by shaly brown clay	1	6
10. Two beds of light grey limestone, divided by clays, with Modiola minima, and small Plagiostoma	1	3
11. Dark blue clays with Plagiostoma	1	4
Total	17	4

The strata are nearly horizontal. About two hundred and fifty yards distant, the Red Marl is exposed on the side of the Wells road. The upper beds consist of Lias clays, and rubbly limestone about three feet thick, passing into a soft dingy white, or yellow limestone, having a very irregular fracture, nearly a foot thick, and abounding in Plants belonging to the family Naiades (see page 92), with innumerable *Cypris* and *Cyclas ?* in all respects identical with those in the *Cypris and Plant bed.*

The upper part of this stone is soft and earthy, while the lower part is much harder, where it passes into a kind of "Bone bed," which is undoubtedly the representative of the true "Bone bed," the limestone being there replete with bones, teeth, and scales, and leaves of the Plants

intermingled with them. A thin layer of subjacent black shale reposes on the Red Marl, which is seen to great advantage in a deep cutting on the Bristol and Exeter Railway adjoining.

The total thickness of the Lias, amounts to nearly six feet, and it dips rapidly to the south-east. The shales and clays below the "Bone bed" are much reduced in thickness, when compared with those in Gloucestershire, and at Aust Passage.

The last section which I shall notice, is one taken from a quarry on Bedminster Down, a quarter of a mile beyond the one last described, and two miles south-east of Bristol.

In descending order:

	FEET.	INCHES.
1. Eight thin beds of nodular and laminated limestone, divided by layers of clay containing Pectens, Ostrea, Cidaris, Cardium, Avicula, Modiola, and scales of Fish	12	0
2. Light blue compact limestone, with Ostrea, Modiola, Lima, and Plagiostoma	0	6
3. Two thin beds of whitish limestone, divided by brown clays	0	10
4. Shaly brown clay, with Ostrea, Pentacrinites, Fish scales, Cidaris, Plagiostoma, Ostrea, and Modiola . . .	0	10
5. Two beds of compact blue limestone like No. 2, divided by brown clay with Plagiostoma giganteum, P. rusticum, Ammonites, charred wood, &c. . . .	2	8
6. Blue shale, with Cidaris, scales of Fish, and the corneo-calcareous bodies, described at page 78. . . .	0	11
7. Four beds of *Insect Limestone* separated by clays. The three top beds are alike, but the lowest differs slightly from the others. They contain only a few *Insects*, *Coleia*, Plants, Modiola, and the black sepiaceous bodies of the previous bed	1	9
8. Blue shaly clay, with nodules of stone, Pectens, Plagiostoma, Cidaris, and Cardinia	0	5
9. Five beds of compact crystalline limestone, of a bluish colour, very hard, and full of Fish scales; the second one contains a small Ammonite and Plagiostoma . .	3	4
Carried forward	23	3

	FEET.	INCHES
Brought forward	23	3
10. Marly clay, with Ostrea, Plagiostoma, and Pecten . .	0	5
11. Four beds of a hard crystalline limestone, like No. 9, of a blue colour, divided by clays, with Plagiostoma, a small Pecten, and Ostrea	3	0
12. Blue shaly clay	0	6
13. Dark blue limestone resting on clay, with Ostrea and Pectens	0	10
14. Blue limestone with Gryphæa, Terebratula, Ostrea, and Plagiostoma	0	5
15. Shaly clay passing into sandy stone	0	6
16. Two beds of blue limestone separated by shale . .	1	0
17. Highly ferruginous limestone of a yellow colour, and very hard	0	3
18. Dark blue shaly clay	0	3
19. Three beds of a light blue, very crystalline limestone with Ostrea	0	6
Total	30	11

The strata are horizontal.

The foregoing and ensuing statements will explain the difference in these sections, as regards the thickness of some of the beds between the "Insect Limestone" and Red Marl, and between the former and the "Landscape stone," whilst they will also show the comparative thickness of the same strata in parts of Gloucestershire and Warwickshire. At Stoke (page 85,) there are eleven inches between the "Insect Limestone," and the "Landscape stone." At Horfield, there are ten feet between the same strata; on Bedminster Down no "Landscape stone" is visible; at Wainlode Cliff (page 58) there are twenty-five feet one inch, between the "Insect Limestone" and Red Marl; and five feet eight inches between the former and the "Cypris and Plant bed." At Temple Grafton in Warwickshire, (page 74) there are five feet eleven inches between the lowest bed of "Insect Limestone," and the "Firestone," (*Cypris* bed?) although at Bickmarsh there are only six inches between the same strata (page 74).

In all these sections, the "Insect Limestone" preserves its peculiar and remarkable character, and contains the same fossils; and here, as in other places, it can at once be readily identified, not only by its position, but by its mineralogical structure also.

The "Landscape stone," too, is a distinct and marked bed, and can in all cases where it appears in this district, be easily detected. The fact of its affording Insects, is a mere local circumstance, and this does not serve to distinguish it so much as its lithological peculiarities. The existence of Insects in this stratum rather tends to corroborate the suggestions at page 94, with regard to the physical causes which affected the formation of the lower Lias.

The Phenomena thus presented in the vicinity of Bristol lead to the following conclusions:

First. In comparing these sections together, and with those elsewhere, it will be seen that we have a true bed of "Insect Limestone," in all cases and respects, similar and identical, though divided into three distinct beds at Bedminster, as at Temple Grafton in Warwickshire.

Secondly. In most parts of the southern sections there is a band of stone locally termed "Landscape stone," or "Cotham marble," which may have no exact equivalent in other places, but which, from its peculiar character, seems more closely connected with the "Cypris and Plant bed" of the northern sections, than with the "Insect Limestone," although occasionally containing *Insects*.

Thirdly. In several of the sections, especially at the Nubbers and Bedminster, there are thick strata of limestone yielding many shells, *below* the "Insect Limestone," which is not the case in other parts of Gloucestershire or Warwickshire; but a similar fact has been observed

at Strensham in Worcestershire (page 70). Still, as the shales in the section on the Bristol and Wells road, above the Red Marl, are much reduced in thickness, it may be inferred that these limestones are the representatives of the beds which intervene between the "Insect Limestone" and Red Marl.

Fourthly. The "Cypris and Plant bed" developed at Aust and on the Wells road, is shown both from position and fossils, to be the equivalent of that at Wainlode and Westbury, and of the Firestone in Warwickshire.

Fifthly. That the thickness of the beds which are interposed between the "Insect Limestone" and Red Marl, is not so great (as far as can be ascertained) as at Wainlode and Westbury.

Lastly. That these differences are such as might be expected in the same formation several miles distant, and that the similarity and identity of certain beds (*e. g. Insect Limestone* and *Cypris bed*) both lithologically and zoologically is remarkable, and is now found to extend from the centre of Warwickshire, to the borders of the southern part of Wales.

I will just add a few remarks in conclusion, on the plants from the "Cypris and Plant bed," and give a general statement derived from these and other facts, respecting the conditions which may have prevailed during the deposition of the lower Lias. Professor Lindley has been good enough to examine the characters of these plants, and he states that their striated leaves prove them to be Monocotyledonous, and also aquatic, belonging to the family *Naiades*, but he could not positively determine whether they were marine or freshwater, as some genera of *Naiades* (Zostera) inhabit the sea, and others (Potamogeton) fresh water.

A large suite of specimens have been since carefully inspected by some botanical friends whose knowledge of the subject may give some weight to their opinions, and they conclude from their peculiar venation and general form, that they are *fluviatile* plants, and were perhaps more closely allied to the *Callitriche*, which inhabits fresh-water pools and streams. I propose to call them *Naiadita lanceolata ;* the generic name, will explain the family to which they belong, and the specific one, the form of the leaves, which are lanceolate at the lower part of the stem. A more accurate description of these characters is given in the second edition of Mr. Murchison's "Geology of Cheltenham." (Appendix.)

From the occurrence of *Cypris*, (which are very numerous,) supposed *Cyclas*, and in some places *Insects* with them, it seems more likely that these plants were originally inhabitants of freshwater streams and rivulets. And as we have evidence of adjoining land in the existence of Ferns, and other terrestrial flora in different portions of the lower Lias, it is not more improbable that these aquatic plants should have been carried into the sea by the rivers in which they grew, than that land plants themselves should have been intermingled with marine exuviæ. We have therefore, perhaps, upon the whole, stronger testimony in favour of their *freshwater* than of their marine origin ; and if so, we may use this as an argument to prove the varied and mixed nature of the waters which deposited this part of the lower Lias.

The remains of the *Naiadita* are in some places exceedingly abundant, particularly on the Wells road near Bristol, (page 88,) where they are far better preserved than in any other locality. *Cypris,* too, are intermingled with them in profusion, as at Westbury, (page 79,) and

hence, we may infer that these Crustaceans and Plants inhabited the same streams, and that they were both carried down and deposited together at the borders of the sea, into which these rivers flowed.

In addition to these facts, the frequency of such delicate creatures as Insects in the "Landscape stone," and in another band of limestone only a few feet higher, (some of which, especially the wings, are beautifully preserved, and could not therefore have been long subject to the action of the waves,) gives a greater probability to the supposition, that this part of the Lias may have been formed in an *estuary*, which received the waters of some neighbouring coast (perhaps numerous scattered islands) and which brought down the remains of *Insects*, *Cypris*, and *Plants* above referred to. It is also worthy of observation, that the usual shells in the "Insect Limestone," are *Ostrea* and *Modiola*, both of which frequently inhabit estuaries, and are capable of living in brackish water, as well as in the open sea. Indeed, these genera are plentiful in some portions of the Wealden; the presence of land at no very great distance, is likewise proved, (as I have before observed) by the intermixture of Ferns, Reeds, and one or two species of the Moss tribe.

In using the term estuary I do not mean to imply that it was such an estuary as that in which the Wealden is conceived to have been deposited, but rather an *estuarine condition*, a certain mixture of freshwater with a sea interspersed with islands, or bounded by low shores which pouring their rivers into the surrounding ocean, would, in some places, be sufficient to render the water brackish, and to allow an occasional admixture both of land, marine, and freshwater animals. In many cases where land was more remote, we might anticipate fewer

traces of Insects, and other evidences of adjacent coasts, and marine productions would again predominate. Thus in other and more distant localities, even the same band of limestone would contain marine shells and other fossils of a similar kind. At present, however, I have never been able to detect many of the more ordinary marine fossils of the Lias in these particular beds. With the exception of Ostrea and Modiola, there are but few other shells; and of course, the pre-supposed conditions would not preclude the assemblage of marine remains, but quite the contrary. Indeed there are Fucoids, Nucula, Avicula, and at Westbury a great quantity of Monotis decussata. A species of Ammonite is met with in some of the upper beds at Temple Grafton, and I procured a fragment of one near Tortworth in this limestone; but they are very scarce. This fact is remarkable because Ammonites generally abound in the Lias, and their absence or extreme rarity would seem to imply a certain degree of change in the state of the sea at that time.

It is certainly unusual to find fluviatile or estuarine strata interpolated among thick beds which are undoubtedly marine, but, nevertheless, there may be some exceptions, like the case in point, just as we have in the converse of this, where marine strata are intermingled with freshwater deposits.

With regard to the occurrence of Insects in a fossil state as an evidence in favour of an estuarine condition, and of neighbouring coasts, it is certain that most of those hitherto known have been discovered in strata which were derived from lakes, rivers, or estuaries, where land could not have been very far distant; and those observed in strata decidedly marine, are ordinarily accompanied (as in the Stonesfield Slate,) by such a preponderance of terrestrial

remains, that the existence of adjoining land cannot for a moment be doubted. The Solenhofen Slate would seem to form an exception, as the Insects there are associated almost exclusively with marine productions.

In the beautiful collection of Solenhofen fossils, in the Woodwardian Museum at Cambridge, I remarked that all the Insects, although much larger than most of those either from the Lias or Wealden, were still not so well preserved, or so clearly defined as some which distinguish certain parts of these formations. Generally speaking, the impressions only are left, as if they had been partially soddened and decomposed previous to their deposition in the soft mud at the bottom of the sea, and thus they would naturally appear in the form of casts after its consolidation. The Rev. F. W. Hope has confirmed this opinion, as he informs me that he has invariably noticed this, in all the specimens of Insects which he has seen from that well-known locality; but of course this may not apply in every instance.

In the Lias Insects, on the other hand, we have not only the nervures of the wings beautifully defined, but even the original colour, or rather the spots (see pl. viii.) retained, and the texture and sculpture of the elytra may occasionally be distinctly traced. (See pl. vi. figs. 23, 25, 26, 27, 28, &c.) There are several Beetles with the eye preserved. (Pl. vii. figs. 5, 6, 10, 11, 12.) Abdomens of others displaying their original colouring, and the articulations or segments. (Pl. vii. fig. 14,—pl. ix. figs. 4, 5, 6.) A Gryllus having a wing and leg attached, (pl. vii. fig. 16,) and the abdomen of a Libellula, or larva of some unknown Insect. (See Addenda.) Perfect specimens are certainly rare, yet portions of these fossils are very abundant, and attached elytra often occur. (Pl. vi.

figs. 32, 33, 34.) Many small slabs of limestone exhibit several wings, abdomens, and elytra; and on one larger block at Bickmarsh there were no less than eight or ten parts of Insects similar to the above. This remark applies to the "Insect Limestone" generally, more especially to the "Landscape stone," at Aust Passage, (p. 85,) where the Coleoptera and other Insects are crowded together in extraordinary profusion.

Now if these fossils had been carried far out to sea, or remained long in the water exposed to the action of the waves, they would have been scattered and dispersed by winds and currents, and many more or less injured or destroyed, so that in such a case, we could expect to find few of them in a fossil state, and those few seldom preserved. Otherwise, it is highly probable that there would be more frequent traces of Insects in other formations, in which they have never as yet been detected. The very few elytra from the middle part of the lower Lias, and the supposed larva of one of the Annulosa in the Oxford Clay, were most likely stray specimens which had been transported further into the ocean, and by some unusual chance had escaped destruction. A recent example is known of a dragon-fly having been seen nearly six hundred miles from land, but this is a very rare occurrence, for the Insecta in a living state are commonly found upon, or at any rate near their food. With regard to the beautiful wings from the upper Lias, it is fair to conclude, even in this instance, that land was not very remote from the spot where they were deposited, for the shales and slate-bed contain masses of decomposed vegetables.

From Mr. Westwood's introductory observations it will be seen, that the Insects from the Lias are not generally so well preserved as those in the Wealden. This

implies that they were conveyed further to their place of interment, and that they had consequently suffered more from maceration and exposure,* and hence the Coleoptera, being less liable to destruction, would be of course most abundant. Another thing which will account for their imperfect state of preservation, is the frequently soft and earthy condition of the "Insect Limestone," most of the specimens where this is the case being indistinct and badly defined. It must be remembered that we cannot expect to find *perfect* insects in a fossil state, the wonder is to discover them at all; and therefore in animals so fragile and delicate as these, the Entomologist must not feel surprised, if the greater part are wanting in those distinctive characters, by which alone their true relations can be determined. Although the remains of this class are very plentiful throughout the Lias, even in localities many miles apart, still the families and genera are comparatively few, and much less varied than those in the Purbeck strata; but it is not to be supposed, on this account, that other tribes of Insects were not in being at the same period.

The minute size of these ancient relics will also be observed, and in this respect they agree precisely with the Wealden Annulosa. The families and genera too are mostly identical, and it is somewhat singular that the difference is not greater, considering the distance of the two formations from each other in point of time, and the distinctions which exist between the other fossils in these respective deposits, and which invariably prevail as we ascend or descend in the Geological series. For although

* It is difficult, however, under these circumstances to explain the excellent preservation of the delicate detached wings, which, as Mr. Westwood remarks, are as well defined as those in the Wealden, except upon the presumption, that the *Neuroptera* were *not* carried so far from their native habitats.

this portion of the lower Lias approaches so near to the Triassic system, yet the Insecta present but few extinct or unknown genera.

The Coleoptera are very numerous; the other orders are Orthoptera, (which agree very nearly both in regard to numbers, and identity of genera, with the Wealden,) Neuroptera, Hemiptera, and Homoptera, and but few Diptera, which are so prevalent in the Purbeck beds. Some of the Coleoptera appear to have been xylophagous or herbivorous in their habits; others belong to aquatic species. Among the various families we have terrestrial and fluviatile genera, which are omnivorous, herbivorous, and predaceous in their economy. Consequently the land must have contained such plants as were best adapted to their food, and insectivorous animals to devour them in their turn. Mr. Westwood states (see explanation of Plates), that fig. 14, pl. vii. reminded him, in its flattened oval form, of the genus Trogulus (a subaquatic genus of Arachnida); and, although this is very doubtful and impossible to determine, still even the supposition is an interesting one, and by no means improbable. He also considers that "the Lias Insects are more decidedly aquatic, or subaquatic, than the Wealden ones, because there are a smaller number of vegetable feeders, though the Elaters satisfactorily prove the existence of the latter." With some rare exceptions, (e. g.,) the gigantic Libellulidæ, Termitidæ, and larger Chauliodes, these Insects seem to have belonged to a temperate climate, and thus they offer, as in the Purbeck series, a remarkable distinction in the contemporary forms of animal life, which, both in the Wealden and Lias, are chiefly referable to new and extinct genera, and were most probably natives of warm latitudes.

In one respect, however, they differ from the Wealden Insecta, since they are less closely allied to European forms, and more nearly to those which now inhabit North America.

A comparison of the tabular lists of Insects from the Wealden and Lias, (pages 32 and 101,) will show what genera and families are common to both formations; indeed there are but few in the latter which do not occur in the former; among these we have only Gyrinus, Laccophilus, Berosus, Telephoridæ, Melolontha, Gryllidæ, Agrion, Hemerobius, Ephemera, and Asilus, which have not as yet been observed in the Wealden.

The total number of specimens examined by Mr. Westwood amounts to 300.

LIST OF THE NEW AND MORE CHARACTERISTIC FOSSILS FOUND IN *PART* OF THE LOWER LIAS ALLUDED TO IN THIS WORK.

PLANTÆ.

NAMES.	REFERENCES.	LOCALITIES.
Otopteris obtusa.	Foss. Flora, p. 128.	Wainlode, Brockeridge, Bidford, Bidminster.
„ acuminata?	*Id.* t. 132.	Binton.
And one or two other species.		
Musci?	Page 65.	Wainlode.
Calamites?	. . . . .	Bedminster, Stoke, Aust Cliff.
Confervæ.	. . . . .	Wainlode, Apperley.
Naiadita lanceolata (Brodie).	Page 92. (*Cypris bed.*)	Wainlode, Westbury, and near Bristol.

FORAMINIFERA.

Two new species, (Strickland.) (Journal of the Geol. Soc. for Aug. 1845.	Bed above "In. L."	Wainlode, and Combe bank, Warwickshire.

List *continued.*

Insecta.*

Coleoptera.

SPECIES.	REFERENCES.	LOCALITIES.
Buprestidæ, or Elateridæ. (Elytra apparently of.) . .	Pl. vi. figs. 23, 24, 25, 26. . .	Wainlode, Apperley, Brockeridge, Churchdown. (*Landscape stone.*) Aust.
Curculionidæ, or Chrysomelidæ, (*id.*). .	Pl. vi. figs. 27, 32, 33, 34.	Hasfield.
Carabidæ, (*id.*). .	Pl. vi. fig. 28. Pl. x. f. 2.	Apperley, Brockeridge.
Telephoridæ, (Elytron apparently of.) .	Pl. vi. fig. 29.	Forthampton.
Laccophilus? aquaticus. (Brod.) (*id.*) .	Pl. vi. fig. 31.	Hasfield.
Elateridæ. .	Pl. vii. figs. 1, 2.	Apperley.
Elater vetustus (Brod.) .	Pl. vii. fig. 1.	
Gyrinus? natans (*id.*) .	Pl. vii. fig. 5.	Forthampton.
Chrysomelidæ? (one of the,) .	Pl. vii. fig. 7.	*Id.*
Melolontha? (abdomen of,) .	Pl. ix. fig. 4.	Cracombe, Worcestershire.
Buprestidæ, (one of the,) .	Pl. x. fig. 1.	Strensham, (*id.*)
Berosus? (Elytra of.) .	Pl. ix. fig. 10.	(*Landscape stone*) Aust.

Orthoptera.

Gryllus Bucklandi (Brod.) .	Pl. vii. fig. 16.	Grafton, Warwickshire.
Gryllidæ, (legs of,) .	Pl. ix. figs. 1, 2, 14.	Forthampton, (*Landscape stone,*) Aust.
Blattidæ? (tegmina of,) .	Pl. viii. figs. 12, 17.	Wainlode, Strensham.

Hemiptera and Homoptera.

Cicada Murchisoni,(Brod.) .	Pl. vii. fig. 20.	Hasfield.
Homopterous insect, (remains of an,) .	Pl. vii. fig. 15, 21.	*Id.*
Cimicideous insect, (*id.*) .	Pl. vii. fig. 22.	Strensham.

Neuroptera.

†Libellula Brodiei, (Buckman. Geol. Proc. vol. iv. p. 211,) *Upper Lias.* .	Pl. viii. fig. 1.	Dumbleton.

* There are twenty-four families and genera determined as far as the state of the specimens will permit.

† This specimen, supposed to belong to the genus Æshna by Mr. Buckman, is pronounced by Mr. Westwood to be a Libellula.

List *continued*.

SPECIES.	REFERENCES.	LOCALITIES.
Libellula ? Hopei, (Brod.)	Pl. x. fig. 3.	Strensham, Worcestershire.
Agrion Buckmani, (*id.*) *Upper Lias*.	Pl. viii. fig. 2.	Dumbleton.
Orthophlebia (*n. g.*) communis, Westwood.	Pl. viii. figs. 7, (and 8,) and 9.	Wainlode, Forthampton, Strensham, Cracombe, Bidford.
Hemerobius ? Higginsii, (Brod.)	Pl. ix. fig. 15.	. . .
Æshna liassina. (Strick. Mag. Nat. Hist. vol. iv. N. S. p. 301.)	Pl. x. fig. 4.	Bidford, Warwickshire.
Chauliodes, (Wings allied to)	Pl. x. figs. 6, 9, 10, 11, 12. Pl. viii. figs. 3, 5, 6, 14.	Hasfield, Strensham, Bidford.
Ephemera, (Wing analogous to,)	Pl. x. fig. 14.	Strensham.
	Diptera ?	
Asilus ? ignotus, (Brod.)	Pl. vii. fig. 19.	Forthampton.
	Crustacea.	
Coleia, (new species,) And fragments of one or two others species.	Page 65, note.	Coombe Hill, Brockeridge, Strensham, Bickmarsh, Westbury, Bedminster, Aust.
Cypris liassica, (Brod.)	Page 80. (*Cypris bed.*)	Wainlode, Westbury, Bickmarsh, Bedminster, Aust.
	Conchifera.	
Cyclas ?	Page 60. (*Cypris bed.*)	Wainlode, Westbury, Dunhampstead, Bedminster, Aust.
Modiola minima.	M.C. t. 210, fig. 5—7.	Wainlode, Strensham, Bidford, Bedminster, &c.
Monotis decussata.	Gold. Pet. t. 120, fig. 8.	Wainlode, Westbury, Bedminster.
Ostrea.		Wainlode, Strensham, Brockeridge, Westbury, Bedminster, &c.

LIST *continued.*

CEPHALOPODA.

SPECIES.	REFERENCES.	LOCALITIES.
Corneo-calcareous bodies, perhaps connected with Ammonites.	Page 77.	Wainlode, Bickmarsh, Bedminster.

PISCES.

Pholidophorus, Stricklandi.	Agass. An. Nat. H. 6, p. 237.	Bickmarsh.
Small Fish.	(Lands. stone.)	Aust.
(*Id.*) four inches long		Forthampton.

REPTILIA.

Ichthyosaurus. Plesiosaurus.	Bones of, rare,	Brockeridge.

A detailed list of the other organic remains from the whole of the Lias of the district referred to in this volume, will be found in Mr. Murchison's "Geology of Cheltenham," 2nd. Edit., and therefore it is unnecessary to add them here, although many new species are mentioned. I have only given this brief enumeration of some of the new and more interesting specimens which *mark* the *Insect* and *Cypris* Limestones, as it is the object of this memoir to describe these beds more in detail, particularly with reference to their organic contents. A few of the more characteristic fossils of the other divisions of the Lias, are inserted at pages 53 and 54.

The whole of the above are from the "Insect Limestone," unless specified to the contrary.

CHAPTER IV.

Insects and Isopoda in other Strata.—Remarks.—Conclusion.

Insects as may be anticipated, both from their delicate and fragile nature, and from the great preponderance of marine formations over those either of a mixed or estuarine, or of a decidedly freshwater character, are usually rare in a fossil state.

The discoveries, however, which have lately been made, show that these beautiful fossils are far more abundant than has been at first sight supposed, the greater portion being at present chiefly confined in this country to the Wealden and Lias. The newest formation in which these interesting relics of a former world have been hitherto met with in England, is a very recent Tertiary deposit (newer Pliocene) at Mundesley in Norfolk, mentioned by Mr. Lyell, Geol. Proc. vol. iii. page 175. They consist for the most part of elytra of Beetles, many of which are identical with British Insects; belonging to the genera, Copris, Donacia, and Harpalus, associated with freshwater shells, which, with two exceptions, belong to species now living; remains of freshwater fish, and seed-vessels of an aquatic plant.

To these succeed those already described in the Wealden, Oxford Clay, Forest Marble, Stonesfield Slate, and Lias. The Coal formation is the lowest in which Insects are at present known. A few fine specimens have been found in the ironstone of Coalbrook Dale, in Shropshire:

one of these, a large and nearly perfect Beetle, is figured in the Bridg. Treat. vol. ii. pl. xlvi. fig. 1, and another at fig. 2. They belong to the genus Curculio, and are provisionally named Curculioides Ansticii, and C. Prestvicii. Mr. Prestwich tells me that the Insects are exceedingly scarce, and, like the Trilobites and shells, are confined to a few particular places.* In the British Museum there is a large wing of a Neuropterous Insect, resembling the living Corydalis (C. Bronginarti, Mantell) of Carolina, in a nodule of ironstone from the same Coal field. (Murchison Sil. Sys. page 105.) The Rev. F. W. Hope has been kind enough to allow me to figure a remarkable fossil from Coalbrook Dale in his Cabinet, (pl. i. fig. 11,) which Mr. Westwood thinks has very much the appearance of a large *Caterpillar*. See introductory observations.

With these there are numerous terrestrial Plants, some Fishes, Trilobites, and marine and freshwater shells.

It is not improbable that Insects may be eventually discovered in the band of cream-coloured freshwater limestone which accompanies the coal, in the neighbourhood of Shrewsbury and Manchester, and there contains *Cypris inflata*, *Cyclas*, and a new genus of microscopic shells called *Microconchus* by Mr. Murchison. (Sil. Sys. pages 83, 84.) Dr. Buckland also mentions some small Hymenopterous Insects, from the Coal shale near Glasgow. (Geol. Proc. vol. iii. page 505.)

There are several formations on the Continent, which afford many very perfect fossil Insects, most of which have been already figured and described by foreign authors. The tertiary deposits of Aix in Provence, and Œningen near Geneva, are well-known for the extreme beauty

* Further details are given in Mr. Prestwich's valuable memoir in the Geol. Trans., 2nd series, vol. v., and Geol. Proc. vol. ii. page 401.

and variety of their fossils. The following are among some of the genera of Insects at the former place: Tettigonia, Mycetophila, Bibio, Lathrobium, Liparus, and several others; seventy genera have been enumerated. Many of the species are identical with those which now inhabit Provence, being allied to European forms, and mostly referable to existing genera. The orders Diptera and Hemiptera are the most prevalent, which is the case in the Wealden (pages 119, 121). The Coleoptera are likewise abundant, with only a few Hymenoptera, and but one of Lepidoptera. Some freshwater spiders belonging to the genus Argyroneta are associated with them. (Geol. Proc. vol. i. page 151, and vol. iii. page 505.)*

The Miocene strata at Aix also abound in remains of Fish, land Plants, freshwater shells, and Cypris.

In the newer Pliocene formation at Œningen† forms allied to Formicidæ and Hymenoptera have been noticed, together with larva of Libellulæ, and the genera Anthrax, Cimex, Coccinella, Cerambyx, Blatta, and Nepa. Their generic characters are nearly allied to those now inhabiting the neighbourhood. This is a lacrustine deposit, and is replete with the remains of Birds, Fishes, Reptiles, Crustacea, land and fresh-water Plants, fluviatile Shells, Cypris, and several terrestrial animals (Geol. Proc. vol. i. page 169.)‡

* There is a paper on these Insects by Mr. Curtis. Edinburgh Philos, Jour. No. 14, pages 287—298. See also M. Marcel des Serres, "Géognosie des terrains tertiairs," pages 206, 244; and a translation of a memoir by the same author in the Quarterly Journal of Science for September 1828.

The Rev. F. W. Hope has obtained many beautiful Insects from the tertiary beds at Senigaglia, near Ancona, in Italy, which closely resemble those at Aix. Saporta and Boisduval describe and figure a fossil butterfly, "Annal. Soc. Entomol. de France, vol. ix. pl. 8.

† Germar, in the "Nova Acta," describes the Insects at Œningen, and in Amber.

‡ Mr. Murchison has given a most interesting account of this locality in the Geol. Trans. vol. iii. New Series.

Insects have been observed in a Tertiary Molasse (probably about the age of the deposits at Œningen) at Radoboj, in Croatia, which are described by Unger in "Verhandl. der Kais. Leop. Acad. d. Naturforscher." 19. 11. S. 415. T. 71. 72. And also by Von Charpentier, in the same work, 20. S. 401. T. 21. 23. See "Erichson's Jahrbericht," for 1842, in "Weigmann's Archives."

Scheuchzer alludes to the discovery of a Libellula with its wings attached, at Monte Bolca.

In the collection of my friend Mr. Strickland, I detected an elytron of a coleopterous Insect in the tertiary lacustrine marl (also containing Isopods, vid. page 110) of Le Puy in Auvergne.

Mr. Lyell notices a very interesting fact with reference to certain strata in that country,—"There is another remarkable form of freshwater limestone in Auvergne, called 'indusial,' from the cases, or *indusiæ* of the larva of Phryganea, great heaps of which have been encrusted as they lay, by carbonate of lime, and formed into a hard travertin. These cases are often covered by the shells of a large species of Paludina. When we consider (adds this author), that ten or twelve tubes are packed within the compass of a cubic inch, and that some single strata of this limestone are six feet thick, and may be traced over a considerable area, we may form some idea of the countless number of insects and mollusca which contributed their integuments to compose this singularly constructed rock." (Lyell, Princ. vol. iv. p. 165.)

Insects have been detected in the tertiary beds of Gergovia, near Clermont, and at Armissan near Narbonne.

The existence of Insects in Amber is well-known; most of these are allied to forms now in existence, and are in

most cases very beautifully preserved. Some Amber is obtained from the eastern coasts of England, but the greater part from the coasts of Prussia, Sicily, and the Baltic. It is derived from beds of Tertiary lignite.

Several species of Insects have been discovered by Goldfuss in the lignite beds near Bonn.*

Dr. Buckland mentions a beautiful specimen of a Buprestis from Japan, about an inch long, converted into chalcedony, having the antennæ and legs preserved. (Bridg. Treat. vol. ii. page 78, note.)†

In the secondary deposits the Solenhofen Slate, which belongs to the upper part of the Oolitic series, presents many different genera of fossil Insects (as the annexed list will show); and a Spider allied to the genus Nymphon. The rest of the fossils are entirely marine, consisting chiefly of Fish, Crustacea, Reptiles, Shells, and Fucoids.

Among the Insects in the Oolite of Germany, chiefly I believe from Solenhofen and Pappenheim, Bronn enumerates (vol. i. page 210),

COLEOPTERA.	NEUROPTERA.	HYMENOPTERA.
Cerambyx, Hydrophilus	Libellula, Æshna, Agrion, Myrmelion.	Sirex, Ichneumon.

LEPIDOPTERA.

Sphinx and others.

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* A detailed list of the different insects found in Amber, Brown Coal, (*lignite*,) and the gypsum formation at Aix, is given in Bronn's "Lethæa geognostica," vol. ii. page 811. Germar in the 19th part of the "Fauna Insectorum Europæ," describes the Insects from the Braun Kohle, and those in Amber, in the "Nova Acta."

† I may take this opportunity of stating, that the Rev. F. W. Hope is about to publish a description of all the fossil insects in the tertiary strata of foreign countries, which will prove a valuable acquisition to our present knowledge, as he has already detected many new and undescribed varieties from Aix and other places.

Germar in the "Nova Acta, Leopold. Carol." 19, also describes several genera from Solenhofen, viz.,

Scarabæides deperditus.
Cerambycinus dubius.
Chresmoda (Truxalis?) dubia.
Locusta speciosa.
„ prisca.

Æshna Munsteri.
„ gigantea.
Libellula longialata.
Agrion Latreilli.
„ antiqua.

Apiaria (Bombus?)
„ antiqua.
Ricania hospes.
Ditomoptera dubia.
Belostoma elongatum.

Nepa primordialis.
Pygolampis gigantea.
Syrphus (Munster).

Sciaria prisca.
Musca lithophila.

This list is added because it may be interesting to some of my readers to compare these fossils from the German Oolite with those in our Wealden and Lias.

Munster's "Beitrage" may be advantageously consulted for a full account of the Solenhofen Insects which are also alluded to by Knorr.

There are other memoirs by L. Von Buch on a large fossil Æshna from "Kalkschiefer," Solenhofen, in Jura von Deutschland, and by von Charpentier on a fossil Æshna in his great work on Libellulidæ.*

The late Count Munster's collection alone contained twenty-six species of Insects from Solenhofen. That eminent geologist also detected some wings of Insects in the lias of Bayreuth. (Vid. Leonhard, "Jahr Buch fur Mineralogie," 1835, page 333; and Bronn "Lethæa geognostica," vol. i. page 210.) This additional fact is one of great interest, as it not only proves the existence of similar fossils in a very distant portion of the same formation, but it obviously shows that causes of a like nature were in operation during the deposition of the lias in parts of Germany.

* Von Meyer has an article on fossil insects in Ersch and Gruber's Encyclopædia. Those in the secondary rocks relate chiefly to the ones previously indicated in this volume.

The Sandstone of the Coal formation at Chomle in Bohemia has produced two new genera of fossil Scorpions, the first instance of the kind hitherto met with. Although these animals, as well as the Spiders, belong to the class Arachnida, still there is a sort of connection between them and the Insecta, which induces me to notice them here. Indeed, Professor Buckland brings forward an ingenious argument to prove that their presence in a fossil state would alone afford a very fair presumption that Insects co-existed with the Arachnida, because the former constitute the prey on which the latter feed. I refer for further descriptions and figures to the Bridgr. Treat. vol. ii., and Geol. Proc. vol. iii. Four species of Insects are stated to occur in the Palæozoic rocks of the north of Germany and Belgium by Professor Sedgwick and Mr. Murchison, Geol. Trans. vol. vi. page 308, for 1842.

FOSSIL ISOPODA.

Crustaceans belonging to this order are very rare in a fossil state. The new genus already described (page 10, and pl. i., figs. 6, 7, 8,) from the Wiltshire Wealden is at present the only one of the kind known in this country. M. Milne Edwards has described another genus in the marine Tertiary marls near Paris, which he denominates *Palæoniscus Brongniarti.* (Annal. des Sciences Nat., 2nd series, vol. xx.) M. Latreille mentions a small fossil Crustacean, the locality of which is not given, apparently belonging to the sub-genus *Limnoria.* In the Tertiary lacustrine marls of Auvergne (page 107), there is a species of Isopod resembling in form the *Archæoniscus* from the Wealden, but it is by no means so well preserved, though equally numerous and characteristic.

Count Munster notices a fossil of this kind (*Reckur punctatus*) from the Solenhofen Slate: the *Sculda pinnata* from the same formation is considered by M. Milne Edwards to be only fragments of *Macrura*, and not an Isopod. There are three other specimens described and figured in Munster's "Petrefacten;" but as he states them to be very indistinct and ill preserved, it is very doubtful to what order they belong.

Bronn refers to some fossils (vol. ii. page 809), one of which was found in Amber, and the others at Paris, probably the same as those since named by M. Milne Edwards. I am not aware that there are any other fossil Crustacea of this order at present known, although future discoveries may bring more to light.

REMARKS ON FOSSIL INSECTS.

In general it may be expected that Insects would be most prevalent where there are the greatest quantity of terrestrial plants, all other circumstances being favourable for their preservation; and this is really the case in all the fresh-water deposits which contain them, and in the marine formation of the Stonesfield Slate. In most instances we have reason to believe that land was not far remote, and that consequently these delicate creatures were not embedded at any very great distance from their original habitats; though of course there may be, and are, some exceptions to this rule. Wherever the remains of Insects occur, elytra of Coleoptera would probably be most numerous (as in the case of the Lias), because these wing-covers are more readily preserved, owing to the hard indestructible nature of the *Elytrine* or *Chitine* of which they are composed. Hitherto, Insects have been dis-

covered chiefly in fresh-water or estuarine formations, where the spoils of adjacent continents or islands would be from time to time embedded, and which offer suitable conditions for their mineralization. It will be observed that the greater number of the Insects alluded to in the preceding pages belong (with a few exceptions) to terrestrial genera, most of which inhabit woods or low marshy places, although there are certainly others which appear to belong to subaquatic forms.

It is also deserving of attention that this class of articulated animals, even in the older strata (e. g. the Lias), is far more closely allied to those now in existence than the rest of the fauna in the ancient world. The discoveries of Geology have revealed many wonderful and gigantic creatures, widely differing, both generically and specifically, from recent forms; but with regard to the Insecta, although some of them cannot be identified with any living types, still there is a much less proportional difference in this respect than might fairly be expected: so that these fossils may be almost said to afford an exception to the usual conclusions which have been derived upon this subject. It is a curious fact too, that the greater part of the Insect remains, both in the Wealden and Lias, are of a most diminutive character, and that the other organic bodies associated with them are proportionably minute. In both these cases the presence of some Insectivorous animals may fairly be inferred.

CONCLUSION.

One object in the present imperfect sketch has been to show the value and importance of even *minute* investigations, in elucidating the conditions under which certain strata were deposited, and more especially to point out the existence of many of those fragile but beautiful forms of animal life which tenanted our earth at very early geological periods. Our minds are so constituted that we readily admire everything grand or sublime in nature; but we are apt to overlook those small and less striking objects, which are, in fact, equally worthy of our admiration and regard. And this may be readily shown by the reflection, that one and all, either separately or united, are as much an evidence of design as they are of kindly forethought and goodness on the part of their beneficent Creator. Indeed, it is not, perhaps, too great an assumption to suppose that past time and past events (the history of which is best told in the relics and remnants of a former world) were all tending to one great and final object; and that, although man was not then among the inhabitants of that ancient globe, still his interest and welfare were all consulted in fitting and preparing it as a residence for a being more beautiful in form and mightier in intellect than any other which had as yet been called into existence. Nor can it be unscriptural or unphilosophical to believe, that this formed a *part* of a vast and far-extending scheme in the councils of the Almighty when he first framed the Universe, and adapted it to fulfil all those

noble and comprehensive purposes for which it was designed.

Geology is daily enlarging our views and extending our acquaintance with the varied phenomena which, in remote ages, produced and remodelled the framework of the globe; and even every hour may be said to give us a clearer insight into the nature and habits of those innumerable living creatures which have successively peopled the land and waters.

Thus, then, in all our labours and reasonings it should never be forgotten, in any case, that every examination into the wonders and beauties of God's creation, whilst it increases our knowledge and improves the understanding, has also a far higher and better purpose in displaying the glory of God, and in leading us to adore and praise the wisdom and omnipotence which are daily displayed in the material world.

EXPLANATION OF PLATES.*

Plate I.

PISCES.

Pl. i. figs. 1, 3.—Leptolepis Brodiei (pp. 15, 16, 17).
Pl. i. fig. 5.—Leptolepis nanus (*id*).
Pl. i. fig. 2.—Ceramurus macrocephalus (*id*).
Pl. i. fig. 4.—Oxygonius tenuis (*id*).

CRUSTACEA.

Pl. i. figs. 6, 7, 8, 9.—Archæoniscus Brodiei (pp. 10 to 15).
Pl. i. fig. 10.—Eye magnified.

INSECTA.

Pl. i. fig. 11.—Caterpillar? in ironstone, from Coalbrook Dale (p. 105).

WEALDEN INSECTA.

Plates ii. iii. iv. (except fig. 13,) v. and vi. (figs. 1—15.)

Coleoptera. (Plates ii. iii. vi.)

Pl. ii. fig. 1.—A small beetle, with rather small head, filiform antennæ, oval thorax, and elongate-obovate elytra which are striate-punctate. The feet are very indistinct, the hind ones not at all visible. It is in consequence of having been much flattened, I presume, that the elytra

* The whole of the explanation of Plates ii. iii. iv. v. vi. vii. viii. ix. x. and fig. 11, pl. i. is by Mr. Westwood.

have a transversely-striated appearance which is not seen in living beetles. The specimen has most the appearance of a small elongated Harpalideous insect, but I cannot define it more precisely.

Pl. ii. figs. 2, 3.—These may possibly be the remains of small Staphylinidæ ; fig. 2, has, however, somewhat the appearance of the body of a minute Termes.

Pl. iii. fig. 1.—This appears to be a minute xylophagous beetle allied to Cerylon, with striated elytra, but it is much damaged, and none of the limbs are visible.

Pl. iii. fig. 2.—This has the appearance of a small Helophorus, but it is not to be determined.

Pl. iii. figs. 3, 4, 5.—These are the remains of very minute beetles, the families of which it is impossible to determine ; fig. 3 looks like a Cyphon, and fig. 4, one of the short-snouted weevils, with the snout indistinct.

Pl. iii. fig. 6.—Appears to be the pupa of some very minute Coleopterous insect.

The collection contains nearly fifty specimens of detached elytra, for the most part not exceeding one sixth of an inch in length, belonging to various families, from which the fourteen following have been selected as the most conspicuous.

Pl. vi. fig. 1.—One of the elytra of a beetle, being the largest specimen of these parts of Coleopterous insects in the collection. It measures about six lines, so that the entire insect must have been about three quarters of an inch long. From its form and very slight striation, it may have belonged to a Buprestideous insect.

Pl. vi. fig. 2.—An elytron five lines long, of nearly equal breadth throughout, with the outer apical angle rounded off, thickly covered with slight longitudinal rugose striæ. (Tenebrionidæ ?)

Pl. vi. fig. 3.—An elytron three lines long, rather broad, attenuated behind, and with ten or eleven clear longitudinal striæ. (Harpalidæ ?)

Pl. vi. fig. 4.—An elytron nearly two lines long, with six coarsely punctate striæ. (Curculionidæ ?)

Pl. vi. fig. 5.—An elytron gradually attenuated, and with eight clear longitudinal striæ. (Colymbetes ?)

Pl. vi. fig. 6.—An elytron rather narrow, and striated with rugose interstices. (Elateridæ ?)

Pl. vi. fig. 7.—A narrow elytron with seven not very clear longitudinal striæ. (Elateridæ ?) *From Aylesbury.*

Pl. vi. fig. 8.—An elytron two and a half lines long, rather narrow, and very coarsely punctate-striate. (Curculionidæ ?)

Pl. vi. fig. 9.—A minute broad elytron rudely punctate-striate. (Limnius ?)

Pl. vi. fig. 10.—A very narrow minute shining black elytron, very delicately punctured, and marked with slight but clear impressed striæ. (Buprestidæ ?)

Pl. vi. fig. 11.—A minute, rather narrow, brassy black, slightly shining elytron, closely covered with delicate punctures. (Cantharidæ ?)

Pl. vi. fig. 12.—Two elytra very much pressed. They must have belonged to an oval-formed beetle, with rugose and slightly striated elytra. (Hydrophilidæ ?)

Pl. vi. fig. 13.—Two elytra, much pressed, of some oblong beetle, with slightly striated elytra. (Helephoridæ ?)

Pl. vi. fig. 14.—Two much compressed, rudely punctate-striate elytra. (Curculionidæ ?)

Hymenoptera. (Plate iv.)

I have found no specimens which I can satisfactorily

refer to this order. Pl. iv. figs. 2. and 4, have, indeed, somewhat the appearance of Hymenopterous insects, when magnified, but their very minute size and unintelligible state prevent my determining whether they are not Dipterous.

Orthoptera. (Plates ii. iii. iv. v.)

Pl ii. fig. 4.—A minute Cricket (Acheta) about the size of the English A. sylvestris, Fabr.

Pl. iii. fig. 7.—Abdomen of a small Blatta, about the size of our Blatta germanica.

Pl. iv. fig. 11.—This is evidently a small Blatta, allied to the preceding, with the body much injured, and the segments, limbs and head indistinct, the dark marks, although nearly symmetrical, appear to be portions only of the outer tegument of the dorsum, and not dorsal spots.

Pl. v. figs. 1, 5, and 20.—These appear to be the tegmina of Blattidæ. They differ from any specimens of that family which I have examined, in not having the costal area distinct; that part, may, however, possibly have existed in the present specimens, which are but fragments. The intervention of the isolated veins in the apical portion of these wing-covers is to be noticed; the same character also occurs in fig. 5.

Pl. v. fig. 19.—Appears to be portion of the lower wing, folded up, of a species of the Cricket family.

Neuroptera. (Plates ii. v.)

Pl. ii. fig. 6.—Appears to be one of the Caddice flies belonging to the sub-family Leptoceridæ.

Pl. ii. fig. 7.—From the more robust body, this at first sight appears to be one of the Cicadellinæ, but the branching veins of the wings (which are much displaced at the

base) seem to indicate it to be one of the true Phryganeidæ.

Pl. ii. fig. 5.—This may possibly be the body of a minute Termes distended, and showing the abdominal arcs.

Pl. v. figs. 2, 3, 13, 14, 16.—Wings or parts of wings of insects which appear to belong to a family of which Corydalis is the type, but of which we have no exact representatives in the known series of Neuroptera. They varied greatly in size, but not more so than the recent species of the closely allied family of the Perlidæ. The form of the wing as well as the arrangement of the wing-veins, differs in all these specimens, so that it is probable that the group was an extensive one.

Pl. v. figs. 7, 8, 9, 10.—Portions of the wings of Libellulidæ, the first of a comparatively very large size. The last of these is remarkable for still retaining the dark colour with which the base of the wing was stained. The cells are remarkably minute and numerous, and the veins appear white on the dark ground; the characteristic triangular space is comparatively short.

Pl. v. figs. 12, 18.—I am unable to refer these wings to any known Neuropterous type, although approaching in general form to Bittacus or Panorpa, and like them having the costal portion of the wing not obliquely veined and the wings themselves maculated. They form a distinct genus, to which the name of Orthophlebia may be applied in allusion to the possession of only longitudinal veins.

Pl. v. fig. 21.—Two spotted wings of some other Neuropterous insect, but they are so much folded, that I cannot determine them. They appear, however, closely allied to the preceding.

HEMIPTERA. (PLATES II. IV. V.)

Pl. ii. fig. 11.—This appears to be a reversed specimen of one of the Linnean Cimices, possibly allied to Kleidocerys or some of the broader Pachymeri.

Pl. ii. fig. 8.—Appears to be a portion of the body and one of the hemelytra of an insect allied to the genus Cixius, there being no vein parallel with the apical margin of the hemelytron, which is moreover maculated as in that genus.

Pl. iv. fig. 12.—A beautiful species of the Fulgoridæ, allied to Ricania, but which the very indistinct state of the head prevents me from assigning to its true genus.

Pl. iv. figs. 7, 8.—I infer these to be allied to the genus Asiraca, from their minute size, and the punctated veins of the wing covers.

Pl. iv. fig. 3.—A minute Aphis.

Pl. iv. fig. 6.—Appears to be a suctorial insect (Cimicideous?) in an immature state, the proboscis being straight and porrected.

Pl. iv. fig. 9.—This may possibly be a Cuckoo spit insect (the larva of a Cercopis).

Pl. ii. fig. 12.—The same remark may also be applied to this figure, which is very indistinct.

Pl. ii. fig. 10.—This may possibly be an apterous Aphis, the haustellum being slightly visible.

Pl. ii. fig. 9.—Ditto, but the head obliterated.

Pl. v. fig. 4.—This is the punctured upper wing of one of the Centroti belonging to the Linnean genus Cicada, the inner portion of the wing, as well as the narrow membranous apical margin not being preserved in the specimen.

Pl. v. fig. 17.—From the arrangement of the wing-veins, this appears referable to the genus Delphax.

Pl. v. figs. 6, 11.—I am quite unable to determine to what insects these minute relics could have belonged: from their being veined, they appear to be wings, or wing-covers, but they are too much mutilated to allow me to determine.

Amongst the unfigured specimens of wings were several which appeared from their proportions to be those of species of Velia and Hydrometra, but their veins were not sufficiently clear to be figured with precision.

Diptera. (Plates iii. iv. v.)

The minute individuals of this order appear to have been extremely abundant, as the collection contained a considerable number beyond those now figured. Most of them appear to belong to the smaller tribes of Tipulidæ.

Pl. iii. fig. 8.—Simulium?

Pl. iii. fig. 9.—Platyura?

Pl. iii. fig. 10.—Tanypus?

Pl. iii. fig. 11.—One of the smaller Empidæ.

Pl. iii. fig. 12.—Sciophila?

Pl. iii. fig. 13.—Macrocera?

Pl. iii. fig. 14.—One of the smaller Chironomi.

Pl. iii. fig. 15.—Culex?

Pl. iv. fig. 5.—Chironomus?

Pl. iv. fig. 10.—Rhyphus?

Pl. iv. fig. 1.—This is probably the vermiform larva of a sub-aquatic dipterous insect, with tubercles on the segments of the body. There do not appear to be any exserted organs of motion.

Pl. v. fig. 15.—This appears from the arrangement of the veins, to be allied to the genera Macropeza and Chenesia, amongst the minute Tipulidæ.

Lepidoptera.

There are no specimens in the collection which I can assign to this order.

Pl. iv. fig. 13.—Supposed Larva of an unknown Insect from the Oxford Clay.

Stonesfield Slate Insecta. (Plates vi. figs. 15—22.)

Pl. vi. fig. 15.—This is an elytron of a beetle and is one of the most common occurrence in the Stonesfield Slate. It has been figured by Dr. Buckland in his Bridgwater Treatise, and is described by him as Buprestideous. It does not, however, agree with any of the larger Buprestidæ upon comparing it with Mr. Hope's magnificent series of those insects, the deep lateral impression not occurring in any of them. In a note published in the Proceedings of the Entomological Society, for September, 1841, I suggested that it belonged to the Prionidæ; but none of these Insects exhibit this lateral impression. The three more decided dorsal striæ are certainly Prionideous, and some of the species of this family have margined elytra, and by flat pressure they might assume this appearance, which is the more remarkable as it occurs on several of the other smaller elytra.

Pl. vi. fig. 16. The united elytra of a broad, convex beetle, with the apical portion more suddenly deflexed, the texture of which, however, is greatly injured, so that it is impossible to decide to what family it belonged. It seems, however, in form to approach the Blapsidæ.

Pl. vi. fig. 17. A single elytron (from Mr. Witts' collection) which may have belonged to a Buprestideous or Longicorn beetle; it is longitudinally, slightly punctate-striate.

Pl. vi. fig. 18. A single elytron, (also from Mr. Witts' collection,) completely covered with minute raised tubercles and with a deep lateral longitudinal impression. It appears to belong to the same family as the preceding and following.

Pl. vi. fig. 19. A single long, rather narrow elytron, slightly convex, delicately punctured, and with a slender, sutural stria, and with a deep lateral impression.

Pl. vi. fig. 20. Two united elytra (Mr. Witts') of a convex, circular beetle, possibly one of the Pimeliidæ, or Chrysomelidæ, but very badly preserved.

Pl. vi. fig. 21. Two united elytra of a small globose, or semi-globose beetle, such as the Coccinellidæ, but badly preserved.

Pl. vi. fig. 22. Portion of one of the wings of Hemerobioides giganteus.—Buckland.

LIAS INSECTA.

PLATES VI. VII. VIII. IX. X. (figs. 23—34.)

COLEOPTERA.—PLATES VI. (figs. 23—34,) PLATES VII. (fig. 1—14,) PLATE IX. (fig. 4—13,) PLATE X. (fig. 1, 2.)

Pl. vii. figs. 1, 2.—These are evidently small species of Elateridæ, the posterior acute angles of the prothorax and the oblique grooves of the prosternum for the reception of the Antennæ leave no doubt upon the subject.

Pl. vii. figs. 3—7.—It is difficult from the imperfect state of the specimens to determine the families to which these figures apply: fig. 5, has somewhat the appearance of a Gyrinus, and fig. 7, may be Chrysomelidous.

Pl. vii. figs. 8, 9, 10, 11, 12, 13, 14.—Neither can I determine the families of these Insects which in the originals are very indistinct and imperfect; indeed by re-

versing the figures some of them have very much the appearance of Caligi, or Geoffroy's Binocle à queue en plumet, or rather Prosopistoma, amongst the Entomostracous Crustacea. Others in their flattened form seem more like the genus Trogulus (fig. 14). In the original of fig. 9, very slight traces of short, broad feet were to be seen near the extremity of one of the elytra.

Pl. x. fig. 1.—Mr. Hope considers this to be one of the small, broad species of Buprestidæ.

Pl. vi. figs. 23, 24, 25, 26.—These belonged to elongated Coleoptera, apparently of the families Buprestidæ or Elateridæ.

Pl. vi. fig. 27.—This is not sufficiently attenuated at its extremity for a species of either of these families, nor is it easy to refer it to its legitimate family; it seems nearest allied to fig. 8. pl. vi. amongst the Wealden Insects.

Pl. vi. fig. 28, and pl. x. fig. 2.—Pale elytra with dark brown markings; they appear in form nearest to the Harpalideous Carabidæ; indeed I have an Indian undescribed species with the elytra very similarly marked.

Pl. vi. fig. 29.—May possibly belong to the Telephoridæ; it has the disc covered with very delicate punctures.

Pl. vi. fig. 30.—May have belonged to a globular aquatic beetle, with small elytra.

Pl. vi. fig. 31.—Is something like the elytron of Laccophilus. (Dyticidæ.)

Pl. vi. fig. 32—34.—Are minute globose elytra, which may have belonged to the Chrysomelidæ, or Curculionidæ.

Pl. ix. fig. 4.—Conical extremity of the abdomen of a beetle, most like that of the Cockchaffer.

Pl. ix. figs. 5, 6.—Abdomens of small beetles of doubtful family.

Pl. ix. fig. 7.—Mass of beetles of different sizes, the

larger ones of the same species as some of those figured in pl. vii. *Aust Cliff.*

Pl. ix. fig. 8.—Mass of small beetles. *Aust.*

Pl. ix. fig. 9. { Mass of beetles and Neuropterous Insects. } *Aust.*

Pl. ix. fig. 10. { Two elytra of a small subglobose beetle. Berosus? Cercyon? } *Aust.*

Pl. ix. fig. 11. { Large elytron like pl. vi. fig. 23. } *Aust.*

Pl. ix. fig. 12. { Part of the ventral surface of the abdomen of a beetle. } *Aust.*

Pl. ix. fig. 13. do?? (*id.*)

Hymenoptera.

I have found no Insects of this order amongst the Lias Insects.

Orthoptera. (Plates vii. viii. ix.)

Pl. vii. fig. 16.—This appears to be a small species of the family Gryllidæ with one of the hind legs dislocated.

Pl. ix. figs. 2, 3.—These also appear to be portions of the hind feet of other species of the same family.

Pl. ix. fig. 14.—Part of the leg of a Gryllus. *Aust. Cliff.*

Pl. viii. figs. 12, 17.—Probably the tegmina of Blattidæ.

Neuroptera. (Plates viii. ix. x.)

Pl. ix. fig. 1.—Appears to be the head of a dragon-fly.

Pl. x. fig. 3.—Appears to me to be a portion of the abdomen of a gigantic species of the same family, dilated near the extremity, and furnished with two oval anal appendages. I know no other annulose structure to which it

can be referred. M. Milne Edwards has, indeed, suggested that it may be the subaquatic larva of some Dipterous insect.

Pl. x. fig. 4.—Wing of Mr. Strickland's Æschna liassina, drawn from the original.

Pl. ix. fig. 15.—May possibly be part of the abdomen of a dragon fly, mixed with fragments of beetles from Aust.

Pl. viii. fig. 1.—A remarkably fine wing of a Libellula. *Upper Lias.*

Pl. viii. fig. 2.—An equally fine wing of an Agrion (*id.*).

Pl. viii. fig. 4.—Portions of wings of dragon flies, fig. 4 having remarkably large meshes, which must have belonged to a very gigantic species, the meshes being nearly half a line square.

Pl. x. figs. 6, 9, 10, 11, and 12.—Wings, or portions of wings, of Neuropterous Insects allied to Chauliodes, but belonging to the same group as the Wealden wings (pl. v. fig. 12, 16, &c.); and fig. 5 may be a portion of the wing of another still larger species more analogous to pl. v. fig. 13 in its reticulated structure; if indeed it be not Myrmeleon: it can hardly, I think, be Libellulideous.

Pl. viii. figs. 3, 5, 6, 7, 8, 9, 14.—These are also wings of Insects allied to the preceding species, figs. 7 (and 8) and 9, in their narrow form and general arrangement of the veins being more analogous to Panorpa, but differing from that genus in wanting the transverse veins, the longitudinal veins being consequently more regular. *G. Orthophlebia. W.*

Pl. viii. figs. 10, 11.—These are too minute and imperfect to allow of their being defined; but, from their maculated appearance, may be presumed to be Neuropterous. *Upper Lias.*

Pl. viii. fig. 16,—Appears to be part of the fore-wing of some unknown Neuropterous Insect.

Pl. ix. figs. 16, 17.—Two specimens of small Neuropterous Insects, like Hemerobius in general form, but with the wing-veins more resembling those of Panorpa. (The comparatively smaller size of the hind-wings, and their resemblance to the upper ones, prevents me from considering them as Trichopterous.) *Aust.*

Pl. x. fig. 14.—This wing appears, from its form and maculations, to be more analogous to Ephemera than any other Neuroptera.

Pl. x. fig. 8.—I do not know to what family this fragment is referable.

Pl. vii. fig. 18.—Appear to be relics of a Trichopterous Insect, but the head, antennæ, and legs are wanting, and the wings and abdomen are imperfect.

Hemiptera and Homoptera. (Plates vii. viii. x.)

Pl. vii. fig. 20.—Probably part of the body of a species of a Cicada.

Pl. x. fig. 7.—It is not easy to decide whether this flattened and very imperfect specimen may be the remains of a Cicada. The small portion of the wing marked x x, is part of the under wing, and is seen through the fracture of the upper wing. It is drawn from the reverse block.

Pl. x. fig. 13. Hemelytron of some unknown genus of Hemiptera, probably allied to Belostoma, from Mr. Brodie's collection.

Pl. vii. figs. 15, 21.—Has the appearance of a broad-headed Homopterous insect, with dilated hemelytra; and fig. 21 may possibly be the pupa of the same, or a specimen destitute of wings.

Pl. vii. fig. 22.—Apparently a Cimicideous Insect in an imperfect state, but the impression is very faint in the only specimen.

Pl. viii. fig. 15.—If this belongs to an Annulose animal, it must either be the hemelytron of some new genus of Homoptera, or some curiously striated elytron of a beetle, but I remember nothing analogous to it.

Pl. viii. figs. 17, 18.—These may possibly be the hemelytra of some genus like the last.

Diptera. (Plates vii. viii.)

Pl. vii. fig. 17,—Seems like the body of a Tipulideous insect with elevated thorax, or it may be a larva.

Pl. vii. fig. 19.—May possibly be Dipterous, allied to Asilus.

EXPLANATION OF THE SECTIONS.

Plate XI.

Nos. I. and II. are two sections of the Vale of Wardour, one transverse, the other longitudinal.

No. I. is reduced from Dr. Fitton's Work, and is intended to show the extension of the Purbeck beds from the heights at Lady Down near Tisbury, to their termination near Dinton on the east.

No. II. illustrates the position of the formations which rest upon the Purbeck series on each side of the valley, the latter being seen to emerge from beneath, and being well exhibited in one or two parts of the Vale.

No. III. This section is taken across the Vale of Bristol from north to south, and points out the *Insect Limestone* in situ in that neighbourhood.

No. IV. explains the geological structure of part of the Vale of Gloucester, especially as regards the *Insectiferous beds* in the upper and lower Lias. Churchdown Hill on the south-east is capped by a thin layer of upper Lias Shale, with its included "Fish bed," which at Dumbleton contains the remains of Insects. A thick bed of subjacent Marlstone (the first in the lower Lias), is succeeded by still thicker courses of clays, limestones, and shales, here and there yielding Insects. These are followed by nearly similar strata, forming the base of the lower Lias, and including a certain band of limestone abounding in the remains of Insects, and hence called *Insect Limestone.*

This is developed at its outcrop on Wainlode and Corsewood Hills, where it reposes conformably on the Red Marl. The section is continued to Eldersfield in order to display the Keuper Sandstone which is exposed there.

No. V. illustrates the general bearing of the Oolitic strata in the Cotteswolds, particularly with reference to the Stonesfield Slate, which forms the summit of the hill on Sevenhampton Common. One of the numerous faults by which the range is affected may be observed between Brockhampton and Fox Hill.

THE END.

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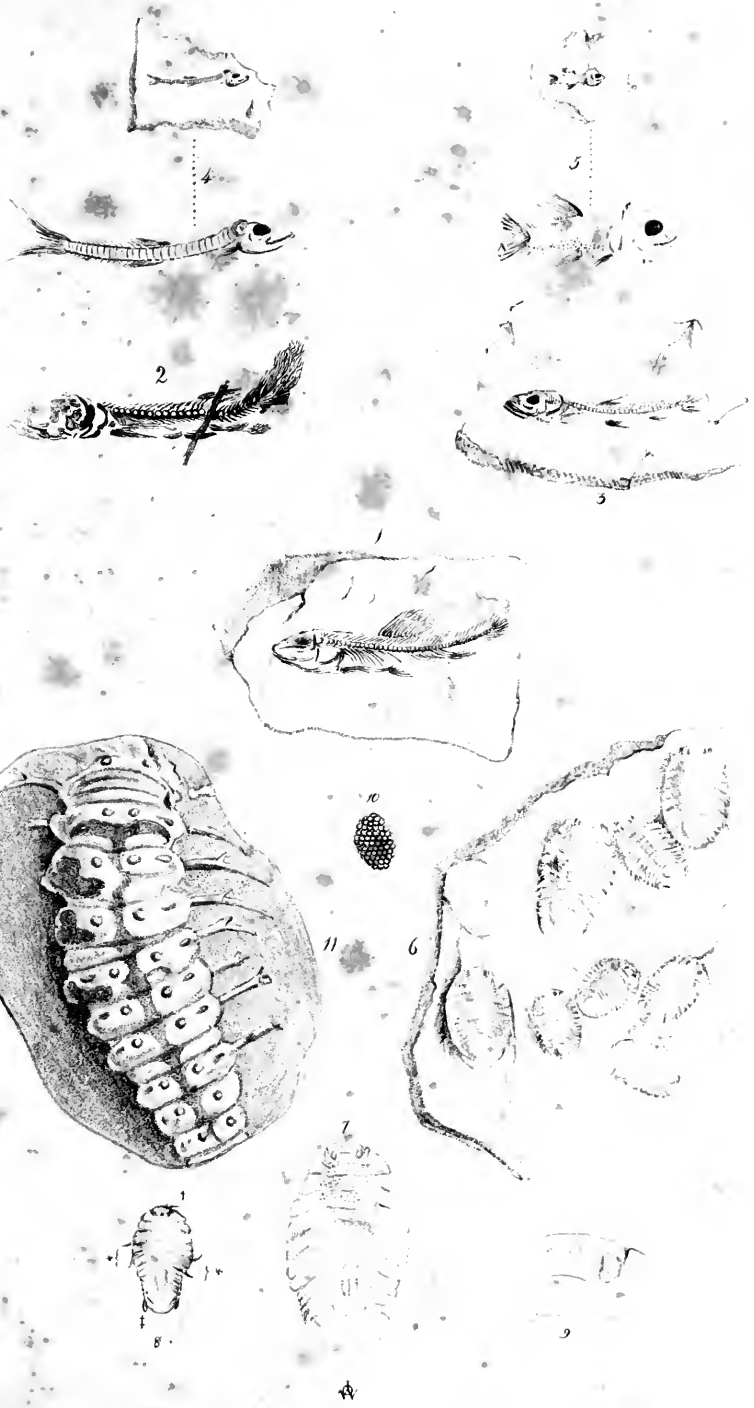
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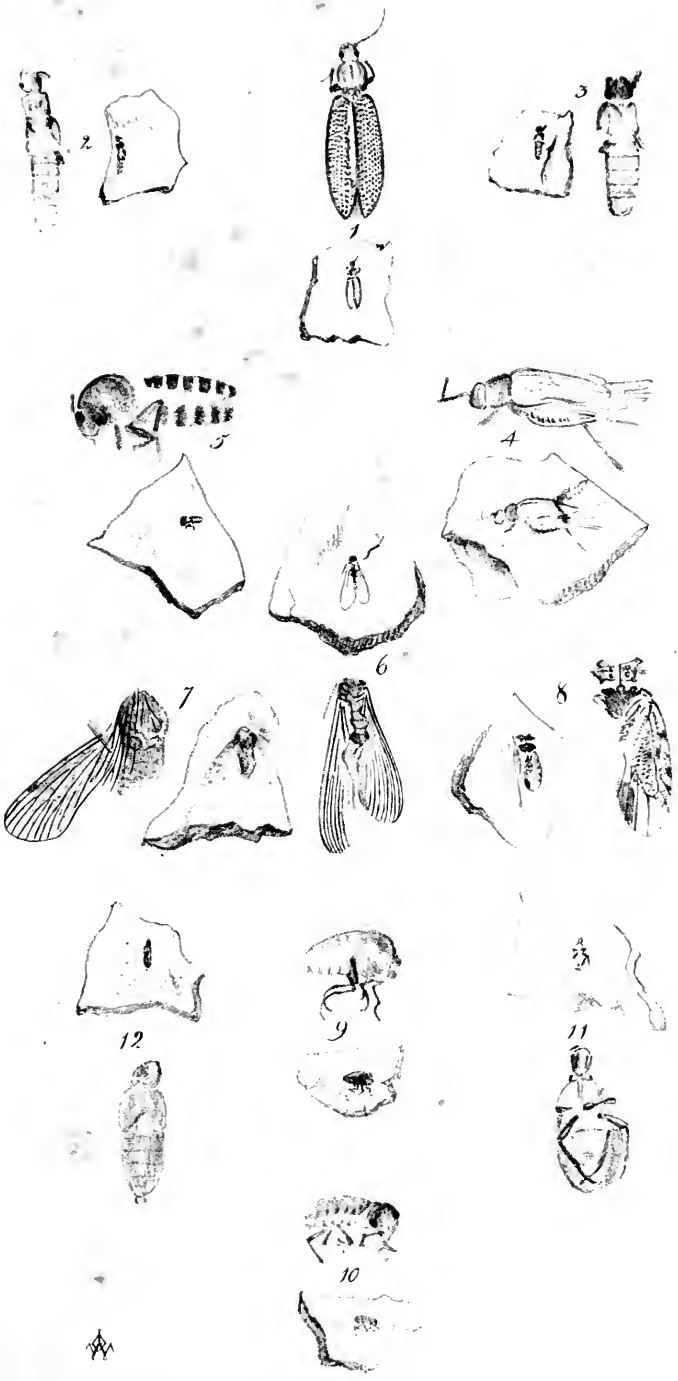
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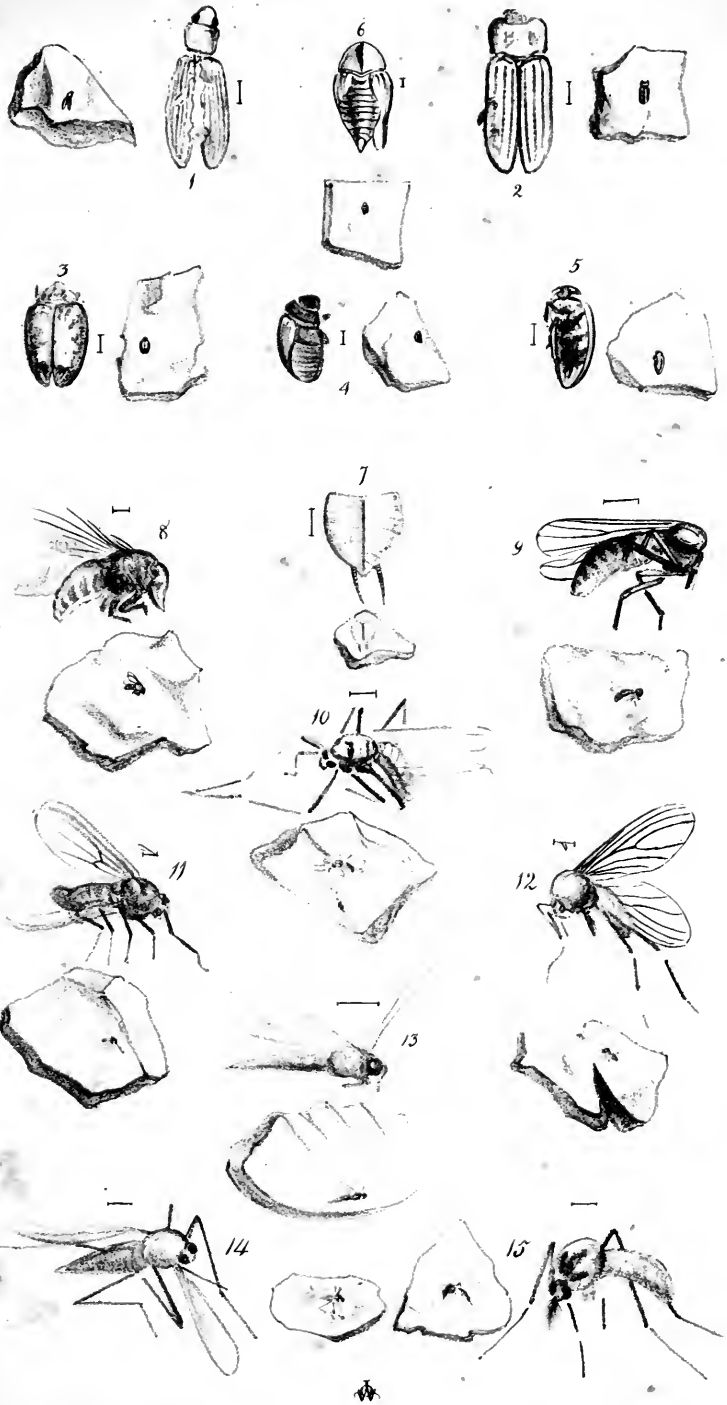
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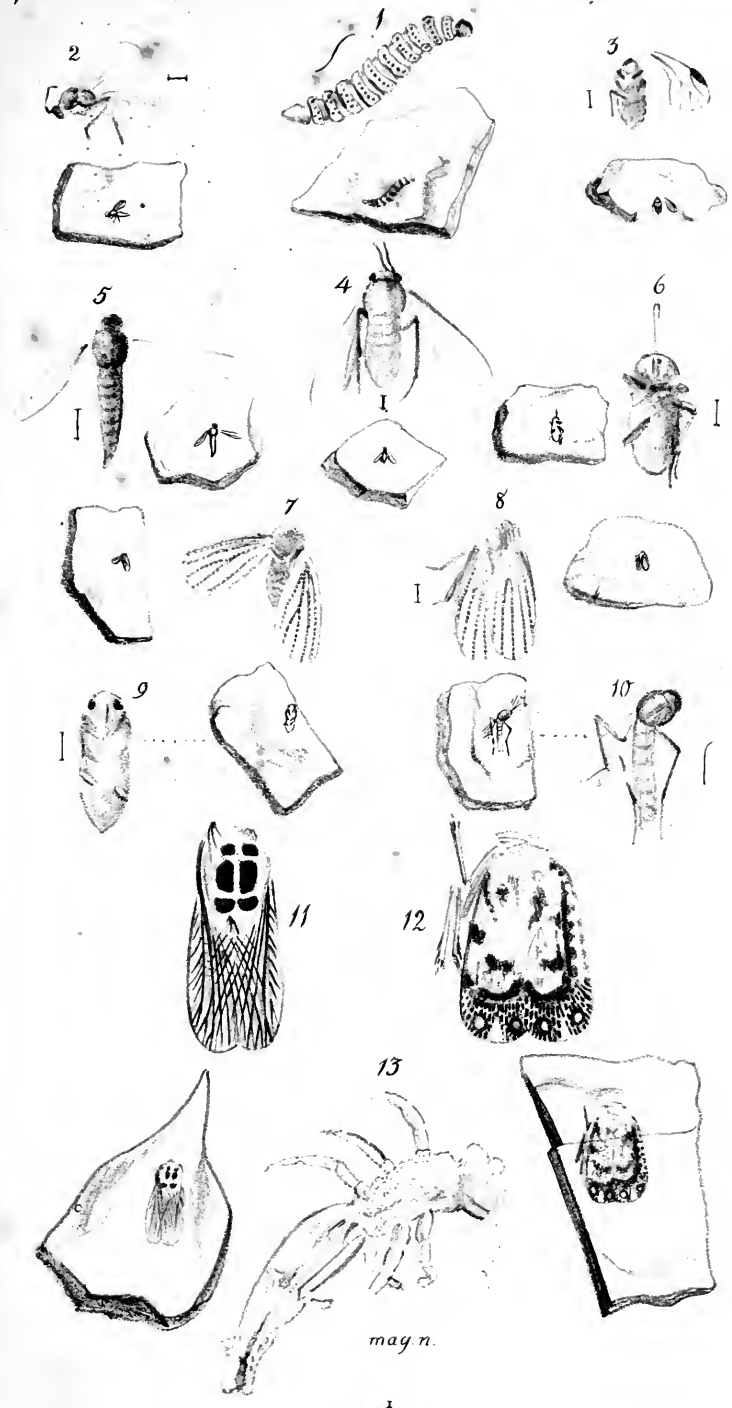
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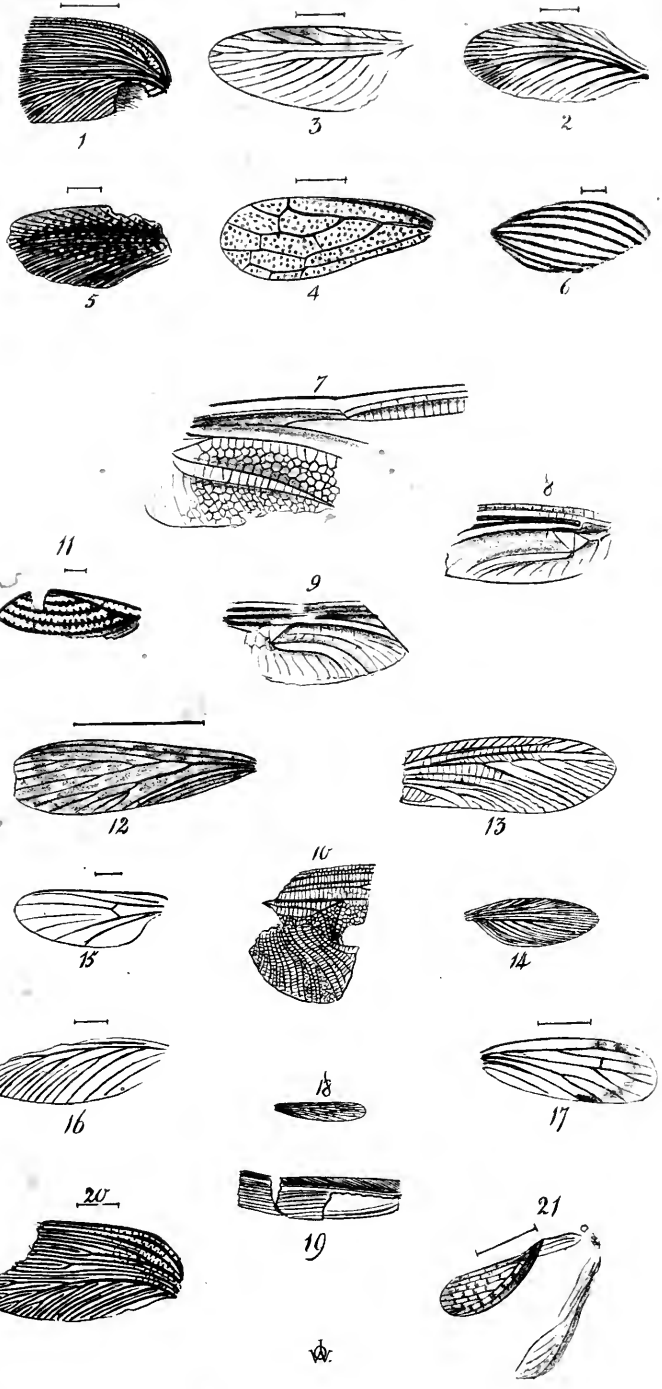
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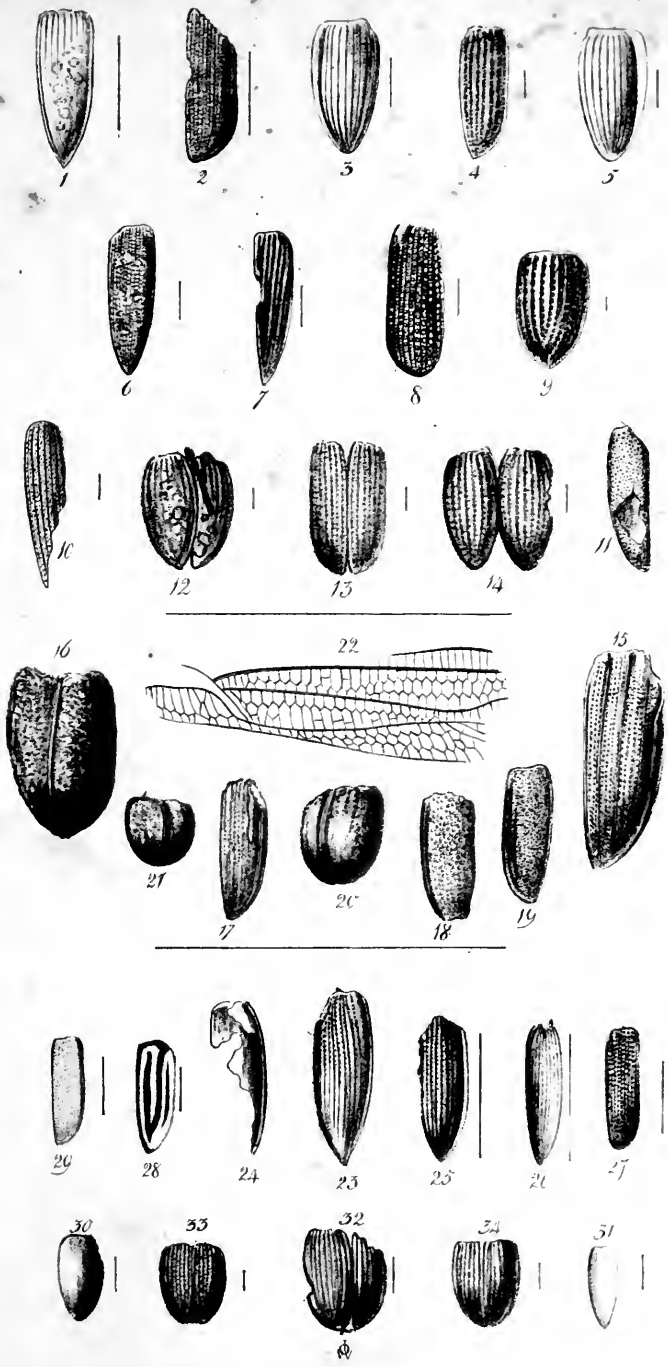
Pl. 6.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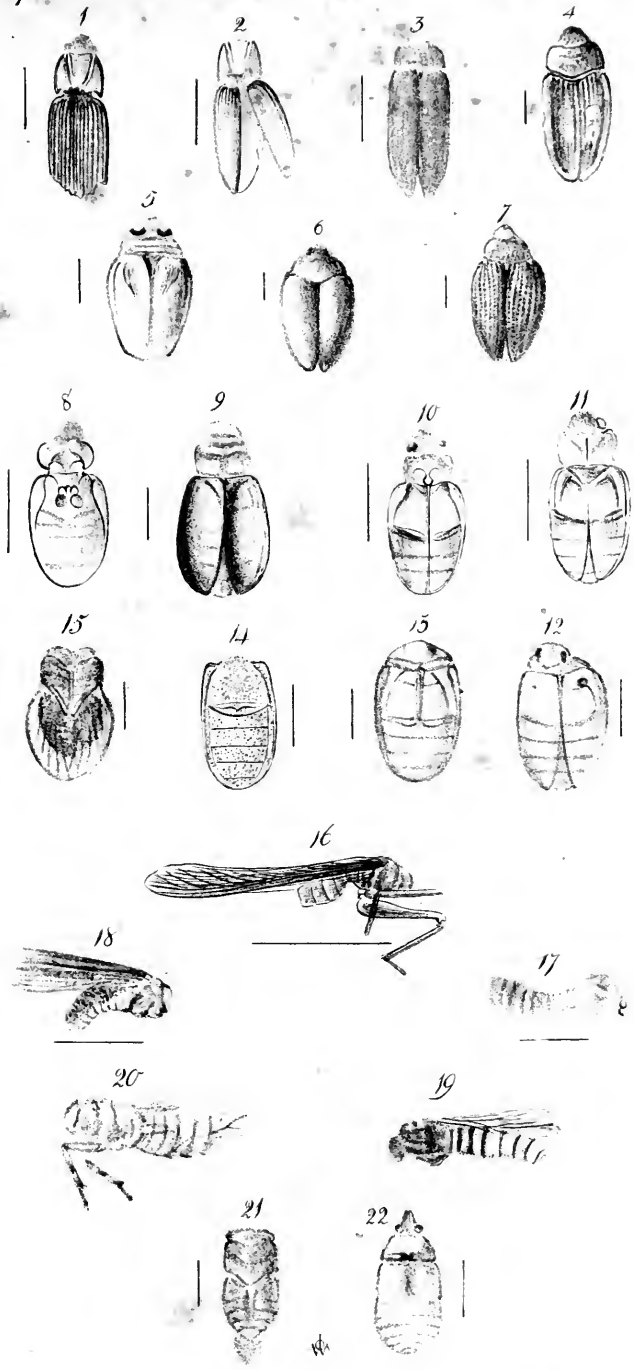
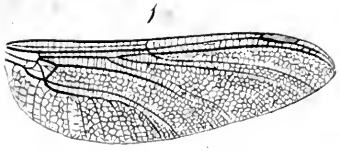
PL. 7.

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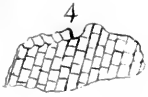
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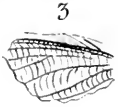
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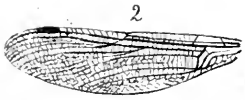
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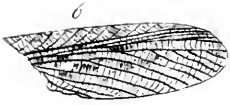
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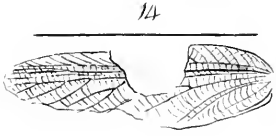
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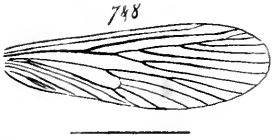
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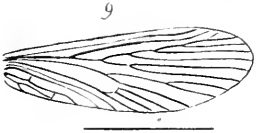
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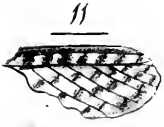
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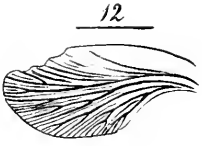
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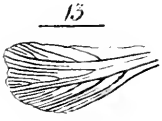
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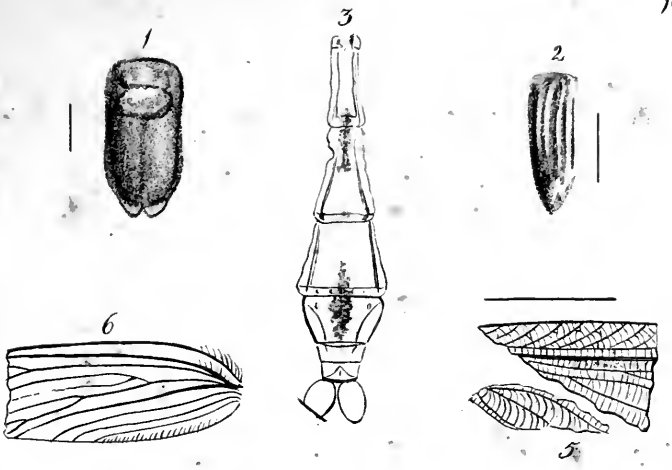
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I. [illegible] Section of the Vale of Wardour

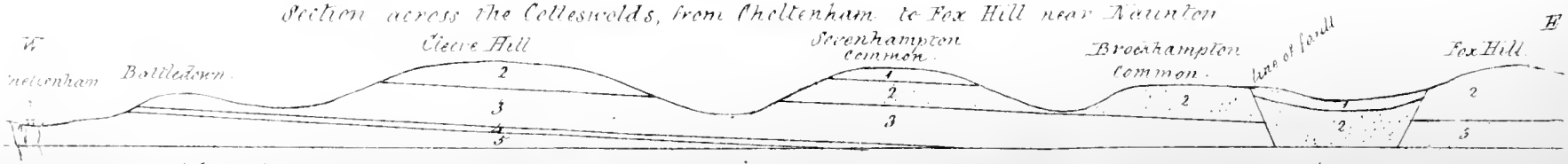
II Transverse Section of the Vale of Wardour

1 Upper Green Sand 2 Gault 4 Purbeck Beds 5 Portland Stone 6 Portland Sand 7 Kimmeridge Clay

III. Section of the Vale of Bristol.

IV Section of the Vale of Gloucester.

Section across the Cotteswolds, from Cheltenham to Fox Hill near Naunton



1 Stoneshield Slate. 2 Inferior Oolite. 3 Upper Lias. 4 Marlstone. 5 Lower Lias.

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