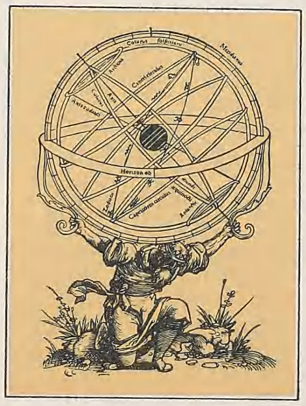

THE

SILURIAN SYSTEM,

FOUNDED ON

GEOLOGICAL RESEARCHES

IN THE COUNTIES OF

SALOP, HEREFORD, RADNOR, MONTGOMERY, CAERMARTHEN,
BRECON, PEMBROKE, MONMOUTH, GLOUCESTER,
WORCESTER, AND STAFFORD;

WITH
DESCRIPTIONS OF THE COAL-FIELDS AND OVERLYING FORMATIONS.

BY

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ETC. ETC. ETC.

IN TWO PARTS.

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1839.

PART II.

ORGANIC REMAINS.

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CHAPTER XLIII.

Introductory View of the Distribution of Organic Remains in the Older Formations.

GEOLOGY reveals to us the extraordinary fact, and without its aid the fact never could have been known, that as the globe passed from one condition to another, whole races of animals perished, and were succeeded by others with organizations adapted to the altered state of our planet.

On this phenomenon is based the fundamental principle of the identification of strata by their imbedded remains; the passage from one deposit to another being marked by a change in the animals which lived and died during the accumulation of each. Thus, although the fossils of any one great series of beds possess a common character, yet those which are found in the lowest and highest strata of a great formation are for the most part dissimilar in species, and often in genera.

This principle, so little adverted to in the early days of the science, and yet so vitally essential to its advance, has hitherto been chiefly tested by the examination of the tertiary and secondary deposits, and its complete development required, that succeeding observers should laboriously work out its application to the numerous older strata which are contained in the crust of the globe. In the progress of inquiry, this method of proof having been sometimes too minutely exercised, and at others too vaguely, has undeservedly incurred discredit. Some persons, for example, have endeavoured to show, that because within a limited area every succeeding stratum was charged with peculiar species, so we ought to find the same distinctions universally; while others, merely comparing lists of species in the works of authors of different countries, or erroneously identifying figures and descriptions of fossils, have inferred, that many species have a much wider range in the geological scale than experience confirms.

The only effective remedy for the scepticism engendered by such loose comparisons is to publish monographs, with figures of all the remains found in each group of deposits, the stratigraphical limits of which have been precisely defined by competent observers. This object having been in great measure accomplished in respect to the tertiary and secondary rocks, the inquiry has been recently carried down to the still lower strata of the Carboniferous System. We may, therefore, say that the chronological zoology of the science in England has been, on a general scale, systematically conducted to the verge of the ancient strata illustrated in this work; though from this step downwards in the series, it must be allowed, that the natural history of the fossils has never yet been directly connected with the order and arrangement of the rocks.

In the commencement of this volume, while sketching the previous state of our knowledge of these older formations, I pointed out the confusion which had been introduced by so applying the word "transition" as to embrace in one meaning, the Carboniferous, Old Red, Silurian and Cambrian Systems. If the Old Red Sandstone had been clearly separated from the Carboniferous System above and from the Silurian Rocks below it, the term "transition" (as formerly used by certain English geologists, and applied by them to the *lower* divisions only) might well have been retained. Seeing, however, that all the continental and most of our native writers had in the mean time extended the application of this word to the carboniferous deposits inclusively, there appeared to be no possibility of preventing confusion without the introduction of a distinct classification. In the previous pages it has I hope been clearly established, that the Old Red Sandstone and Silurian Rocks are completely distinct from the Carboniferous System, by order of superposition and lithological characters; and my present aim is to prove that they are equally distinct by their imbedded organic remains.

If this principle of classification, which is established in the arrangement of the tertiary and secondary deposits, be once admitted as respects the more ancient rocks of the British Isles, I have no doubt that in other parts of the world, where deposits of the same age occur, it will be found equally true. It is, in fact, only in countries like our own where all those strata exist, which rising from beneath a well-developed carboniferous system, connect it by unbroken links with the inferior slaty rocks, that such an inference can be sustained; and hence it follows, that no counter evidence can be received, when derived from tracts in which many of these links are wanting, or where the convulsions and alterations of the rocks have been so great, that the correct identification of their contents is impracticable. Still less can we admit the validity of arguments founded, either upon mere lists of fossils which may have often been erroneously identified, or simply upon the names attached to formations by geologists who have not studied the whole sequence of the deposits in question[1].

[1] On this point I may remark that a paper by Mr. Weaver on the south of Ireland, containing much valuable matter, has just appeared in the Transactions of the Geological Society, vol. iv. This memoir seems to warrant the necessity of the above caution. After separating the Carboniferous from what he continues to term

Looking, therefore, steadily to the object of this work, and restricting myself to that field of inquiry with which I am conversant, I distinctly maintain, what is asserted in the Introduction; that the fossils of the Silurian System here represented, and amounting in all to about 350 species, are, with the exception of a very few (chiefly doubtful casts), essentially distinct from any of the numerous and well-defined fossils of the Carboniferous System; and further, that the Old Red Sandstone which separates these two systems is also characterized by fossils peculiar to it. In testing this inference, I merely require, that if the organic remains of formations of dissimilar age are compared, they may be selected from well-known and clearly established *geological* types of such rocks. Having for a series of years collected fossils from every stratum of the Silurian Rocks, throughout a large region, in which the stratigraphical order is clear, I now present the results. Professor Phillips had previously completed a valuable monograph of the organic remains of the Carboniferous System. If the naturalist will compare the figures in these, the only two works yet published upon the older fossiliferous rocks, which combine geological description with zoological proofs, he will at once see the truth of my position.

Beginning with the *vertebrata*, are not the *fishes* of the Old Red Sandstone as distinct from those of the Carboniferous System on the one hand, as from those of the Silurian on the other? M. Agassiz has pronounced that they are so.

Are any of the *crustaceans*, so numerous and well-defined throughout the Silurian rocks, found also in the Carboniferous strata? I venture to reply, not one.

Are not the remarkable *cephalopodous mollusca*, the *Phragmoceras* and certain forms of *Lituites*, peculiar to the older system?

the "Transition Rocks," Mr. Weaver arrives at the conclusion, that a large number (between 60 and 70 species) of the fossils of these two systems are *identical*. I need not inform my readers, that my zoological data and inferences are completely at variance with those of Mr. Weaver.

Respecting the Irish case, it may be stated that Mr. James de C. Sowerby, whose authority is much cited in the memoir of Weaver, is of opinion that all the fossils therein enumerated, p. 21, as belonging to the *transition* limestone of Cork and neighbourhood, are, with one exception, characteristic fossils of the *carboniferous* limestone of England and Ireland; and therefore that they are of the *same* geological age as those which, in another part of the memoir, are described as *exclusively* belonging to the carboniferous strata.

Judging from the printed lists, Professor Phillips also thinks that the Cork limestone fossils are carboniferous.

Mr. Sowerby coincides with me in believing, that the only fossils alluded to by Mr. Weaver, *which really belong* to the more ancient rocks (Silurian, &c.) are those enumerated (pp. 10, 15 *et seq.*). Should this view be substantially correct, the south of Ireland, so far from offering evidence to contradict my classification, will eventually be found to support it.

From an inspection of Mr. Weaver's map alone, I cannot avoid surmising, that the localities where true Silurian fossils might occur, are those alone where such *have really been* detected, as the strata in those situations are separated from the carboniferous limestone by large masses of Old Red Sandstone. (See Smerwick Harbour, &c., on the coast of Kerry, and the east of Bon Mahon river, Waterford.) The Old Red Sandstone, that important feature of separation, being wanting in all the remainder of the country described, is it hazarding too much to suggest, that some of the limestones which there occur, and which are loaded with carboniferous fossils, may be outliers and remnants of the base of that system, which we know to be so vastly expanded and widely diffused throughout other parts of Ireland?

Is there one species of the *Crinoidea* figured in this work, known in the carboniferous strata?

Has the *Serpuloides longissimum*, or have those singular bodies the *Graptolites*, or in short any zoophytes of the Silurian System been detected in the well-examined carboniferous rocks?

And in regard to the *corals*, which are so abundant that they absolutely form large reefs, is not Mr. Lonsdale, who has assiduously compared multitudes of specimens from both systems, of opinion, that there is not more than one species common to the two epochs?

If, therefore, it should prove after all, that a *few* species of *conchifers* (an order of beings capable, perhaps, more than any other of enduring vicissitude), continued in existence, from the formation of the Silurian Rocks to the accumulation of the carboniferous limestone, how can their presence break down the individuality and separation of systems, established upon such a vast preponderance of direct zoological evidence in the other natural classes? Even should a few other *mollusca* in the two systems be considered identical, there is no doubt, that by far the greater number of them which truly belong to rocks rising from beneath the Old Red Sandstone, are distinct from those which inhabit the strata above that system.

Such evidences are therefore, as before mentioned, nothing more than additional supports of the important truth which geology has already established; that each great period of change, during which the surface of the planet was essentially modified, was also marked by the successive production and obliteration of certain races.

Let it not, however, be imagined that I wish to inculcate the doctrine, of every ancient formation having been tenanted by creatures absolutely peculiar to it. The large natural groups of strata only, or, so to speak, systems, can be thus distinguished. We have, indeed, ascertained to a great extent the distribution of organic life in the epochs anterior to our own, and we now know, that with each great increment of newly deposited matter, new animals appeared, and that while some vanished with the lapse of time, others unsuited to sudden changes were destroyed.

Among the secondary causes by which such results have been aided, the volcano and earthquake have assuredly been most prominent. We believe, therefore, that inasmuch as the outbursts of volcanic matter, in the region under review, have been numerous and often repeated, they must have materially operated in the destruction of animal life; but as we have shown that all the lines of eruption were *limited*, so we infer that no general destruction can have taken place; and hence it is, that this territory, when examined carefully and in all its parts, presents us with so many examples of a perfect "sequence" in the succession of the strata and the progressive development of their zoological contents.

Thus certain species, whether endowed with powers to resist vicissitude or living in those parts where few active agents of destruction were at work, continued to live through long epochs; while others of a higher structure, passed away in comparatively short periods.

There is yet, however, a phenomenon of the highest importance, connected with the distribution of organic remains in the older strata, which has not been adverted to; namely, that the same forms of crustaceans, mollusks and corals, are said to be found in rocks of the same age, not only in England, Norway, Russia, and various parts of Europe, but also in Southern Africa, and even at the Falkland Islands, the very antipodes of Britain. This fact accords, indeed, with what has been ascertained concerning the wide range of animal remains in deposits equivalent to our oolite and lias; for in the Himalaya Mountains, at Fernando Po, in the region north of the Cape of Good Hope, and in the Run of Cutch and other parts of Hindostan, fossils have been discovered, which, as far as the English naturalists who have seen them can determine, are undistinguishable from certain oolite and lias fossils of Europe[1].

Another remarkable fact illustrating this point of inquiry is, that although the older fossiliferous strata often contain *vast quantities* of organic remains, the *number of species is much smaller* than in more recent deposits. Judging from my own labours, I can affirm, that after seven years devoted to this inquiry, the number of species collected at the end of four years was little less than the aggregate now published. The above resemblance, therefore, (if not identity) of certain forms, out of this number, which are found in opposite hemispheres, is the more surprising.

[1] The largest collection of fossils from the Himalaya, with which I am acquainted, was brought home by Lady Sarah Amherst, and being examined by Mr. James Sowerby was found to contain several Ammonites undistinguishable from our English species of the lias.

The specimens from Fernando Po and the opposite coast of Africa were collected by Capt. Sir C. Bullen, R.N., and when placed on the table of the Geological Society every person present who was conversant with lias fossils, thought these samples had been merely sent up from Lyme Regis (*Ammonites communis, &c.*).

The fossils from the Orange River, six hundred miles north-east of Cape Town, including *Astarte orbicularis* and *Gervillia aviculoides* of the green sand, and *Trigonia clavellata* of the oolite, were collected by Dr. Smith, the enterprising explorer of Southern Africa.

The fossils collected by Captain Smee in the Run of Cutch, are very numerous, and several of them, such as *Gryphæa dilatata, Trigonia costata, &c.*, are identical with English oolitic species. (See Proceedings of the Geological Society, vol. ii. p. 77.)

The fossils from the Falkland Islands were discovered by Mr. C. Darwin, and they appear to me to belong to the Lower Silurian Rocks.

It is well known that certain species of Trilobites are common to the older rocks of North America and various parts of Europe; the same fact has been since established repecting South Africa, through the labours of Dr. Smith above alluded to. At Cedarberg, one hundred and fifty miles north of Cape Town, he found an assemblage of fossils evidently composing an Upper Silurian group, in which are some species which mark the passage from the Old Red Sandstone to the Ludlow Rocks and others which are abundant at Ludlow and Wenlock. These fossils were first forwarded to me by my distinguished friend Sir John Herschel, and among them we observe the *Homanolotus Herschelii* (Nob.), Pl. 7 *bis*. f. 2., with *Calymene Blumenbachii* and other trilobites, associated with casts of shells undistinguishable from the following species figured in this work. *Cucullæa ovata, Leptæna lata ?, Orbicula rugata, Nucula, Turbo, Turritella* and *Conularia quadrisulcata.*

But it has been said, that a species in these old rocks has been often decided by a mere cast, grounds upon which no conchologist can pretend to set up real distinctions. Now to this objection I would first reply, that sharply defined casts may sometimes suffice to prove the identity of forms to be compared, and secondly, that it is by no means on such evidences alone, that my conclusions have been drawn; for in numberless instances the fossils of the Silurian System preserve their shelly covering as perfectly as the testacea even of the youngest deposits.

On this point, however, of specific identity (particularly in the case of very distant deposits) let us not insist too strongly. It is enough to state, that on comparing the fossils from different localities of each Silurian formation we find the closest agreement; certain forms being found in one formation, certain other forms in another; and by this means we have been able to determine the age of the rocks, and to verify the justness of the division by order of superposition.

Extending this mode of investigation to fossils obtained from other parts of the world, and comparing casts with casts, an identity of form as well as of muscular and other impressions will be at once admitted. It is on these grounds we assert, that while the Silurian System was in the course of deposition, similar *mollusks*, *crustaceans* and *corals*, lived in very distant parts of the globe, and where climates of very different temperature now prevail.

In the meantime we may appeal to our records in the rocks, and if each succeeding system is found to contain different species of animals, there can be no difficulty in determining, whether their former geographical distribution was or was not similar to that which now prevails.

Examining the strata with this view, we find that in the ascending geological series the quantity of species increases considerably as we approach the younger deposits, and that in proportion to this increase, their geographical distribution harmonizes more and more with that of existing nature. For example, in the older Tertiary strata (Eocene), there are scarcely any examples of shells identical, being found in opposite hemispheres, and in the younger Tertiary (Pliocene) absolutely none; though in these deposits the number of species is at least tenfold greater than in the ancient rocks under consideration.

Now if this position be admitted, it is manifest that it cannot be explained by reference to the present distribution of animal life. For not only has each latitude, in our days, its different products, but even in distant parts of the same latitude (and in the same hemisphere), the amount of variation of species is often very great.

Again, reverting for an instant to our argument in the last chapter, we must recollect, that it does not merely depend upon the wide area over which the sediment containing these fossils was spread, but also upon the fact, that these ancient rocks are of vastly greater thickness than any of the succeeding deposits, and must therefore have occupied a much longer period during their formation.

Hence it is that the geologist, whose science consists in unfolding the records of lost epochs, is not manacled by present conditions, and if the phenomena to which he appeals convince him, that the former changes of the planet were of surpassing grandeur, he may also conclude, that some general cause must explain the distribution of the same species over distant regions. If the existence of formations, so nearly universal as respects the surface of the globe, be admitted, it would seem to be a fair inference, that however we may explain it, there must have *then* prevailed a generally equable temperature.

But let us pass from these general views to the immediate objects of this work.

The following pages and accompanying plates are intended to develop the amount of zoological mutation throughout a large portion of these ancient fossiliferous strata; and the inference we obtain is, that most of the groups which graduate into each other by lithological and geological characters, exhibit also a true zoological transition. Thus, in reviewing this ancient succession in ascending order, we perceive a certain number of species common to the Upper Formations of the Cambrian System and the Lower Silurian Rocks; and that while some of the Lower Silurian animals lived on to those days when the Upper Silurian beds were deposited, scarcely a single species which existed when the Silurian æra commenced, can be detected in the strata which mark its close.

Again, in proceeding upwards from the Silurian period into that of the Old Red Sandstone, we find in its lowest member, a partial intermixture of a few fossils, typical of the Upper Ludlow Rock or the last-formed beds of the Silurian System, associated with some new species; and ascending higher amid these red deposits, we meet with fishes of entirely distinct genera and species, as unlike those of the Silurian æra as they are to those of the overlying Carboniferous System. In the upper division, however, of the Old Red System (though of enormous thickness) scarcely the trace of fossil animals has yet been detected, and hence we are unprovided with zoological links to connect the whole series, though I have no doubt that such proofs will be hereafter discovered, and that we shall then see in them, as perfect evidences of a transition between the Old Red and Carboniferous rocks, as we now trace from the Cambrian, through the Silurian, into the Old Red System.

When, therefore, it is asserted, that the fossils of the Carboniferous æra are dissimilar from those of the Silurian, the reader must bear in mind, that the strata so broadly distinguished, are separated by accumulations of enormous thickness, and that the vast time occupied in their deposit, accounts satisfactorily for an almost entire change in the forms of animal life.

The same order and change of species is apparent throughout the overlying formations. Thus, although there is a slight community of character between the upper members of the Carboniferous rocks and the lower strata of the New Red System, particularly in the plants[1]; and although certain *mollusca* of the Magnesian Limestone

[1] I have adverted slightly in this volume, to the vegetables which may be found in the Silurian System; for although I am persuaded of the truth of the induction of M. Adolphe Brongniart and other fossil botanists, that each geological period, from the tertiary down to the carboniferous deposits, is marked by a distinct Flora,

differ little from those of the coal measures, we cannot examine even that formation, still less pass onwards through the overlying red sandstone and marl without perceiving, that in the Sauroids of those days, we are surrounded by entirely new types of animal life, which conduct us by almost imperceptible gradations into the period of the *Ammonites* and *Belemnites*; and as we enter among those groups, we take leave of many of the generic forms, such as *Goniatites*, *Orthoceratites* and *Producti*, which abound in the older periods. Lastly, in the tertiary system which links on the ancient deposits with our own, we entirely lose sight of many of the former types, and are introduced to a series of animal forms much resembling those which are now in existence.—Such is the vast succession with which geology has made us acquainted[1].

I have now only to observe, that in the following plates and their descriptions the organic remains are for the most part figured in the order in which they lie in the strata, a method by which the chronology of the subject is strictly maintained. Every fossil which occurs in more than one formation, is figured as belonging to that in which it is most abundant, and its repetition in other strata is explained in the text and lists. If naturalists should criticise this distribution, they will I hope excuse me when they consider, that my great object is to record perspicuously *a geological* succession.

Of the zoological department I have now to state, that the fishes are described by M. Agassiz; the mollusca and conchifers by Mr. J. de C. Sowerby; the corals by Mr. Lonsdale; the crustaceans by myself. I have further to mention with gratitude, that in various points of illustration I have been materially aided by Mr. Broderip, and that Professor Phillips, Mr. C. Stokes, Dr. Beck, Dr. Milne Edwards, and Mr. König have also contributed their assistance. The support, therefore, of such eminent naturalists must have greatly augmented the value of this division of the work.

the almost total absence of plants in the Silurian strata scarcely entitles me to enter upon this field of inquiry. It is, however, fair to state, that two or three plants, said to be species well known in the carboniferous strata, have recently been found in certain rocks of North Devon (considered to lie far below the culm or coal measures), and therefore as old, at least, as any portion of the Silurian System. If these data be eventually sustained, they will only compel us to suppose, that the changes in the physical state of the bottom of the sea, which produced the variations of its marine inhabitants, did not of necessity cause a change in the vegetable forms of the land; because the submarine operations may have exercised little or no influence upon aerial conditions or climate; and hence it may eventually be demonstrated, that the changes in animal and vegetable life do not continue to run parallel to each other beneath a certain limit in the order of the strata, or in other words during the earliest sedimentary accumulations. I confess that (judging from the analogy of the younger deposits) I at one time held a different opinion; but if the evidences above alluded to are substantiated, I have no difficulty in comprehending the rationale of the case.

[1] Although the stratigraphical order is strictly maintained in the collocation of the plates, the description sometimes embraces a class or family in the same chapter.—Thus the *Trilobites* of all the Silurian strata, described in Plates 7, 7 *bis*, 14, 23, 24 and 25, occupy one Chapter.

CHAPTER XLIV.

ORGANIC REMAINS OF THE OLD RED SYSTEM.

Introduction.—Fishes (Pls. 1, 2 and 2 *bis.*)—*Mollusca, &c.* (Pl. 3.)

It was a prevalent belief among geologists, when this work commenced, that few or no animal remains existed in the Old Red Sandstone of England. I first undeceived myself on this point by observing shells in the lower group or tilestones in Caermarthenshire, where they have been already alluded to (p. 183.). I afterwards discovered similar fossils in the great outlier of Clun Forest (p. 191.). These remains which occur in the very lowest beds only of the Great Red System are figured in Pl. 3.

Subsequently my attention was called to other singular forms, which Dr. Lloyd of Ludlow had discovered in the central parts of the system north of Ludlow, and in the hills between Tenbury and Leominster. From the shield or buckler-shape of the most remarkable of these bodies, some of the naturalists to whom they were first referred, considered them to belong to crustaceans, an opinion, however, in which their discoverer did not participate; Dr. Lloyd having originally suggested, that the bony structure apparent in some of the fragments appeared to exclude them from that class. The opinion, however, that these remains might be Trilobites did not long prevail; for when Mr. Lyell received specimens of unquestionable, though undescribed fossil fishes from the Old Red Sandstone of Scotland (1833), it was at once perceived by Mr. Lonsdale of the Geological Society, that our shield-shaped bodies from Herefordshire and Shropshire, were nothing more than the heads of the same singular genus of fishes, which at that time had not been seen by M. Agassiz. After being thus convinced, that these curious fragments really belonged to fishes, my geological examination during the following year brought forth similar remains from nearly every part of the great area occupied by the cornstone and marls of the Old Red Sandstone. Before the close of the summer of 1833 I had, indeed, traced them through large tracts of Hereford, Salop, Worcester, Monmouth and Brecon; and as they were always found in the same division of the Old Red System, they had become valuable auxiliaries in enabling me to identify subdivisions through England and Wales, and also to institute direct comparisons between the different strata of the Old Red Sandstone of England and Scotland. These remains occur both in the impure and sandy cornstones, and in the larger sub-crystalline masses of limestone which have been described; but they are generally in fragments, there not having yet been any example of an entire fish found in England. This condition of the fishes is in some degree accounted for by their structure, as subsequently explained by M. Agassiz; though it might be supposed that their mutilated state would also seem to prove, that they had not been suddenly killed and entombed, but were long exposed to destructive sub-marine agencies, such as the attacks of animals, currents, concretionary action, &c., by which they were dismembered[1].

The fragments being usually of blueish and purple plum-colours, are strongly contrasted with the dull red tint of the surrounding rock, and thus the geologist has little difficulty in recognising even the smallest portion of these ichthyolites. Their peculiar colour is probably due to the presence of phosphate of iron, which has communicated a similar tint to the fishes of the Caithness schist. (See Trans. Geol. Soc., vol. iii. p. 142.)

Notwithstanding the most assiduous search by myself, assisted by Dr. Lloyd of Ludlow and the Rev. T. T. Lewis of Aymestry, no shells have yet been found associated with these fishes in the central or cornstone formation, wherein they most abound. In one situation, however, at the Daren near Crickhowel, I found the impression of a large scale of an undescribed species of *Holoptychus*?, in beds of younger age than the great mass of cornstones, and as I have also discovered the remains of other species in the lowest or tilestone division, the Old Red System may now be fairly said to be characterized throughout by ichthyolites peculiar to it.

That fishes existed in strata of the age of the Old Red Sandstone was first pointed out in the year 1827 by Professor Sedgwick and myself. In a geological memoir upon the Caithness schists, certain fossil fishes were described which we had obtained from strata, proved by actual sections to form part of the Old Red System of the Highlands, and it was therefore gratifying to find that one of the species which I detected in the very bottom of this system, near Ludlow, was recognised by M. Agassiz to be identical with the *Dipterus macrolepidotus* of the north of Scotland. That celebrated ichthyologist has, indeed, the real merit of having cleared away all the zoological obscurities which previously hung over this branch of our subject. Upon his arrival in this country (to which he was attracted by the well-merited honours conferred on him[2]) geologists at once placed all the fruits of their labours in his hands. The specimens of fishes col-

[1] The beautiful entire fish, *Cephalaspis Lyellii*, Pl. 1. f. 1., (of which species I have found hundreds of fragments in England and Wales) was discovered in the Old Red Sandstone of Forfarshire; and Professor Agassiz has with great propriety named it after the geologist who, in addition to his excellent works upon the general principles of our science, was among the first to explain the structure of his native county, Forfar. The ichthyolites of Forfarshire were, however, first described by the Rev. Dr. Fleming. See Edinb. New Phil. Journal, No. 45. p. 137.

[2] "The Wollaston Medal," presented to him by the Geological Society, 1834. The British Association for the Advancement of Science has since done honour to itself, by granting money to M. Agassiz to aid the publication of his great work.

lected for the illustration of this volume were submitted to his examination, and many of them have already been described in his admirable work (Récherches sur les Poissons fossiles). From that work, and from communications addressed directly to myself, the following descriptions are derived. In them we learn, that as some of these fossils are almost connecting links between crustaceans and fishes, the first rude guess of geologists was after all not remote from the truth.

FISHES OF THE OLD RED SANDSTONE.

CEPHALASPIS, Agass.

Cephalaspis Lyellii, Agass., Pl. 1. f. 1. and Pl. 2. f. 1, 2 and 3.
———— *rostratus*, Agass., Pl. 2. f. 4 and 5.
———— *Lewisii*, Agass., Pl. 2. f. 6.
———— *Lloydii*, Agass., Pl. 2. f. 7, 8 and 9.

CTENACANTHUS, Agass.

Ctenacanthus ornatus, Agass., Pl. 2. f. 14.

ONCHUS, Agass.

Onchus arcuatus, Agass., Pl. 2. f. 10 and 11.
——— *semistriatus*, Agass., Pl. 2. f. 12 and 13.

CHEIROLEPIS, Agass.

Cheirolepis Traillii, Agass. vol. ii. t. 1 *d* and 1 *e*. f. 4.
———— *uragus?* Agass. vol. ii. t. 1 *e*. f. 1, 2 and 3.

DIPLOPTERUS, Agass.

Pro. Brit. Ass. vol. iv. p. 75; Agass. vol. ii. p. 113.

CHEIRACANTHUS, Agass.

Cheiracanthus Murchisoni? Agass. vol. ii. t. 1 *c*. f. 3 and 4.
———— *minor*, Agass. vol. ii. t. 1 *c*. f. 5.

HOLOPTYCHUS, Agass.

Holoptychus Nobilissimus, Agass., Pl. 2 *bis*.

PTYCHACANTHUS, Agass.

Ptychacanthus? (spine of), Pl. 1. f. 9 and 10.

DIPTERUS, Cuvier.

Dipterus macrolepidotus, Agass., also Sedgw. and Murch., Geol. Trans., vol. iii. p. 143.

OSTEOLEPIS, Val. and Pent.

Osteolepis macrolepidotus, Val. and Pent.; Agass. vol. ii. t. 2. f. 1, 2, 3 and 4, and t. 2 *c*. f. 5 and 6.
——— *microlepidotus*, Val. and Pent.; Agass. vol. ii. t. 2 *c*. f. 1, 2, 3 and 4.

1. *Cephalaspis Lyellii*, Agass., Pl. 1. f. 1. and Pl. 2. f. 1, 2 and 3. (Récherches, vol. ii. tab. 1 *a*. figs. 1, 2, 3, 4 and 5; and tab. 1 *b*. figs. 1, 2, 3, 4 and 5.)

This species, so abundant in the Old Red Sandstone both of England and Scotland, is constituted by M. Agassiz the type of this genus, because the most perfect specimens yet discovered belong to it. The individual represented, Pl. 1. f. 2. (from the cabinet of Mr. Lyell) presents its dorsal aspect, the head being seen along its superior surface with its lateral prolongations. "This specimen," says M. Agassiz, "is particularly instructive, as it exhibits the junction of the head with the body, the disposition of the scales on the nape (nuque) and the middle of the back, and the points of insertion of the two dorsal fins. (Fig. 1. of the same Plate is also from a specimen in Mr. Lyell's collection.)

"The head of this fish is very large in proportion to the body, and occupies nearly one third of its whole length. The outline is rounded, in the form of a crescent, the lateral horns inclining slightly towards each other, while the anterior and central parts project much. These lateral prolongations are in fact less distant from each other, than they are from the round part of the snout. The middle of the head, including the region of the eyes, the cranium and the occipital crest, is elevated, whilst the sides and anterior edge are considerably dilated and horizontally extended, so that the two horned prolongations of the head overlap the sides of the body and extend considerably behind it, as seen in Pl. 1. f. 1. It is probable the head only appears to extend so much below the body, because the left wing of the disk has been bent back into a more vertical position than was natural to it. The eyes are placed in the middle of the shield, and near each other, but a little nearer to the end of the snout than the occipital crest. They appear to have been directed straight upwards, as in the *Uranoscopes*; at least such is their position in the specimens best preserved, and which are completely extended in their natural state, Pl. 2. f. 1. In Pl. 2. f. 2. where the sides appear to be somewhat contracted, the eyes are a little inclined towards the sides. Between them and in front of the orbits there is a triangular depression, which appears to have been occupied by the nostrils. Behind the orbit is another longitudinal narrow depression, bordered by two projecting crests, probably the parieto-frontal crests, so that the depressions would be found at the junctions of the frontal bones. These crests approach each other behind, and rise to form the occipital crest, which is very prominent, as is seen in Pl. 2. f. 2, whilst in f. 1. they are almost broken away. The posterior and middle portion of the head is nearly square, and is edged by the first series of scales, whilst the sides are very much sloped, and form the interior border of the lateral prolongations of the disk of the head, Pl. 2. f. 2. and Pl. 1. f. 2.

"The outline of the disk is surrounded by a bony plate, which, being bent back on itself, forms the inferior, as well as lateral margin of the head. Unable to determine the form and connection of the bones of the cranium, in consequence of the state of preservation of the head, (probably the result of its structure,) I proceed to notice the appearance of other parts of the surface of the head. The exterior surface is in a great measure covered by irregular scales, in form approaching to circular, the edges of which, notwithstanding they are more or less straight, are united in juxtaposition, so as to form a pavement of scales, exactly similar to those which cover the heads of the *Ostracions*. Each of these scales has a convex centre, and hollow furrows diverging towards the edge, where they form a denticulation by which one scale is dove-tailed into another. The form of these scales varies extremely; the greater part are circular, but some are angular; the latter are attached to the straight edge of a scale, which on other sides is circular, and here and there small ones are seen filling up the intervals between the larger. These scales are bony, and their exterior surface enamelled. At the outline of the disk they are more confused, and the furrows of the enamel are parallel to the edge. (See a profusion of these scales in Pl. 2. f. 1. and magnified representations of them in Pl. 1. f. 7.)

"The bones of the head have also a fibrous structure, as may be seen in all the specimens where any fragments of it remain. This fibrous structure is most clearly observable on the internal surface of the disk as represented in Pl. 1. f. 1.; also Pl. 2. f. 1. in the place where the scales are removed; and even on the specimens which are merely casts, where it may be traced in relief upon the rock, on which the sinuosities of the interior surface of the bones of the head are left as impressions. On the anterior part of the disk the osseous fibres are directed straight forward; on the sides they are oblique, afterwards transverse; and lastly, in the lateral prolongations of the crescents of the head, they follow the direction of these prominent parts, and appear in general to diverge to every point from the sides of the cranium. The bones of the cranium itself, present a similar radiation between the parieto-frontal crests, as seen in Pl. 2. f. 1. The lateral prolongations of the head are thicker than its bony membranes, and narrow insensibly, so as to form a round and compact point, which extends further back from the occipital crest (Pl. 2. f. 3.), and which is more detached from the body in consequence of the slope of the posterior border of the disk becoming wider as it recedes from the sides of the fish. The difference of form observable in Pl. 2. f. 1 and 2. and Pl. 1. f. 1 and 2. appears to arise solely from the different states of preservation of the specimens, and chiefly that in Pl. 1. f. 1. and Pl. 1 and 2. f. 1. the bones were as completely extended as their articulation would admit of, at the time when they were surrounded by the substance which formed the rock in which they are imbedded; whilst in the other specimens they were more pressed together, the pressure giving to them a narrower form.

"It is very probable that the heads of these fishes being so frequently found detached from the bodies, may be accounted for by the great difference which exists in the structure of these two parts, and above all in the disproportion of their dimensions and forms, which would offer a distinct resistance to the pressure, to which these animals must have been exposed. If, on the other hand, the heads usually present their superior surface to us, it is because their inferior surface, the cavity of the mouth, the branchial arch and sinuosities of the inferior bones of the cranium, are points of support comparatively more solid, and more adapted for sustaining the matter which has filtered into them, than a large surface slightly convex, which would naturally be detached from the rock wherever a separation was formed in it.

"The body most resembles that of certain fishes of the family of *Lepidoïdes*, but differs considerably from them in the two dorsal fins, in the anal being thrown further back, and in the singular scales with which it is covered. Its form is that of an elongated spindle, swelling out on the anterior parts, and narrowing insensibly to the end of the tail, which is proportionately very slender, since its diameter does not exceed a quarter of the width of the body near the nape of the neck.

"The first dorsal is placed on the most elevated part of the back immediately behind the occipital crest. Its existence is only known by the impression of its rays. On its anterior edge are two grooves, somewhat larger than those which succeed; there are certainly the impressions of two large rays, the first of which may have been short, and attached the whole length of the second, which extended probably to the extremity of the fin. It is impossible to decide whether there were any small imbricated rays. The other rays have left no other traces of their presence, than a striated appearance on the edge of this part of the back, to the middle of which they extended.

"The second dorsal is more distinct; its anterior edge is supported by a very large ray, the transverse articulations of which are very near each other, and on the edge of it are observable very small imbricated rays, closely pressed against the larger. The rest of the fin, which appears to have extended to the very slender pedicle of the tail, is only shown by a striated mark, parallel to the anterior ray, of which the striæ were the small blunt rays of the strong part of the fin. The relative position of the two dorsals is exactly indicated in the engraving, Pl. 1. f. 2. We here see, that behind the neck and on the posterior part of the back, the scales are not united, but have an interval between, on which the rays of the fin were inserted.

"The anal fin has not even left so distinct a mark of its presence; by comparing the two sides of the specimen represented Pl. 1. f. 1. we merely discover that it was placed further back than the second dorsal, so much so that its anterior edge corresponded to the middle of this dorsal. Its position is also indicated by the interruption to be remarked on the scales of the edge of the belly. The caudal fin had no large rays; the lobes are only indicated by the particular colour of the rock; the inferior one extends to the middle of the superior. Their insertion is very oblique, so that the prolongation of the pedicle (*pédicule*) of the tail is proportionately very long. Its superior edge supports a large ridge of imbricated rays, very thick in proportion to the size of this fish, which enlarge from the posterior edge of the second dorsal to the middle of the pedicle, and which diminish again insensibly to its extremity. These little rays are very thick in proportion to their length. They are less strongly attached to the edge of the pedicle, and less inclined towards its extremity than most of the other genera of this family.

"The scales of the body are of a very peculiar form, and quite unlike those of any other genera. Fishes of the genus *Callichthys* only have also on their sides a series of very elevated scaly plates; but in the genus *Cephalaspis*, there is on each side only one range of plates, high and narrow, inserted transversely on the middle of the sides; whilst on the edge of the back and the belly there are series of little scales disposed obliquely to the extremities of those on the sides. On the pedicle of the tail, and on its prolongation, the scales have all the same form, they are rhomboidal, and diminish in size. Those on the centre of the sides Pl. 1. f. 4, are so high that their breadth exceeds their length eight or ten times, and they occupy more than half the height of the fish, at least in its anterior division. Towards the middle of the body they are less high, and below the second dorsal they end by being confounded with the little scales of the back and belly; so that the sides of the tail and its prolongation do not present the striking disproportion which there is in front, between the scales of the sides and those of the back and belly. The posterior edge of these high plates is straight, perpendicular to the longitudinal diameter of the fish, whilst the superior edge is cut off in a slope; the posterior angle is much more elevated than the anterior one. At the inferior edge, which is parallel to the superior, the obliquity of the angle is inverted. The exterior surface of these scales is ornamented with undulated furrows disposed in the direction of their greatest diameter. There are from 26 to 30 of these plates on the sides. The series of scales on the edge of the back are placed obliquely at the extremity of the high scales of the side, and run from top to bottom, from the front to the back, so that the opening of the obtuse angle which they form together is turned towards the head, and its summit towards the tail. In Pl. 1. f. 2. the disposition of this series is seen from the top, and their junction with the side plates; each one is composed of several scales as long on the anterior part of the back, as the ridges of the sides are wide, but which become smaller in proportion as the latter diminish in height, and are soon confounded with the scales on the edge. In each of these series there appears to be from four to five scales (f. 5.): on the edge of the belly the scales are turned obliquely backwards, to the extremity of the great transversal plates. This series in (f. 3.) are much narrower than that of the back, and appear to be formed of two scales only. Near the middle of the second dorsal all the scales are about the same size; those of the sides only are a little higher than they are long; but towards the extremity of the tail, they become more and more equilateral, and finish on the prolongation of the pedicle in a lozenge-shape, (f. 6.) of which the sharp angles are in the longitudinal direction of the fish. All these small scales appear smooth.

"The analogy in the structure of the scales of the genera *Callichthys* and *Cephalaspis*, appears to me to confirm the position I have assigned to the *Gonoidonts* and *Siluroïds*, in the order *Ganoïds* following the *Accipensers* or Sturgeons."

2. *Cephalaspis rostratus*, Agass. (Pl. 2. f. 4 and 5.) Récherches, vol. ii. t. 1*b*. f. 6 and 7.

"This species evidently belongs to the genus *Cephalaspis* as characterized in the preceding description, and differs essentially only in the form of the head, which is narrow and much elongated. I have as yet only seen one good specimen, which is represented with its superior surface, fig. 6, Agass., and f. 4 of this plate in profile. It is a head in the same state of preservation as fig. 3 of *C. Lyellii*; the impression only gives us the form of the head, none of the bones having been preserved. We can however trace some details marking the generic character, and which are not discoverable in the preceding species. I have named this fish *C. rostratus*, because the anterior portion of the head is prolonged to a pointed snout. The eyes are placed much further backwards on the disk of the head, nearly on the third posterior division, turned directly upwards, and still nearer each other than they are in *Cephalaspis Lyellii*; they appear to have had an oblong form (judging from the slight impression left of the orbits). Behind these we find also the parieto-frontal crests, which are very near each other and less projecting than those of *C. Lyellii*, and between which the occipital crests begin to rise. This head is much longer than wide, and its sides lessening rapidly, are more arched than the line which runs from the extremity of the snout to the neck, and which rises into a central crest from the anterior third of the head to the orbit. At the anterior extremity of this crest there is a triangular, longitudinal depression which may have been occupied by the nostrils, which must have been very near the end of the snout, and very distant from the eyes; on each side of this depression are two elevated points (fig. 6, *c c*), which lead me to suppose the superior maxillary bones were detached from the head, as in the genus *Hypophthalmus* and some other of the family *Silures*. These bones were perhaps prolonged in the form of barbs on the sides of the head, and were inserted in the cavity formed by these elevated points. The piece denoted by *o* appears to be the ethmoid bone, rounded at its anterior edge, and in front of which the intermaxillary bone formed the end of the snout and the reflected edge of the sides of the head. In this part of the impression are seen some traces of this bone, the surface of which is striated longitudinally, while its fracture presents a granulated structure. I dwell particularly on this peculiarity, and especially on the striated surface being seen distinctly as well as the granulous structure of the bone, in a specimen which evidently belongs to the genus *Cephalaspis*. This circumstance, joined to that of the lateral bones of the head being bent back towards the inferior surface, will facilitate the determination of the other species. Towards the region of the eyes are also seen two lateral prolongations, which appear to be the equivalents of the horns of the crescent of *C. Lyellii*. On the right side of the head it is evident that the inferior surface is longitudinally striated; on the left side there is a portion of the bone, the surface of which is striated in the same manner; on both sides is seen the granular structure of the bone. On the posterior edge of the left side there is a portion of the lateral divisions of the head uninjured, on the exterior surface of which may be observed similar longitudinal striæ, as on the impression of the inferior surface at the edge of its fracture. Between these two surfaces we again discover the granulous structure of the bone, and distinctly see that the striated surfaces are of a different substance; that it is a coat of enamel covering the bones of the head[1]."

3. *Cephalaspis Lewisii*, Agass. (Pl. 2. fig. 6.) Récherches, vol. ii. t. 1*b*. fig. 8.

Of this species M. Agassiz says, "The specimen here figured is the only individual yet known to me of this species. It is a simple impression in relief of the head, on the sides of which there are some traces of organic substance. This impression, moreover, is so little characteristic, that it would be impossible to decide on the genus to which it belongs, if it did not present in some

[1] This species has at present only been found at Whitbatch, in the central portion of the Old Red Sandstone: Dr. Lloyd pointed it out to me, and stated from whence the specimen described was taken.—R. I. M.

parts a striking analogy with *C. rostratus*: thus, at its anterior extremity we find again exactly the same piece which I have designated as the ethmoid bone, with this difference, that here the impression of this bone is cut off square on its anterior edge; its lateral edges being straight and parallel to each other, and its posterior edge advancing towards the disk of the cranium by a narrower pedicle. The posterior border of the head is truncated as in *C. Lyellii* (Pl. 2, fig. 3,); but it is directed more obliquely forward, and elevated on each side so as to form a sort of hinge, as we often observe on the articulated borders of the rings of certain crustaceans. These elevated edges do not however join at the nape of the neck, which is depressed. On exposing this fossil to the light so as to exhibit all its inequalities, a line is distinctly traceable on the centre of it, extending from the ethmoid bone to the most elevated part of the cranium, the surface of which is completely round. On the sides of the disk is seen a sinuous furrow, which is lost in front in the edge of the impression, and at about the place where, in the *C. rostratus*, we perceive the two lateral elevations. The lateral edges of the head, especially on the posterior part, are flattened in the same manner as in the *C. rostratus* with this difference only, that in *C. Lewisii* they are perpendicular towards the junction of the head and body, and inclined outwards in their anterior and middle parts. On the left side is still seen some trace of the inferior surface of the bones of the cranium, and immediately at its edge, and on the posterior and inferior angle of the head, there remains a fragment which displays the granular structure of its substance, and which presents a perfect identity of organization with *C. rostratus*. In the *C. Lewisii*, however, I have not been able to trace any lateral prolongation in the shape of a horn[1].

"The head has something very remarkable in its form: the posterior part is narrowed and more arched than the middle part, which is flattened and dilated laterally; the snout is also flat; the disk has an oval form, truncated at its two extremities."

This species was found in the Old Red Sandstone of Whitbach by Dr. Lloyd, together with *Cephalaspis Lloydii, &c.* It was named by M. Agassiz, at my request, after the Rev. T. T. Lewis.

4. *Cephalaspis Lloydii*, Agass. (Pl. 2. f. 7 and 9.) Récherch., vol. ii. t. 1*b*. f. 9, 10 and 11.

"This species resembles the preceding in the general form of the head (the only part preserved amongst the numerous specimens I have seen) except that its anterior edge is rounder, and its posterior extremity less narrow. *Of the four species this is the one, the head of which at first sight least resembles that of a fish. In the specimens where the superior surface is preserved, it is difficult to divest oneself of the idea, that these fossils are the shells of some molluscous animal; for so completely regular are the striæ, that they perfectly resemble the lines of growth of the testacea.* On a nearer examination, however, these striæ are disposed differently from those of the shells of any mollusks; for even if we were disposed to consider these disks the shells of patelliform mollusks, or even of any conchifer, the disposition of the striæ would at once contradict such hypotheses. In reality these striæ are disposed on the sides of a central line running from the front to the back of the disk, and offering in the posterior part a perfect parallelism, whilst on its anterior part they follow its curvature, and in no respect resemble the concentric lines, formed by the new plates of shells in their growth. By comparing many broken specimens of these fossils it is evident, that this striated surface *is a coat of enamel*, distinct from the substance which forms the solid part of the disk; and that these striæ are grooves in the superficial part of the specimen, and not the ele-

[1] Fig. 8. represents a horn of the disk of one of the heads of *Cephalaspis* before described.

vated edges of the successive plates of growth. A clear proof of this is, that on making a transversal cut through the shell, nothing is perceptible on one side but small perpendicular clefts which terminate abruptly, and on the other, notwithstanding the regularity of these striæ, they are sometimes distinctly bifurcate. Finally, their similarity on both sides of the disk, without the least trace of a longitudinal division on the inferior layers of the substance, is a character which does not in any way accord with what is known to us in the enlargement of mollusks, and in the scales of the tail of crustaceans; whilst the analogy of these disks, with the heads of the *Cephalaspis* which have been just described, is more striking the more they are examined in detail.

"The head of this species is a more obtuse oval than the preceding; its anterior edge is completely circular: we can, however, evidently see the impression of an ethmoid bone similar to that of *C. Lewisii*, but narrower and longer; it was even decidedly longer than it appears to be in fig. 9; the original of which is broken on its anterior edges. The posterior border of the disk of the head is cut off obliquely as in *C. Lewisii*, but it is not raised up. The lateral edges are inclined uniformly to one side, and follow the general curvature of the arch of the head, which is nowhere depressed on its anterior part, as in the preceding species. Besides the coat of enamel which forms the exterior surface of the disk, and which is particularly well seen on the right and interior side of fig. 9, as well as on a fragment preserved towards the posterior edge of this same specimen, there may also be distinguished two other layers of very different structure: one, which is the centre of the shell, has a granulous structure similar to that of the bones of the chondropterygians, and perfectly identical with that of the plates in *C. rostratus*; the other, which is the inferior layer, decomposes in laminæ superposed one to another, like the plates of growth in molluscous shells. This last layer is thicker than the other three. In the specimen (fig. 7.), that in which the form is best preserved, no plates are seen except those of this third coat, which in part cover the raised impression of the inferior surface of the head. In fig. 9, on the contrary, at the edge of the disk, we recognize first the exterior coat, under which the middle coat is concealed, and a little further in the interior of the cast, the plates of the inferior coat. Finally, in fig. 8, is seen a fragment so broken as to present the *three* coats in their natural order of *superposition*.

"There is no trace visible on the sides of the head of any horn-shaped lateral prolongation any more than in the *C. Lewisii*. *These two species ought perhaps, therefore, to be generically separated from* C. Lyellii *and* C. rostratus.

"From what has already been said, the structure of the head of the *Cephalaspis resembles singularly that of the shell of crustaceans, which possess also an exterior coloured layer, under which is found a layer of a granulous structure, and then a layer of lamellar structure; and it was not without long deliberation that I decided on considering the fossils represented in figs.* 6, 7 *and* 9., *as the heads of Cephalaspis, rather than the terminal scales of some unknown crustacean.* It is very extraordinary that shields of which the ichthyological characters cannot be mistaken, in the species represented in figs. 1, 3 and 5, one of which at least has been found with its body and fins, should have exactly the *same structure* with other disks that might be supposed to be the *tails of trilobites.* The difficulty of deciding on these fossils is greater, because the buckler and tail of many species of trilobites have also the outer layer of their shell ornamented with furrows similar to those on the head of the *Cephalaspis,* and their edges sometimes raised up as a border, like the posterior edge of *C. Lewisii.* The constant presence, however, of the piece which seems to me to be the ethmoid bone, and the longitudinal ridge along the middle of the disk, seems to decide the question, and compel us to place all these specimens in the class of fishes, and to look upon them as the heads of *Cephalaspis,* or of some nearly allied genera. Their particular structure requires the greatest circumspection in establishing species, in order to avoid the chance of considering as peculiar species those specimens where the exterior layer having been destroyed, the surface of the disks exhibit a totally different aspect. Similar mistakes have already been made in the class of crustacea, among which the inferior surface of the shell has frequently a different aspect from that of the superior, so that their casts or impressions have no resemblance to each other." (See Chapter on Trilobites.)

The *Cephalaspis Lloydii* occurs in several situations in the cornstone of Herefordshire, Shropshire, Worcestershire, &c., and in the same localities with the *C. Lyellii.* It has with great propriety been dedicated to Dr. Lloyd of Ludlow, who first made known to me the existence of fishes in the Old Red Sandstone, see p. 180, and whose collection has supplied the greater number of the forms here described.

Ichthyodorulites.

"The Ichthyodorulites of the Old Red Sandstone," observes M. Agassiz, "belong to distinct species of the genera *Onchus* and *Ctenacanthus*, some species of which exist in your Carboniferous, Old Red and Silurian Systems. These bony spines are more or less arched, and grooved by longitudinal furrows, separated by round ridges forming ribs. In the greater number of the species, these ridges cover the whole surface of the fins: there is, however, one species of *Onchus*, the posterior side of which is partly smooth. The great distinction between this genus of Ichthyodorulites, and the large species of *Hybodus* of the lias (and New Red Sandstone)[1], to which they have some resemblance in the arrangement of their longitudinal furrows, is, that their posterior edge has no sharp points (piquans) or teeth, while in the genus *Hybodus* there are on that side strong points which are arched downwards."

Onchus arcuatus, Agass. (Pl. 2. figs. 10 and 11.; Récherch. vol. iii. t. 1. figs. 3, 4 and 5.)

"This genus is easily distinguished. It embraces certain *cartilaginous fishes*, the dorsal spines of which only have yet been discovered.

"Dorsal fins large at their base, very much bent backwards, narrowing rapidly towards the superior end, furrowed along the whole of their surface by grooves parallel to the posterior margins, between which pretty strong ribs rise up, which so terminate as to give the anterior edge a toothed aspect. It is the largest species of the Old Red System, though inferior in size to some species of the Carboniferous Limestone."

Onchus semistriatus, Agass. (Pl. 2. figs. 12 and 13.; Récherch. vol. iii. t. 1. f. 9.)

"Characteristic though imperfect fragments," observes M. Agassiz. "The posterior portion of the lateral faces of these fins is smooth, but the anterior part is grooved with numerous longitudinal furrows, between which are delicate flattened ridges. As the other species of *Onchus* are channeled all over, this form may, after all, belong to a distinct genus, but the imperfect condition of the specimens I have seen does not permit me to establish it."

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[1] A dorsal spine of *Hybodus* has recently been found in the Keuper Sandstone of the red marl of England, which, appearing to differ from any published species of Agassiz, Mr. Strickland and myself have called "*Hybodus Keuperi.*"—See Proceedings of the Geological Society, vol. ii. p. 563.

Ctenacanthus ornatus, Agass. (Pl. 2. f. 10.; Récherch. vol. iii. t. 2. f. 1.)

"This fragment," says M. Agassiz, "is probably derived from the middle of a dorsal fin. Imperfect as it is, the characters of the fins of the genus *Ctenacanthus* are easily distinguished in *the furrows and longitudinal parallel ridges, with transverse folds.* This species differs from its congeners in the Carboniferous Limestone (*Ctenacanthus major, C. tenuistriatus, C. brevis*) by the tenuity of the longitudinal ridges, which lie very near each other, and by the delicacy of the transverse folds. The interior cavity of the fin appears, proportionably, very large, and the surrounding walls more slender than in the other species."

Locality, near Sapey, Worcestershire: found with other ichthyodorulites by Mr. H. E. Strickland; also north of Abergavenny where I have myself observed it.

Ptychacanthus? Agass. (Pl. 1. figs. 9 and 10.)

It is with great doubt that the fragment, f. 9., of which f. 10. is an enlarged representation, is referred to the genus *Ptychacanthus*, Agass. "If this form should eventually be ascertained to belong to *Ptychacanthus*, still," says M. Agassiz, "the species is quite distinct, and unlike those of the Carboniferous Limestone." The fragment is supposed to be the portion of a dorsal fin, because its transverse section exposes a central cavity.

The above ichthyodorulites, or portions of them, are sometimes abundant where few or no specimens of the head of *Cephalaspis* can be detected. I have observed them in various parts of Herefordshire, near Abergavenny, in Brecknockshire, and also in the north-western district of Worcestershire.

Structure of Ichthyodorulites.

M. Agassiz conceives that these fossil-dorsal spines belonged to cartilaginous fishes, the other portions of the animal having been destroyed. Some doubt has recently been thrown upon this view by Mr. Connell of Edinburgh, who, having analyzed these fossils from the limestone of Burdie House near Edinburgh, has found in them the same constituents as in the bones of the osseous fishes, notably of the pike.—Trans. Roy. Soc. Edin., vol. xiii.

In writing to me concerning this analysis, M. Agassiz thus expressed himself: "So far from fearing that I have misunderstood the nature of Ichthyodorulites, in referring them to *cartilaginous* fishes, instead of viewing them as fins of *Balistes* and *Silures*, as was formerly the case, I believe that the result obtained by Mr. Connell is a confirmation of my opinion; at least the texture ('contexture') of the spines of *Spinax* and *Trygon* which I have examined with this object, coincides completely with that of the bones of the bony fishes, and differs in consequence from the other portions of the skeleton of those fishes which are cartilaginous. It would, therefore, be very important to be assured by chemical analysis, whether the spines of the existing cartilaginous fishes (*Spinax, Trygon, &c.*) have also the same composition as the fossil Ichthyodorulites."

To determine this point, so important in the classification of M. Agassiz, I procured from Mr. Yarrell a serrated spine of one of the rays of a cartilaginous fish, of which he says, "whether this belongs to a species of *Trygon*, or to a species of one of the allied genera *Myliobatus* or *Cephalopterus*, all three of which are furnished with similarly serrated spines, I am unable to determine."

I next obtained from Dr. Mantell a smooth spine of the *Spinax acanthias* (the common "Bone Dog" of our shores).

The analysis of these two bodies was most obligingly undertaken by Dr. Bostock, who has arrived at the following conclusions[1].

"The larger of the bodies, *Trygon*, was first examined; the weight of the whole was very nearly 60 grains. For the purpose of ascertaining the proportion of the animal matter to the earthy salts, portions of it were respectively exposed to a red heat in a platina crucible for about half an hour, and digested for 24 hours in diluted muriatic acid. By comparing the results of these processes it appeared that the proportion of the animal and earthy ingredients was as 35·1 to 64·9. The muriatic solution was then examined, and was found to consist of a combination of the phosphate and the carbonate of lime, in the proportion of 49·15 to 15·65, making the composition of the entire substance as follows:

Animal matter	35·1
Phosphate of lime	49·15
Carbonate of lime	15·65
Loss	0·1
	100·00

"The structure both of the animal and the earthy matter appeared to be entirely fibrous, without any cellular or laminar arrangement, as is generally the case in bone, at least in the bones of the mammalia. The whole of the body presented an homogeneous appearance, there being no central cavity nor any obvious difference in the structure or consistence of its different parts.

"The smaller body (*Spinax acanthias*) differed essentially in its structure from the above; it consisted of an external shell, containing a quantity of loose membranous matter very similar to the root of a quill. The external shell differed obviously from the larger body in not exhibiting any fibrous appearances, so that when it had been either calcined or acted upon by the acid it lost its form, in the first case being reduced to a number of irregular fragments, and in the latter to a mere pulp. The proportion of animal and earthy matter seemed to vary considerably in its different parts, the former predominating in the root and the latter in the tip. This body also differed essentially from the larger in the nature of its earthy salts, which were found to consist almost entirely of the phosphate of lime, the carbonate being in a very small and nearly inappreciable quantity. The total weight of the smaller body was 4·9 grains."

This analysis of Dr. Bostock has, therefore, effected the desired object. It enables us to infer, that the original views of M. Agassiz concerning the nature of ichthyodorulites are completely borne out; for the quantity of earthy and bony matter in these dorsal spines of existing cartilaginous fishes is so great, particularly in such fishes as the *Trygon, Myliobatus, Cephalopterus, &c.*, that we may well conceive how, if imbedded in sand or mud, such bodies might be preserved as permanent relics, while every trace of the other parts of the soft and easily destructible animals to which they belonged would be entirely obliterated.

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[1] Dr. Bostock will, I hope, soon add to his well-earned reputation as a physiologist by completing an extensive analysis (in which he has already made much progress) of fossil organic remains of all ages, indicating the processes by which they have been converted into their present condition.

Dipterus macrolepidotus, Sedgwick and Murchison. (Geol. Trans. vol. iii. p. 143. Pl. 15, 16 and 17; Agass. vol. ii. p. 117.)

The genus *Dipterus* was established by Cuvier from specimens which I sent to him from Caithness in the year 1827. In the following year, Professor Sedgwick and myself having visited the North of Scotland, we described the general structure of that country, including the black schists and flagstones of Caithness, in which the *Dipteri* are contained, and we then expressed our belief, that these strata were, in part, the equivalents of the Old Red Sandstone of England. That opinion is now confirmed by independent zoological evidence, for I have since detected the above-named species (which is very prevalent in the North of Scotland) in the lower beds of the Old Red Sandstone, at the Tin Mill near Downton Castle, Herefordshire.

This genus was at first separated by Valenciennes and Pentland into 4 species (see Geol. Trans. vol. iii. p. 143.), but after an attentive examination of a great variety of specimens, M. Agassiz, who attempted to class these fishes in the genus *Catopterus*, has definitively concluded, that although the genus *Dipterus* ought to be retained, the supposed four species are only differently modified forms of the same animal.

The generic character of the *Dipterus*, as now confirmed by M. Agassiz, consists in "*Two dorsal fins opposite to two similar anal fins, with a caudal fin conforming to that of the genus Palæoniscus, in having the vertebral column prolonged into the extremity of the tail.*"

Having as yet discovered small fragments only of the *Dipterus* in the Old Red Sandstone of the Silurian region, I refer above to the figures of this genus in the Transactions of the Geological Society, and to M. Agassiz's work, vol. ii. tab. 2*a*. p. 115.

Holoptychus Nobilissimus, Agass. (Pl. 2 *bis*. f. 1, 2, 3, 4, 8 and 9 ?)

This splendid specimen, of which f. 1. is a reduced sketch and which measures 2 *feet* 4 *inches by* 12 *inches*, was discovered in the Old Red Sandstone at Clashbinnie, near Perth, North Britain, by the Rev. James Noble, and was sent to me by him for the illustration of this work[1]. A drawing of it having been forwarded to M. Agassiz, he has favoured me with the following description:

"I am delighted with the fish represented in your drawing. It is a magnificent specimen, the discovery of which is of great value in advancing my researches. I was previously acquainted with fragments of several different species of the same genus, found at Gamrie and Burdie House in Scotland, and also in the coal-field of Staffordshire from which you sent me specimens. This individual, however, will at length enable me to define precisely the characters of the genus which I named *Holoptychus* from the folds of the scales. I had, it is true, seen detached scales of this species in

[1] It is to my friend Sir John Robison, Sec. Roy. Soc., Edinb., that I owe the appearance of *Holoptychus Nobilissimus* in this work. He presented a rough drawing of this ichthyolite to the British Association for the Advancement of Science at the meeting at Bristol, on which occasion I was much struck by its form, and was persuaded, that if properly described and examined by M. Agassiz, this splendid specimen would throw a new light on the fossil fishes of the Old Red Sandstone. Sir J. Robison having explained these circumstances to the Rev. J. Noble, that gentleman sent the original to my care, and thus M. Agassiz has been enabled to make an important improvement in his description of certain forms belonging to this fine type, which previously remained in obscurity or were assigned to other genera.

the possession of Professor Jameson and Dr. Buckland, but so imperfect, that before I was acquainted with those of Gamrie, which convinced me of my error, I intended to refer them to my genus *Gyrolepis*. Compare my chapter on *Gyrolepis*, (p. 172. 5 liv.), and particularly the article *Gyrolepis giganteus*, which is the fish you have sent me, and the name of which must now be changed." (The figures of it have, fortunately, not yet appeared.) M. Agassiz then proceeds to show that the fish in question has no relation to the accipenser or sturgeon with which it had been compared. "No sturgeon has similar scales. In the genus *Accipenser* there are only 5 rows of 'ecussons' scutcheons upon the back and sides, whilst this specimen proves that the whole surface of the *Holoptychus* was covered by them, as, indeed, I had perceived in various specimens found at Burdie House and Gamrie. Not one, however, of these species had conveyed to me so complete an idea of the characters of the genus as your specimen; and since, for the reasons assigned, its generic name must be changed, I see no inconvenience in also changing the name of the species, and in adopting, instead of *giganteus*, that which you suggest in honour of the discoverer, Mr. Noble, (*Holoptychus Nobilissimus*); the more so, since the species found in the carboniferous deposits at Burdie House is of as gigantic dimensions as that of the Old Red Sandstone."

"The generic characters consist in the peculiar structure of the scales, the enamelled surface of which is marked by large undulating furrows. Another characteristic feature is in the distant position of the ventral fins, far removed towards the tail, and much nearer the anus and anal fin *than in any other genus* of the family of *Ganoids*. Lastly, the arrangement of the branchial 'branchiostègues' rays is very remarkable, for they form two large plates between the branches of the inferior jaw, as in the genus *Megalichthys*. They are perfectly well seen in this specimen, and are of a *triangular shape*. What is perhaps most striking in this Old Red species, is the small size of the head in comparison with the body; for the outline of the two branches of the inferior jaw, which are narrow, are so clearly seen as to enable us to judge of the size or rather length of the head, which was certainly short and obtuse. The structure of the 'nageoirs,' the rounded form of the ventral fin, and the manner in which the rays of its anterior edge are insensibly prolonged, coupled with their relative thinness, are also very marked distinctions, and the same may be said of the anal fin and the disposition of its anterior edge. It is to be hoped we shall at some future day discover a specimen, placed in profile, which will enable us to decide the position of the dorsal fin and the fin of the tail. (The tail is wanting in this specimen.) This individual is lying on its back, and the attitude is very expressive; for it proves that the fish was naturally of a depressed form, 'plutôt déprimé que comprimé,' and not compressed by force. In fact, whenever flat fish are found placed on their backs or bellies in the rock their scales are always deranged, and it is only when they are naturally very *round*, or even depressed (déprimé), that the ventral scales preserve their natural position as in this example."

In Plate 2 *bis.*, a ventral scale of *H. Nobilissimus*, natural size, is given, f. 2. Fig. 3. is probably a scale or portion of the operculum, also of natural size; and being found in the same quarries of Clashbinnie, is also supposed to belong to *H. Nobilissimus*; as well as the very remarkable form, f. 4, which exhibits the toothed processes beneath the scales.

Does the tooth (Pl. 2 *bis.* figs. 8 and 9.) belong to this genus or to *Megalichthys*? It was found with other remains of fishes (such as large scales of *Holoptychus*, figs. 2 and 3), four miles to the south of Elgin, by Mr. Martin of that town, who, together with the Rev. G. Gordon, has made considerable collections of the ichthyolites of that neighbourhood. These remains occur in pretty highly inclined strata of coarse, slightly calcareous conglomerate, very low in the system of Old Red Sandstone, for the beds dip under the cornstones of Murrayshire, described by Professor Sedgwick and myself.

Mr. G. Gordon believes, that from their position, the beds with ichthyolites are probably of the same age as those of Clashbinnie in Perthshire, and of Strath Eden and Drum Dryan in Fifeshire.

I owe this information to Mr. J. Malcolmson, F.G.S., who having recently brought away specimens from the district, has obligingly enabled me to figure the conical tooth, and other portions of fishes found in the same quarries, figs. 5, 6, 7.

I may here remark, that although I have never yet found a perfect specimen of *Holoptychus* in the Old Red Sandstone of England, I have now no doubt, that the large scale which I detected in the Old Red Conglomerate near Crickhowell (p. 175) is identical with the scales which occur in Perthshire, Murrayshire and Caithness. (Pl. 2 *bis*. f. 3.)

M. Agassiz must determine the genera and species to which the other remains of fishes found near Elgin may belong. (Figs. 5, 6 and 7, are drawn from specimens belonging to Mr. Malcolmson.)

The great thickness of the bony matter which supports the scaly covering (figs. 5 and 6.) is very remarkable. It was this structure, so apparent in some of the Caithness fossils, which led Professor Sedgwick and myself to refer them to the class of reptiles. Geol. Trans. vol. iii. p. 144.

Diplopterus, Agass.

The remarkable ichthyolite, which enabled M. Agassiz to establish the genus *Diplopterus*, was found by Dr. Traill in Pomona, Orkney, the sandstones and schists of which were previously shown to belong to the Old Red System.—Sedgwick and Murchison, Geol. Trans. vol. iii. p. 141.

M. Agassiz has not yet fully described this genus, though he tells us that it is of "the family of *Sauroid fishes*. Like the genus *Dipterus*, it has two dorsal opposite two anal fins, but the caudal fin is of a very peculiar form; the throat is very large, and the jaws are armed with *large conical teeth*." Récherches, vol. ii. p. 113.

Osteolepis.

This generic name was given to fossil fishes of Caithness (collected by Professor Sedgwick and myself) by M. Valenciennes and Mr. Pentland; Geol. Trans. vol. iii. p. 143. The genus has since been found in the Orkney Isles by Dr. Traill, and M. Agassiz has continued to use the name first assigned to it. Two species occur in Caithness and the Orkney Islands (*Osteolepis macrolepidotus* and *O. microlepidotus*), while a third, *O. arenaceus*, Agass., is found at Gamrie. As this genus has not yet been found in the Old Red Sandstone of England, I refer my readers to the work of M. Agassiz for the description of the Scottish species.

The reader may perceive that there are yet two genera of Ichthyolites enumerated in the preceding table, the *Cheiracanthus* and *Cheirolepis*, Agass., to which I have not adverted. Through the researches of Dr. Traill, who found the *Cheirolepis Traillii* and *Cheiracanthus minor*, Agass., in Pomona, Orkney, there is no doubt that these genera belong to the Old Red System.

Other species of these genera have been found at Gamrie, Banffshire, in which locality they were first mentioned by myself, though I never examined the relations of the strata. Those relations have since been described by Mr. Prestwich, in an able memoir on the coast of Banffshire, and according to him, the nodules containing the Ichthyolites are imbedded in an argillaceous, horizontally stratified deposit, which is unconformable to the adjoining masses of Old Red Sandstone. On the other hand, I have recently been informed by Mr. Malcolmson, that Mr. Miller of Cromarty (who has made some highly interesting discoveries near that place), pointed out to him *nodules resembling those of Gamrie and containing similar fishes, in highly inclined strata, which are interpolated in, and completely subordinate to the great mass of Old Red Sandstone of Ross and Cromarty.*

This important observation will I trust be soon communicated to the Geological Society, for it strengthens the inference of M. Agassiz respecting the epoch during which the *Cheiracanthus* and *Cheirolepis* lived. In the mean time the phenomena at Gamrie may be explained, by supposing that the beds in which the nodules there occur, are regenerated or made up of the detritus of the adjoining Old Red Sandstone. At all events, certain species of *Cheiracanthus* and *Cheirolepis*, as above stated, belong to undisputed strata of the Old Red Sandstone, while no traces of these genera have been perceived in the Carboniferous System.

These two curious genera have not yet been found in the Old Red Sandstone of England.

FOSSIL SHELLS IN THE LOWEST BEDS OF THE OLD RED SANDSTONE, Pl. 3.

(See pp. 183—191.)

The shells are described by Mr. J. de C. Sowerby. Those marked * occur also in the Upper Ludlow Rock and are figured in Pl. 5., thus proving a transition from the Old Red into the Silurian System.

Cypricardia cymbæformis, f. 10 *a*. (*Cardites carpomorphus*, Dalm., *Act. Holm.*, 1824, p. 372. t. 4. f. 2. *Cardium carpomorphum*, *Hising. Petr. Suec.*, p. 63. t. 19. f. 5.) Transversely oblong, striated near the beaks, valves very deep, carinated; posterior extremity suddenly contracted into a point; beaks small, incurved, close to the anterior extremity; length 5 lines, width 11 lines, depth of each valve 4 lines.

Loc. *Felindre on the Teme, 10 miles west of Knighton.*

Pullastra lævis, f. 1 *a*. Transversely elongated, slightly convex, smooth, plain; anterior side small, rounded; front straight, nearly parallel with the hinge line; posterior side large, rather flattened towards the edge, which is nearly straight and oblique; length ¾ inch, width 1¼ inch.

Loc. *Horeb Chapel, in the Cwm-dwr, between Trecastle and Llandovery.*

Cucullæa antiqua, f. 1 *b* and 12 *a*. Transversely ovate, rather convex, smooth; posterior side largest, acutely-angular; internal lamina longitudinal; length from 3 to 4¼ lines, width from 4 to 6½ lines.

Loc. *Horeb Chapel. Felindre on the Teme.*

Cucullæa ovata, f. 12 *b*. Transversely ovate, convex, even; beaks near the anterior extremity; interior lamina longitudinal, not oblique; length 9 lines, width 13 lines.

Loc. *Horeb Chapel.*

Cucullæa Cawdori, f. 11. Transversely elliptical, convex, posteriorly obliquely truncated; a rounded ridge extends from the nearly central beak to the posterior angle of the margin; internal laminæ oblique; length 4 lines, width 7 lines.

This shell is named after the Earl of Cawdor who found it. It ought to have been figured among the Upper Silurian fossils.

Loc. *Freshwater East, Pembrokeshire* (see p. 391).

Arca ———— ? Transversely oblong, very convex; muscular impressions very deep. Too imperfect to figure or to name; it is not very unlike *A. Eastnori* of the Caradoc sandstone.

Avicula rectangularis, f. 2. Subtriangular, very convex, approaching to carinated, smooth; anterior side nearly straight, at a right angle with the equally long hinge line; front rounded; posterior side slightly projecting in form of a large lobe; length 1 inch 2 lines, width the same.
Loc. *Horeb Chapel.*

**Leptæna lata*, figs. 10 *b* and 12 *c*. This is one of the most characteristic shells of the Upper Ludlow Rock. (see Pl. V. f. 13.)
Loc. *Felindre. Horeb Chapel.*

**Spirifer ptychodes*, f. 13. (*Delthyris Dalm. Act. Holm.*, 1827, p. 124. t. 3. f. 5; *Hising. Petr. Suec.* p. 73. t. 21. f. 8.) Slightly elongated, smooth, with 5 rounded plaits; beak of the larger valve prominent, curved; length 3½ lines, width about the same.
Loc. *Felindre. Also in Upper Ludlow Rocks.*

**Orthis lunata*, f. 12 *d.*; also in the Upper Ludlow Rock. (See Pl. 5. f. 16 and description.)
Loc. *Horeb Chapel.*

**Terebratula Nucula*, f. 1 *c* and 12 *g*. Abundant in the Upper Ludlow Rock. (See description Pl. 5. f. 20.)
Loc. *Horeb Chapel. Felindre.*

Lingula cornea, f. 3. Compressed, oblong, rectangular, nearly half as long again as wide; texture approaching horny; length 7 lines, width 5 lines.
Loc. *Tin Mill, Downton, Ludlow.*

Natica glaucinoides, f. 14. Small, globose, with a closed umbilicus: very like the *N. glaucinoides*, M.C., when young; width about 3 lines.
Loc. *Felindre.*

**Trochus helicites*, f. 1 *e* and 5. Depressed, smooth, convex beneath; whorls about 4, hardly convex above (except in the cast), obtusely angular at the margin of the base; umbilicus small and deep; width from ½ inch to nearly 1 inch.
The large specimen, f. 5, is rather more angular about the margin; f. 1 *e** shows the impression of the outer surface.
Loc. *Horeb Chapel. Also in Upper Ludlow Rock.*

Turbo Williamsi, f. 6. Conical, smooth; whorls convex, about 4; base convex, with a narrow umbilicus; aperture round; height 1¾ inch, width 1½ inch.[1]
Loc. *Horeb Chapel.*

Turritella obsoleta, f. 7 *a* and 12 *f*. Subulate, elongated, smooth; whorls 9, convex; aperture round; length 1¼ inch, width 5 lines. Variable in size; the measures given are of the largest specimen.
Loc. *Horeb Chapel. Felindre.*

Turritella gregaria, f. 1 *f*. Subulate, smooth, whorls 6, convex; aperture round; length 4 to 6 lines, width 2 to 3 lines. Many individuals of this *Turritella* occur together, and mostly of one size; it may nevertheless possibly be the young of the last species.
Loc. *Horeb Chapel.*

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[1] I have named this shell after my friend Mr. Williams of Llandovery, who has materially enriched this work by collecting fossils. (See p. 350.)—R. I. M.

Turritella conica, f. 7 *b* and 8. Conical, pointed, smooth, whorls 6, convex, rather angular; length 4½ lines, width 2 lines. Not so frequent as *T. gregaria*.

Loc. *Horeb Chapel. Felindre.*

Orthoceras semipartitum, f. 9 *a*. Very slightly tapering, smooth; septa rather close, concave; siphuncle nearly central, connected with the side by a longitudinal plait; diameter 3 lines.

A small species; the plate which connects the siphuncle with the side forms a fissure in the cast of each chamber.

Loc. *Horeb Chapel. Felindre.*

Orthoceras ———— ?, f. 12 *h*. Smooth; septa rather distant; siphon central, large. Specimen too imperfect to name.

Loc. *Horeb Chapel.*

**Orthoceras striatum*. (See Pl. 5. f. 29.) Also in the Upper Ludlow Rock.

Loc. *Horeb Chapel.*

Orthoceras tracheale, f. 9 *b*. Very slightly tapering, finely striated transversely; covered with obtuse, annular undulations; septa rather flat; diameter 4 lines.

Loc. *Horeb Chapel.*

Bellerophon carinatus, f. 4 and 1 *d*. Convoluted, compressed, keeled, smooth; inner whorls several, small, partly visible; aperture an equilateral triangle.

Loc. *Horeb Chapel.*

Bellerophon striatus, f. 12 *e*. Carinated, covered with sharp striæ parallel to the edge of the aperture; apex (spire ?) very small, convoluted; aperture cordate (with a narrow deep sinus in the front ?); keel flattened at the edge and transversely striated; length 6 lines, breadth 5 lines.

Loc. *Felindre.*

Bellerophon trilobatus, f. 16. Convoluted, smooth, 3 lobed, central lobe largest; inner whorls small, visible; aperture above twice as wide as long; length and breadth 4 lines.

Loc. *Felindre. Is the same species in the Caradoc Sandstone at Eastnor Park; north-east of Gaerfawr, Prescoed Common; and Michaelwood Chace, Tortworth?*

Bellerophon globatus, f. 15. (See Pl. 4. f. 50.) Globose, smooth; aperture transversely oblong, with a small sinus; width about 4 lines.

Loc. *Felindre; also in the Upper Ludlow bone bed.*

**Tentaculites scalaris*? Schlotheim. Also throughout the Silurian series. (See Caradoc sandstone, Pl. 19. f. 15.)

Loc. *Horeb Chapel. Felindre.*

Crustacea.

Agnostus tuberculatus, f. 17. (*Battus tuberculatus, Klöden. Verstein der Mark. Brandenb.*, p. 112. t. 1. f. 16, 17 and 18.) Semi-circular, smooth; lobes three, equal, the central one undivided.

Loc. *Lodge Bank, Downton.*

CHAPTER XLV.

FISHES AND SHELLS OF THE LUDLOW AND WENLOCK FORMATIONS, OR UPPER SILURIAN ROCKS.

Fishes, &c. of the Upper Ludlow Rock, Pl. 4.—*Shells of the Upper Ludlow Rock*, Pl. 5.—*Shells of the Aymestry Limestone*, Pl. 7.—*Shells of the Lower Ludlow Rock*, Pl. 8, 9, 10 and 11.—*Shells of the Wenlock Limestone and Shale*, Pl. 12 and 13.

1. *Fishes of the Upper Ludlow Rock.* (Pl. 4.)

SPHAGODUS, Agass.

Sphagodus pristodontus, Agass., Pl. 4. f. 6 and 1, 2, 3.

PTERYGOTUS, Agass.

Pterygotus problematicus, Agass., f. 4 and 5.

PLECTRODUS, Agass.

Plectrodus mirabilis, Agass., f. 14 to 26.
(Coprolites of the *Plectrodus*, f. 46, 47, &c.)

SCLERODUS, Agass.

Sclerodus pustuliferus, Agass., f. 27, 28, 29, 30, 31, 32, 60, 61 and 62.

THELODUS, Agass.

Thelodus parvidens, Agass., f. 34 and 36.

ONCHUS, Agass.

Onchus Murchisoni, Agass., f. 9, 10 and 11.
——— *tenuistriatus*, Agass., f. 57, 58 and 59.

THE researches of geologists have not yet made us acquainted with the existence of fossil fishes in any strata so low in the series as the Silurian rocks, and hence the forms about to be described are of great interest. They appear, in short, before naturalists, as *the most ancient beings of their class*, which have yet been brought to light.

In advancing our knowledge of fossil ichthyology, the discovery of these fishes has also confirmed the important inference drawn by M. Agassiz, from an examination of all the younger deposits; that each great formation is characterised by species peculiar to it. This doctrine is, indeed, strikingly corroborated by the evidence now produced, for of the six genera above enumerated, four are entirely new, and wholly unlike any forms in the overlying strata; while the genus *Onchus*, though known in the Carboniferous and Old Red Systems, is here composed of distinct species.

In Pl. 4. are figured all the remains which have been found in the highest stratum of the Ludlow Rocks, constituting in parts a complete "bone bed" or matted mass of scales, teeth, jaws, and coprolites of fishes (see p. 199)[1]. The fishes have been named, and are briefly described by M. Agassiz, from drawings sent to him by myself, but more detailed descriptions of them will hereafter appear in his great work, Récherches sur les Poissons Fossiles.

"The figures 1, 2, 3," says M. Agassiz, "are very probably fragments of the skin (shagreen) of some Placoid, of which the teeth and the vertebræ are found detached in the same beds. Examine the drawing of the *Squaloraia* which I sent to the Geological Society[2], and you will perceive that the skin consists of similar tubercles, though these appear to me more pointed. They perhaps belong to the same animal of which fig. 6. represents the tooth. This tooth is sufficiently characterized to be distinguished from all those which have been already described. It constitutes a new generic type, which may be designated by the name of *Sphagodus,* (slaughtering or murderous tooth) and the species *Sphagodus pristodontus,* Agass."

"Fig. 4 and 5 belong undoubtedly to the same animal as the *Seraphim*[3] of the Old Red Sandstone. The more I know of this creature, the more I am tempted to believe that it was a fish; but how absolutely decide upon it, when we have neither discovered head nor tail, but only large wings? It may provisionally bear the name of *Pterygotus problematicus,* Agass. (wing fish)."

"Figs. 14 and 26 represent the most curious fragments of fish that have yet been discovered in the Silurian rocks. The teeth cannot be referred to any species already known, and constitute a genus, the fishes of which were without doubt the pirates of the seas of that period. The shape of these teeth, bristled with sharp points like the spurs of a cock, induce me to give it the name *Plectrodus* (cock-spur). The marked differences which your figures display in the form of the teeth, seem to indicate that this genus contains more than one species. The figures 18, 19, 22, 23, represent teeth differing sensibly from those which appear among the bones, figs. 14, 15, 16, 25 and 26, and of which figs. 20 and 21 appear to be detached teeth. Perhaps the great number of points which are visible on some of these teeth, arises from the circumstance of our seeing them on their interior or exterior surfaces. If there is but one species, it might be named *Plectrodus mirabilis,* Agass.; if there are two, that with the greatest number of points may be *Pl. pleiopristris.* The coprolites (see subsequent description) figs. 46, 47, &c. are doubtless the produce of this species, which fed on the small shells contained in those excrementitious bodies. The figs. 17 and 33 do not appear to me to differ from each other; and like figs. 1, 2 and 3, they may be the tubercles of the skin; perhaps they may have belonged to the skin of *Plectrodus*?"

"Figs. 27, 28, 29, 30, 31, 32, and 60, 61, 62, indicate another new type of tooth approaching that of the *Psammodus,* but differing from it by the raised pustules on the surface: I shall name it *Sclerodus* (rough tooth), and the species *Scl. pustuliferus.*"

"Figs. 34, 35, 36 represent other teeth, approaching in some respects to those of the *Lepidotus,* of which I form a new genus *Thelodus* (mammillated tooth), and the species may be named *Th. parvidens.*"

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[1] I have previously expressed my obligation to Dr. Lloyd, the Rev. T. T. Lewis, and Mr. W. Evans for their exertions in developing the fossil wealth of this curious stratum or *bone-bed,* masses of which may be seen in the museums of the Ludlow Natural History Society, and of the Geological Society of London.

[2] Now figured, Geological Transactions, vol. 5. Pl. 4.

[3] The name of *Seraphim* was given to these singular winged bodies (*Pterygotus,* Agass.) by the Scotch quarrymen, who first found them in the Old Red Sandstone of Forfarshire. On seeing specimens of them at Edinburgh, 1834, in a collection of Mr. Lyell, M. Agassiz referred them, though with some doubt, to the class of fishes.

" Figs. 40 to 45 represent rays of the fins, belonging probably to the genus *Onchus*, and which appear also to indicate another new species. Figs. 37, 38 and 39 do not appear to me determinable at present; perhaps they may be rays, or perhaps tubercles of the skin?"

ICHTHYODORULITES OF THE UPPER LUDLOW ROCK.

1. *Onchus Murchisoni*, Agass. (Pl. 4. f. 9, 10, and 11.)

"The defensive fin," observes M. Agassiz, "which I have termed *Onchus Murchisoni*, is very characteristic. Its lengthened, slender, and almost straight form, its imperceptible tapering away, the great size of the longitudinal ribs, and the depth of the alternating furrows, are traits which distinguish it at a first glance from every other species of this genus. It is very interesting (adds M. Agassiz) that your Upper Silurian Rocks should have produced a species so remarkable, and of the distinct nature of which no doubt can be entertained. The presence of three of these defences, in one small specimen which you sent me, would seem to indicate, that the species is not very rare. It is, however, to be observed, that the fishes to which they belonged, bore a spine upon each of the two dorsal fins. At all events this is the case with the living genera (*Cestracion*, *Centrina* and *Spinax*), with which it must be compared, though such affinity may be rather distant."

2. *Onchus tenuistriatus*, Agass. (Pl. 4. f. 57, 58, and 59.)

" The above-named figures best represent this species, while figs. 12 and 13 show the cavity which occurs in the posterior side of the base, and which is more or less prolonged into the interior of the spines 'rayons' of all the cartilaginous fishes with bony dorsal spines[1]. This species differs from the preceding, both in having finer and closer ribs, and in its general form, which is more arched. The rays are also proportionally shorter than those of *Onchus Murchisoni*." Extracts from letters of M. Agassiz to myself. See also Récherches, tom. iii. p. 6, since published.

Coprolites.

The coprolites formerly alluded to as occurring so abundantly in this "bone bed" are represented in the figures 46, 47, 54, 55. Having submitted them to Dr. Prout, whose analysis established the views of Dr. Buckland concerning the fæcal origin of similar bodies in the lias and other formations, that distinguished chemist has favoured me with the following account of those which occur in the *bone bed* of the Ludlow rocks.

" I find all the specimens examined to consist essentially of the phosphate of lime and of the carbonate of lime. There was, however, a considerable residuum undissolved by acids, consisting apparently of silex, oxide of iron, together with carbonaceous and other matters, the nature of which was not ascertained.

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[1] For an account of the proof that the dorsal spines of cartilaginous fishes have a bony structure, see structure of ichthyodorulites in preceding Chapter.

"From these and other circumstances to be presently mentioned, and from their mechanical structure, there can, I think, be little doubt that the masses in question are really coprolites. I confess, however, that I should hardly have arrived at this conclusion, had I not before repeatedly examined coprolites, and witnessed the variety to which they are liable.

"I have alluded above to certain other circumstances corroborative of the opinion advanced. These relate to the *origin* of the principal materials of which our 'supposed coprolites' are composed, and may in conclusion be briefly stated.

"The mass of the bed, containing these concretions, consists almost entirely of a congeries of various organic remains. Of these organic remains, two kinds strikingly predominate. One kind, and by much the most abundant, consists of fragments of bones (scales or spines), for the most part of a dark or black colour. The other kind of organic remains differs altogether in texture and appearance from the black fragments, and is of a reddish brown colour. The black organic fragments I find to consist of phosphate of lime and of carbonate of lime; and there is left, undissolved in the acid employed, some carbonaceous and other matters. The reddish brown fragments consist also of carbonate of lime and phosphate of lime, but the phosphate of lime appears to be in much less proportion than in the black fragments. The composition, therefore, of these organic remains seems to account very satisfactorily for the *origin* of the phosphate and carbonate of lime in the 'supposed coprolites.'"—*Letter from Dr. Prout.*

The small shells (*Orbicula rugata*, f. 47 and 48; *Lingula minima*, f. 49; *Bellerophon globatus?* f. 50; *Turritella*, f. 51; and *Orthoceras semipartitum*, f. 52 and 53.), as well as the cast of a crinoidal column, f. 54, were found both in the coprolites and diffused through the layers.

FOSSIL SHELLS OF THE UPPER LUDLOW ROCK.

Described by Mr. James de C. Sowerby.

PLATE V.

Serpulites longissimus, f. 1.[1] Very long, hardly diminishing in diameter, compressed, smooth, slightly tortuous, composed of numerous thin layers of shell containing much animal matter.

No part of this extraordinary fossil has been observed attached to other bodies; it forms large curves, sometimes almost circles, occasionally even a foot in diameter. The tube is so much compressed that its sides nearly touch, and that this is the effect of pressure is shown by the form it has assumed. Those parts which were nearly perpendicular to the direction of the compressing force have resisted pressure most powerfully, and fractures have taken place in longitudinal lines near such parts. The quantity of animal matter in the laminæ gives them an opalescent appearance. In structure, this fossil resembles the *Serpula compressa of Min. Con.*, tab. 598. f. 3; but it does not diminish so rapidly. Width ½ an inch.

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[1] In the description of the Upper Ludlow Rock this fossil has been inadvertently named *Serpuloides longissima*.

No naturalist who has examined this form has been able to throw any light upon its true place in the animal kingdom, and I have therefore named it provisionally *Serpulites longissimus*.—R. I. M.

Loc. *Ludlow, very abundant; Kington, Herefordshire; and very generally throughout the Upper Ludlow Rock of Salop, Hereford, Radnor, &c.*

Cypricardia? amygdalina, f. 2. Transversely ovate, elongated, obtusely keeled, smooth; posterior extremity pointed; hinge line straight; beaks short, very near to the anterior extremity; valves deep. Frequently much distorted by pressure. Length $1\frac{1}{4}$ inch, width $\frac{1}{2}$ inch.

Loc. *Abundant in the Ludlow promontory, and very generally characteristic of the Upper Ludlow Rock.*

Cypricardia? impressa, f. 3. Transversely oblong, smooth; anterior extremity slightly truncated, the other pointed obtusely; front concave; hinge line straight, long; beaks near the anterior extremity. Variable in size. Very much like the last, but more rounded, and further distinguished by the depression along the middle. Length 7 lines, width 1 inch 3 lines.

Loc. *Delbury near Ludlow.*

Cypricardia? undata, f. 4. Transversely elongated, very convex; surface largely undulated; front concave; beaks short, close to the anterior extremity; lunette heart-shaped. Length $\frac{1}{2}$ an inch, width 1 inch.

Loc. *Near Aymestry.*

Cypricardia? retusa, f. 5. Heart-shaped; anterior extremity rather pointed, and separated from the other parts by a concave space; beaks large. Length 5 lines, width 8 lines.

Loc. *Delbury.*

Cypricardia cymbæformis, var., f. 6. (*Cardites carpomorphus? Dalm. Act. Holm.* 1824., p. 372. t. iv. f. 2; *Cardium carpomorphum? Hisinger Petr. Suec.*, 63. t. xix. f. 5.) Transversely oblong; valves deep, carinated; the keel acute, extending from the beak to the angular extremity of the narrow, oblique, produced posterior side; beaks short, incurved, close to the small heart-shaped anterior side. Length 7 lines, width 1 inch 4 lines.

This differs from *C. cymbæformis* of the Old Red Sandstone in being less inflated and rather wider. Both are much less triangular and shorter in proportion than *Cardites carpomorphus* of Dalman, of which, however, we have only seen the figure. *Serpulites longissimus?, Cucullæa antiqua, Leptæna lata*, and *Bellerophon expansus* occur in the same mass with the specimen before us.

Loc. *Ludlow.*

Pullastra complanata, f. 7. Transversely elongated, twice as wide as long, smooth, rather flat; anterior extremity small, rounded; posterior extremity pointed, its edge oblique; beaks not prominent, very near the anterior extremity. Length $\frac{3}{4}$ inch, width $1\frac{1}{2}$ inch.

This differs from *P. lævis* of the Old Red Sandstone chiefly in the angular form of the posterior margin.

Loc. *Darley Brook, Linley, near Bridgenorth; rare.*

* *Cucullæa antiqua.* (See Pl. 3. f. 1 *b*.)

Loc. *Ludlow.*

Nucula? ovalis, f. 8. Transversely oval, rather convex; beaks pointed, near the anterior side. Length nearly 4 lines, width 5 lines.

Not having been able to clear the stone from the hinge of the only specimen obtained of this fossil, which is a cast of the interior, the genus remains doubtful.

Loc. *Trewerne Hills on the Wye, Radnorshire.*

Avicula retroflexa? f. 9. (*Hisinger. Act. Holm.* 1826. t. vii. f. 9; *Petr. Suec.* 57. t. xvii. f. 12.)

Semicircular, two-lobed, oblique, rather convex, transversely wrinkled; anterior lobe very small. Length 10 lines, width $1\frac{3}{4}$ inch.

Hisinger refers this species to the lias and lower oolite. If this be correct, our species cannot be the same as that of Hisinger.

Loc. *Hale End, Malverns; and near Usk.*

Avicula lineata, f. 10. Obliquely ovate, flattened, ornamented with many radiating elevated lines; anterior lobe minute, the posterior ear distinct, triangular, half as long as the posterior slope. Length 9 lines, width 1 inch 2 lines.

Loc. *Ludlow.*

Orbicula rugata, f. 11. Nearly orbicular; upper valve a very low oblique cone with a concentrically wrinkled surface; lower valve nearly flat. Diameter 6 lines, height 2 lines.

Loc. *Ludlow promontory, viz. Richards Castle, &c.; Delbury; Bradnor Hill, Kington; Bagbarrow Hill; Pains Castle, Radnorshire. Very abundant.*

Orbicula striata, f. 12. Orbicular, convex, covered with minutely radiating striæ; apex deflected, marginal. Diameter 7 lines, height 3 lines.

One specimen is attached to the septum of an *Orthoceras.*

Loc. *Delbury, and Ludlow Hills.*

**Leptæna lata*, f. 13. (*Von Buch; Producta*, Sow.) Semicircular, the front rather straight; upper valve convex, the middle a little depressed; lower one concave; surface covered with fine radiating ridges; hinge line straight, furnished with 8 or 10 long divaricating spines. Length half the breadth.

The spines in all the specimens we have seen are simple tubes, not jointed as they are figured and described by Baron Von Buch, who must have had much better specimens than occur in England.

Loc. *Ludlow promontory; Delbury, and the range of Mogg Forest, Munslow, &c.; Presteign; Stoke Edith; Fownhope, and outer band of Woolhope Valley; Bradnor Hill; near Kington; near Usk; Bagbarrow Hill; North of Barrow; near Newnham; in the Brecon anticlinal. Characteristic and most abundant.*

Atrypa didyma, Dalm. (See Pl. 6. f. 4.) Also Aymestry Limestone.

Loc. *Fownhope; Dog Hill, Ledbury.*

Atrypa affinis. (*Min. Conch.* t. 324. f. 2.) (See Pl. 6. f. 5.) Also in Aymestry Limestone and throughout the Upper Silurian Rocks.

Loc. *Ludlow; Aymestry, and many localities.*

Spirifer crispus. (See Pl. 12. f. 8.) Also Wenlock Limestone.

Loc. *Abberley; Freshwater east, Pembrokeshire.*

**Spirifer ptychodes*. (*Delthyris ptychodes, Dalm. Act. Holm.* 1827. p. 124. t. iii. f. 5.; *Hisinger Petr. Suec.* p. 73. t. xxi. f. 8.) (See Pl. 3. f. 13.) Also Old Red Sandstone.

Loc. *Abberley; Bradnor Hill; near Kington; Fownhope.*

Spirifer trapezoidalis, f. 14. (*Cyrtia trapezoidalis, Dalm. Act. Holm.* 1827. p. 119. t. cxi. f. 2; *His. Pet. Suec.* p. 72. t. xxi. f. 1; *Von Buch.* Pl. 1. f. 15 and 16.) Nearly semicircular, transverse longitudinally striated: a rounded elevated ridge extends from the beak to the front of the upper valve with a corresponding furrow in the other valve; hinge line rather shorter than the diameter of the shell, the extremities rounded; area large, curved; the foramen narrow.

Loc. *Usk; Craig-y-garcyd.* (*Iron Bridge, Coalbrook dale, Von Buch.*)

N.B. This fossil has been figured in this plate inadvertently, for it does not belong to the Upper Ludlow, but rather to the Lower Ludlow and Wenlock strata.

Orthis lunata, f. 15. Transversely obovate; finely and deeply striated; valves almost equally convex; the lesser with a slight depression along the middle; beaks not very prominent, and within it has two semicircular ridges; area of the hinge small. Length 5 lines, width 7 lines.

Loc. *Ludlow; Delbury; of very frequent occurrence; also in the lowest beds of Old Red Sandstone.*

Orthis orbicularis, f. 16. Obovate, approaching to orbicular; finely and deeply striated; the larger valve very convex, with a slighly curved beak, within which is a straight longitudinal ridge, with a curved one on each side of it (seen best in the impressions they leave in the cast); the other valve slightly convex with a wide depression along the middle; area of the hinge very small. Length 6 lines, width 7 lines.

Loc. *Ludlow; Delbury; Sutton, near Wenlock; Dog Hill, near Ledbury; Cwm-nant-gwyn, near Builth.*

These two species of *Orthis* are so nearly alike, that it is often impossible to determine to which the specimen under examination may belong, unless it be very perfect, or show the impressions upon the cast of the characteristic ridges in the interior. One or both species occur with *Leptæna lata* and *Terebratula Nucula* in numberless localities near Ludlow, Munslow, Aymestry, Presteign, Knighton, Kington, Builth, Brecon (the Corn-y-fan, or Brecon anticlinal), Usk, Sedgeley, Abberley and Ledbury.

Terebratula Navicula, f. 17. Oblong, boat-shaped, smooth; the upper valve nearly flat, its sides elevated, the front depressed; the lower valve obtusely keeled, its beak short, incurved: f. 17 *a* represents the cast of the interior. Length 7 lines, width 5 lines.

Loc. *Ludlow promontory; Clyro Hills, Radnorshire; Brecon anticlinal, viz., Corn-y-fan; Alltfawr and Rhiwannest, abundant, at the base of the Upper Ludlow.*

Terebratula canalis, f. 18. Elliptical, smooth, with a narrow longitudinal furrow; front emarginate; beak incurved. Length ½ an inch, width 4½ lines.

Our description of this is necessarily meagre, because we have only seen one valve. The fossil belongs rather to the Lower Ludlow.

Loc. *Near Usk.*

Terebratula lacunosa, f. 19. (*Anomia lacunosa, Linn.; Gmel.* t. i. 3343. *Terebratulites lacunosus, var. Schlotheim, Nachtrage, zur Petrefact.* p. 68. t. 20. f. 6; *Ter. borealis, Von Buch. loc. cit.* p. 67; *von Hisinger.*) Obovate, gibbose, obscurely 3 lobed, acutely plaited; plaits about 16, 4 or 5 of which in the middle of the front are much elevated; beak small, pointed, slightly incurved. Length 7 lines, width 8 lines.

This is one of the least lobed varieties of *T. lacunosa*, if it be a variety of that species; the specimens before us are not complete enough to determine a question so difficult in this section of the family of *Terebratulæ*.

Loc. *Ludlow promontory and Delbury, Salop; Aram, near Newnham; Trewerne Hills; the Maund, Abbereddw, and Pain's Castle, Radnorshire; Abberley Hills.*

* *Terebratula Nucula*, f. 20. Globose, obscurely 3 lobed, plaited; plaits sharp, about 15, 3 or 4 of which are prominent and elevated in the middle of the front; beak small, adpressed; lower valve slightly flattened. Length 5 lines, width the same.

Loc. *Ludlow; Delbury; Presteign; Ledbury; Bagbarrow Hill; and west of Malvern*

Hills; Abberley; Bradnor Hill, Kington; Trewerne Hills, Radnorshire; Aram, near Newnham: abundant.

Terebratula pulchra, f. 21. Globose, rather triangular, obscurely 3 lobed, plaited; plaits sharp, about 20, 5 of which are elevated in the front; beak small, projecting.

This resembles the last, but is more angular, and has smaller and sharper plaits, which make it peculiarly elegant, while *T. Nucula* is rather clumsy in its appearance. Length 4 lines, width the same.

Loc. *Delbury; Bagbarrow Hill; Malverns.*

Terebratula pentagona, f. 22. Pentagonal, wider than long, depressed, obscurely 3 lobed, plaited; plaits about 25, rounded, not extending to the beaks, 9 or 10 of the central ones raised at the front; beak very small. Length 6 lines, width $6\frac{1}{2}$ lines.

Loc. *Delbury, Salop.*

Lingula minima, f. 23. Oblong, elongated, with parallel sides, flat, smooth and thin. Length 4 lines, width $2\frac{1}{2}$ lines.

The species of *Lingula* so nearly resemble each other, that it is difficult to distinguish them by words. This specimen may be the young of some other species.

Loc. *Delbury; Downton Castle.*

Natica parva, f. 24. Sub-hemispherical, smooth; spire flat, of little more than one whorl; aperture semicircular, very large. Greatest diameter $4\frac{1}{2}$ lines, height 3 lines.

Loc. *Fownhope; in the outer band or Ludlow Rock of the Woolhope Valley.*

Pleurotoma articulata, f. 25. Turretted, nearly smooth, being only marked with sharp lines of growth; whorls 8 or 10, very convex; sinus nearly in the middle of the whorl, forming a broadish band. The whorls are so round and distinct as to give the spire a jointed appearance like a row of beads. Length $10\frac{1}{2}$ lines, width $3\frac{1}{2}$ lines.

Loc. *Ludlow, and near Ledbury.*

Pleurotoma corallii, f. 26. Turretted, smooth; whorls 8 or 10, convex; lines of growth indistinct; sinus below the middle of the whorl forming a narrow band. Length $6\frac{1}{2}$ lines, width 3 lines.

Loc. *Ludlow promontory; Larden; Fownhope; Botteville, north side of Caer Caradoc; Aram, near Newnham; north-east of Gaerfawr (generally enveloped in coral); Bradnor Hill, Kington.*

Trochus helicites. (See Pl. 3. f. 1 *e* and 5.) Also Old Red Sandstone.

Loc. *Ludford; Ludlow.*

Turbo corallii, f. 27. Conical, acute, covered with sharp spiral lines; whorls about 6, rounded; aperture orbicular; umbilicus closed. Length $\frac{1}{2}$ an inch, width 4 lines.

Loc. *Larden; near Ludlow; Trewerne Hills, Radnorshire; Aram; near Newnham, Glostershire (in all these distant places enveloped in the same coral,* Favosites fibrosa, *Goldfuss*).

Turbo carinatus, f. 28. Conical, acute, ornamented with several spiral sharp carinæ, and longitudinally striated; aperture orbicular; umbilicus closed. Three of the carinæ are visible upon each whorl. Length $\frac{1}{2}$ an inch, width 5 lines.

Loc. *Ludlow promontory; Trewerne Hills; generally imbedded in coral like the last.*

Orthoceras striatum, f. 29. (*Min. Conch.* t. 58.) Gradually tapering, finely and regularly striated longitudinally; septa very close, deep; siphuncle central, rather large, nearly cylindrical. Length 9 inches or more, width 2 to 3 inches.

Loc. *Ludlow; Brecon anticlinal; Tortworth (generally compressed).*

Orthoceras virgatum. (See Pl. 9. f. 4.) Also Lower Ludlow Rock.

Loc. *Bagbarrow Hill (Malverns).*

Orthoceras Ibex, f. 30. (*Orthoceratites annulatus, Hisinger Petr. Suec.* 29. t. ix. f. 8.; *not of Min. Con.*) Very gradually and irregularly tapering, compressed, smooth; surface elevated in oblique rings, one fourth their diameter apart. Length of the fragment about 2¾ inches, width 8 lines.

Loc. *Ludlow.*

Orthoceras articulatum, f. 31. Very gradually tapering, compressed, smooth; surface elevated in oblique rings, one third their diameter apart. Length of the fragment about 2 inches, width ½ an inch.

Loc. *Ludlow promontory; east of Aymestry; near Ledbury; occurs also in Lower Ludlow Rock.*

It appears probable that these two fossils are straight portions of *Lituites*, the *O. articulatum* being a portion of *Lituites articulatus.*

Cyrtoceras (Goldfuss) *læve.* (See Pl. 8. f. 21.) Also Lower Ludlow.

Loc. *Ludlow.*

Bellerophon expansus, f. 32. Spire small, rounded; aperture very large, two lobed, twice as long as broad; sinus broad and short. Length of the aperture 7½ lines, width of ditto 11 lines.

Loc. *Ludlow; Treweme Hills.*

**Bellerophon globatus.* (See Pl. 3. f. 15. and Pl. 4. f. 50.) Base of Old Red Sandstone and Ludlow *bone-bed.*

The figure in Pl. 4. is taken from a cast contained in Coprolites.

Loc. *Ludford; Ludlow.*

**Bellerophon carinatus.* (Pl. 3. f. 4 and 1 *d.*) Also Old Red Sandstone.

Loc. *Bradnor Hill.*

**Tentaculites scalaris.* (See Pl. 19. f. 15.) (*Schlotheim Petrefact.* t. 29. f. 9 *b.*) Also Caradoc Sandstone.

Loc. *Delbury; Bradnor Hill; Fownhope.*

Tentaculites tenuis, f. 33. Subulate, pointed, very narrow, with numerous slender elevated rings upon the surface. Width of the aperture ½ a line.

More slender in form, and with closer rings, otherwise much resembling *T. annulatus*, Pl. 19. f. 16.

Loc. *Near Usk in the same mass with Terebratula canalis*, f. 18.

N.B. The shells marked with an asterisk occur also in the Tilestones or lowest beds of the Old Red Sandstone, and mark the transition from the Old Red into the Silurian System.

Spirifer trapezoidalis, Terebratula canalis, Tentaculites tenuis, Cornulites serpularius, and Cyrtoceras læve, are not fossils of the Upper Ludlow but rather of the Lower Ludlow and Wenlock strata.

SHELLS OF THE AYMESTRY LIMESTONE OR MIDDLE LUDLOW ROCK.

PLATE VI.

Mya rotundata, f. 1. Transversely elongated, convex and wrinkled; beaks near the anterior portion, which is separated by a slightly concave space from the middle of the shell. Length 11 lines, width 1 inch 5 lines.

Distinguished from *Cypricardia undata* (Pl. 5. f. 4.) by the want of a lunette.

Loc. *Caynham Camp near Ludlow.*

Cardium? striatum, f. 2. Orbicular, convex, longitudinally striated; striæ numerous; beaks prominent. Length 1 inch 10 lines, width the same.

Loc. *Aymestry; also near Shelderton in Lower Ludlow.*

Cardium? striatum, var. Larger than the above, and rather oblique in form and furnished with more distant and deeper striæ.

Loc. *From the landslip in Wheeler Vallets Wood, north flank of Brindgwood Chace.*

Avicula reticulata? f. 3. (*Hisinger Petr. Suec.* 57. t. xvii. f. 13?) Ovate, broad, pointed towards the beaks, rather convex, ribbed; ribs numerous, decussated by the lines of growth; one valve nearly flat; ears unequal, one very large, right-angled. Length 2 inches, width 1 inch 8 lines.

Loc. *Croft Valley; Aymestry.*

Leptæna euglypha. Productus euglyphus, passim. (See Pl. 12. f. 1.) Also Wenlock Limestone.

Loc. *Mocktree; Aymestry.*

Leptæna depressa. Productus depressus, passim. (See Pl. 12. f. 2.) More prevalent in Wenlock Limestone.

Loc. *Mocktree Forest.*

Atrypa didyma, f. 4. (*Ter. didyma, Dalm. Act. Holm.* 1827. p. 146. t. 6. f. 7; *Hisinger Pet. Suec.* p. 77. t. xxii. f. 7.) Nearly globose; beaks small; front emarginate, with a furrow in each valve reaching nearly to the beaks. Length 5 lines, width the same.

This is often found inclosed in *Ter.? Wilsoni*, and sometimes a pair of *T. Wilsoni* inclosing one of this is contained in another of *T. Wilsoni*. (See f. 7*b*.)

Loc. *Wallsgrove Quarry; Sunny Hill Bank, Ludlow; and also in Upper Ludlow Rock.* (*Pretty abundant.*)

Atrypa affinis, f. 5. (*Ter. affinis, Min. Con.* t. 324. f. 2; *Atrypa reticularis, Dalm. Act. Holm.* 1827. p. 127. t. 4. f. 2; *Hisinger Petr. Suec.* 75. t. xxi. f. 11; *Ter. priscus, Schl.* t. 17. f. 2; *Von Buch. Terebrat.* p. 71.)

Loc. *Very abundant in the Aymestry Limestone and throughout the Upper Silurian Rocks.*

Atrypa aspera (Schlot.). (See Pl. 12. f. 5.) Also Wenlock Limestone.

Loc. *Churnbank or Palmer's Cairn, and other parts of Ludlow promontory.*

Spirifer crispus. (*Delthyris crispa, Dalm. loc. cit.* p. 122. t. 3. f. 6; *S. octoplicatus, M. C.* t. 562. f. 4.) (See Pl. 12. f. 8.) Also Wenlock Limestone.

Loc. *Sunny Hill Bank near Ludlow.*

Spirifer interlineatus, f. 6. Transversely oval, convex, finely striated longitudinally, ribbed; ribs all rounded, 5 on each side, a large elevated one in the middle; beak of the larger valve produced, and then so much incurved as to meet the beak of the other valve. Length 5½ lines, width 6½ lines.

Loc. *Aymestry; also in Wenlock Limestone.*

Orthis Pecten, var.? Transversely obovate, flat with numerous sharp radiating sulci increasing in number towards the margin. Length 10½ lines, width 1 inch 4 lines.

A much wider shell than the true *O. Pecten*. Specimen only one imperfect valve.

Loc. *Aymestry.*

Orthis orbicularis. (See Pl. 5. f. 16.) Also Upper Ludlow Rock.

Loc. *Botville, near Church Stretton.*

Terebratula Wilsoni, f. 7 *a.* (*M. C.* t. 118. f. 3; *Ter. lacunosa, Wahl. Dalm. loc. cit.* p. 139. t. 6. f. 1; *Hisinger Petr. Suec.* 80. t. xxiii. f. 3, not Linn.; *Ter. Wilsoni, Von Buch, Terebr.* p. 47.) The form of the shell, approaching to cylindrical, and the long furrows upon the front sufficiently distinguish this species.

Loc. *Aymestry.* This shell is highly characteristic of the central beds of the Ludlow formation and is of very constant occurrence in Salop, Hereford, Radnor, &c.

Terebratula Nucula. (See Pl. 5. f. 20.) Also Upper Ludlow Rock.

Loc. *Aymestry, Ludlow, Sutton; Bottville, Caradoc.*

Terebratula Navicula. (See Pl. 5. f. 17.) Also in the lowest bed of the Upper Ludlow Rock.

These three species of *Terebratula* often mark the place of the Aymestry Limestone, as in the Brecon anticlinal, the valley of Woolhope, at Usk, &c.

Loc. *Aymestry, Ludlow, Yeo Edge, and in numerous places.*

Pentamerus Knightii, f. 8 *a, b, c.* (*Min. Con.* t. 28; *Uncites Gryphoides, Defr., Ter. Gryphus, Von Buch,* p. 69; *Gypidia Conchidium, Linn. Mus. Tessin.* p. 90. t. 5. f. 8; *Dalm. loc. cit.* p. 125. t. 4. f. 1; *Hisinger Petr. Suec.* 711. t. xxi. f. 10; *Anomia bilocularis*; *Hisinger Act. Holm.* 1798. p. 285.) After the examination of a great number of specimens it has been ascertained that the lesser valve varies much in convexity, and hence that *P. Aylesfordii, Min. Con.* t. 29, is not a distinct species. (See f. 8 *c.*)

The *Pentamerus Knightii* presents the peculiar organization by which the genus is marked in a high degree of perfection; the lesser valve being divided internally by two longitudinal, parallel, approximate septa, and the other valve by one large, also longitudinal, septum, which is forked towards the beak. These septa are composed of short fibres which meet in the middle, so that each septum is easily divided into two. Owing to this structure and to its usually being filled with subcrystalline carbonate of lime, this fossil, though sometimes entire, frequently splits into two parts, one containing two and the other three of the chambers formed by the septa: commonly also, a small piece separates from within the forked part of the large septum near the beak. (See f. 8 *b.*)

The *Pentamerus Knightii* may be seen in this state all along the escarpments of the Ludlow formation, extending from Aymestry to the View Edge west of Ludlow. Throughout that district and at Sedgeley near Dudley, this species of *Pentamerus* is *peculiar to the Aymestry Limestone,* though one example of it has been observed (by Mr. Davies of Presteign) in the equivalent of the Wenlock Limestone near Presteign. (See p. 313.)

The name of Mr. Thomas Andrew Knight, F.R.S., President of the Horticultural Society of London, in whose beautiful demesne of Downton Castle it is found abundantly, has been with great propriety attached to this curious and characteristic fossil.

Loc. *Aymestry; Downton on the Rock; Yeo Edge; and Sedgeley, Staffordshire.*

Lingula Lewisii, f. 9. Oblong, compressed, smooth; sides straight and parallel. Length 1 inch 2 lines, width 9½ lines. The squareness of the outline produced by the straight sides is characteristic.

Loc. *Aymestry and many situations in the Ludlow promontory, viz. Mary Knoll, Sunny Bank, Palmer's Cairn; also at Abberley and at Sedgeley; very characteristic.*

This large and beautiful species, of which the shell is generally well preserved and often of a blue colour, is named after the Rev. T. T. Lewis of Aymestry.

Pileopsis vetustis. The aperture of the only imperfect specimen yet obtained from the Aymestry Limestone, appears less expanded than in the *Pileopsis vetusta* of the Carboniferous Limestone. (*Min. Con.* t. 607.)

Loc. *Aymestry.*

Euomphalus funatus. (*Min. Con.* t. 450; *Hisinger Petr. Suec.* 37. t. xi. f. 11.) (See Pl. 11. f. 20.) Also Wenlock Limestone.

Loc. *Walls Grove Quarry, Aymestry; Usk.*

Euomphalus carinatus, f. 10. (Is this *Inachus sulcatus, Hisinger Petr. Suec.* 38. t. xii. f. 1?) Nearly discoid, with a broad sharp keel around the margin; umbilicated; whorls few, convex, marked with many small concentric ridges crossed by sharp lines of growth; aperture ovate, longer than wide. Diameter nearly 3 inches.

Loc. *Aymestry; also in the Wenlock Formation, at Delves Green, Wallsall.*

Pleurotoma corallii. (See Pl. 5. f. 26.) Also Upper Ludlow Rock.

Loc. *Aymestry; Botville, Caradoc; Fownhope.*

Turbo corallii. (See Pl. 5. f. 27.) Also Upper Ludlow Rock.

Loc. *Fownhope; Aymestry; Botville, Caradoc.*

Orthoceras Mocktreensis, f. 11. Gradually tapering; lines of growth distinct; septa rather distant; siphuncle large, spherically inflated between each septum. Diameter 1 inch.

It is difficult to distinguish the species of *Orthoceras* from such specimens as the one figured. Though somewhat resembling it in form, this fossil is of less size than *O. giganteum, Min. Con.* t. 246. The specimen figured is remarkable for being half filled with chert and half with calc spar; the surface is siliceous, and has remarkable lines of growth, indicating a break in the shell. The name is provisionally adopted.

Loc. *Mocktree Hays; Abberley.*

Orthoceras pyriforme. (See Pl. 8. f. 19 and 20.) Also Lower Ludlow Rock.

Loc. *Aymestry* (*specimen small*).

Orthoceras virgatum. (See Pl. 9. f. 4.) Also Lower Ludlow Rock.

Loc. *Abberley.*

Bellerophon Aymestriensis, f. 12. Thick, discoid, with a broad, rather flat, margin; whorls few, their section transversely oblong and but slightly indented by the preceding whorl; aperture expanded. The greater part of the mouth is, in this specimen, broken away, but enough is left to show that it expands: is it not possible that if it were perfect it would prove to be like *B. dilatatus,* (Pl. 12. f. 23 and 24)? Diameter $3\frac{1}{4}$ inches, thickness 2 inches 10 lines.

Loc. *Aymestry.*

Bellerophon ——. Somewhat resembling *B. tenuifascia, Min. Con.* t. 470., but too imperfect to name.

Loc. *Westwood Common.*

N.B. Several of the above fossils occur in the beds of the Upper and Lower Ludlow Rock, immediately above and below the Aymestry Limestone.

FOSSILS OF THE LOWER LUDLOW ROCK.

PLATE VIII., IX., X. AND XI.

Spirorbis tenuis, Pl. 8. f. 1. Whorls about 2, dextral; diameter about 1 line.

Many individuals of this shell, too imperfect to be described, are imbedded in the matrix which filled the interior of a *Phragmoceras* and are accompanied by a coralline. Little more than the surfaces by which they were attached is distinguishable, and viewing them thus, the whorls appear to be sinistral. The name expresses the thinness of the shell.

Loc. *Leintwardine near Ludlow.*

Cypricardia solenoides, Pl. 8. f. 2. Subcylindrical, a little compressed; beaks near to the small, rounded, anterior extremity; posterior extremity flattened and truncated at the edge; lunette large and deep. Length $5\frac{1}{2}$ lines, width $11\frac{1}{2}$ lines.

Some specimens of *C. amygdalina* approach near to this species, but the fossils referred to this genus throughout the Upper Silurian Rocks are often so much distorted by pressure that it is difficult to distinguish their original form.

Loc. *Ludlow escarpments; Abberley.*

Psammobia rigida, Pl. 8. f. 3. Subcylindrical, three times as wide as long; surface raised in 10 or 12 sharp undulations; anterior side slightly attenuated; the posterior truncated; beaks rather nearest to the former; base straight. Length $3\frac{1}{2}$ lines, width about 9 lines.

A small shell, the specimen is not perfect, but shows indications of 3 ridges diverging from the beaks over the posterior side.

Loc. *Garden House near Aymestry.*

Cardium striatum. (See Pl. 6. f. 2.) Also Aymestry Limestone.

Loc. *Shelderton.*

Cardiola (*Broderip*). Gen. Char. "An oblique, equal-valved, unequal-sided bivalve; beaks prominent and curved; surface concentrically furrowed; hinge line long, with a flat area."

Not being able to refer the two following fossils to any established genus, Mr. Broderip proposed a new one for them. He has not, however, had access to those parts which are required for clear generic distinctions, and was obliged to confine himself to an indication of the general contour. These shells are very characteristic of the *lower* members of the Upper Silurian Rocks over very wide tracts.

Cardiola fibrosa, Pl. 8. f. 4. Cordiform, longitudinally striated; striæ numerous, fine; beaks elongated, sharp; concentric furrows about 9. Length 11 lines, width about 10 lines.

The absence of the longitudinal striæ upon the zones near the beak may be due to the fossils being casts of the internal surface of the shell.

Loc. *Mary Knoll Dingle, near Ludlow; Long Mountain, near Welch Pool; Flagstone Quarries of Yechad, Montgomeryshire; Radnor Forest, &c.*

Cardiola interrupta, Pl. 8. f. 5. (*Cardium cornu-copiæ*[1], *Goldfuss*, t. 143. f. 1.) Cordato-ovate, rather compressed; surface marked with many diverging furrows which are not so deep as the less numerous concentric ones; beaks short. Length 11 lines, width the same.

Loc. *Garden House Quarry near Aymestry; Breidden Hills; Long Mountain and Railth near Welch Pool; Water-break-its-neck, Radnor Forest; Cwm-craig-dhu, Myniddepynt, Brecknockshire.*

Modiola? semisulcata, Pl. 8. f. 6. Transversely ovate, convex, imperfectly 2 lobed; anterior lobe

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[1] The *Cardium cornu-copiæ, Goldfuss,* is the *Cardiola interrupta* of the Lower Ludlow. Our name was adopted and printed (see Geol. Proc. vol. ii. p. 13. Jan. 1834.) four years before the last fasciculus of the work of Goldfuss was published. Although describing it as a *Cardium,* Goldfuss allows that he refers it with uncertainty to that genus.—R. I. M.

much smallest, transversely furrowed, furrows extending into the middle of the shell; beaks prominent, near the anterior extremity. Length 2 inches, width 1 inch.

A portion of the anterior extremity of the most perfect specimen of this shell being wanting, we are quite uncertain of the genus; very probably it does not belong to *Modiola*.

Loc. *Shelderton Hill; and near Aymestry.*

Avicula reticulata. Also Aymestry Limestone. (See Pl. 6. f. 3.) Casts in a soft ferruginous stone.

Loc. *Myddleton Hall, Caermarthenshire.*

Leptæna Lepisma (*Dalm.?*), Pl. 8. f. 7. Semicircular, convex, shining, with a few obscure slightly elevated forked rays; hinge line equal to the width; front moderately deflected. Length about 3 lines, width 5½ lines.

A pretty shell with a satin-like tissue; a few punctures in the substance give obscure indications of minute spines.

Loc. *Near Clungunford.*

Leptæna euglypha. Productus euglyphus. (See Pl. 12. f. 1.) More frequent in Wenlock Limestone.

Loc. *Eastnor Park; Myddleton Hall, Caermarthenshire.*

Leptæna depressa. Productus depressus. (See Pl. 12. f. 2.) More frequent in Wenlock Limestone.

Loc. *Abberley; the Hayes, Dudley; Myddleton Hall, with L. euglypha, &c.*

Orthis orbicularis? (See Pl. 5. f. 16.) Also Upper Ludlow Rock.

Loc. *Myddleton Hall; Oldcastle, Malverns; Abberley; near Aymestry.*

Atrypa obovata, Pl. 8. f. 8 and 9. Transversely obovate; convex, smooth; beaks small, close; front with a marginal elevation in one valve, forming a rounded sinus in the edge of the other. Length 5 lines, width 5½ lines.

Loc. *Mathon Lodge; west flank of the Malvern Hills.*

Atrypa didyma (*Dalm.*). (See Pl. 6. f. 4.) Also Aymestry Limestone, &c.

Loc. *Shelderton Hill, Ludlow.*

Atrypa galeata, (*Dalm.*), Pl. 8. f. 10. (See Pl. 12. f. 4.) Also Wenlock Limestone. The section figured here shows the internal septa, which are not so well seen in the specimens from the Wenlock Limestone.

Loc. *Ludlow escarpments; Stumps Hill; Eastnor Park; Oldbury Camp; Westwood Common; Pendle beds, Aymestry* (*Sitch Wood, Ledbury*).

Atrypa affinis. (*M. C.* 324.) (See Pl. 6. f. 5.) More frequent in Aymestry Limestone, &c.

Loc. *Myddleton Hall; Turner's Hill, Dudley.*

Atrypa aspera (*Scloth.*). (See Pl. 12. f. 5.) Also Wenlock Limestone.

Loc. *West flank of Malverns.*

Spirifer radiatus. (*M. C.* 493.) (See Pl. 12. f. 6.) Also Wenlock Limestone.

Loc. *West flank of Malverns; Myddleton Hall.*

Spirifer trapezoidalis? (*Dalm.*) (See Pl. 5. f. 14.) Also Wenlock Shale.

Loc. *Mathon Lodge.*

Terebratula Wilsoni. (See Pl. 6. f. 7.) Also Aymestry Limestone.

Loc. *Sitch Wood; Turner Hill.*

Lingula lata, Pl. 8. f. 11. Obovate, squarish, flat, smooth; front edge truncated. Width about 2 lines, length 3 lines.

Loc. *Ludlow escarpments, viz., Elton, Evenhay, &c.*

Lingula? striata, Pl. 8. f. 12. Obovate squarish, very flat, minutely striated transversely; front edge truncated. Length 5 lines, width 4 lines.

This is of the same shape as the last, but has minute striæ, on its inner surface at least, and thus closely resembles a fish's scale. Is it a shell?

Loc. *Near Aymestry.*

Euomphalus funatus. (*M. C.* t. 450.) (See Pl. 12. f. 20.) Also Wenlock Limestone, &c.

Loc. *Myddleton Hall; Abberley.*

Pleurotomaria undata, Pl. 8. f. 13. Conical, with a convex base, obtuse; whorls about 4, very convex or round, crossed by many oblique slightly prominent waves; sinus in the lip deep, forming a narrow scarcely elevated band around the whorls; aperture round. Height $2\frac{1}{2}$ inches, diameter $2\frac{1}{4}$ inches.

Loc. *Escarpments near Ludlow; Presteign; Dean's Corner.*

Pleurotomaria Lloydii, Pl. 8. f. 14. Conical, with a very convex base, acute; whorls about 5, convex, ornamented with many striæ, 5 carinæ below and 2 above the prominent narrow band which is formed by the filling up of the deep marginal sinus; aperture longer than wide. Height $2\frac{1}{4}$ inches, diameter $1\frac{1}{4}$ inch.

This shell is much longer in form, and has less convex whorls than the last; it is often much pressed; but its carinæ distinguish it well. Named after Dr. Lloyd of Ludlow, whose labours in advancing the objects of this work have been often adverted to.

Loc. *Shelderton Hill; near Aymestry; Dean's Corner.*

Terebra? sinuosa, Pl. 8. f. 15. Turreted, subulate; whorls numerous, convex, marked with sharp lines of growth; a wide, shallow, angular sinus in the edge of the lip, the angle a little above the middle. Length $1\frac{1}{4}$ inch, diameter 5 lines.

The sinus in the edge of the aperture is nearly right-angled, but it is indicated in our specimen only by the lines of growth; independent of these lines, the whorls are smooth.

Loc. *Garden House Quarry, Aymestry.*

Orthoceras Ludense, Pl. 9. f. 1 *a.* Very gradually tapering, smooth; septa very convex, few; siphuncle central. Diameter 2 inches.

β. f. 1 *b.* Surface marked with small annular waves near the aperture. Diameter $3\frac{1}{4}$ inches.

This fossil approaches to *O. giganteum* of the Carboniferous Limestone. We provisionally employ a new name until we can define the specific character with greater precision.

The waved lines in var. β are probably only lines of growth, and as they are upon the portion free from septa, they may perhaps indicate a full-grown shell; if so, it does not attain to the size of *O. giganteum* of the Carboniferous Series.

Loc. *Ludlow.*

Orthoceras gregarium, Pl. 8. f. 16. Very gradually tapering, smooth; septa numerous, distant in the young shell, deep; siphon central, small; aperture round. Length 4 to 6 inches, diameter about $\frac{1}{2}$ an inch.

This shell bears some resemblance to *O. inæquiseptum* of Professor Phillips, but is supposed to be distinct.

Loc. *Ludlow.*

Orthoceras distans, Pl. 8. f. 17. Very gradually tapering, smooth; septa almost as distant as they are wide, deep; siphon large, eccentric; aperture nearly round; diameter about $1\frac{1}{4}$ inch.

We have only a few joints in any specimen of this very distinct shell.

Loc. *Near Aymestry; also at the Hay Head Limeworks near Bar Beacon, Staffordshire.*

Orthoceras eccentricum? Also Wenlock Shale. (See Pl. 13. f. 16.)

Loc. *Trefnant, Montgomeryshire; in black calcareous nodules.*

Orthoceras imbricatum, Pl. 9. f. 2. (*Orthoceratites imbricatus*, "*Wahl.*" *Hising. Petr. Suec.* p. 29. t. ix. f. 9?) Gradually tapering; septa very near, waved.

We have not been able to discover the position of the siphuncle in the shell before us. It resembles *O. undulatum* of M. C. t. 59. in the curvature of the septa, but is more gradually tapering in form, and has not so much tendency to enlarge in the last chamber, and to contract again towards the aperture, which gives the *O. undulatum* a fusiform aspect; it agrees better with *O. imbricatus* of Wahlenberg and Hisinger, which perhaps differs from *O. undulatum* M. C., in the position of the siphon. The *O. undulatus* of Hisinger is *O. annulatum* of M. C., and his *O. annulatus* is probably our *O. Ibex*, for he describes it smooth, in which it differs from *O. annulatum*.

This specimen is much flattened, perhaps by pressure.

Loc. *Ludlow escarpments.*

Orthoceras filosum, Pl. 9. f. 3. Rather quickly tapering, longitudinally ribbed; ribs fine, numerous; septa numerous.

This differs from *O. striatum* of M. C. in the coarseness of the lines upon the surface, which in this are sharp elevations. The position of the siphon is unknown; length 1½ foot, greatest width about 4 inches.

Loc. *Ludlow escarpments.*

Orthoceras virgatum, Pl. 9. f. 4. Subfusiform, elongated, longitudinally and irregularly but not deeply fluted, grooves 40; septa numerous; length 6 or more inches, diameter one inch and a half.

Nearly like *O. Gesneri* of Martin t. 38; but it has smaller and less regular grooves, and is rather fusiform. *O. angulatus* of Wahlenberg (Hisinger) is curved but is apparently *O. Gesneri* of Martin, and *O. circularis* M. C. is a worn specimen of the same.

Loc. *Mocktree Forest; Abberley Hills.*

Orthoceras dimidiatum, Pl. 8. f. 18. Slender; surface transversely undulated, waves reaching only half across; septa moderately distant; length $2\frac{1}{2}$ inches, diameter $\frac{1}{4}$ inch.

Loc. *Water-break-its-neck, Radnor Forest.*

Orthoceras fimbriatum. (See Pl. 13. f. 20.) Also Wenlock shale.

Orthoceras annulatum, Pl. 9. f. 5.

This also occurs in the Wenlock shale, and is described hereafter.

Orthoceras Ibex. (See Pl. 5. f. 30.) Also Upper Ludlow Rock.

Loc. *Near Ludlow and Western flanks of the Malvern Hills.*

Orthoceras pyriforme, Pl. 8. f. 19, 20. Ovato-pyriform, smooth, the chambered portion elongated; septa numerous, even; siphuncle half way between the centre and margin, rather large, inflated between the septa; aperture narrow, enlarged at one extremity where the edge is reflected. Length of inflated portion 4 inches, diameter of ditto $2\frac{1}{2}$ inches.

The last chamber occupies half the ovate portion of the shell, and varies in shape according to the direction of the pressure. The form of the aperture, as far as can be collected from the imperfect specimens in our hands, is curious, being very narrow for about half an inch, and then expanded to circular; the edge is reflected, especially at the larger end of the aperture, where it resembles the beak of a pitcher. This remarkable shell thus forms a link between *Orthoceras* and *Phragmoceras*, differing from the latter only in being straight. Were it thought necessary to establish a distinct genus, we might perhaps name it *Gomphoceras*, from its club-like form[1].

Loc. *Leintwardine Hill, near Aymestry; also Ledbury in Wenlock Limestone.*

Cyrtoceras læve, Pl. 8. f. 21. Also in Upper Ludlow Rock, Pl. 5. f. 34. (For the generic description of Cyrtoceras see Goldfuss.) Elongated, pointed, curved into a semicircle, smooth or only marked with lines, of growth; generally compressed; we have not seen the septa. Length 1½ inch, diameter of aperture 7 lines.

This strongly resembles *Hortolus convolvens* of Steininger, (*Mem. de la Soc. Geol. de France*, vol. i. p. 370. t. xxiii. f. 3.) but has a more even surface.

Loc. *Abberley.*

Phragmoceras (Broderip). (Φράγμα or φραγμὸς, *septum*, κέρας, *cornu.*) Gen. Char. Shell incurved and compressed, more or less conical; septa entire at their edges, crossed externally by the lines of growth; siphuncle near the inner margin; aperture contracted at the middle, its outer extremity produced into a subcylindrical beak.

A genus distinguished from Orthoceras by being curved and having a nearly marginal siphuncle; also from all the species of that genus, except *O. pyriforme*, by the form of the aperture, which further distinguishes it from *Cyrtoceras* of Goldfuss, the aperture of which is round.

Phragmoceras arcuatum, Pl. 10. f. 1 *a*. Slightly arched, gibbose, elongated; surface even; siphuncle broad, beak direct? the lines of growth are sharply marked; length 2¾ inches. Length of aperture 1¾ inch.

Around the edge of the last septum is a series of furrows indicating a thickening of the shell about the base of the last chamber; similar furrows, but longer, occur upon the only specimen we have seen of *Orthoceras inflatum* from the Eifel.

Loc. *Ludlow escarpments, and near Ledbury.*

β. Pl. 11. f. 1. Rather more elongated than var. α. Length 2½ inches; length of aperture 1¼ inch.

Loc. *Shelderton Hill, near Ludlow.*

Phragmoceras ventricosum, Pl. 10. f. 4, 5, 6. (*Orthoceratites ventricosus? Steininger, Mem. de la Soc. Geol. de France*, vol. i. p. 368. t. xxii. f. 5.) Slightly arched, hooked near the apex, compressed; surface marked with numerous ridges which cross the edges of the numerous septa; aperture nearly closed in the middle, beak produced. Length 6 inches; length of aperture 4 inches.

This is the largest species of the genus; we have not been so fortunate as to detect the siphuncle. F. 4. represents a nearly entire shell; f. 5. is a view of the aperture of a specimen which has been depressed so as to bring the lips nearer in the middle than the natural position; f. 6. is from a specimen which has the beak nearly perfect. If the fossil described by Steininger be the same as our species, the artist has apparently reversed the curve of the septa.

Loc. *Leintwardine Hill, Gardenhouse Quarry, Aymestry; also from the Western flank of the Malverns; Dudley.*

Phragmoceras compressum, Pl. 11. f. 2. Much curved, elongated and compressed; marked with distant lines of growth; this is so much curved as to form nearly a circular hook. Longest diameter 3 inches; length of aperture 1¼ inch.

Loc. *Near Aymestry.*

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[1] I am indebted to Mr. Proctor, Surgeon, of Leintwardine, for several Orthoceratites, and particularly for one of the most illustrative specimens (f. 20.), which best shows the sudden diminution of the inflated portion towards the apex.

Phragmoceras? nautileum, Pl. 10. f. 2, 3. Broad, compressed, much curved; surface transversely waved, waves forked. Length 3 inches; ditto of aperture 2 inches.

We have not seen the septa of this shell; it has much the aspect of a Nautilus, but is too irregular and has no columella.

Loc. *Myddleton Hall. In shale south of the Longmynd.*

Lituites articulatus, Pl. 11. f. 5 & 7. Volutions about 3, compressed, crossed by numerous ring-like costæ, whose distance nearly equals their thickness. Diameter of the whorled portion $1\frac{1}{4}$ inch; diameter of aperture 5 lines.

This is suspected to be the involute portion of the same species of shell as that which is called *Orthoceras articulatum*, Pl. 5. f. 31. F. 7. is from a portion a little bent, and approaching the straight specimens, which might have been decidedly referred to this species, but that the involute parts have not yet been found in the same rock with them.

Loc. *Ludlow escarpments; Elton*, f. 5. *Shelderton*, f. 7.

Lituites? Ibex, Pl. 11. f. 6. (*Inachus costatus? His. Petr. Suec.*, p. 38. t. xii. f. 2.) This figure represents an arched portion of probably *Orthoceras Ibex*, Pl. 5. f. 30, which therefore approaches to *Lituites*, but we have not seen specimens perfect enough to settle the question.

Loc. *Ludlow; Black Mountain near Clun, Long Mountain near Welch Pool.*

Lituites giganteus, Pl. 11. f. 4. Volutions about 3, close, rather compressed, crossed by many oblique arched ribs which are lost over the margin; siphuncle central, aperture nearly square, rounded; the inner whorls slightly indent those around them. Diameter of the last whorl $4\frac{1}{2}$ inches; length of the aperture $1\frac{3}{4}$ inch; width $1\frac{1}{2}$ inch.

Loc. *Mocktree Hays; Churn-bank near Ludlow.*

Lituites tortuosus, Pl. 11. f. 3. Irregularly curved; whorls diminishing very slowly; surface even; septa numerous, curved only one way; aperture oblong-ovate, imperfectly 5 angled. Length of aperture $10\frac{1}{2}$ lines, width 8 lines.

We have only an imperfect specimen the chambers of which are filled with black limestone, and the place of the shell with sulphate of barytes, which adheres to the matrix, so that we cannot see the outer surface.

Loc. *Between Welch Pool and Berriw in black calcareous nodules.*

Bellerophon dilatatus. (See Pl. 12. f. 23, 24.) Also Wenlock Limestone.

Loc. *Kingsland.*

FOSSIL SHELLS OF THE WENLOCK LIMESTONE.

PLATE XII.

Leptæna euglypha, Productus euglyphus passim, f. 1. (*Dalm. Act. Holm.*, 1827. p. 108. t. i. f. 3; *His. Pet. Suec.*, p. 69. t. xx. f. 4.) Sub-prismatic, three-angled, with an obtuse front; flattened above; surface covered with fine radiating, elevated lines and numerous slender ridges; depressed margin large; hinge-area long, narrow, and straight. Length of flat portion 1 inch; width $2\frac{1}{2}$ inches; depth of front 1 inch.

This shell varies in its form, the sides being sometimes less flat than in the figure; the fine lines also are variable, sometimes becoming as large as the slender ridges between which they occur; the sides are extended at the extremities of the hinge-line, and form projecting angles, which together with the general form serve to distinguish this shell from *Spirifer crenistria* of Phillips, to the flatter valve of which some specimens bear a great resemblance. The striæ are often so like those on *Orthis alternata*, Pl. 19. f. 6., that it is sometimes almost impossible to say to which shell fragments belong.

Loc. *Wenlock; Dudley; Aston, near May Hill; Ledbury; Fownhope; Abberley; and near Wigmore.*

Leptæna depressa, Productus depressus passim, f. 2. (*Dalm. l. c.* p. 106. t. i. f. 2; *His. Pet. Suec.* p. 69. t. xx. f. 3; *Productus depressus, M. C.* t. 459.) A shell frequently found on the surface of slabs of limestone at Wenlock and Dudley, and easily distinguished from a somewhat similar fossil which occurs in the Mountain Limestone of the North of England and the Queen's County and other parts of Ireland, and which Prof. Phillips has named *Producta analoga*. In that shell the valves are almost equally convex, and the deflected portion descends very little lower than the convex surface of the lower valve, while in *L. depressa* of our Silurian Rocks, the middle of the lower valve is concave, the sides are expanded like wings at the extremities of the hinges, and the deflected margin is at least as deep as the valve is long. In the *P. analoga*, the outline approaches nearer to a semicircle than in the *L. depressa*, and in this respect agrees better with the *L. rugosa, Dalm.*, a species we believe not yet found in England. Besides its difference in form, *L. depressa* is usually of less size than *P. analoga*. Length of flat portion about $\frac{3}{4}$ inch; width $1\frac{1}{2}$ inch; length of deflected portion nearly 1 inch.

Loc. *Wenlock; Dudley; near Aymestry; Abberley; May Hill; the Lye near Stourbridge.*

This highly characteristic fossil occurs both in the Aymestry and Wenlock Limestones, but most abundantly in the latter. It is sparingly distributed throughout the other strata of the Silurian Series.

Atrypa didyma, (Dalm.). (See Pl. 6. f. 4.) Also Aymestry Limestone.

Loc. *Limestone Quarries, Eastnor Park, Ledbury.*

Atrypa tenuistriata, f. 3. (*Terebratula obtusa, Linn. Trans.*, vol. xii. p. 516. t. 28. f. 3, 4.) Transversely obovate, gibbose, with the beaks rather prominent, and a narrow elevation in the front; longitudinally striated; beaks small, close. Length $1\frac{3}{4}$ inch; width the same.

So nearly is this related to *A. oblata, M. C.* t. 268., which in some states even shows indications of striæ, that it is not easily distinguished, but the position of the beaks affords a strong character. The extent of front which is elevated, varies in different specimens.

Loc. *Wenlock; Croft; Crew's Hill and the Purlieux,* (*Malvern Hills*); *Lindells and Fownhope, Woolhope.*

Atrypa galeata, f. 4. & Pl. 8. f. 10. (*Dalm. l. c.* p. 130. t. V. f. 4. *His. Pet. Suec.*, p. 76. t. xxii. f. 1.) Obovate, ventricose, longitudinally furrowed, finely wrinkled with lines of growth; front depressed in the middle; lesser valve convex, the other very deep with a large incurved umbo. Length 14 lines; width the same; depth of each valve $\frac{1}{2}$ inch.

The furrows are chiefly confined to the middle of the shell; they are irregular, and form several teeth in the edge of the deflected portion. The interior has septa resembling those of *Pentamerus*; a section of which is shown in Pl. 8. f. 10.

Loc. *Westhope in Wenlock Edge; near Aymestry, &c.; also Lower Ludlow Rock.*

Atrypa affinis, (*M. C.*) (See Pl. 6. f. 5.) Also Aymestry Limestone.

Loc. *May Hill; Limestone Quarries, Eastnor Park; Malvern Hills; Abberley Lodge.*

Atrypa aspera, f. 5. (*Dalm. l. c.* p. 128. t. iv. f. 3. *His. Pet. Suec.* p. 75. t. xxi. f. 12. *Ter. asper, Schloth. Nach. Petr.* 1822. p. 68. t. xviii. f. 3.) Orbicular, with the front slightly truncated; marked with radiating furrows, which increase in number towards the margin, and are crossed by undulating laminæ; valves equally convex. Length ½ inch, width the same.

Distinguished from *A. affinis*, Pl. 6. f. 5. by the equally convex valves, and their more orbicular form.

Loc. *Benthall Edge and other places in the Wenlock Edge.*

Spirifer radiatus f. 6. (*M. C.* t. 493.) A very neatly striated shell, which can hardly be confounded with any other. Length 14 lines; width 16 lines; depth of each valve 6 lines.

Although this shell occurs in other situations, it is most abundant in the Wenlock and Dudley Limestone.

Loc. *Wenlock and Dudley; Tynewidd, Caermarthenshire; Abberley Lodge.*

Spirifer octoplicatus? f. 7. (*M. C.* t. 562. f. 2, 3.) Our specimen is smaller than those figured in Min. Con., but otherwise agrees with them. The surface is nearly smooth, the plaits 4 on each side of the central one. Length 2½ lines; width 4½ lines. Fragments that appear to be portions of this species, have been met with in several parts of the Silurian System, but not perfect enough to be identified.

Loc. *Abberley; Dudley.*

Spirifer crispus? f. 8. (*Delthyris crispa, Dalm. l. c.* p. 122. t. iii. f. 6. *His. Pet. Suec.*, p. 73. t. xxi. f. 5.) Transversely elongated, gibbose, plaited; plaits 5 or 7, crossed by elevated laminæ; beaks remote; extremity of the hinge line obtuse. Length 3½ lines; width 5½ lines, often larger.

In some specimens of this shell, the transverse laminæ are so prominent as to lead us to think they belong to *D. sulcata, Hisinger*, only they do not show the projecting lateral angles which distinguish that species.

Loc. *Dudley; Walsall; Wenlock, (very frequent).*

Orthis rustica, f. 9. Transversely oblong, rather square, depressed, uneven, with many rounded radii, which become more numerous towards the margin; front straight or slightly elevated. Length 1 inch 1 line; width 1¼ inch.

The hinge area is triangular and rather large; radii between 40 and 50.

Loc. *Wenlock; Valley of Woolhope.*

Orthis alternata? (See Pl. 19. f. 6.) Also Caradoc Sandstone.

Loc. *Abberley Lodge.*

Terebratula lacunosa, Linn. f. 10. & Pl. 5. f. 19.; also Upper Ludlow Rock. *Schloth. Nach.* 1. p. 68. t. xx. f. 6. *T. borealis, Schl. Von Buch, Tereb.* p. 67. The difficulty in distinguishing between the allied species of plaited *Terebratulæ*, (especially from fragments only) has induced us to figure what may be called similar shells on the Upper Ludlow and Wenlock Limestone plates. It is not impossible, however, that they may be different species, although we cannot, in the specimens we have had to compare, find a distinguishing mark. *T. lacunosa* of Von Buch belongs to the Oolitic Series; and is probably *T. intermedia* of Min. Con. Length 9 lines; width 11 lines.

Loc. *Wenlock Edge; Nash Lime Scar, Presteign; Wallsall.*

Terebratula crispata, f. 11. Rhomboidal, convex, transverse, subtrilobate, acutely plaited; plaits about 18, all terminating in the front, about 6 of them raised in the middle; sides smooth; beaks small. Length 10 lines; width 11 lines.

Loc. *Nash Scar, and other places in Radnorshire.*

Terebratula imbricata, f. 12. Obovate, transverse, 3-lobed, plaited; plaits twice or thrice forked, crossed by imbricating scales, especially near the edge; front much elevated. Length 8 lines; width the same.

If specimens we have seen from Sweden be correctly labelled, *T. marginalis of Dalman* is probably the same species.

Loc. *Wenlock Edge.*

Terebratula cuneata, f. 13. (*Dalm. l. c.* p. 141. t. vi. f. 3. *His. Pet. Suec.* p. 81. t. xxiii. f. 5.) Triangular, longer than wide, depressed, strongly plaited; plaits 10 or 12, straight, of which a few in the front are elevated; beak of the larger valve straight, produced. Length ½ inch; width 5 lines; depth of each valve 2 lines.

Peculiar to the Wenlock Limestone.

Loc. *Wenlock and Lincoln Hill; Dudley; Abberley.*

Terebratula bidentata, f. 13 *a.* (*Dalm. l. c.* p. 142. t. vi. f. 5. *His. Act. Holm.* 1826. t. vii. f. 5. *Pet. Suec.* p. 81. t. xxiii. f. 7.) Triangular, with a rounded front, smooth, depressed, strongly plaited; plaits acute, about 8, two of which in the front are raised; beak sharp. Length 3 lines; width 3½ lines.

Much like the last, but shorter and furnished with fewer plaits.

Loc. *Dudley; Abberley.*

Terebratula deflexa, f. 14. Transversely obovate, gibbose, sharply plaited; plaits about 24, of which 4 or 5 in the front are turned downwards; beaks small, adpressed. Length nearly 5 lines; width 6 lines; depth 4½ lines.

A rare species, remarkable for the sinus in the front being in the larger or lower valve.

Loc. *Wenlock Edge.*

Terebratula Wilsoni; (See Pl. 6. f. 7.); common at Aymestry; rare in the Wenlock formation.

Loc. *Limestone Quarries, Eastnor Park.*

Terebratula Nucula?; (See Pl. 5. f. 20.); also Ludlow Rock.

If this differ at all from the Ludlow species, it is in being rather flatter.

Loc. *Limestone Quarries, Eastnor Park; Dudley; and Western slopes of the Malvern Hills.*

Patella? implicata, f. 14 *a.* Oval, depressed, surface composed of concentric laminæ. Longest diameter 2 lines.

We have only seen the upper surface of this small shell, and therefore assign its generic name with doubt; it bears some resemblance to *P. antiquissima,* (*His. Pet. Suec.* p. 45. t. xii. f. 10.) and may represent that fossil in its young state. We have several individuals all of one size, on the same mass of stone with *Spirifer octoplicatus?*.

Loc. *Abberley.*

Nerita spirata, var.? f. 15. (*M. C.* t. 463. f. 1, 2.) Subglobose, smooth; spire small; upper part of the whorls flattened; aperture transversely oval. Height ¾ inch; diameter the same.

This has a slightly more prominent spire than *Nerita spirata,* M. C., and the upper part of the whorls are less flattened and smoother; but as the species of the Carboniferous Limestone also varies in these points, we do not feel justified in considering this distinct.

Loc. *Nash Limestone; Presteign; Ledbury; New's Wood, Eastnor Park.*

Nerita Haliotis, f. 16. Subglobose, with the last whorl greatly expanded towards the aperture, and irregularly undulated; spire small, rather sunk; aperture orbicular. Height 1 inch; diameter 1 inch 4 lines.

Some specimens are so flat as to resemble a *Haliotis* or *Sigaretus,* and many have a furrow around the upper part of the last whorl.

Loc. *Ledbury, and West flank of Malverns; Wren's Nest, &c., Dudley.*

Euomphalus discors, f. 18. (*M. C.* t. 52. f. 1.) The upper part of this shell being covered by coarse undulating laminæ or scales, and the under by fine close ridges only, render it easy to be distinguished.

Loc. *Wenlock; Dudley.*

Euomphalus rugosus, f. 19. (*M. C.* t. 52. f. 2. *E. catenulatus. His. Pet. Suec.* p. 37. t. xi. f. 9.) The two surfaces of this shell being alike, distinguish it from the last. We see no reason for supposing *E. catenulatus* of *Hisinger* to be different.

Loc. *Wenlock; Dudley.*

Euomphalus funatus, f. 20. (*M. C.* t. 450. f. 1, 2. *His. Pet. Suec.* p. 37. t. xi. f. 11.) The sharp concentric ridges joined by lines of growth, distinguish this species.

Loc. *Wenlock; Dudley; Abberley; Walsall; Benthall Edge; and many other places.*

Euomphalus sculptus, f. 17. Depressed, conical; surface ornamented with concentric furrows and elevated lines; whorls about 3; aperture circular; umbilicus large. Height 8 lines; diameter nearly $1\frac{1}{4}$ inch.

The concentric lines and furrows, which are numerous but not deep, give an elegance to this fossil.

Loc. *Ledbury; Eastnor Park.*

Orthoceras Brightii, f. 21. Conical, elongated, smooth?; siphuncle nearly central, large, cylindrical; septa $\frac{3}{4}$. Their diameter apart. Diameter about $1\frac{3}{4}$ inch.

Judging from the fragments we have examined of this large specimen, we suppose it to taper more rapidly than its congeners; the marks upon the siphuncle indicate very close septa, but we have not been able to trace the degree of their convexity. The septa have been extended a short way into the siphuncle, which is occupied by stone; the chambers are filled with white calcareous spar, which has received a tinge of brown around the siphuncle. From the rich collection of Mr. B. Bright.

Loc. *Western flanks of Malvern Hills.*

Orthoceras annulatum. (See Pl. 9. f. 5.) Also in Wenlock Shale.

Loc. *Hay Head, Walsall; Nash Scar, Presteign.*

Orthoceras pyriforme. (See Pl. 8. f. 19 and 20.) Also Lower Ludlow. A small individual; the diameter of the base of its last chamber is nearly $1\frac{1}{2}$ inch.

Loc. *Ledbury.*

Lituites? Biddulphii, Pl. 11. f. 8. We have seen a fragment only of this shell, consisting of a cast from the inside of the two last chambers, but it shows that the whorls were flat on their sides, that they increased in size rather rapidly, and that each received a slight impression from the preceding one. The length of the aperture is 17 lines, width 13 lines. Many individuals of the minute shell *Spirorbis tenuis* are imbedded on the cast, having been detached from the inner surface of the *Lituite* where they had taken up their residence after the *Cephalopod* had quitted it. Found by Mr. Ormus Biddulph, whose cabinet has furnished other species for the illustration of this work.

Loc. *Ledbury.*

Lituites giganteus. (See Pl. 11. f. 4.) Also Lower Ludlow.

Loc. *Aston near Ludlow.*

Conularia quadrisulcata, Miller, f. 22. (*M. C.* t. 260. f. 3 and 4; *His. Pet. Suec.* p. 30. t. x. f. 5; *C. Sowerbii, Defr. Blainv. Malacol.* p. 377. t. xiv. f. 2 *b, c, d* and *e.*) This fossil is little understood. In all probability it ought to be ranked in a higher class than Mollusks. The specimen figured shows a septum in a very perfect condition; it is convex, with a sharpish compressed umbo in the centre and a deep depression at each of the most remote angles, bearing much resemblance to two siphuncles; its surface is marked with short striæ in the direction of its longest diameter, giving it an aspect totally different from that of the septum in *Orthoceras*. It is one of the few animals of the Silurian period, whose existence would at first sight seem to have been prolonged beyond the æra of the Old Red Sandstone, for forms, approaching very near to our specimens, are found in the ironstone nodules of the carboniferous series. In the Min. Con. no distinction is drawn between the specimens from the transition limestone and those from the carboniferous ironstone. By close comparison, however, it would appear that different species may be established; for the obliquely transverse furrows in the former are crossed by little grooves very regularly arranged over the shell, while in the ironstone specimens the corresponding furrows are either smooth or irregularly grooved; the ridges in both appear when perfect to be crenated, but most distinctly so in the specimens from Coal Brook Dale, from whence Mr. Prestwich has a large collection. If this structure of the surface be sufficient to indicate two distinct species, one must retain the original name, and the other may have that given by Defrance.

By some accident, Hisinger has given to this genus, Lamarck's generic character of *Conilites*, which is probably only the alveolus of a *Belemnite?*. He may possibly have taken the *Conularia teres, M. C.*, for the type of the genus, the square form not having been mentioned in the generic character; but that species it is said, "probably belongs to another genus." Defrance (see De Blainville as above) has referred to both species as different portions of the same. His figures are copied from Mineral Conchology.

Loc. *Wenlock, Dudley, &c.*

Bellerophon apertus. (*M. C.* t. 469.) (See Pl. 13. f. 21.) Also Wenlock Shale.

Loc. *Ledbury.*

Bellerophon dilatatus, f. 23 and 24. Discoid, smooth; sides largely umbilicated; margin broad, slightly convex, with a central ridge; whorls few; aperture suddenly dilated to a much greater diameter than the spire, and inclosing it, orbicular. Diameter of the spire 1 inch 8 lines, thickness 1 inch, longest diameter of the aperture 3 inches, rather longer than wide.

The last whorl, before it expands to form the large aperture, is twice as wide as long. The edge of the aperture embraces two thirds of the discoid spire; the front of it has no fissure, although there is a ridge upon the whorl which indicates the existence of such a fissure at an earlier period of growth.

Two of our specimens show furrows inside the mouth; the one from the Lower Ludlow Rock is nearly smooth, but has slight indications of them: may not the former be impressions of the outer surface?

Loc. *Burrington near Ludlow.*

Cornulites serpularius, Schlot. Pl. 26. f. 5. (*Schloth. Petr.* t. xxix. f. 7.) We can scarcely attempt a description of this anomalous fossil, of which at present but one species is known. So unlike is it to anything we have seen, that we are unable to assign it a place in the system of animals, or draw a comparison between it and any other creature. Its general form is a much elongated, hollow, more or less crooked cone, open at the base; in its early state it is parasitical, being attached by its side and often in pairs. The external crust is longitudinally striated, and marked with slightly raised rings, which indicate its passage over the margins of the series of truncated cones of which the fabric is constructed. These short cones are placed within each other, their widest edges being directed towards the apex of the general envelope, the smallest or most internal cone occupying the apex itself. Thus they form a pyramid of cups, or if viewed in a reversed position, a series of broad rings gradually increasing in size, and capping but not covering each other. Each cup or ring is thinnest at that part which is inclosed by the succeeding ring, where also its diameter is least; both surfaces are of a foliated structure, and the outer blends with, and is lost in the external coat. Internally, each ring was apparently of a cellular structure, for it is composed of depressed, imbricating, and regularly arranged grains of calcareous spar. Some of the grains leave an impression upon the surface of each of the steps, which is formed upon the cast of the cavity of the cone by the thick edges of the rings. If these cells were the habitations of minute *Polypes*, they must have opened upon the edge of the cup, and each succeeding generation must have been located around the parent stock, and not upon or within the *Polyparium*, as in corals; but there is no appearance of stellæ or radiating laminæ. Upon the cast of the inner cavity may often be observed two, three, or more longitudinal impressions, each composed of two nearly approximating, fine, sunken lines, produced by elevations where probably there were joinings in the cups. The cone of the larger specimens is generally rather straight, with the rings regular, and no appearance of having been attached to any other body; but the young specimens are irregularly curved, have more or less distorted rings, and are fixed upon corals or shells. With such only does Schlotheim appear to have been acquainted, and had not we been supplied with a complete series by Mr. B. Bright, we should have been induced to consider the full-grown specimen as another species of the same curious genus.

Loc. *Western slopes of the Malvern Hills; Dudley.*

Tentaculites (Schloth.). Gen. Char. Shell subulate, tubular, open at one end; its outer surface surrounded by rings; aperture circular. (*Schloth. Petr.* p. 377.)

Various opinions have been formed concerning the fossils comprised under this generic character, some considering them to be the arms of Crinoidal animals and others the spines of a *Leptæna* (*Recueil des Planches,* 1831. Pl. 6. f. 6, 12 and 13., *Von Buch.*). Their structure is laminated and their shell thin.

Tentaculites ornatus, f. 25. (*Tent. annulatus? His. Pet. Suec.* p. 113. t. xxxv. f. 2; *Cyathocrinites pinnatus, in part, Goldfuss, Pet.* vol. i. p. 190. t. lviii. f. 7 *a.*) Subulate, ornamented with large rounded rings at irregular distances, the spaces between them filled with very small rings or striæ; the interior even. Diameter 1 line, length 10 lines. Very frequent on the slabs of limestone.

Loc. *Dudley.*

Avicula reticulata? Also Aymestry Limestone, (see Pl. 7. f. 6.)

Loc. *Falfield, Tortworth.*

Mya? Three very imperfect specimens.

Loc. *Falfield, Tortworth.*

SHELLS OF THE WENLOCK SHALE.

PLATE XIII.

Modiola antiqua, f. 1. Obliquely ovate, rather convex, smooth; anterior lobe indistinct; beaks small, near the anterior extremity. Length 8 lines, width 4½ lines.

This is a shorter shell than *M. Nilssoni* of Hisinger, and does not gape, otherwise it seems to be nearly related to that fossil.

Loc. *Glass House Hill, east flank of May Hill.*

Leptæna transversalis, f. 2. (*Dalm. l. c.* p. 109. t. 1. f. 4; *His. Pet. Suec.* p. 69. t. xx. f. 5.) Semicircular, very convex, finely striated and costated longitudinally; costæ linear, distant; hinge inflected; hinge line straight, equal in length to the width of the shell; lesser valve very concave. Length about 7 lines, width 8 or more.

Loc. *Hay Head and Tame Bridge, near Wallsall; Woolhope; Burrington; Buildwas Bridge; Stumps Wood, near Ledbury.*

Leptæna lævigata, f. 3. Semicircular, depressed, with projecting angles or ears at the extremities of the hinge line; surface shining, obscurely marked with minute concentric waves and a few radiating lines; front slightly depressed. Length $2\frac{1}{2}$ lines, width excluding the ears 4 lines.

It may be doubted whether this be an *Orthis* or *Leptæna*; we have seen but one valve.

Loc. *Burrington, near Ludlow.*

Leptæna minima, f. 4. Hemispherical, sharply radiated; radii alternately long and short, smooth. Length 2 lines, width 3 lines.

A very neatly formed and regularly striated species.

Loc. *Burrington.*

Leptæna euglypha. (See Pl. 12. f. 1.) Also Wenlock Limestone.

Loc. *Woolhope.*

Leptæna depressa. (See Pl. 12. f. 2.) Also Wenlock Limestone.

Loc. *Woolhope; Tynewidd; Croft; Hay Head; Frith Wood Coppice.*

Atrypa compressa, f. 5. Ovato-orbicular, transverse, rather compressed, smooth; front slightly indented; beaks very small. Length 5 lines, width 6 lines.

Loc. *Woodside and Nash, near Presteign.*

Atrypa depressa, f. 6. Transversely obovate, compressed, smooth, with about 3 obscure furrows along the middle; sides depressed; the front much elevated; the elevated portion square; beaks unequal. Length 4 lines, width 5 lines.

Loc. *Stumps Wood, Malverns; Delves Green, near Wallsall.*

Atrypa rotunda, f. 7. Nearly orbicular, very convex, smooth, with 5 obscure furrows; front elevated; beaks small, equal. Length 7 lines, width $7\frac{1}{2}$ lines.

Loc. *Escarpments of Wenlock Edge.*

Atrypa linguifera, f. 8. Orbicular, very convex, smooth; front elevated, the elevated portion tongue-shaped; beaks large, unequal. Length 9 lines, width the same; depth of both valves together $7\frac{1}{2}$ lines.

A nearly globose shell with prominent beaks.

Loc. *Stumps Wood; Valley of Woolhope; Delves Green.*

Atrypa tenuistriata. (*Terebratula obtusa, Sowerby in Linn. Trans.* vol. xii. p. 516. t. 28. f. 3 and 4.) (See Pl. 12. f. 3.) Also Wenlock Limestone.

Loc. *Woolhope; Malvern Hills.*

Atrypa galeata. (See Pl. 12. f. 4.) Also Wenlock Limestone.

Loc. *Delves Green and Hay Head, near Wallsall; Frith Wood, near Ledbury; Woolhope.*

Atrypa affinis. Also Aymestry Limestone. (See Pl. 6. f. 5.)

Loc. *Stumps Wood; Tame Bridge; Nash; Hay Head; Croft; Woolhope; Frith Wood Coppice; Delves Green.*

Atrypa aspera. (See Pl. 12. f. 5.) Also Wenlock Limestone.

Loc. *Delves Green; Hay Head; Woolhope; Stumps Wood.*

Spirifer? Pisum, f. 9. Lenticular, convex, indistinctly six-sided, smooth; front even, truncated; beaks equal, small; the area between them triangular, small. Length 3 lines, width the same.

Loc. *Hay Head.*

Spirifer trapezoidalis. (See Pl. 5. f. 14.) Also Ludlow Rock.

Loc. *Stumps Wood, and other places west side of Malvern Hills.*

Spirifer radiatus. (See Pl. 12. f. 6.) Also Wenlock Limestone.

Loc. *Woolhope; Hay Head and Tame Bridge, Wallsall.*

Spirifer crispus. (See Pl. 12. f. 8.) Also Wenlock Limestone.

Loc. *Wallsall.*

Spirifer sinuatus, f. 10. (*Terebratula sinuata, Sowerby in Linn. Trans.* vol. xii. p. 516. t. 28. f. 5 and 6; *Delthyris cardiospermiformis; His. Anteckn.* vol. iv. t. 7. f. 6; *Dalm. l. c.* p. 124. t. 3. f. 7; *His. Pet. Suec.* p. 74. t. 21. f. 9; *Sp. cardiospermiformis; Von Buch sur les Spirifers et Orthis,* t. 1. f. 7.) Obcordate, deeply two-lobed, eared, longitudinally striated; larger valve very deep, with an incurved beak; area between the beaks triangular. Length $3\frac{1}{2}$ lines, width about the same, often more.

A drawing and description of this curious shell was sent to the Linnean Society in 1815, under the name *Ter. sinuata,* and printed in 1818, it is therefore necessary to retain that specific name. The length of the hinge line is liable to much variation; in some cases it equals the width of the shell.

Loc. *Malvern; Hay Head.*

Orthis hybrida, f. 11. Lenticular, most convex near the beaks, wider than long, radiated; radii increasing in number towards the margin; front rather straight; valves equal; hinge line short. Length $5\frac{1}{2}$ lines, width 6 lines.

In the short hinge line this species forms a link with the genus *Atrypa*; but the narrow area between the beaks and striated surface distinguished it as an *Orthis.*

Loc. *Hay Head, Wallsall.*

Orthis filosa, f. 12. Semioval, very flat, finely radiated; radii very numerous, unequal; hinge line equal to or exceeding the length of the shell; sides rather straight; beaks scarcely elevated. Length 10 lines.

This is a delicate thin shell; the radii resemble threads, stretched from the beaks to the margin.

Loc. *Burrington; and also at Oldcastle, Malvern.*

Orthis canalis, f. 12 *a.* (See Pl. 20. f. 8.) Also in Caradoc Sandstone. Semioval, finely radiated; radii more numerous near the margin; larger valve very deep, with a pointed incurved beak; the other concave along the middle, slightly convex along the sides; front rather pointed and gently depressed; hinge line shorter than the width of the shell. Length $6\frac{1}{2}$ lines, width about the same.

This form resembles *Orthis elegantula* of *Dalman,* but as it cannot be positively identified we venture to give it a new name; it is an extremely neat shell, with a hinge line shorter than any of Dalman's figures.

Loc. *Delves Green; Croft; Tame Bridge; Woolhope (Falfield, near Tortworth).*

Orthis antiquata, f. 13. Semicircular, depressed, radiated; radii deeply divided by distant lines of growth; principal radii few, with shorter intermediate ones near the margin; lesser valve flat; dorsal area narrow, the full width of the shell. Length 6 lines, width about 8 lines.

Loc. *Woolhope.*

Terebratula læviuscula, f. 14. Rhomboidal, slightly convex, smooth; front rounded, even; sides angular. Length 3 lines, width the same.

Loc. *Tynewidd, Llandovery.*

Terebratula brevirostris, f. 15. Transversely elliptical, plaited; plaits about 25, sharp; margin even; valves very convex, nearly equal; beaks large, short. Length 4 lines, width 6 lines.

Loc. *Croft Valley; Woolhope.*

Terebratula interplicata, f. 23. Obovate, transverse, plaited; plaits sharp, principal ones about 14, the four middle ones depressed at the front, and between each lateral one is a shorter plait; valves very convex, nearly equal; beaks short, nearly equal; the sides near the beak smooth, with prominent edges. Length 5 lines, width 5½ lines, depth 3 lines.

Loc. *Woolhope; Delves Green.*

Terebratula sphærica, f. 17. Orbicular, ventricose, plaited all over; plaits about 14, many of them forked, rather obtuse, 3 or 4 middle ones much depressed at the front, forming a longitudinal canal; beaks equal, short; sides concave. Length, width and depth about 6 lines.

Loc. *Tame Bridge.*

Terebratula crebricosta, f. 18. Obovate, transverse, subcylindrical, depressed, plaited; plaits about 30, rather sharp, 6 or 8 of them raised into a deep sinus in the edge of the upper valve; beaks small, acute. Length 7 lines, width 8 lines.

Loc. *Tynewidd, Llandovery.*

Terebratula Stricklandii, f. 19. Obovate, transverse, ventricose, plaited; plaits about 30, sharp, 5 of them raised at the front, producing a broad elevation in the upper and more convex valve, and a corresponding canal in the other flatter one; beaks small, sharp, adpressed; near that in the upper valve is a longitudinal canal; sides smooth near the beaks. Length 11 lines, width 13 lines.

Communicated by Mr. H. E. Strickland, after whom it is named.

Loc. *Longhope.*

Terebratula imbricata, var. f. 27. (See Pl. 12. f. 12.) Also Wenlock Limestone. This is a shorter variety than that figured in Pl. 12., and many specimens are much more ventricose, though smaller.

Loc. *Woolhope; Stumps Wood; Hay Head; Tame Bridge; Croft.*

Lingula Lewisii? (See Pl. 6. f. 9.) Also Aymestry Limestone.

Loc. *Buildwas; Wenlock; Tynewydd.*

Euomphalus alatus (*Wahlenberg*), f. 28. (*His. Pet. Suec.* p. 36. t. xi. f. 7.) Conical, depressed, marked with prominent lines of growth; umbilicus very open; margin winged, entire. Height ½ an inch, diameter 1 inch 4 lines.

Loc. *Delves Green; Tame Bridge.*

Euomphalus funatus. (See Pl. 12. f. 20.) Also Wenlock Limestone.

Loc. *Woolhope.*

Turbo cirrhosus, f. 22. Conical, turreted, whorls few, round, longitudinally grooved; grooves about 6, broad; aperture round; umbilicus open. Length 2¼ inches, diameter of the base 1⅝ inch.

Loc. *Wenlock.*

Orthoceras eccentricum, f. 16. Also Lower Ludlow Rock. Very slightly tapering, obscurely striated and furrowed longitudinally; septa very numerous, almost flat; siphuncle eccentric. Diameter 1¼ inch.

Loc. *Old Radnor.*

Orthoceras Nummularius, f. 24. Conical ?, smooth ?; septa very numerous, very convex, $\frac{1}{9}$th their diameter apart; siphuncle large, inflated between the septa to about 3 times its own diameter, and $\frac{1}{3}$ the diameter of the septum. Diameter about 4 inches.

This much resembles *O. crassiventris, Wahl.* (*His. Pet. Suec.* p. 30. t. x. f. 3.) but in that species the siphuncle fills $\frac{2}{3}$rds of the diameter of the chamber, and the septa are not so close. Portions of the siphuncle when separated, resemble thick, coarsely made coins.

Loc. *Whitfield Quarry, Tortworth.*

Orthoceras attenuatum, f. 25. This figure is taken from a drawing supplied by Dr. Lloyd from a fine specimen discovered by him, and now in the Ludlow Museum.

Loc. *Banks of the Onny, near Stretford Bridge.*

Orthoceras virgatum. (See Pl. 9. f. 4.) Also Lower Ludlow Rock.

Loc. *Stumps Wood.*

Orthoceras canaliculatum, f. 26. Very gradually tapering, longitudinally furrowed; furrows about 26, shallow, regular; siphuncle central, small. Diameter $1\frac{1}{4}$ inch.

Somewhat resembling *O. Gesneri, Martin,* but much less conical and the septa more numerous than in that species. It differs from *O. angulatus, Wahl.* (*His. Pet. Suec.* p. 28. t. x. f. 1.), in having a central siphuncle, and in being straight.

Loc. *Ledbury.*

Orthoceras fimbriatum, f. 20. Gradually tapering, straight and even; ornamented with transverse many arched laminæ or flounces, about one line apart, and slight irregular longitudinal furrows and striæ; siphuncle central, large; septa moderately numerous. The arches of the laminæ terminate in the furrows. Diameter 2 or more inches.

This differs from the following in the position of the arches of the laminæ and in the generally even surface. A specimen in Mr. B. Bright's cabinet contains 3 smaller *Orthocerata.*

Loc. *Aston, May Hill; also on the western slopes of the Malverns.*

Orthoceras annulatum. Pl. 9. f. 5. (*M. C.* 133; *O. undulatus, Hisinger Anteckn.* p. 236. t. vii. f. 8; *Pet. Suec.* p. 28. t. x. f. 2. It is not *O. nodulosus* of Schlotheim which has been referred to *O. annulatum* of *M. C.*) Very gently tapering, ornamented with prominent transverse rings, very numerous, transverse, many-arched laminæ, and more or less deep longitudinal furrows; siphuncle central, large; septa equal in number to the rings; the arches of the laminæ terminate between the furrows. Diameter $1\frac{1}{2}$ inch.

The longitudinal furrows in this species are sometimes hardly perceptible, but whenever they can be perceived, the arches of the flounces will be found to spring from the raised spaces between them.

The figure in *Min. Con.* was taken from a fossil in which the furrows were very slight; our figure is from the more deeply furrowed variety. We have also a specimen in which the fimbriæ are nearly as distant as in the last species, although usually there are four times as many. One individual in Mr. B. Bright's cabinet contains two other small *Orthocerata* penetrating the chambers; one of them is annulated and has a lateral siphuncle[1].

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[1] The *Orthoceras annulatum* of the Silurian Rocks is very prevalent in strata of the same age on the continent, where it is known as *O. undulatum*. This confusion is the more to be regretted, as Mr. Sowerby had previously figured another species from the "Carboniferous Limestone" under the latter name. My readers who may refer to the original figure of *O. annulatum* in the Mineral Conchology, will, however, be surprised to see that it differs considerably from the fossil given in this work; but Mr. J. Sowerby contends that his species is identical with those I have collected, and hence I have retained the name first applied to the fossil.—R. I. M.

Loc. *Stumps Wood, near Malvern; Tynewidd.*

Bellerophon Wenlockensis, f. 21. (*M. C.* t. 460.) This specimen differs a little from the species of the Carboniferous Limestone figured in *M. C.*, but it is difficult to indicate a real difference owing to the calcareous spar having taken the place of the shell. We assign it provisionally the name of *B. Wenlockensis.*

Loc. *Wenlock; Croft, Malvern.*

Several of the shells, figured as belonging to the Wenlock shale, may be classed either with the Wenlock or Caradoc formation. They, in truth, belong to the beds of passage between the Upper and Lower Silurian Rocks, and are therefore common to both. (Ex. Tynewidd, near Llandovery, &c.)

CHAPTER XLVI.

SHELLS OF THE LOWER SILURIAN ROCKS.

Shells of the Caradoc Formation, Pls. 19, 20 and 21.—*Shells of the Llandeilo Flags*, Pl. 22.

LET us now see to what extent the *mollusca* of the Lower Silurian are distinguishable from those of the Upper Silurian Rocks. In the first place we may repeat, that although a very few species of shells are found nearly throughout the Silurian System[1], by much the greater number which we are about to examine, are dissimilar from those described in the preceding chapter. Secondly, it may be said, that this inquiry has led to the development of an important modification of the distribution of species during those ancient periods;—namely, that in these, the lowest rocks of which the fossils have been closely scrutinized, the same species is ascertained to pervade a much greater thickness of strata than in the overlying deposits. For, not only are many of the mollusks of the Caradoc Sandstone common to the Llandeilo Flags, but some of them are also detected in strata of the Cambrian System, far, indeed, beneath the upper limit of that system, as at present assumed. Hence we are entitled to assert, that such shells must have lived through much longer epochs than any species in the younger accumulations; and further, looking to the smaller number of species which we can detect in the older rocks, we may believe, that new forms were less frequently called into existence than in succeeding ages.

If, however, it be granted that a good many species of mollusks are common to vast accumulations, embracing the Lower Silurian and Upper Cambrian groups, we are still not at liberty to infer that there is no zoological demarcation between the two systems, and therefore that the Silurian System is without a base. We have already shown, that throughout the overlying geological series, no two great contiguous systems are ever abruptly separated from each other, except in those tracts where the order of deposit has been broken up.

Thus, passing over more modern analogies, we know that wherever the lower beds

[1] Three or four species of shells range from the Ludlow to the Caradoc formation inclusive, though each species is much more common in *one* formation than in any other.

I may, however, here state that Trilobites (crustaceans) more precisely mark the age of each deposit in which they occur than mollusks. (See the ensuing chapter.)

of the Old Red Sandstone graduate into the Upper Silurian Rocks, there the conterminous deposits contain many similar fossils; and the same is observed when we descend from the Silurian amid the Cambrian Rocks. We must, however, admit that this lower transition zone is of vastly greater dimensions than in any of the younger formations, and that we are not yet acquainted with its lower limit.

The examination of all the fossils of the Cambrian System will eventually determine this point, by showing us what new forms appear as we pass through that great slaty series and approach the lowest strata in which the vestiges of life have hitherto been detected. This interesting subject will be cleared up by the labours of Professor Sedgwick.

FOSSIL SHELLS OF THE CARADOC SANDSTONE AND LLANDEILO FLAGS OR LOWER SILURIAN ROCKS.

PLATES XIX, XX, XXI AND XXII.

Arca Eastnori, Pl. 20. f. 1. Transversely ovate, smooth?, very convex; beaks central, short; shell thick; muscular impressions deep, especially the posterior one; hinge teeth numerous, slightly diverging. Length 8 lines, width 14 lines; one imperfect specimen from Golden Grove is nearly $1\frac{3}{4}$ inch wide.

In the specimens from Eastnor Park, f. 1 *a*., the casts of the inside show a deep channel bordering the rising corresponding to the posterior muscular impression. In those found at Golden Grove a similar channel, though not so deep, also accompanies the anterior muscular impression f. 1 *b*. If the latter be not an old shell grown very thick, it may be a different species; it somewhat resembles the imperfect *Arca* mentioned in the description of the shells from the Old Red Sandstone.

Loc. *In Caradoc Sandstone, near the obelisk of Lord Somers in Eastnor Park; also near Golden Grove, Llandeilo.*

Nucula? lævis, Pl. 22. f. 1. Oval, transversely elongated, ventricose, smooth. Length $3\frac{1}{2}$ lines, width nearly 2 lines.

Loc. *Pensarn, near Caermarthen, in black schist.*

Avicula orbicularis, Pl. 20. f. 2 and 3. (*Pleurobranchus? G. B. Sowerby in Geol. Trans.* p. 268 and 340. t. xxxiii. f. 2.) Orbicular, becoming oblong by age, convex, nearly smooth; beaks prominent; ears small, the anterior one round. Length of the rounder variety $1\frac{1}{2}$ inch, width the same.

Fig. 3. is the form of the old shell or elongated variety from Acton Scott. In some specimens the lines of growth form obtuse ridges. Length 2 inches 2 lines, width 1 inch 8 lines.

Loc. *Horderley; Cheney Longville; and Acton Scott, near the Caradoc; also near Ems, Nassau?*

Avicula obliqua, Pl. 20. f. 4. Obliquely ovate, elongated, convex, smooth; hinge line rather short; ears undefined. Length $1\frac{3}{4}$ inch, width nearly as much.

This species occurs in clusters in the Caradoc Sandstone.

Loc. *Soudley, near Acton Scott, east flank of Caer Caradoc.*

Orbicula granulata, Pl. 20. f. 5. Lenticular, punctated.

This is an imperfect specimen, but from its remains we presume that it was very flat, with the apex near the margin. Diameter about $\frac{1}{2}$ an inch.

Loc. *Chatwall, east flank of the Caradoc.*

Leptæna sericea, Pl. 19. f. 1. (*L. striatella? Dalm. l. c.* p. 111. t. i. f. 5.) Semicircular; finely striated longitudinally, with a silky lustre; a few striæ deeper than the others; larger valve convex, the other nearly flat; front not concave, considerably deflected at the edge. Length 5 lines, width 10 lines.

In general form this fossil resembles *L. lata* of the Ludlow Rock (Pl. 5. f. 13.), but has much finer striæ and more angular sides; the front also is straighter, and there are no indications of spines. Sometimes a few concentric lines of growth are conspicuous.

Loc. *Whittingslow; Horderley, and east flank of Caradoc*[1]*; Guilsfield and Cefn, near Welchpool; the Maen and Allt-yr-ankr, Meifod; east flank of Berwyns; Goleugoed; and Cerrig-gwynion, Llandovery.*

Leptæna sericea, var., Pl. 19. f. 2. Rather longer than the last.

Loc. *Cefn-rhyddan, Llandovery.*

Leptæna complanata, Pl. 20. f. 6. Semioval, nearly as long as wide, almost flat, finely radiated; radii linear, increasing in number towards the deflected margin; beak projecting; the extremities of the hinge line rounded. Length 11 lines, width 1 inch, one imperfect specimen is larger.

Loc. *Acton Burnell, Salop.*

Leptæna duplicata, Pl. 22. f. 2. Transverse, convex, internally marked with furrows arranged in pairs. Length $5\frac{1}{2}$ lines, width 9 lines.

Loc. *Cefn, near Welchpool; Robeston Wathen, Pembrokeshire.*

Leptæna euglypha, Pl. 12. f. 1. Wenlock Limestone.

Loc. *Horderley; and Cefn, near Welchpool.*

Leptæna depressa, Pl. 12. f. 2. Occurs from the Aymestry Limestone downwards through the inferior strata.

Loc. *Hope Mill, Shelve; Goleugoed, Mandinam, Caermarthenshire.*

Leptæna tenuistriata, Pl. 22. f. 2 *a*. Semicylindrical, closely striated; top of the upper valve with 12 or more concentric rugæ, convex; sides expanded.

A shell much resembling *L. depressa*, and about the same size, but ornamented with much closer striæ and of a thinner substance. Can this be *L. depressa* of Swedish authors, and may our *L. depressa* be their *L. rugosa*?

Loc. *Marloes Bay; Narbeth, Pembrokeshire; also at Gaerfawr in the Caradoc Sandstone of Montgomeryshire.*

Atrypa crassa, Pl. 21. f. 1. Spherical, smooth? very thick, the three muscular impressions very deep, the central one tongue-shaped, striated, the lateral ones marked with 5—7 angular furrows more or less deep.

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[1] Whenever the reference " east flank of Caradoc " is given, the fossils alluded to, may be detected at Soudley Quarries near Hope Bowdler, Wilson, Enchmarsh, Broome, Chatwall, and in the hills ranging to Acton Burnell and Stevens Hill on the north-east, and to Acton Scott, Whittingslow, Horderley, Long-Lane, Wistanstow, Cheney Longville, Aston and Corton on the south-west.

We have only seen casts of portions near the beak of this shell, but there is enough to show that it must have been very heavy. F. 1*b*. probably indicates a variety with irregular cells rather than furrows. Diameter about 1¾ inch.

This and the following figure belong to the lowest beds of the Silurian System.

Loc. *Cefn Rhyddan; Caermarthenshire.*

Atrypa undata, Pl. 21. f. 2. Transversely elliptical, gibbose, smooth; an elevation along the middle leads to a tongue-shaped sinus in the edge of one valve, and a corresponding projection in the other. Length 10 lines, width 1 inch 4 lines.

Loc. *Cefn Rhyddan, Llandovery; west side of Cefn-y-Garreg, Llandovery; Robeston Wathen, Pembrokeshire.*

Atrypa Lens, Pl. 21. f. 3. Suborbicular, depressed, smooth, obscurely radiated, elevated along the middle of the upper valve. Length nearly 2¾ inches, width about 2 inches.

Loc. *North end of Snead's Heath (Lickey Quartz); Mandinam and Cefn Rhyddan, Llandovery.*

Atrypa plana, Pl. 21. f. 4. Orbicular, with the front rather produced, flattened, smooth. Length about 7 lines, width 8 lines.

Loc. *Tynewidd, Llandovery.*

Atrypa globosa, Pl. 22. f. 2 *b*. Globose, obscurely channelled, smooth. Diameter about 6 lines.

Loc. *Castell Craig, Gwyddon; and Gorllwyn-fach, Caermarthenshire.*

Atrypa polygramma, Pl. 21. f. 4 *a*. Transversely obovate, finely radiated, valves unequally convex, the lower with a wide, shallow canal along the middle; radii increasing in number towards the margin. Length 1 inch, width 1 inch.

Loc. *Powis Castle.*

Atrypa orbicularis, Pl. 19. f. 3 and 4. Suborbicular, rather wider than long, with a slight sinus in the front, furrowed; furrows numerous, forked, the ridges between them not scaly; valves equal. Length 7 lines, width 8 lines.

Much resembling *A. aspera*, but smoother.

Loc. *Gorllwyn-fach* (f. 1.); *Conygree Coppice* (f. 4.); *Woodford Hill, Abberley; Malvern Ridge, End Hill.*

Atrypa hemisphærica, Pl. 20. f. 7. Almost orbicular with the back nearly straight, radiated; radii about 12, angular; valves unequal, one hemispherical, the other nearly flat. Length 4 lines, 5 lines.

A beautiful fan-like shell.

Loc. *Ankerdine Hill, Worcestershire; Damory Hill, Michaelwood Chace, Gloucestershire.*

Atrypa affinis, Pl. 6. f. 5. Ranges from the Aymestry Limestone to the upper beds of the Caradoc Sandstone.

Loc. *Cefn, Welch Pool to the Breiddens; Tynewidd; Golden Grove; Marloes Bay, Pembrokeshire; Lower Lickey (overlying beds).*

Atrypæ, Pl. 22. figs. 3, 4 and 5. These are curious casts of different valves, but so much distorted that we cannot determine their general form, nor even say whether or not they belong to the same species. Figs. 4 and 5 are two views of one specimen.

Loc. *Marloes Bay, Pembrokeshire.*

Spirifer radiatus, Pl. 12. f. 6. Ranges from the Wenlock Limestone to the upper beds of the Caradoc formation.

Loc. *Gaerfawr, Guilsfield; Lower Lickey (overlying beds).*

Spirifer radiatus, var., Pl. 21. f. 5. The beak of this variety is not curved as in the ordinary form of *S. radiatus*.

Loc. *Castell craig-gwyddon, Llandovery.*

Spirifer plicatus, Pl. 21. f. 6. Semicircular, convex, sharply plaited, especially towards the margin; beaks near each other, hinge line nearly double the length of the shell. Length 11 lines, width 1 inch 7 lines.

Loc. *Goleugoed, Llandovery; Bala?*

Spirifer alatus, Pl. 22. f. 7. Semicircular with expanded cuspidate sides, plaited, slightly raised in the middle; plaits about 18, acute. Length 5½ lines, width 9½ lines.

Loc. *Pensarn and Mount Pleasant, Caermarthen.*

Spirifer liratus, Pl. 22. f. 6. This represents the distorted cast of a large *Spirifer* or *Orthis*. Length nearly 3 inches.

Loc. *Marloes Bay, Pembrokeshire.*

Spirifer? lævis, Pl. 21. f. 12. Semicircular, compressed, smooth; a slight elevation along the middle; beaks rather prominent, the area between them narrow with parallel edges. Length 8 lines, width twice as much.

In general form this shell approaches to that of *Orthis*.

Loc. *May Hill, Gloucestershire; Noeth-grüg, Llandovery; Gullet Wood, Eastnor Park; Hope Mill, Salop; Lower Lickey* (*overlying beds*).

Orthis grandis, Pl. 20. f. 12 and 13. Semi-oval, short, nearly flat, irregularly radiated within; radii numerous, forked. Length about 1½ inch, width nearly 2 inches.

Having only seen impressions of the interior of this fine shell; the description, as in many similar cases, is necessarily incomplete.

Loc. *Horderley; Acton Scott; and flank of Caradoc.*

Orthis expansa, Pl. 20. f. 14. Semicircular, flat, internally plaited near the margin; muscular impression deeply furrowed. Length 1 inch 7 lines, width 2 inches.

Loc. *Moel-y-Garth and Gaerfawr, near Guilsfield.*

Orthis alternata, Pl. 19. f. 6. Transversely obovate, finely radiated; one valve convex, the other flat or concave; radii extremely numerous, of unequal fineness and increasing in number towards the edge; hinge line shorter than the width of the shell. Length 10 lines, width 13 lines.

Loc. *Whittingslow; Soudley; and east flank of the Caradoc; Alt-yr-ankr; and the Maen Meifod; Lower Lickey Ridge; east flank of Berwyns; Mandinam, Llandovery.*

Orthis compressa, Pl. 22. f. 12. Lenticular, compressed, with a straight hinge line; striato-punctated throughout its substance. Length 1 inch; width 14 lines.

Loc. *Hope Quarry, near Shelve, Salop.*

Orthis protensa, Pl. 22. f. 8 and 9. Semioval, depressed, radiated; radii linear, sharp, unequal in thickness. Length 8 lines, width 7 lines.

Loc. *Goleugoed; Meadow Town, near Shelve; Berwyns.*

Orthis anomala, Pl. 21. f. 10. (*Anomites anomalus, Schl. Nacht. Pet.* 1. p. 65. t. xiv. f. 2.) Oblong with straight sides, convex, striated. Length 1 inch 7 lines, width 1 inch 5 lines.

Only one valve has fallen under our observation, we are not sure therefore that the margin would be like that in Schlotheim's figure.

Loc. *Horderley; east flank of Caradoc; east flank of Berwyns.*

Orthis Pecten?, Pl. 21. f. 9. (*Dalm. l. c.* p. 110. t. i. f. 6; *His. Pet. Suec.* p. 70. t. xx. f. 6.) Semi-oval, short, convex, finely radiated; radii nearly equal, cut by the lines of growth; hinge line equal to the width of the shell; one valve nearly flat. Length $1\frac{1}{2}$ inch, width 1 inch 11 lines.

Having seen specimens of several distinct species sent from Sweden, as *O. Pecten*, it is with some doubt we refer our shell to that name.

Loc. *Horderley, Caradoc and Meadow Town, Salop; the Maen, near Meifod.*

Orthis semicircularis, Pl. 21. f. 7. Semicircular, slightly produced in front, convex, radiated; radii 30, sharp, increasing in number towards the margin; beak projecting. Length $3\frac{1}{2}$ lines, width $\frac{1}{2}$ an inch. (It occurs in the Silurian Rocks of North Devon, near Barnstaple.)

Loc. *South of Bogmine, at Hope, in the Corndon or Shelve Hills.*

Orthis Flabellulum (α), Pl. 21. f. 8. Transversely obovate, with about 24 large, rounded, smooth radii; hinge line less than the width of the shell, slightly arched; one valve flat, the other convex with a slight channel in the middle. Length $8\frac{1}{2}$ lines, width 13 lines.

In this shell the ribs are remarkably regular, their breadth equal to the spaces between them, and they continue strongly marked to the very beak; the outline is very regularly rounded and forms an obtuse oval. Can this be *O. callactis* α of Dalman? (*L. c.* p. 112. t. ii. f. 2.) It appears to have a wide range, descending deep into the Cambrian System.

Loc. *Corton, Clunbury and other places in true Caradoc Sandstone; Bala and Snowdon in Cambrian Rocks.*

Orthis Flabellulum (β), Pl. 19. f. 8. This variety is rounder than α and has a few short radii between the long ones. Length 11 lines, width 14 lines.

Loc. *East flank of the Caradoc.*

Orthis virgata, Pl. 20. f. 15. The specimens of this species are very imperfect; it resembles the last, but has above 30 in place of 24 radii. Length $8\frac{1}{2}$ lines, width 11 lines.

Loc. *Acton Scott; Horderley; Llanwyth, Builth.*

Orthis radians, Pl. 22. f. 11. Semicylindrical, concave in front, compressed, plaited; beaks elevated; plaits about 15, sharp. Length $4\frac{1}{2}$ lines; width $\frac{1}{2}$ an inch.

Loc. *Goleugoed; Llandegley.*

Orthis? costata, Pl. 21. f. 11. Semicircular, with angular sides and about 20 unequal sharp radii. One valve somewhat conical, with a large triangular area beneath the beak. Length $5\frac{1}{2}$ lines, width $7\frac{1}{2}$ lines.

Only one imperfect valve has come to our knowledge.

Loc. *Cefn, near Welch Pool.*

Orthis Actoniæ, Pl. 20. f. 16. Transversely obovate, with about 14 large radii, trifid or quadrifid at their extremities; one valve flat, the other very convex. Length $8\frac{1}{2}$ lines, width 11 lines.

Greatly resembling *O. Flabellulum*, but known at once by the forked radii, a character particularly useful in distinguishing the species among the slaty rocks.

Named after Mrs. Stackhouse Acton, in whose property, near Church Stretton, it is abundant.

Loc. *Acton Scott, Horderley, and the flanks of the Caradoc; also in the Llandeilo Flags, and in the Cambrian Rocks of Bala.*

Orthis callactis, β? Pl. 19. f. 5. (*Dalm. l. c.* p. 113.) Almost circular, but wider than long, nearly flat, ornamented with about 20 rounded radii, which are obscure towards the beaks. Length 7 lines; width 9 lines.

The most convex valve of this, is much flatter than the convex valve of *O. Flabellulum*, which otherwise it much resembles.

Loc. *Old Storridge Hill, Worcestershire; Caradoc Hills; Hope Mill, Salop.*

Orthis lata, Pl. 22. f. 10. Semicylindrical, rather straight in front, depressed, radiated; radii linear, unequal in thickness. Length 5 lines; width 9 lines.

This much resembles *Leptæna lata*, but both valves are convex, the radii unequal in size, and there are no spines upon the hinge line.

Loc. *Gorllwyn and Goleugoed, Caermarthenshire; Berwyns.*

Orthis triangularis, Pl. 20. f. 17. Triangular, rounded in front, convex, finely radiated. Length $4\frac{1}{2}$ lines; width 5 lines. Found in Volcanic Grit.

Loc. *Marrington Dingle, near Chirbury.*

Orthis canalis, Pl. 20. f. 8., & Pl. 13. f. 7 *b*. Also Wenlock shale.

We have here figured casts of the interior, to show how they differ from the allied species in the higher beds of the Upper Silurian Rocks. The specimens are larger than those in the Wenlock shale.

Loc. *In Caradoc Sandstone at Horderley and Whittingslow, near the Caradoc; Moel-y-garth and Gaerfawr, near Welchpool. In Llandeilo Flags at Clog-y-frain; Golden Grove, Caermarthenshire; and at Llampeter-felfrey, Pembrokeshire.*

Orthis testudinaria? Dalman, Pl. 20. f. 9. (*Dalm. l. c.* p. 115. t. ii. f. 4. *His. Pet. Suec.*, p. 70. t. xx. f. 11.) Nearly orbicular, with a straight back, radii numerous, unequal in length, granulated; larger (upper) valve very convex, approaching conical, with an incurved beak; the other slightly convex, with a depression along the middle; hinge line nearly as wide as the shell. Length $6\frac{1}{2}$ lines; width 8 lines.

Orthis canalis differs from this in being less convex and more finely radiated; the internal structure is also different.

Loc. *Gaerfawr, Guilfield and Moel-y-garth; east and south of the Caradoc, abundant; also at Powis Castle; Mandinam and Golden Grove.*

Orthis bilobata, Pl. 19. f. 7. Transversely obovate with a straight back; covered by thin irregular radiating ridges; upper valve concave, with a broad angular elevation along the middle; lower valve very convex, with a deep broad channel along the middle; sides a little produced towards the extremities of the hinge line, rounded. Length 1 inch 2 lines; width about 1 inch 7 lines.

Loc. *Acton Scott, Horderley; and also in the Upper Cambrian Rocks of Bala.*

Orthis Vespertilio, Pl. 20. f. 11. Transversely obovate elongated, with a straight back, covered by thin irregular radiating ridges; upper valve slightly convex, with a broad angular elevation along the middle; lower valve convex, with a deep broad channel along the middle; sides angular at the extremities of the hinge line. Length $\frac{3}{4}$ inch; width 1 inch 2 lines.

A less convex shell than the last, but in many points strongly resembling it.

Loc. *From Corton near Clunbury, along the south-east flank of the Caradoc; Acton Burnell and Stevens Hill, Cound; the Maen, Meifod; Trilobite Dingle, Welch-Pool; in Llandeilo Flags, Caermarthenshire; and in the Cambrian Rocks of Bala.*

Terebratula furcata, Pl. 21. f. 16. Orbicular, very convex, smooth; beak of one valve much curved; interior marked with several furrows, and a forked channel in the middle. Length and width 4 lines.

Loc. *S. of Bogmine in the Corndon Hills;* (*Caradoc Sandstone.*)

Terebratula unguis, Pl. 21. f. 13. Orbicular, very convex, plaited; plaits about 12, sharp and large; beak incurved. Length $5\frac{1}{2}$ lines; width 5 lines.

Loc. *Horderley; Cefn near Welchpool* (*Caradoc.*).

Terebratula neglecta, Pl. 21. f. 14. Orbicular? convex, plaited; plaits 17, acute; beaks small. A fragment.

Loc. *Mandinam, Llandovery.*

Terebratula tripartita, Pl. 21. f. 15. Transversely oval? convex, plaited; plaits 15 or 20, rugose, often forked; middle much elevated so as to divide the surface into 3 nearly equal parts. Length $\frac{1}{2}$ inch; width 1 inch 2 lines.

Loc. *Goleugoed, Llandovery.*

Terebratula decemplicata, Pl. 21. f. 17. Nearly globose, plaited; plaits 10, angular, two of them greatly elevated in the front; beaks small, pointed. Length 4 lines; width $4\frac{1}{2}$ lines.

Loc. *Bransill Castle, Eastnor Park; Ankerdine Hill; May Hill; Prescoed Common, Usk; Hill End Farm, Longmynd.*

Terebratula pusilla, Pl. 21. f. 18. Nearly globose, plaited; plaits about 14, sharp, 4 of them elevated in the front. Length and width nearly 4 lines.

Loc. *Cefn Rhyddan, Llandovery.*

Pentamerus lævis, Pl. 19. f. 9. (*Min. Con.*, v. 1. p. 76*. t. 28.) The general outline of this shell is nearly orbicular; it is very convex and smooth. The upper or flatter valve is not so perfectly divided into 3 cells as in the *Pent. Knightii.* But the division in the other valve is always very conspicuous. Length about 1 inch; width about $1\frac{1}{4}$ inch, or sometimes larger.

Loc. *The Hollies near Hope Bowdler, Buildwas; Old Storridge Hill, Worcester; Castell craig-gwyddon, Llandovery; Michaelwood Chase, Tortworth.*

Pentamerus oblongus, Pl. 19. f. 10. Oblong-oval, depressed, smooth; a few shallow longitudinal furrows are sometimes observable, especially two in the lower (larger) valve, the beak of which is produced. Length $2\frac{3}{4}$ inches; width $2\frac{1}{4}$ inches.

Occurs with *P. lævis* in the upper beds of the Caradoc formation. The edges of the valves are waved by the shallow furrows without deviating from the same plane.

Loc. *The Hollies, Soudley and Norbury, Salop; Castell craig-gwyddon, Llandovery.*

Lingula attenuata, Pl. 22. f. 13. Depressed, smooth; front rounded; sides nearly straight; attenuated towards the apex. Length $7\frac{1}{2}$ lines; width 5 lines.

Loc. *Rorington and Meadow Town, Salop; Golden Grove, Caermarthenshire.*

Euomphalus tenuistriatus, Pl. 22. f. 14. Discoid, whorls few, round, rapidly increasing in size, crossed by numerous regular striæ; aperture round, equal in diameter to half the width of the shell. Diameter about $4\frac{1}{2}$ lines.

Loc. *Middleton, Corndon Hills.*

Euomphalus perturbatus, Pl. 22. f. 15. Discoid, whorls 3 or 4 rounded, smooth. Diameter about 1 inch.

So much are all the specimens distorted, that our description is necessarily meagre.

Loc. *Pensarn, Caermarthen.*

Euomphalus Corndensis, Pl. 22. f. 16. Discoid, smooth, whorls about 3, ventricose; aperture transversely oval. Diameter $2\frac{1}{2}$ lines. f. 16 *a.* is magnified. (In Volcanic Grit.)

Loc. *Leigh Hall, at the Northern extremity of the Corndon Hills.*

Euomphalus funatus, Pl. 12. f. 20. Ranges from the Aymestry Limestone to the Caradoc Sandstone.

Loc. *Golden Grove; Middleton, Corndon Hills; Old Storridge Hill, Worcester.*

Pleurotomaria angulata, Pl. 21. f. 20. A cast of rather more than one whorl, from which it appears to have been a conical shell with angular whorls, and probably a striated surface; the aperture was nearly round with an angle at its upper part. Diameter 1 inch 4 lines, height $1\frac{1}{2}$ inch.

Loc. *Mandinam, Llandovery.*

Trochus lenticularis, Pl. 19. f. 11. Lenticular, smooth, with a sharp edge; whorls three, with a single line round the inner margin. Diameter $1\frac{1}{4}$ inch.

A very flat shell, we have only seen the upper surface.

Loc. *Old Storridge Hill, Worcester.*

Littorina striatella, Pl. 19. f. 12. Conical, with a convex base, marked with fine longitudinal lines of growth; whorls 3 or 4, rounded. Height 8 lines, diameter 7 lines.

Loc. *Horderley and Wistantow (Caradoc).*

Turbo? Pryceæ, Pl. 21. f. 19. We have only a cast of the interior, composed of one whorl, which is angular in the middle. The shell appears to have been very short with a large aperture and narrow deep umbilicus; the substance thick. Height about $1\frac{3}{4}$ inch, diameter nearly 2 inches. (Collected by Miss Pryce.)

Loc. *Mandinam, Llandovery.*

Turritella cancellata, Pl. 20. f. 18. Subulate?, longitudinally striated, carinated; carinæ about 6 to each whorl, unequal, crossed by the numerous striæ. Diameter $6\frac{1}{2}$ lines.

Loc. *Mandinam, Llandovery; Hope Mill, Shelve.*

Buccinum? fusiforme, Pl. 20. f. 19. Fusiform, smooth; whorls few, the last with a shoulder near the upper edge; aperture narrow, as long as the spire. Height $4\frac{1}{2}$ inches, diameter 1 inch 11 lines. In Caradoc Sandstone with *Atrypa hemisphærica,* Pl. 20. f. 7., and fragments of the stems of *Crinoidal animals.*

Loc. *Corton, near Presteign.*

Orthoceras annulatum, Pl. 9. f. 5. Also Wenlock Limestone and Shale.

Loc. *Goleugoed, Llandovery.*

Orthoceras conicum, Pl. 21. f. 21. Conical, smooth; septa near together; siphuncle central, large, cylindrical. Diameter 1 inch 2 lines.

(Occurs in Upper Caradoc with *Pentam. lævis.*)

Loc. *Michaelwood Chase, Tortworth.*

Orthoceras approximatum, Pl. 21. f. 22. Cylindrical for part of its length, conical towards the apex, smooth, slightly curved, septa very near together; siphuncle lateral. Diameter $\frac{3}{4}$ inch.

Loc. *Eastnor Park.*

Orthoceras bisiphonatum, Pl. 21. f. 23. Septa very numerous, pierced by two siphuncles, one small, very eccentric, globose (inflated) between the septa, the other large, cylindrical, extending from near the small siphuncle to the edge of the septum. Diameter about $3\frac{1}{4}$ inches.

Orthocerata with two siphuncles have been observed, but there has always appeared something doubtful about them. See description of Mr. Bright's specimen of *O. annulatum.* In the present instance, however, this structure cannot be questioned.

Loc. *Gorllwynfach, Llandovery.*

Nautilus undosus, Pl. 22. f. 17. Discoid, inner whorls exposed; sides largely waved; front flat; septa numerous; aperture oblong.

This specimen is obliquely compressed into an oval form and much resembles *Nautilus compressus* (M. C. t. 38.). The large waves on the sides distinguish it. Diameter $3\frac{1}{4}$ inches, length of aperture $10\frac{1}{2}$ lines.

Loc. *Blaen-y-cwm, near Llandovery.*

Lituites? Cornu-arietis (α), Pl. 20. f. 20. Discoid; whorls about 4, close, crossed by numerous, oblique, sharp, slightly raised costæ, mixed with lines of growth. Diameter nearly 2 inches.

Loc. *Corton, Presteign.*

Lituites Cornu-arietis (β), Pl. 22. f. 18. This differs from var. α only in having the costæ more distant and regular. Diameter nearly 2 inches.

Loc. *Cefn-y-garreg, near Llandovery, in black schistose beds of passage from the Silurian into the Cambrian Rocks.*

Bellerophon trilobatus, var.?, Pl. 3. f. 16. (In the upper beds of Caradoc Sandstone.)

Loc. *Eastnor Park; Michaelwood Chase (with Pentamerus lævis); north-east of Gaerfawr; Prescoed Common, Usk.*

Bellerophon acutus, Pl. 19. f. 14. Compressed, smooth, umbilicated; whorls keel-shaped, acute; umbilicus broad; aperture triangular, longer than wide. Diameter nearly ½ an inch, width of aperture about 2 lines.

Loc. *Horderley.* (In the upper beds of Caradoc Sandstone.)

Bellerophon bilobatus, Pl. 19. f. 13. Nearly globose, smooth; aperture two-lobed. Diameter 1½ inch, width of aperture 1 inch 3 lines.

Loc. *Horderley and Wistanstow; Welch Pool; Michaelwood Chase; Tortworth; Berwyns.*

Tentaculites scalaris, Pl. 19. f. 15. (*Schloth. Pet.* t. xxix. f. 9 *b.*) Subulate, composed of a series of truncated cones; internal cast of the same form, but even towards the apex. Diameter 1 line.

The truncated cones of which this appears to be formed have their bases directed towards the apex of the shell; so forming a set of steps rather than rings, like the sliding joints of an opera-glass.

It is not possible to distinguish this body from the *Tentaculites* of the Ludlow formation, though it is much more abundant in the Caradoc Sandstone or Upper Member of the Lower Silurian Rocks.

Loc. *South of the Bogmine, Shelve; Eastnor Park; Damory Hill, Tortworth.*

Tentaculites annulatus, Pl. 19. f. 16. (*Schloth. Petr.* t. xxix. f. 8; *Cyathocrinites pinnatus* (*Brachia auxiliaria*), *Goldfuss*, vol. i. p. 190. t. lviii. f. 7 ε, ζ.) Subulate, ornamented with rounded rings placed at regular distances; the spaces between them smooth; the interior of the same form as the outside. Diameter 1½ lines.

(In the upper beds of Caradoc Sandstone.)

Loc. *East flank of the Caradoc; Hope Mill, near Shelve; Michaelwood Chase, Tortworth.*

The generic names of *Leptæna, Atrypa*, and *Orthis*, being new to English geologists, their use on this occasion demands an explanation. They are, in fact, subdivisions of the great family of *Terebratula*, which, having been established by Dalman, have been since adopted by many foreign authors; and Mr. J. de C. Sowerby gives the following reasons for sanctioning their introduction among us.

"The generic names *Leptæna, Atrypa*, and *Orthis*, have been adopted from *Dalman's* memoirs in the *Stockholm Transactions*, in deference to the opinion of that author. The first of these synonyms (derived from λεπτος) stands in the place of *Producta* or *Productus*, a name to which grammarians have objected.

"The second genus, *Atrypa* (from α privative, and τρυπα), is divided from *Spirifer*, and includes those species which have a short hinge line without a large area, and are either destitute of a foramen or possess only a small triangular one. They are rounded shells, and are not furrowed like the typical species of *Spirifer*; the internal spiral arms are preserved in some species. *Atrypa affinis* and similar striated shells, would form another natural group, in which the internal structure, as well as the general form, is different; for the spiral appendages, if ever they possessed any, do not appear to remain, and there are two short crenated teeth in the hinge; the species of this division have generally been described as *Terebratulæ* by British authors, but they have acute, not perforated beaks."

"The genus *Orthis* (ορθος) is another division of *Spirifer*, no species of which has heretofore been described in England; it is distinguished from *Spirifer* by the long narrow hinge and circular flat form of the striated shells."

"Our genus *Pentamerus* is called *Delthyris* by the Swedes, but we see no reason for altering the name. If we were well assured of the stability of the genus *Delthyris* we should remove to it *Atrypa galeata*, and perhaps one or two other species of *Atrypa*."

In consequence of the name of *Productus* having been changed for that of *Leptæna* since the earlier chapters of the work were printed, the reader must pardon a slight incongruity which is, however, explained by the double synonym in the description of the shells. For *Productus* read *Leptæna*.

CHAPTER XLVII.

TRILOBITES OF THE SILURIAN SYSTEM.

General view of Trilobites.—Their geological range.—Trilobites of the Ludlow and Wenlock Formations, or Upper Silurian Rocks, Pl. 7., Pl. 7 *bis.* & Pl. 14.—*Trilobites of the Caradoc and Llandeilo Formations, or Lower Silurian Rocks*, Pl. 23., Pl. 24. & Pl. 25.—*Structure and Affinities of Trilobites.*

THE natural history of the fossil crustaceans called Trilobites is still imperfect. Though unable to remedy this deficiency, I hope to effect my chief object, by presenting correct sketches of such species of these animals as have been found in the Silurian Rocks of England and Wales, and by explaining the order in which they lie in the strata.

These bodies have been noticed by numerous writers from the year 1699, when our countryman Lhwyd or Lloyd first described them, to the present time; including French, Swedish, German, Russian and American authors. Linnæus considered them to be insects, and named a remarkable species *Entomolithus paradoxus.* They were afterwards termed *Concha-Triloba*, and Knorr, applying this description to the whole family, called them Trilobites, under which name they have been generally known. Brongniart had the merit of being the first to render them serviceable to the advancement of geology, not merely by pointing out their place in the animal kingdom and by dividing the family into genera and species, but also by endeavouring to show what species were peculiar to different deposits. My wish is chiefly to carry out the geological views of M. Brongniart, by adapting them to the present state of knowledge ; for as at the period when he wrote (1822), no one had attempted to systematize and classify the older fossiliferous rocks, so it was impossible, even for one who like himself, united the powers of a naturalist and geologist, to draw correct inferences concerning the relative age of these fossils.

It is probable that the generic divisions of this family will hereafter be much altered, and that a nomenclature founded on natural characters will be adopted. In the meantime I shall, as far as possible, adhere to that of Brongniart, merely attaching new names to such forms as have not previously been published. Every naturalist is opposed to the unnecessary use of synonyms, and hence in common with French and English geologists, I see no reason for abandoning the well-known term Trilobites, to adopt that of *Palæades* (from παλαιος, *old*, *ancient*), or to substitute certain generic names for others previously in use, even though proposed by so eminent an author as Dalman[1]. What does science gain by changing the *Paradoxides* of Brongniart, first called *Entomolithus paradoxus* by Linnæus, for *Olenus*, the name of a son of Vulcan, who, together with his beautiful wife Lethæa, was converted into stone? What advantage has Battus over Agnostus? Such terms, derived from the Heathen Mythology, would doubtless have been well received, if M. Dalman had applied them before these forms had received other names; but are inadmissible when, though not conveying new views in natural history, they are put forth to supplant a nomenclature already established. New generic names are only to be adopted, when forms entirely new are discovered.

As, however, our own country abounds with many well-preserved trilobites, so among them some have been found which really require to be generically distinguished; such, for example, are the *Homalonotus* (König), the *Acidaspis* and *Bumastus* (nobis), and the *Trinucleus* (Lhwyd)[2].

Of the place which these animals occupied in the animal kingdom, I will now merely state that naturalists are agreed in considering them to be marine crustaceans, and that Dr. Buckland, combining in his recent Bridgewater Treatise the observations of Audouin, Brongniart, Leach, and other modern authors, has given his view of their

[1] The original work of Dalman is published in the Swedish language, (Trans. of the Stockholm Academy), but it has been translated into German by Engelhart, "Ueber die Palæaden oder die so genannten Trilobiten." Although for the reasons assigned, I have adhered to the terminology of Brongniart, I ought at the same time to state, that the monograph of the Swedish author is one of high merit. In it we find a list of thirty-eight writers upon trilobites, including Linnæus, Lhwyd, Wilckens, Wahlenberg, Knorr, Da Costa, Lehmann, Blumenbach, Schlottheim, Sternberg, Keilhau, Parkinson, Stokes, Guettard, Audouin, Brongniart, Latreille, Dekay, Leonhardt, Bronn, &c. To this long list we may add the name of Goldfuss, who has illustrated the views of Audouin, and imagined that he discovered vestiges of articulated feet attached to the under surface of trilobites.

From the work of Eichwald "*De Trilobitis Observationes*," Casan, 1825, we learn that in the Russian provinces adjoining the Baltic, there is a succession of marly, compact, and crystalline limestones, underlaid by sandstone and shale. Subsequent examination will, I have little doubt, enable us to place the trilobitic rocks of Sweden and Norway as described by Hisinger, Dalman and Keilhau, as well as those of Russia above alluded to, in parallel with our Upper and Lower Silurian Rocks of Britain, although the mineral characters may vary, as indeed they do in our country, when the strata, of the same age, are followed to considerable distances.

Klöden has collected many trilobites in the gravel of Brandenburg, including our well-known species, *Calymene Blumenbachii*, *C. macrophthalma*, *Asaphus caudatus*, and others of our genus *Trinucleus* of the Lower Silurian Rocks, all of which have apparently been drifted from Scandinavia. "*Versteinerungen der Mark Brandenburg*, 1834," a work full of close research.

In alluding to the literature of this branch of natural history, I must lastly mention an interesting German memoir by Dr. Quenstedt in Wiegmann's Archiv, Part iv. 1837., in which the author attempts to establish a new classification of trilobites by their structure. A translation of this sketch is about to appear in the highly useful new English periodical, the Annals of Natural History.

[2] *Trinucleus* is the old name of Lhwyd or Lloyd (spelt Llhwydd p. 217 *ante*), see p. 659.

affinities. This treatise contains, besides, some excellent original illustrations of parts of Trilobites, particularly of the structure of the eyes and the adaptation of those organs to the submarine habits of the life of the animals[1].

Still more recently, M. Milne Edwards has given us some interesting general views concerning the place which these animals hold among crustaceans. After dividing the whole class into certain families, he shows, "that among the *Decapods*, the *Brachyura* are the highest in organization, and these appear to have been the last created, since no fragments have been detected beneath the tertiary rocks, which can, with any certainty, be referred to that great division, whilst in the supracretaceous deposits many different species of them occur. The *Anomoura*, which establish the passage between the *Brachyura* and the lower tribes of *Decapods*, appear in the cretaceous and oolitic rocks, and the *Macroura*, which of all the *Decapods* are the least elevated in the Zoological series, existed in as old a stratum as the muschelkalk. Lastly, he observes, *the Trilobites, a class of crustaceans still lower* in the natural order, abounded in the seas of the Transition æra, and were at those periods the only known representatives of the class of which they form a part[2]."

Geological distribution of Trilobites.—Extensive examination of the older rocks has convinced me, that although these animals have a wide range, extending from some of the slaty rocks upwards to the carboniferous deposits inclusive; by far the greater number of Trilobites occur in the Silurian System. Some genera and species are doubtless found in the older slaty rocks; but the Silurian deposits may be called the great centre of their creation, from which we trace them both downwards and upwards, diminishing, however, rapidly in quantity and variety, either in the descending or ascending series. Let us first observe how they are successively developed in descending order, from their highest station, the carboniferous deposits, down to the lowest in which we know them, the Cambrian Rocks. One species of Trilobite is figured by Martin[3] and supposed to have been found in the coal measures near Mansfield, Derbyshire; also a *Limulus* from Coalbrook Dale by Dr. Buckland in his Bridgewater Treatise[4]; and in a memoir on the same coal-field by Mr. J. Prestwich, about to be published in the Geological Transactions[5], four or five other crustaceans will be given. The whole of these fossils are distinct from any species figured in this work.

Passing down to the limestone which forms the base of the carboniferous system, we meet with other species distinct from those of the coal-measures. Several of these are

[1] After the following descriptions were written, but before these pages were finally printed off, Mr. W. S. MacLeay furnished me with some original observations of high value on the structure and affinities of these animals, which, I am confident, will be deemed well worthy of the attention of naturalists. (See end of Chapter.)

[2] See L'Institut, 1837, p. 254.

[3] *Entomolithus monolites,* Martin Petrif. Derb. Pl. 45. f. 4.; *Belinurus bellulus,* König.

[4] Pl. 46''. f. 3.

[5] Vol. v. p. 2.

figured by Martin[1], and others may be seen in the recent publication of Professor Phillips[2]. Though differing from those of the coal-measures, they appear to resemble them in their small size. Some of them have the generic characters of certain Silurian Trilobites, though of completely distinct species. On the whole, however, so far from being characteristic of a deposit, otherwise rich in organic remains, Trilobites are comparatively of rare occurrence in the Carboniferous Limestone.

We next descend through the Old Red Sandstone, in which we have not yet found these crustaceans, though the shield-shaped heads of the singular fishes which specially characterize the central member of this system, were first supposed to be the bucklers of Trilobites; a mistake by no means to be wondered at, if M. Agassiz be right in informing us, that some of these fossils are almost connecting links between crustaceans and fishes. (see p. 595.)

It is only on reaching the Upper Silurian Strata that we enter upon the great "Trilobitic series." In the highest zone or Ludlow Rock, we find that remarkable form the *Homalonotus* (König), so distinct from any individual observed in the overlying groups. This genus is peculiar to the upper formations of the system; the *Homalonotus Knightii* (König), and *H. Ludensis* (nob.), being very characteristic of the Ludlow Rocks, while the splendid species *H. delphinocephalus* (nob.), (*Trimerus delphinocephalus*? (Green)), occurs in the Wenlock Limestone[3]. The *Calymene Blumenbachii* ranges through the Ludlow and Wenlock formations, but is particularly abundant only in the Lower Ludlow Rock and Wenlock Limestone, beneath which we no longer detect it. The well-known and equally abundant *Asaphus caudatus*, extends from the Lower Ludlow Rock to the base of the Wenlock formation. Both of these trilobites are therefore generally characteristic of the Upper Silurian Rocks. The Wenlock formation contains, however, other forms peculiar to itself, such as the *Calymene macrophthalma*, *C. variolaris*, the remarkable new genera *Acidaspis* and *Bumastus* (nobis), two species of *Paradoxides*, the *Asaphus longicaudatus*, &c.

The Lower Silurian Rocks contain three distinct genera, the *Trinucleus*, *Agnostus* and *Ogygia*, and several species of *Asaphus*, all different from those of the Upper Silurian Rocks. In the Caradoc formation the *Trinucleus* is most characteristic. This genus (of which 6 species are here described) pervades the Lower Silurian Rocks, occurring not only in vast abundance in the Caradoc Sandstone, but occasionally also in the underlying flags. The *Entomostracites punctatus*, Wahl., (*Calymene ? punctata*, Dalm.), and the *Asaphus Powisii*, (nob.), seem to be peculiar to the Caradoc formation.

Lastly, in the Llandeilo flags and associated schist, we are presented with distinct forms of Asaphi, in the large *Asaphus Buchii*, and the still larger *A. Tyrannus* and others,

[1] Petrif. Derb.

[2] Geology of Yorkshire, vol. ii.

[3] In describing the Dudley tract (p. 492.), I have not distinguished the *Homalonotus Knightii* from the *H. delphinocephalus*; for I had not then carefully examined the specimens, the latter species having only just been discovered. (See subsequent description, p. 652.)

together with the *Agnostus* and *Ogygia* of Brongniart. These, with two or three species of *Trinucleus*, are confined to the lower beds of the Silurian System.

The Cambrian Rocks of the region illustrated in this work, are, as far as I know, poor in Trilobites, the only traces of them yet observed being in the limestone near Bala[1].

Examining these fossils in the order in which they occur in their native beds, we shall perceive, that as each formation is characterized by peculiar species, so these crustaceans are of great value in determining the age of the deposits; for though most of the mollusks and conchifers also differ in the successive formations, still a few species of them range almost from the top to the bottom of the Silurian System, *whilst no example is yet known, of a species of trilobite which is common in the Upper Silurian Rocks, being found in the lower beds of the system.* I shall describe all the Silurian Trilobites with which I am acquainted in this chapter, beginning with those of the uppermost strata, and terminating with the species peculiar to the lowest. In the mean time I offer a list of the genera and species.

[1] I have seen Trilobites in Devonshire, some of which differ in species from any described in this work. When the older or Protozoic Rocks shall have been thoroughly examined in all parts of the British Isles, it is probable that the list of Trilobites will be materially enlarged.

LIST OF TRILOBITES IN THE SILURIAN ROCKS.

Homalonotus, König.

Homalonotus Knightii, (König), Upper Ludlow, Pl. 7. f. 1, 2?.
——— *Ludensis*, (nob.), Upper Ludlow, Pl. 7. f. 3 and 4.
——— *delphinocephalus*, (nob.), Wenlock Limest., Pl. 7 *bis*, f. 1 *a* and 1 *b*.
——— *Herschelii*, (nob.), (Silurian Rocks, South Africa), Pl. 7 *bis*, f. 2.

Calymene, Brongniart.

Calymene Blumenbachii, (Brongn.), Ludlow and Wenlock, Pl. 7. f. 5, 6 and 7.
——— *Downingiæ*, (nob.), Wenlock Limest., Pl. 14. f. 3 *a* and *b*.
——— *tuberculata*, (nob.), Wenlock Limest., Pl. 14. f. 4.
——— *macrophthalma*, (Brongn.), Wenlock Limest., Pl. 14. f. 2.
——— *variolaris*, (Brongn.), Wenlock Limest., Pl. 14. f. 1.
——— ? ? *punctata*, (Dalm.), *Entomostracites punctatus*, (Wahlenberg), Caradoc Sandst., Pl. 23. f. 7 and 8.

Asaphus, Brongniart.

Asaphus caudatus, (Brongn.), Ludlow and Wenlock, Pl. 7. f. 8 *a*.
——— *tuberculato-caudatus*, (nob.), Wenlock Limest., Pl. 7. f. 8 *b*.
——— *longicaudatus*, (nob.), Wenlock Shale, Pl. 14. f. 11, 12, 13 and 14.
——— *sub-caudatus*, (nob.), Ludlow Rocks, Pl. 7. f. 10.
——— *Cawdori*, (nob.), Ludlow Rocks, Pl. 7. f. 9.
——— *flabellifer*, (Steininger), (not figured), Wenlock Limestone.
——— *Stokesii*, (nob.), Wenlock Limestone, Pl. 14. f. 6.
——— *Powisii*, (nob.), Caradoc Sandst., Pl. 23. f. 9 *a*, *b* and *c*.
——— *duplicatus*, (nob.), Caradoc Sandst., Pl. 25. f. 7.
——— *Buchii*, (Brongn.), Llandeilo Flags, Pl. 25. f. 2 *a* and *b*.
Asaphus Corndensis, (nob.), Llandeilo Flags, Pl. 25. f. 4.
——— *Vulcani*, (nob.), Llandeilo Flags, Pl. 25. f. 5.
——— ? (*Illænus*, Dalm. ?) *perovalis*, n. s. Pl. 23. f. 7 *a* and *b*.
——— *Tyrannus*, (nob.), Llandeilo Flags, Pl. 25. f. 1 *a* and *b*.
———, (var. *ornata*, nob.), Llandeilo Flags, Pl. 24.

Bumastus, Murchison.

Bumastus Barriensis, (nob.), Wenlock Limest., Pl. 7 *bis*, f. 3 *a*, *b*, *c*, *d*, and Pl. 14. f. 7.

Paradoxides, Brongniart.

Paradoxides bimucronatus, (nob.), Wenlock Limest., Pl. 14. f. 8 and 9.
——— *quadrimucronatus*, (nob.), Wenlock Limest., Pl. 14. f. 10.

Acidaspis, Murchison.

Acidaspis Brightii, (nob.), Wenlock Limest., Pl. 14. f. 15.

Trinucleus, Lhwyd.

Trinucleus Caractaci, (nob.), Caradoc Sandst., Pl. 23. f. 1 *a*, *b*, *c*, *d*, *e* and *f*.
——— *fimbriatus*, (nob.), Caradoc Sandst. and Llandeilo Flags, Pl. 23. f. 2.
——— *radiatus*, (nob.), Caradoc Sandst., Pl. 23. f. 3 *a* and *b*.
——— *Lloydii*, (nob.), Caradoc Sandst., Pl. 23. f. 4.
——— *nudus*, (nob.), Caradoc Sandst. and Llandeilo Flags, Pl. 23. f. 5.
——— *Asaphoides*, (nob.), Llandeilo Flags, Pl. 23. f. 6.

Ogygia, Brongniart.

Ogygia Murchisoniæ, (nob.), Llandeilo Flags, Pl. 25. f. 3 *a* and *b*.

Agnostus, Brongniart.

Agnostus pisiformis, ? (Brongn.), Llandeilo Flags, Pl. 26. f. 5 *a* and *b*.

TRILOBITES OF THE UPPER SILURIAN ROCKS, (LUDLOW AND WENLOCK FORMATIONS.)

The prominent family distinction of Trilobites, is the division of their abdomen and post abdomen into 3 longitudinal lobes, by two furrows; which character being scarcely perceptible in this remarkable genus, it has been named (by Mr. König) *Homalonotus.*

Homalonotus. The following is the short account first given in "Icones Sectiles," No. 85, from a mutilated specimen, of the distinctive characters of

Homalonotus Knightii, (König.), Pl. 7. f. 1 and 2?.

"Testa ovata (?) acuminata: pars anterior sive caput —— ?; corpus multiarticulatum, dorso plano (nec trilobo); pars postica s. cauda simplex, acuminata, parva.

"Nominis occasionem præbuit planities dorsi.

"Exemplar hoc unicum insidens lapidis calcarii fragmini, in Herefordiæ Comitatu, non vero in situ, ut ajunt, reperto, pro humanitate sua ad nos transmisit vir ornatissimus, Andreas Knight, Soc. Hortor. Colendor. Præses."

The above generic character was derived from a form very nearly resembling our figure Pl. 7. f. 1.

Owing to the imperfect condition of the specimens, it is difficult to say whether the form f. 2. belongs to the same species.

Homalonotus Ludensis, (N.S.) Pl. 7. f. 3 & 4.

Head *ovate-acuminate? ornamented with small tubercles* (f. 3.). Body *imperfectly trilobed by two slight longitudinal depressions marked with tubercular cavities, ribs* 13? Caudal portion (Pygidium) *ribs* 9? *tail a plain prominent boss prolonged to a sharp point.*

I have ventured to separate this species from *H. Knightii*, König, on account of the longitudinal depressions which almost divide the animal into 3 lobes. We have no means of determining the form of the head of *Homalonotus Knightii,* and we can merely refer to the drawings to convey an approximate idea of that member in *H. Ludensis*; for that of f. 4. is much compressed, and that of f. 3. has been mutilated. In the general form of the caudal portion, there is, indeed, no well-marked difference between *H. Knightii* and *H. Ludensis*; and I have ascertained from other specimens, that both species had pointed tails, like f. 4., the square terminations of figs. 1, 2 and 3. being solely due to mutilation.

Loc. The *Homalonotus Knightii* and *H. Ludensis* are very characteristic of the Ludlow formation, and particularly of its upper division, in which fragments of them are found throughout the Silurian Rocks of Salop, Hereford, Worcester, Radnor, Brecknock, &c.

Fig. 1. is drawn from a specimen discovered by the Rev. T. T. Lewis, near Ludlow. Fig. 2. belongs to Mr. B. Bright, and is from the western flanks of the Malvern Hills. Figs. 3. and 4. are from Ludlow. The former is in the Cabinet of Mr. Evans, Hon. Sec. Worcestershire Nat. Hist. Soc.; the latter was found by Mr. Edward Davis of Presteign.

Homalonotus delphinocephalus, nob. (*Trimerus delphinocephalus*?, Green), Pl. 7 (bis) f. 1*a*, 1*b*.

Head *depressed, ovate-acuminate. Front of head approaching to even, anterior part flat, slightly raised, and marked with indistinct protuberances. Posterior end marked by a deep groove which produces a ridge closely resembling one of the body ribs.* Eyes *prominent, rather small, papillary and truncated. Facial suture* (linea facialis) *curved, apparently dividing the eye in two, and separating the central lobe from the lateral lobes, passes within the raised anterior margin.* Body *composed of* 13 *ribs with intercostal plates, which extend* *to the end of the ribs. Lateral portions of ribs falciform, and descending abruptly, the points being directed anteriorly.*

Caudal portion (pygidium[1]) *very distinct from the body, ribs* 12, *lateral lobes nearly equal in width to the central lobe.* Tail *smooth and acuminated.*

The genus *Homalonotus* is distinguished from the *Calymene* by the much greater proportional width of its central lobe, as well as by the apparent absence of trilobation and the peculiar structure and form of the head and tail. It is also remarkable in the falciform termination of its lateral ribs or segments.

The suture (linea facialis) which divides the head into 3 parts, and which, according to Dalman and other authors, is a distinguishing feature of many Trilobites, is well developed in the *Homalonotus delphinocephalus,* and is also seen in the *Bumastus Barriensis* (nob.). In the latter, however, this line passes under the anterior part of the head as shown in Pl. 7 *bis,* f. 3 *e.* This suture is rarely seen in our English specimens owing to the nature of their matrix.

The whole of the surface of the *Homalonotus* was scabrous, but this character is best seen in those portions which were apparently least exposed to friction while living, as at the ends of the side lobes, particularly those of the "pygidium"; for on the back or middle lobe the surface is worn into slight indentations. (Fig. 1 *c.* Pl. 7 *bis,* exhibits a portion of the surface of the post abdominal side lobe; f. *d.* a portion of the central lobe, both magnified.)

The smooth parts intermediate between each segment present a different aspect in different specimens, being almost entirely covered by the ornamented portion of the ribs in some (see the 12th and 13th body ribs f. 1 *a* and *b.*), and in others appearing, even in the centre of the body, as considerable ridges nearly half the width of a rib. This sculpture, partially seen in the anterior part of the body of f. 1 *a* and *b.*, and more clearly developed in other specimens of the same species found at Dudley and also in the *H. Knightii* and *H. Ludensis,* Pl. 7. figs. 1, 2, 3 and 4., shows that the animal must have had the power of contracting and expanding by moving the ribs over each other. Thus the lateral termination of these plates is seen to be scabrous, while their central parts over which the ribs worked? are smooth, as may be seen in some sculptured crustaceans which have the power of coiling up their abdomen.

As I can discover no difference between our *Homalonotus* and the American *Trimerus delphinocephalus,* (Green), except in size, (the latter being very diminutive) I have retained the specific name of the American author, while I adhere to the generic name of König, which was applied to bodies of this form before the publication of Dr. Green.

Loc. *Dudley Castle.* (In the upper beds of the *Wenlock Limestone.*) I am indebted to Mr. Blackwell for the loan of the fine fossil Pl. 7 *bis,* f. 1., and also to Mr. John Gray and Mr. Morris of Dudley, for the use of instructive portions of the head, body and caudal portion, which enabled me to describe some of the above-mentioned peculiarities.

Homalonotus Herschelii (n.s.), Pl. 7 *bis,* f. 2.

Differs from *H. Knightii, H. Ludensis* and *H. delphinocephalus,* in the *body being covered by strong and prominent tubercles,* and in the *posterior sides of the head being terminated laterally by a double-headed short process.* In all the essential characters of the genus, however, namely, the indistinct semblance of trilobation, the ovate-acuminated head, form and position of the eyes, number of ribs and their falciform terminations, together with the

[1] I have for the most part employed the terms used by Dalman to designate the different parts of the body.

shape of the caudal portion, this fossil is clearly of the genus *Homalonotus*, and approaches very nearly to our English species. This is the only foreign specimen figured in this work, and I have selected it, because it marks the fact, that the eminent astronomer, after whom it is named, occupied a portion of the time he passed in Southern Africa in promoting geological investigation. The fossil was first sent to me by him. It occurs in the range of the Cedar Mountains (Cedar-berg), N. of the Cape colony, where it is associated with other trilobites, one of which is undistinguishable from *Calymene Blumenbachii*, while another approaches very near to *C. Tristani*, and also with certain mollusks, which leave no doubt of the existence in that region of rocks of the same age as our Upper Silurian; namely, *Cucullæa ovata*, Pl. 3. f. 12 *b*., (passage-beds from the Old Red Sandstone), *Orbicula rugata?*, *Conularia quadrisulcata*, *Leptæna lata*, with fragments of *Turbo*, *Turritella*, *Crinoidea*, and a new species of *Nucula*, which ought to be named *N. Smithii*, in honour of Dr. Smith, the naturalist and explorer of South Africa, who collected the specimens[1].

CALYMENE, Brongniart.

Gen. Char.—"Corps *contractile en sphère presque hemicylindrique.* Bouclier *portant plusieurs tubercules ou plis, deux tubercules oculiformes réticulés.* Abdomen *et* post abdomen *à bords entiers, l'abdomen divisé en douze ou quatorze articles. Point de* queue *prolongée.*"

Calymene Blumenbachii, figs. 5, 6 and 7. (Brongn. Pl. 1. f. 1.) Syn. Dudley fossil, *Entomolithus paradoxus*, Blum.

"*Clypeo rotundato, tuberculis sex distinctis in fronte; oculis in genis eminentissimis; corpore tuberculato.*"

This species has six rounded protuberances on each side of the central lobe of the head, and fourteen articulations in the back. The tail is small, (see f. 7.), and the shell is covered with little round tubercles of unequal size. It may be added that the *Calymene Blumenbachii* generally exhibits a sculpture of the segments somewhat similar to that described in *Homalonotus*, and also has often the appearance of being marked by a row of rather wide, slightly raised, tubercles on each side of the central lobe of the body (one at the end of each rib.). In Pl. 1. f. 1 *c*. of Brongniart, these costal protuberances appear rather as the raised or bent ends of the central segments. In examining a great number of specimens, we find that this feature, though so strongly apparent in our f. 5., is very inconstant; for we detect numerous gradations between the apparently distinct tuberculation in f. 5. and those which are entirely free from it, like f. 6. As the appearance of such tuberculations is most apparent in those specimens which have been coiled up, and is not visible in those which are straight and unfolded, may we hazard a conjecture that the swellings or knots in question are to a great extent the result of torsion and lateral pressure?

Loc. *Ludlow, Dudley, &c.* The splendid specimen, f. 6., is in the cabinet of Mrs. Downing of the Priory, Dudley. The smaller forms, (those usually found), figs. 5 and 7, are from the *Wenlock Shale of Burrington, near Ludlow,* where they were collected by the Rev. T. T. Lewis and myself.

The *Calymene Blumenbachii* occurs both in the Ludlow and Wenlock formations, but most

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[1] In the first part of the 8th vol. of the Journal of the Geographical Society just published, Capt. Alexander thus alludes to the Cedar Mountains:—"The principal rock of the higher parts (5000 feet), appears to be an ash-coloured, quartzose sandstone; the secondary range contains many marine petrifactions, shells and fish, at a height of 2000 feet above the sea."—p. 3.

abundantly in the latter. It is, however, generally characteristic of the Upper Silurian Rocks. Together with the *Asaphus caudatus*, it is one of those trilobites which have the widest geographical range, occurring in North America, Norway, Russia, and in various parts of France, Germany, and Poland. To these localities I may add Southern Africa, where, as above stated, it has been found associated with the *Homalonotus Herschelii*, and other fossils of the Upper Silurian Rocks.

ASAPHUS, Brongniart.

Gen. Char.—" Corps *large et assez plat; lobe moyen saillant et très distinct.* Flancs *ou lobes latéraux ayant chacun le double de la largeur du lobe moyen.* Expansions *submembraneuses depassant les arcs des lobes latéraux.* Bouclier *demi-circulaire portant deux* tubercules oculiformes réticulés ? Abdomen *divisé en huit ou douze articles.*"

Asaphus caudatus, f. 8*a*. Brongn.

This figure is given to show the form of the tail of the species figured by Brongniart and other naturalists as the true *Asaphus caudatus*, which differs from our large figure 8, in exhibiting *a central lobe without tubercles, a very distinct separation of the abdomen from the caudal portion, and the termination of the lateral ribs of the former in points.*

Loc. In great abundance throughout the Upper Silurian Rocks, (*Ludlow* and *Wenlock* formations), being nearly as prevalent as the *Calymene Blumenbachii.*

Asaphus tuberculato-caudatus, (n.s.), f. 8.

Spec. Char. Shield *anterior part oval, posterior strongly margined, sides extended to the sixth rib and terminating in sharp points.* Head *covered with small tubercles, central lobe having* 5 *protuberances,* 4 *of which, somewhat resembling ribs, lie between and below the eyes; the fifth is large, expands laterally, and advancing to the anterior edge of the shield is marked through half its length by a furrow.* Eyes *crescent-shaped, conical, composed of many lenses*[1]. Body, *each rib of central lobe ornamented by a large tubercle on either side.* Caudal portion, *ribs tuberculated like those of the body, terminated by a sharp tail.*

I have ventured to separate this species from the *A. caudatus*, Brongn., because every rib of the central lobe of the body and caudal portion (in all twenty-three) is flanked by a large stud or tubercle. It further seems to differ in its head being enriched with tubercles, and in having an additional frontal protuberance; while the body and caudal portion which are almost inseparable in our species, are very sharply divided in *A. caudatus*, Brongn.

This species resembles *A. limulurus* of the United States, in having a small tuberculated central lobe; but the latter has a fine pointed tail like our *A. longicaudatus*, Pl. 14. figs. 11, 12, 13 and 14, and its ribs terminate laterally in reflected spines. (See Green's Monograph, p. 48. and cast 16.)

Loc. *Dudley.*

Asaphus (*Olenus*) *flabellifer ?*, Steininger; Trans. Soc. Geol. de France, tom. i. pl. 21. f. 10.

The caudal termination of this fan-tailed species, found by Dr. Lloyd, in the Wenlock Limestone, is in the Museum of the Ludlow Society. A good drawing of it was sent to me by Professor Phillips, and I have since seen the original. It somewhat resembles *A. laticauda*, Brongn. Pl. 3. f. 8., and also *A. laciniatus*, Dalm. t. 6. f. 1., but is most probably identical with the *A.* (*Olenus*) *flabellifer* of Steininger from the Eifel. Although I have not figured this curious fragment, I may observe that similar caudal remains are said to occur in South Devon.

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[1] The use of these lenses in horizontal vision, and of which there are at least 400 in *Asaphus caudatus*, is beautifully described in Dr. Buckland's Bridgewater Treatise, p. 399., and has been before adverted to p. 647.

Steininger has not published a specific name, but I learn from M. de Verneuil that he has recently assigned to the fossil the above descriptive term.

Asaphus Cawdori, (n.s.), f. 9.

Asaphus subcaudatus, (n.s.), f. 10.

These post-abdominal terminations of trilobites differ from any published species with which I am acquainted, and are probably portions of an *Asaphus.* I have named No. 9. after the Noble Earl who discovered it.

Loc. *Fresh-water East, South Pembroke,* where they were both found in Upper Silurian Rocks by the Earl of Cawdor.

The species No. 10. has been also observed by Mr. Lewis in the Aymestry limestone near Ludlow.

N.B. Other *Asaphi* which occur in the Wenlock, Caradoc and Llandeilo formations, are described in the subsequent pages.

TRILOBITES OF THE UPPER SILURIAN ROCKS (*continued*).

PLATE XIV.

Calymene variolaris, f. 1. Brong. (var.?)

Spec. Char.—*Clypeo rotundato, lobis inflatis valde tuberculatis, angulis externo-posticis in mucronem productis* (Brongn.).

The prominent distinction of this species consists in *the highly ornamented pear-shaped central lobe of the head with a swelling front.*

M. Brongniart also remarks, "that the numerous small tubercles with which the animal is covered have a small aperture near their summit, similar to the tubercles to which the spines of *Cidaris* are attached," a distinction which I have never observed. Can the remarkable prolongation of the lateral edges of the buckler, given in the figure of Brongniart, Pl. 1. f. 3 A., have been obliterated in our specimen, or is the latter a variety?

Loc. *Wenlock Edge and Dudley.* The *Calymene variolaris* is not very common. It is (as far as I know) peculiar to the Wenlock formation.

The specimen figured is from the cabinet of Mrs. Downing.

Calymene macrophthalma (Brong.), f. 2. Brongn. Pl. 1. f. 5 A, B and C.

Head *round and plain in central division.* Eyes *very large and protuberant, occupying the greater portion of the sides or cheeks and composed of many lenses. The back,* M. Brongniart remarks, *has* 12 *or* 13 *articulations and is neatly separated from the short pointed tail.*

Loc. *Wenlock and Dudley,* but, like the *C. variolaris,* less frequently than the *Asaphus caudatus* and *Calymene Blumenbachii.*

Calymene? Downingiæ (n.s.), f. 3. Buckl. Bridgw. Treat. Pl. 46. f. 5.

Head *ovate-acuminate, central part divided on each side by* 3 *transverse furrows into tubercles.* Eyes *rather smaller than in* C. macrophthalma, *but similarly ornamented.*

I have separated the *Calymene macrophthalma,* Brong., into two species, believing that his figure, Pl. 1. f. 4 B., is our common, large-eyed species, and that his f. 4 A. of the same Plate, judging from the ovate-acuminate head and the tubercles on the forehead, is our *C. Downingiæ.* The last-mentioned species is infinitely rarer than that to which I would restrict the name of *macrophthalma.* That species is at once recognized by its bald, plain, rounded head, as is well exposed in the drawings of Mr. C. Stokes. (See Brong. Pl. 1. f. 5 A, B and C.) I have named this species after Mrs. Downing, to whom I am indebted for the loan of it.

Loc. *Dudley*.

Calymene tuberculata, f. 4.

This species has usually been referred to *C. macrophthalma*, from which it differs in having *a more elevated front and a more tuberculated central lobe of the head.*

Loc. *Dudley*. It occurs also near St. Petersburgh.

Fig. 5., fragment of a trilobite from the Wenlock Shale, probably undescribed.

Asaphus Stokesii (n.s.), f. 6.

Head *oval, shield much prolonged on the sides and central lobe ornamented at the base with 3 tubercles.* Body *with* 9 *or* 10 *articulations;* caudal portion *nearly semicircular; central lobe slightly pointed.*

This beautiful little specimen, which belongs to Mr. Charles Stokes, is clearly distinguished from every published species by its general form and by the curved and projecting sides of the shield.

I have real pleasure in naming this species after so accomplished a naturalist as Mr. Stokes, who it is to be hoped may soon prepare a monograph of fossil crustaceans, concerning which he possesses so much valuable knowledge.

Loc. *Dudley*.

Asaphus longicaudatus (n.s.), figs. 11, 12, 13 and 14.

This trilobite differs essentially from the *A. caudatus*, Brong. Pl. 3. f. 9., or the *A. mucronatus*, Dalm. Tab. 2. f. 3., *both in general form and in the exceeding slenderness and length of the tail. There is, however, another important distinction in the rim or outer edge of the buckler, being produced anteriorly in a large protuberance.*

The most entire of our specimens (f. 12.) is a good deal mutilated in the body, and hence it is impossible to describe that member accurately; but the post abdomen, the most distinguishing portion of the animal, has 15 well-pronounced articulations (the *Asaphus caudatus* having 10 to 11 only) from which the slender and pin-like tail extends in one specimen even to 2½ inches.

Loc. The *Asaphus longicaudatus* is usually found in the lower part of the Wenlock formation.

In the specimen f. 12. (from the shale *under the Wenlock Edge, near Wistanstow, Salop*), the shelly matter, being partially preserved, indicates the extreme thinness of the covering of this crustacean.

Fig. 11 is from the *Malverns* (cabinet of Mr. Bright) and figs. 13 and 14 are from *Dudley*, &c.

Bumastus, Nobis. (*Bumastus*[1].)

Gen. Char. *Pars anterior* capitis rotundato-convexa, subæqualis: oculis lunatis, glabris, remotis. *Pars costalis s. corpus* sulcis longitudinalibus vix apparentibus, costis decem. *Pars posterior* maxima, rotundato-tumida, æqualis. [*Obs.* Omnes testæ partes ultro citroque, linearum sulcatarum subtilissimis ambagibus punctulisque confertis, insignitæ.]

Bumastus Barriensis (n.s.), Pl. 7 *bis.* f. 3 *a*, *b*, *c* and *d.*; Pl. 14. f. 7 *a* and *b*.

Head *round* (*bombé*) *in front, margin raised, oculine protuberances large, surrounded by a depression on the edge of which, over the eyes, two small ovate prominences; in advance of the eyes and towards the margin two slight hollows.* Eye *approaching to semilunar, apparently*

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[1] βούμαστος, uva eadem quæ bumamma, genus uvæ crassioris rotundique acini; a kind of large grape. Virg. Georg. ii. 102. Colum. iii. 2.

smooth. (See Pl. 7. f. 3 *a* and *b.*) *The facial suture* (linea facialis) *traverses the oculine protuberances, separates the upper portion of them from the eye, and passes under the margin.* (See Pl. 7 *bis.* f. 3 *b**.) Body *with no true longitudinal furrows; central lobe only just perceptible by very slight depressions in the body only. Ribs* 10, *those of the lateral lobes terminating in recurved blunt ends.* Caudal portion *round and smooth without a trace of trilobation.* (See Pl. 14. f. 7.) *Surface of the whole animal* (*testa*) *covered by extremely thin, apparently imbricated lamellæ, the edges waved or vermiform, the intermediate spaces studded with minute dots.* (See magnified portions of the eye and head, Pl. 7 *bis.* f. 3 *c* and *d.*) Where exposed to friction during the life of the animal these markings are removed.

This remarkable crustacean has been hitherto known in England as the Barr trilobite, having been found at the Hay Head lime works, near the village and beacon of Barr in Staffordshire. A very large specimen of it, 5 inches long by $3\frac{1}{6}$ inches wide, has been lithographed at Birmingham, and the species has been figured under the English name above stated by Mr. F. Jukes and Mr. J. Sowerby, in Loudon's Mag. Nat. Hist. vol. ii. p. 41., accompanied by a wood-cut.

I formerly supposed that, from its equally balanced extremities, this crustacean belonged to the genus *Isotelus* (Dekay), p. 215., but since the earlier chapters of this work were printed, I perceived that the English fossil was excluded from the American genus by the absence of distinct trilobation in the body, and of any trace of such divisions in the caudal portion, by having 10 instead of 8 ribs, and by other essential differences.

I next observed, that although agreeing with the *Illænus* of Dalman in the number of ribs, that genus differed from our fossil in having the head plain and without protuberances, eyes strongly reticulated, body distinctly divided into 3 lobes, the longitudinal depression being extended into the head and caudal portion, and the lateral ends of the ribs sharp. Though our fossil approaches to *Nileus Armadillo,* Dalman, in the almost entire absence of longitudinal trilobation, that genus is very distinct from ours, by having eight ribs only, which terminate in points, a plain head, and very large reticulated eyes. Again, I was once disposed to think that the mutilated specimen, without a "pygidium" figured by Eichwald as *Cryptonymus Rosenbergii,* De Tril. Obs. Casan, Pl. 3. f. 3 *a* and *b.*, might be identical with our species, but on receiving (while these pages were printing) the rare work of Pander, published subsequently to that of Eichwald but unknown in England, and in which all the transition fossils of the neighbourhood of St. Petersburgh are elaborately described, I ascertained that the *Cryptonymus Rosenbergii* is the *Illænus crassicauda,* Dalm., a fossil quite distinct from our specimen[1].

I have therefore ventured to consider this trilobite a new genus, and to name it *Bumastus,* the specific name being derived from the locality where it was found. The peculiarity of structure of its surface has not I believe been noticed by the Swedish or Russian authors as belonging to any trilobite described by them, nor can I detect it in a specimen of *Illænus crassicauda,* collected by M. Brongniart near Linkoping in Sweden, and lent to me by Mr. C. Stokes, though a specimen supposed to be from Russia, apparently identical with our *Bumastus Barriensis,* and having precisely the same surface, was pointed out to me in the British Museum by Mr. König. Being acquainted with one form only of *Bumastus,* it is possible

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[1] The work of Pander, "*Beiträge zur Geognosie des Russischen Reiches,* 1830," was obligingly sent to me by the Baron de Meyendorf, through my friend M. de Verneuil. I shall allude to this work again at the conclusion of this chapter.

that these markings ought to constitute a specific difference only, for I am aware that this sort of sculpture can seldom be a generic distinction. I have merely added them to the generic character provisionally. They are seen in specimens from Staffordshire as well as in the beautiful head Pl. 7 *bis*. f. 3. belonging to Mr. B. Bright, which was found on the western slopes of the Malvern Hills. The under surface of this head (Pl. 7 *bis*. f. 3 *b*.) also shows how the fine furrows (lines of growth ?) conform separately to the outline of the different parts of the head.

Loc. *Hay Head Lime Works, near the village and beacon of Barr, Staffordshire; near Brand Lodge, Malvern Hills, the residence of Mr. Bright, near Presteign.*

PARADOXIDES Brongniart. *Entomostracites paradoxides* (Wahlenberg). *Olenus* (Dalman).

Gen. Char.—"Corps *déprimé non contractile.* Flancs *beaucoup plus larges que le lobe moyen.* Bouclier *presque demi-circulaire; trois rides obliques sur le lobe moyen. Point de* tubercules, oculiformes. Abdomen *a douze articulations.* Arcs des flancs, *abdominaux et post-abdominaux, plus ou moins prolongés hors de la membrane qui les soutient.*"

Brongniart established this genus, and I therefore retain his name. Without entering into a detail of characters, it may always be recognised by the ends of all the lateral ribs terminating in deflected points, some of which extend in spikes beyond the tail.

Paradoxides bimucronatus (n.s.), f. 8.

Our specimen differs essentially from any published by Wahlenberg, who first figured the genus, or from the figures of Brongniart or Dalman, in having a *sharp, two-pronged tail.* The large, incurvated, flanking spines are also wider apart than in the *P. Tessini,* Brong. Pl. 4. f. 1. (the *Olenus Tessini,* Dalm. tab. 6. f. 3.), which it more nearly resembles.

Fig. 9. is probably the body of *Paradoxides bimucronatus,* f. 8., being found in the same slabs of limestone. The lateral lobes of the body present curiously sculptured plates, *that almost give it the appearance of being divided into five lobes.*

On examining the structure of the segments of trilobites, we find a great variety of sculpture. The sculpture in f. 9. is very remarkable. We may observe, that the further the rough sculpture reaches from the middle lobe, the less the animal must have had the power of moving and coiling itself up. See *Homalonotus Ludensis,* Pl. 7. f. 4. and *Calymene Blumenbachii,* Pl. 7. f. 6. A reference to a lobster's tail will best explain this sort of structure, which is strongly developed in our f. 9. and has been alluded to in p. 653.

Loc. *Wenlock Limestone of the Malvern Hills,* where it was found by Mr. B. Bright.

Paradoxides quadrimucronatus (n.s.), f. 10.

This beautiful little species, from the cabinet of Mr. Stokes, differs from the *P. spinulosus,* Brongn. Pl. 4. f. 2. (*Olenus spinulosus,* Dalm. tab. 6. f. 4.) both in general form and in having a four-pronged instead of a simple rounded tail.

Loc. *Dudley.*

ACIDASPIS, Nobis. (*ακις, mucro, ασπις, scutum.*)

Gen. Char.—Capitis *scutum* marginatum, antice subtruncatum, trituberculatum: tuberculo medio postice in *mucronem* desinente.

Acidaspis Brightii (n.s.), Pl. 14. f. 15.

Although most unwilling to multiply names, the very remarkable form of the head or shield of this trilobite, the posterior end of its central lobe projecting over the body in the form of a stomacher, and rendering it totally distinct from any published figure, induces me to propose it as a new genus.

The raised and beaded, if not toothed rim of the buckler is also curious, and may serve to distinguish this from any species of the genus *Acidaspis* which may hereafter be found. I dedicate it with much pleasure to Mr. B. Bright, to whom the original belongs, and the liberal use of whose rich cabinet has assisted me so materially to illustrate this work.

Loc. *Wenlock Limestone of the Malvern Hills.*

TRILOBITES OF THE LOWER SILURIAN ROCKS (CARADOC AND LLANDEILO FORMATIONS).

TRINUCLEUS, Pl. 23. figs. 1 to 6. (*Lhwyd Ichnogr. Lith. Brit. Epist.* t. 23.) CRYPTOLITHUS, Green. *Asaphus granulatus?*, Dalm.

Gen. Char. (Nobis.)—*Caput* obtusum, *scutum* marginem versus punctulis concavis ex ordine collocatis ornatum, trilobum: lobis rotundato-protuberantibus, medio lateralibus minore.

Corpus breve, 5—7 costatum: costis lateralibus rectis.

Pygidium trilobatum breve.

Seeing that these distinctions, as above defined, prevail in several species of trilobites, I have formed them into a new genus under an old name assigned to one species of an animal of this form by Lhwyd.

Trinucleus Caractaci (n.s.), figs. 1 *a, b, c, d, e* and *f.*

Spec. Char.—*Marginal pores of the shield in concentric rows* (5 *and* 6) *in the front, on the sides scattered and terminated laterally by a plain, slender, pointed cheek or spike, which extends beyond the body. Caudal furrows,* 5 *on each side. Tail obtusely mucronated.*

The marginal pores magnified, are seen (in f. 1.) to penetrate the shield, a peculiarity so great in crustaceans, that if Lhwyd had not originally figured one of this genus as *Trinucleus*, and Green had not subsequently called it *Cryptolithus*, I might, as before stated, p. 217, have proposed the generic name of *Tretaspis* (perforated or deeply sculptured shell). The lateral spike of the buckler is found in well-preserved specimens only, or those which have been deposited in finely levigated materials, figs. 1 *c* and 1 *e*. (Our species is quite distinct from the *Cryptolithus tessellatus* (Green) of N. America in having 5 or 6, instead of 3, rows of marginal sculpture on the shield, and also by the lateral spikes of the buckler.)

Loc. This fossil is so abundant in the Caradoc formation that I have named it *Trinucleus Caractaci*. The specimens figured, as well as those of figs. 2 and 3, were collected by myself in reddish and blackish, sandy shale, in a little dingle west of *Welch Pool Church*. The same species, however, abounds in the impure limestone and sandstone on the eastern flanks of the *Caradoc Hills*, in the *Meifod Hills*, Montgomeryshire, and occasionally, though rarely, in the upper beds of the *Llandeilo flags* (*Caermarthenshire*). It has also been found with other Silurian fossils in *Ireland* (*eastern part of Tyrone*) and has very recently been figured to illustrate a description of the structure of that region by Capt. Portlock, R.E. (See Ordnance Survey of Ireland, vol. viii. Pl. 1, 2 and 3[1].)

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[1] The figs. 6. Pl. 1. and f. 8. Pl. 2. of Capt. Portlock are the forms I should refer to my species *Trinucleus Caractaci*, though not with absolute certainty, seeing that the specimens are mutilated. I may add, that among these Irish specimens, f. 9. Pl. 2., resembles the *Illænus? Corndensis*, Pl. 23. f. 7., while f. 7. Pl. 2. o. the Ordnance Survey is not unlike the *Calymene? punctata* Pl. 23. f. 8., though the former has no punctures.

Trinucleus fimbriatus (n.s.), f. 2.

Marginal pores in diverging rows in the front of the shield; on the sides scattered; lateral spike of the buckler divergent from the body. Caudal ribs 12 *on each side.*

This is probably the same species figured by Lhwyd, Epist. 1. p. 9. t. 23. I have never found it entire, but the caudal extremity occurring in the same fragment of rock with the buckler, and both agreeing with the figure of Lhwyd, I have considered them as parts of the same species. The simple fimbriated rim of the buckler distinguishes this species from the others[1].

Loc. *Near Welsh Pool and Builth.*

Trinucleus radiatus (n.s.), figs. 3 *a* and *b*.

Marginal pores arranged on the front of the head in 1 *or* 2 *rows; on the sides in long radiating lines. Buckler square, lateral spikes short.*

Although fragments of the head only have been found, there can be no hesitation in referring them to the genus *Trinucleus,* while the radiating lines and general outline of the buckler are very distinct from those of any other species.

Loc. *Trilobite Dingle, Welsh Pool; Caradoc and Meifod Hills, &c.*

Trinucleus Lloydii (n.s.), f. 4.

Marginal pores on the front of the head in several rows; on the sides scattered. Buckler round, with lateral spikes advancing beyond the body, which is composed of 5 *ribs.*

Caudal portion semicircular. Tail obtuse, ribs on each side terminating in hooked points.

This species is at once distinguished from other *Trinuclei* by the vast length of the buckler, which with the pendent cheeks advancing to the posterior extremity of the animal, constitute a peculiarity not observed in any other published trilobite.

Loc. This beautiful and rare species was found in the black flag of *Blaen-dyffrin-garn, near Llangadock,* by the Rev. Henry Lloyd of Tan-yr-alt. The rock is one of the superior beds of the Lower Silurian Rocks, and owes its hard character to the boss of trap by which it is thrown off.

Trinucleus nudus (n.s.), f. 5.

Three nuclei of the head without the ornamented buckler. It differs from *T. fimbriatus* in the number of caudal ribs, (9 or 10 instead of 12,) and in the outline of the head which is more oval.

Loc. *Gwern-y-fad, near Builth in Llandeilo Flags; the Gilwern Hills, near Llandrindod.*

Trinucleus? Asaphoides (n.s.), f. 6.

Three nuclei less distinct than in the other species, and general form approaching to that of Asaphus; hence its name.

Though distorted, this little specimen is interesting, in showing the passage from the *Trinucleus* to the *Asaphus,* the leading distinction of a sculptured shield being scarcely perceptible.

Loc. *Near Builth.*

Judging from these specimens, I should infer that they belonged on the whole to the Lower Silurian Rocks. The Graptolite and the Orthoceratite, figured Pl. 3., are probably from the lowest beds of the Upper Silurian Rocks.

[1] Brongniart has figured fragments of this genus, from drawings of Mr. Stokes, Pl. 4. figs. 5, 6 and 7., but assigns no name to them, referring them with doubt to *Asaphus cornigerus,* from which, however, they are distinct.

It would appear from the observations of Bigsby, and also from those of Dr. Green, that the genus *Trinucleus* is very abundant in North America. I have not yet had an opportunity of comparing good specimens, though it is probable that one of the specimens found by Dr. Bigsby, near Montmorenci, and in the collection of Mr. C. Stokes, is our *Trinucleus fimbriatus*, f. 2., called *T. Bigsbii*, p. 397. (See Geol. Trans. vol. i. p. 196.)

Calymene?? punctata, f. 8 *a, b.* (Dalm. Pl. 2. f. 2 *a, b.*) *Entomostracites punctatus*, Wahl., (Brongn., Pl. 3. f. 4.)

The caudal portion of this trilobite, identical with the figures of Wahlenberg, Brongniart and Dalman, is abundant in the Caradoc Sandstone. As neither the body nor head of the animal have yet been found, it is impossible to fix the genus[1].

The old name of *Entomostracites* was also applied by Wahlenberg to the genus *Trinucleus*, one species of which is copied from that author into Brongniart's work, Pl. 3. f. 7., under the name of *Entomostracites granulatus.*

Loc. *Michaelwood Chase, Tortworth; Caradoc and Meifod Hills.*

Asaphus Powisii (n.s.), f. 9. (*a, b, c.*)

Head *having a large round mamillated front, two prominent lateral divisions. Central lobe of the body very wide, and separated by a raised margin from the lateral lobes, which have obtuse ends.* Eyes *composed of many minute lenses arranged in hexagons.* Caudal portion *semicircular, and circumscribed by a broad band.* (*The eye is not seen in the larger figure, but is partially represented in* f. 9 *b.*)

I have named this splendid new species of trilobite after the noble family in whose demesnes in Montgomeryshire it occurs.

Loc. *In the upper beds of the Caradoc formation at Cheney Longville, Salop, and in shale of the same age at Welch Pool, Montgomeryshire.* The fragment f. 9 *b.* was found by Mr. Lewis and myself in the calcareous or upper bed of the Caradoc formation, on the banks of the Onny, near Cheney Longville.

The other portions figured were found by myself in "the trilobite dingle," Welch Pool, to which I have already adverted, (see p. 217 and 303.)

ILLÆNUS (Dalman).

Illænus? perovalis (n.s.), figs. 7 *a* and *b.*

Elongated oval form; central lobe of the body slightly prolonged into the caudal portion. Blind?

From its equally balanced extremities, this animal was supposed to belong, as mentioned p. 215., to the genus *Isotelus.* It appears, however, to differ from every published species, though it most nearly approaches *Illænus*, Dalman, from which, however, it must differ if really blind.

Loc. *Flanks of the Corndon (or Cornden) mountain near Shelve, on the borders of Salop and Montgomery,* where I found it in Lower Silurian Rocks much altered by igneous action. Other trilobites from this tract are figured in Pl. 25. figs. 4 & 5.

Asaphus duplicatus, nob. Pl. 25. f. 7.

Body 13 *to* 14? *ribs, central lobe very small and prolonged to a sudden termination in the*

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[1] A small elongated but mutilated *Calymene,* distinct from *C. Blumenbachii* and nearly resembling *C. Tristani,* Brongn., was found at Cefn Rhyddau near Llandovery, by Mr. W. Williams, and at Cefn-y-garreg; also near that place by myself, in both instances in Lower Silurian Rocks.

tail. Caudal portion *broad and very obtuse, lateral lobes convex, ribs* 10? *each having an additional furrow near its posterior edge.* (The specific name is taken from the last-mentioned feature.)

Loc. *Wilmington* near Marton, Salop. In sandy, black shale which rises from beneath the Upper Silurian Rocks of the Long Mountain. A rare species found by myself.

TRILOBITES OF THE LLANDEILO FLAGS.

PLATES XXIV. AND XXV.

Asaphus Buchii, Pl. 25. f. 2. Brongn., Pl. 2. f. 2. *a, b.*

"Corpore ovato, antice obtuso; pars caudæ membranacea ad marginem longitudinaliter striata."—Brongn.

M. Brongniart further describes this *Asaphus, as having an ovate form, the head being at the larger end; the central lobe of the buckler pretty distinct, and terminating anteriorly in a slightly tuberculated point.*

The lateral lobes of the head described by Brongniart as triangular, are more neatly defined in our specimen, and show a curved outline of the posterior margin, the eye being placed near the lobe centre of the f. 2 *a* and 2 *b*. In Brongniart's specimens the outer rim of the buckler is indistinctly marked. In our figure it is seen to advance beyond the centre of the body, and to terminate in a fine point. The costal arches near the ends of the lateral lobes of the body are double (see f. 2 *a*.) The central lobe is nearly pyramidal. The coriaceous membrane which covered the ends of the caudal ribs, is striated parallel to the margin. The transverse studs, marking the prolongation of the caudal ribs beneath the coriaceous membrane, is a character much insisted on by Brongniart, Pl. 2. f. 3b^1. I may here observe, that after the plates had been engraved, Lord Cole lent me a specimen of *Asaphus Buchii* (from Builth), rather larger and having a more perfect head and buckler than that which I have figured (from the collection of Mr. C. Stokes); this specimen further exhibits the termination of the body ribs in deflected points, and the fine striation of the external coriaceous membrane is beautifully exposed. The specimen figured is from the cabinet of Mr. Stokes.

Loc. *Abundant throughout the Llandeilo formation, portions of it occurring in numberless quarries in Caermarthenshire, Pembrokeshire, Radnorshire, Brecknockshire, Shropshire, east flank of the Berwyns, &c.*

It is said to occur in Norway, Russia and America.

Asaphus tyrannus, n.s. Pl. 25. f. 1 *a b.*, and Pl. 24.

Spec. Char.—Head, *posterior margin of buckler extending in a short spike to the third segment of the body.* Body, *central lobe very broad, and contracting suddenly as it passes into the caudal portion. Ribs* 8, *subdivided by intermediate plates which terminate obtusely.* Caudal portion *elongated and pointed; ribs deflected to the tail at an acute angle.*

This trilobite thus differs essentially from *Asaphus Buchii.*

The specific distinctions are all visible in the figures, though the peculiar form of the head and buckler of *Asaphus tyrannus* is still better seen in an unfigured species recently sent to the British Museum by the Earl of Cawdor.

Asaphus tyrannus, varietas *ornata,* Pl. 24.

I venture to consider the forms in Pl. 25. f. 1?, and Pl. 24., as belonging to the same species, because the central abdominal lobe in each seems to bear precisely the same relative proportions to the flanks or sides of the animal, and to exhibit the same sudden contraction towards the tail.

The large specimen, Pl. 24., presented to me by the Earl of Cawdor, must, however, be considered a variety on account of its ornamented surface; and I have therefore named it *Asaphus tyrannus*, var. *ornata*. Although merely a hollow impression, which has been long exposed action of the weather, it gives a clear idea of the general form and size of the animal, which was nearly one foot in length.

The *Asaphus tyrannus* is equally abundant with the *A. Buchii* in the Llandeilo flags of Caermarthenshire and Pembrokeshire (pp. 357, 397). It is usually found without the head, as in Pl. 25. f. 1.; but even in that condition, the observer can never fail to distinguish it by the great width of its central lobe and the pointed tail, which is strongly contrasted with the round termination of *A. Buchii.* The latter is of smaller size; the largest specimen I have ever seen not exceeding five inches in length, while the new species is often six or seven inches long. This circumstance induced me to give it the name of *tyrannus*, in order to mark this species as the chief being of his race, during the period when the Lower Silurian Rocks were accumulating.

The noble specimen *A. tyrannus*, var. *ornata*, is now placed in the British Museum, illustrated by casts taken from the intaglio figured. It does not appear that any writer has alluded to a specimen of this magnitude; but Professor Phillips informs me, that in a recent tour in Norway he sketched the outline of one in the rock, of about the same size, and apparently of the same species.

Loc. *Banks of the Towy, near Llandeilo; and in Dynevawr Park and Golden Grove; Clog-y-frain, near St. Clears, Caermarthenshire; Llampeter felfrey, Pembrokeshire.*

Asaphus Corndensis, (n. s.), Pl. 25. f. 4.

This species approaches near to *Asaphus Buchii*, Brong., but is distinguished from it by *the greater length of the lateral spinose terminations of the buckler, which advance posteriorly to the penultimate or seventh rib of the body, and also by their terminating obtusely.*

Loc. Found by myself in dark-coloured flagstone, alternating with volcanic grits, near *Middleton, on the north-western flank of the Corndon Mountain.* I have named it after the dominant feature in a tract so interesting from its varied geological phænomena. (See Chapter 22.) The same fossil is associated with *Asaphus Buchii*, *A. tyrannus*, and other species too imperfect to be named, at Rorrington and Meadowtown, in the north-north-eastern prolongation of the same band of Llandeilo flags, and also in the undulating strata of the same age in the adjacent mining tract of Shelve, Hope Mill, &c.

Asaphus? Vulcani, n. s. Pl. 25. f. 5.

Head *plain, the central division being cuneiform at the front, and truncated at the anterior margin.* Central lobe *of caudal portion contracted in the middle.*

Loc. This specimen, with others too imperfect to describe, was found coiled up in the volcanic grit on the western flank of the *Corndon Mountain* above alluded to, in a ravine east of Middleton. I have, therefore, so named the fossil, that its discovery may be connected with the supposed origin of the rock in which it was imbedded. (See Chapter 22, p. 270.) The same species is found in the Caradoc formation near Wistanstow, associated with *Asaphus Powisii.*

Ogygia, Brongniart,

Gen. Char.—Corps *très déprimé, en ellipse allongée, non contractile en sphère.* Bouclier *bordé; un sillon peu profond, longitudinal, partant de son extrémité antérieure.* Point d'autres tubercules que les oculiformes. Protubérances oculiformes, *peu saillantes, non reticulées, angles postérieurs du* bouclier, *prolongés* en pointes. Lobes longitudinaux *peu saillans. Huit articulations* à l'abdomen.

Ogygia Murchisoniæ (n. s.), Pl. 25. f. 3 *a* and *b*.

In establishing the genus *Ogygia*, M. Brongniart remarks that although it has a very different aspect from that of most trilobites, it is not always easily separable from other genera by neatly defined distinctions.

The best marked character, perhaps, is that of *the elongated oval form with nearly balanced extremities, and the prolongation of the buckler on each side, into a slender spike quite separated from the body.* This last-mentioned distinction of the French author is, however, not peculiar to the *Ogygia*, being, if possible, more strongly marked in the *Trinucleus*. The deep longitudinal furrow on the corslet of the buckler, may, however, be considered a generic distinction, and is quite apparent in our specimens. In the general outline and in the shape of the buckler, the Silurian species resembles the *O. Guettardi*, (Brongn.), but differs from it in several respects, particularly in having no appearance of costal divisions in the post abdomen.

Loc. The specimens figured were found by Mrs. Murchison, in a *black schistose rock at Mount Pleasant, near Caermarthen*. These beds lie very low in the Silurian System. Are they of the same age as the black slate of Angers in France, where trilobites of this form have been long known?

Agnostus, Brongniart. Battus, Dalman.

Gen. Char.—" Corps *ellipsoide, hémicylindrique.* Bouclier et flancs *bordés, à bords un peu relevés.* Lobe moyen *ne présentant que deux divisions transversales d'une seule pièce chacune. Deux tubercules glanduleux à la partie antérieure du corps.*" Brongniart.

Agnostus pisiformis? Brongn., Pl. 25. f. 4 *a* and *b*.

Unable to throw any light on the history of these curious bodies, which some naturalists conceived to be crustaceans in an incipient condition[1]; I merely figure this species on the same plate as the *Asaphus Buchii*, to show that its *geological* position in the British Isles is low in the Silurian System. In Norway, the *Agnosti* apparently occur in millions, but in our rocks they are much less frequent.

Loc. *Near Builth.*

Fig. 7. Impressions of crinoidal plates of stems? in the Llandeilo flags. If these are doubtful, I may add that perfect crinoidal plates occur in the Llandeilo limestone at Clog-y-frain, near St. Clears. See Pl. 18. f. 5.

Postscript.—I received the work of Pander, alluded to p. 658., at too late a period to enable me to profit much by his views concerning the original structure of the Trilobite, or the adaptations of the tegumentary skeleton of the animal to its habits, into the consideration of which he enters

[1] The notion of the *Agnostus* being a young trilobite, can have no real foundation; for, as Dalman remarks, we see the most perfect forms of certain species of trilobites, and usually of great size, not larger than peas. Eichwald has conjectured the *Agnosti* to be eggs of *Orthoceras*. According to Klöden they are related to the genus *Limulus*.

at length. He certainly throws some new light upon the nature of these creatures, by exposing the interior or under surface, particularly that of their heads, in which he points out several divisions, and considers them to be thoracic plates and jaws. The central portion, or that which was formerly described by Mr. C. Stokes from a North American specimen, Geol. Trans., vol. i. p. 208. Pl. 27. f. 1*b*., he conceives to have been connected with the head by cartilage only, and to have served as a *thoracic plate to protect the stomach*, the form of which varies in the different genera of trilobites found in Russia[1].

It is remarkable that English collectors should not yet have met with specimens in which this *plate* is discoverable, though it has been observed in Russian and American trilobites. I feel confident, however, that even with the specimens which we possess, a good naturalist may develope much of the organization of these crustaceans, by patient inquiry, and by clearing away with delicacy of hand the matrix of rock which so often obscures their under surface. The specimens Pl. 7 *bis*, f. 3 *b*. and Pl. 14. f. 3 *b*., partially illustrate my meaning; and even while these pages are going through the press, I see enough in my own cabinet to make me regret that I have not had leisure to attend more assiduously to this part of the structure of Trilobites, by a study of which we can alone hope to gain a complete acquaintance with the habits and structure of these animals, as previously suggested by Audouin and Goldfuss. (Ann. des. Sciences Nat. vol. xv. p. 83.)

On referring this subject to my friend Mr. W. MacLeay, whose knowledge of invertebrated animals is so profound, he assures me, that this plate on the underside of the head, above alluded to (Stokes, Geol. Trans. vol. ii. Pl. 27. f. 1 *b*.; Goldfuss, Ann. Scienc. Nat. tom. xv. Pl. 2. f. 8.; Pander, Beitr. Tab. 4.; Buckland, Bridgw. Treat. Pl. 45. f. 12 *f*.), must be considered the *labrum* or upper lip. The trilobite is thus brought into close analogy with certain Entomostraca, such as the *Apus cancriformis*, Latr. The reader who compares the figure of the under side of that animal (Savigny, Animaux sans Vertèbres, 2 mém. Pl. 7.) will observe a similar "labrum" and many other striking analogies with our fossils, particularly in the lateral, inflected terminations of the shelly segments of the body (*geologicè* ribs), a distinctly trilobed "pygidium" or caudal portion, and a prolonged tail; while the feet being foliaceous and the abdomen merely covered by membrane, could scarcely be expected (at least very rarely) to leave traces of their existence in a fossil state.

On the other hand, if viewed on its upper side or back (as is the case in nearly all our specimens), trilobites are more analogous to certain *Isopoda*, such as the *Cymothoadæ*[2], particularly in the eyes and buckler; and thus it is that our fossils appear, as before said, to constitute the link between two orders of existing crustaceans.

The annexed observations on the place which trilobites hold in nature have been contributed by my friend Mr. W. MacLeay in illustration of this work, while the preceding pages were passing through the press.

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[1] These genera, according to Pander, are *Calymene, Asaphus, Illænus, Amphion* and *Zethus*, the two last-mentioned being added by himself to those previously described. It would appear that another Russian author (Stschegloff) described trilobites at as early a period as Dalman, and also subdivided the genus *Asaphus*, Brongn.; calling the *Illænus* (Dalm.), *Deucalion*.

[2] Parkinson seems to have been the first to suspect an affinity between Trilobites and the genus *Cymothoa*. See Organic Remains, Oct. Ed. p. 266.

Observations on Trilobites, founded on a comparison of their structure with that of living Crustacea. By W. S. MacLeay, M.A. F.L.S. &c.

Trilobites were originally considered by Klein and others to be a particular kind of molluscous shell with three lobes. This supposition, however, was afterwards abandoned as untenable, and remained so until Latreille in the 7th volume of the *Annales du Muséum* revived it and referred the trilobitic fossils to the genus *Chiton* among the Mollusca. Latreille founded his argument on the presumed absence of feet, and on the lateral edges of the body in several species having been sub-coriaceous. It is evident, nevertheless, that these early inhabitants of the sea could not have belonged to the sub-kingdom *Mollusca,* since they possessed compound sessile eyes and a distinct labrum. They must, therefore, be assigned to the sub-kingdom *Annulosa,* in which we may find many articulated animals which have compound eyes and a labrum very similar in structure to those of Trilobites. Having a hard, shelly, apterous tergum and inconspicuous feet, the Trilobites must have either belonged to the Order *Chilognatha* among the *Ametabola,* or to the Class of *Crustacea.* But all the *Chilognatha* are terrestrial animals, and the obvious geological fact is, that Trilobites resided in the sea. We must clearly therefore exclude them from the *Chilognatha* and place them among the *Crustacea,* in which class it becomes now necessary to determine their exact place.

The Class of *Crustacea,* so remarkable above all other animals for the great variation of their feet, both in number and form, is divisible into two groups; those which have the eyes sessile or the *Edriophthalma* of Leach, and those which have their eyes supported on moveable peduncles or the *Podophthalma* of Leach. To the *Edriophthalma* the Trilobites clearly belong, and the question is now reduced to determine merely whether they belong to the *Amphipoda* or those existing *Crustacea* which do not undergo metamorphosis in their larva state, (among which I include not only the *Amphipoda* of Latreille, but also his *Læmodipoda* and *Isopoda,*) or whether they belong to the *Entomostraca* or those existing *Edriophthalma* which do undergo a change of form in their larva state. I conceive that the Trilobites will be found to differ in so many respects from both the *Amphipoda* and *Entomostraca,* that according to the present state of our knowledge, we must allow them to form a distinct order, intermediate between the tribe *Isopoda* on the one side, and the tribe *Aspidophora* on the other.

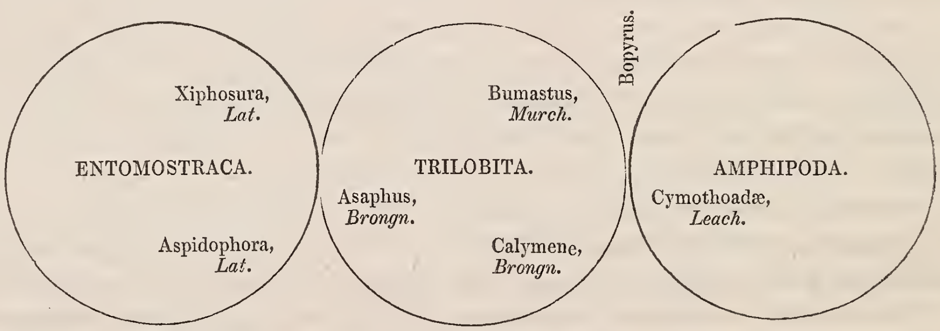
Those circumstances which generally are reckoned most anomalous in the Trilobites are not in reality so very extraordinary, since they may be detected in many *Crustacea* now existing. Thus the trilobed form of the body occurs in *Serolis* and *Bopyrus.* The membranaceous or rather coriaceous margin of the body, assumed by Latreille and others to exist in Trilobites, is to be found in the female *Cymothoæ.* In these last animals also, as well as in the female *Bopyrus,* we observe the eyes to disappear as in many Trilobites. The compound eyes of *Calymene* are situated on the back of the head but wide apart, and are composed of large facets. The same structure may be seen in the male of *Cymothoa trigonocephala,* and many other *Cymothoadæ.* The absence of antennæ and the rudimentary state of the feet, both occur in *Bopyrus,* the well-known parasite of prawns. In *Spheroma* we have not only the onisciform body of *Calymene,* but also its property of rolling itself up into a ball. In *Spheroma* also we find the large convex semicircular anal segment of *Bumastus.* I think, therefore, that we can have no hesitation now in allowing the immediate affinity of the Trilobites to Isopod *Amphipoda,* and more particularly to the *Cymothoadæ* and that parasitical group which is called *Epicarides* by Latreille. Indeed, if the Trilobites are once demonstrated to have possessed articulated feet, it will be difficult to remove a male *Bopyrus* from the group. Here the two eyes are placed on the back of the head wide apart. Here also there are no antennæ, no posterior lateral abdominal appendages, and besides no very distinct articulation to the sternum. If the *Bumastus* of Murchison had a body of thirteen equal segments with short crustaceous feet it would be a male *Bopyrus*, so close is the affinity! The differences between a male and female *Bopyrus*, such for instance as the presence of eyes in the former and the want of them in the latter, may also induce us to fancy that similar differences may have possibly occurred between certain male and female *Trilobita*, which from their *primâ facie* difference of form are now placed in distinct genera, although they may have truly belonged to one and the same species. *Serolis* has been generally considered to come near to *Paradoxides*; but as the former has got four well-developed antennæ with crustaceous feet, and the latter none, I am inclined to believe the relation between them to be one of analogy rather than of immediate affinity.—Let us now turn to the *Entomostraca*.

Dr. Buckland, following other authors, has compared the Trilobites with the genera *Limulus* and *Branchipus*. With the latter genus, however, they obviously have no immediate affinity; although it may be well, by reference to *Branchipus*, to show that *Crustacea* can and actually do exist, with soft membranaceous feet, such as Audouin and Brongniart suspected, and Goldfuss has more lately asserted, to have been the feet of Trilobites. When, nevertheless, I take into consideration the perfect manner in which the soft body of an animal referred to me by Mr. Murchison, and by that gentleman called *Nereites Cambrensis*, has left its impression in a slaty rock, I confess I find it difficult to understand how the vestiges of legs in a Trilobite (if such legs ever really existed) should not be more evident than Goldfuss has represented them in his plates. In short, I consider the question of feet to remain still unsettled. At the same time I ought to remark, that if the Trilobites were *Crustacea*, between *Apus* and *Bopyrus*, a fact I conceive capable of demonstration, they must have been in possession of subabdominal, laminar, oviferous, appendages. Now, no traces of such appendages remain, consequently we can easily understand how feet of a similar membranaceous consistency may have disappeared in like manner. I may here observe, that Brongniart is certainly wrong in imagining that the *Ogygia Guettardi* had oval oviferous bags appendant to the abdomen like *Cyclops*, for what he considers to be such organs are more probably the membranaceous margin of the abdomen, and, besides, *Ogygia* has no immediate affinity to *Cyclops*. With reference to *Limulus*, its crustaceous, semilunar cephalothorax bears considerable resemblance to that of certain Trilobites, such as the genera *Ogygia*, *Asaphus*, *Paradoxides*, &c. In *Limulus*, we find reniform, compound eyes placed widely apart on the back of the head, and consisting of peculiar facets. We find, also, an indistinct trilobed structure of the superior abdominal shield. But then this is composed of a number of confluent segments, so as to appear of one piece; and, besides the two ocelli, the large crustaceous feet and cheliform antennæ throw *Limulus* far away from the Trilobites. We must, therefore, compare them with *Apus* and other *Aspidophora*; animals which, in my opinion, of all the Entomostraca, appear to come nearest to the *Trilobita*. Here we have a large clypeiform shell, rounded in front, and posteriorly emarginate, which forms a cephalothorax, on the back of which are situated three eyes. Of these, the two largest are lunated, and obviously correspond to the eyes of *Trilobita*, although they are placed proportionally much nearer each other. It is true they are simple, but so appear to have been the eyes of *Bumastus*[1] (see Pl. 7 *bis*, f. 3 *c*.). The abdomen, divided into many distinct seg-

[1] The distinction between smooth eyes and granulose eyes does not seem to be of much importance in these animals; for among the existing family of *Cymothoadæ* we not only see the males of some species with eyes

ments, the foliaceous feet, the structure of the front of the cephalothorax, the two rudimentary antennæ, the large labrum and projecting mandibles, all show the affinity of *Apus* to the Trilobites, more particularly to *Asaphus platycephalus*, in a specimen of which from Lake Huron, Mr. C. Stokes has discovered a subquadrate labrum, which only differs from that of *Apus* in being anteriorly deeply emarginate, while the latter is truncated. Dr. Buckland has compared this organ to that of crabs, but decapod *Crustacea* possess a very different structure, and the thing most like this labrum is to be found among the *Xiphosura*, or, still better, among the *Aspidophora* of Latreille, of which group this naturalist's genus, *Prosopistoma*, ought more particularly to be compared with Trilobites. I am not aware, however, that any Trilobite has yet occurred with vestiges of ocelli.

Still there are characters which, in my opinion, distinguish Trilobites from almost all other *Crustacea*; and among these characters I would particularly mention the absence of all lateral, posterior, abdominal appendages. Excepting *Bopyrus*[1] and certain *Lœmodipoda*, all the *Amphipoda* possess these anal appendages, which are generally styliform, articulated, and in number two. The *Lœmodipoda*, however, want these appendages, because the whole abdomen in them has become evanescent, a case totally different from that of Trilobites, which, like *Bopyrus*, have a well-developed abdomen consisting of many segments. I therefore consider this deficiency of anal appendages to a well-developed abdomen, when joined with the evanescent feet, and the total absence of antennæ, to be characters separating the *Trilobita* from all *Crustacea* except *Bopyrus*. The affinities of the group may be roughly expressed by the following diagram.



If we allow any accuracy to belong to the foregoing remarks on the affinities of Trilobites, it will follow that the class of *Crustacea* may for the present be distributed into orders, thus; viz.:

Normal Group.	Orders.	
Podophthalma, Leach. Animals having their eyes supported on moveable peduncles.	Decapoda, Lat.	Antenniferous region of head confluent with the thorax.
	Stomatopoda, Lat.	Antenniferous region of head distinct from the thorax.

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and the females without them, but we observe neighbouring genera, such as *Eurydice* and *Nelocira*, the one with granulose eyes like a *Calymene*, and the other with smooth eyes like a *Bumastus*.

[1] *Bopyrus* may possibly belong to the *Trilobita*, but I confess I do not see how *Agnostus* can. Nor do I believe that the latter fossil has any connexion with the *Annulosa* at all.

Aberrant Group.	Orders.	
Edriophthalma, Leach. Animals having their eyes sessile.	Amphipoda, Lat.	Head distinct with four antennæ. Feet thick and crustaceous. Animals not undergoing metamorphosis.
	Trilobita, Brongn.	Head distinct without antennæ. Feet rudimentary, soft, and membranaceous.
	Entomostraca, Lat.	Head rarely, if ever, distinct from thorax, but provided with antennæ. Feet always distinct. Animals undergoing metamorphosis.

With regard to the habits of true Trilobites, these animals have been supposed by some naturalists to be parasitical; but I conceive this hypothesis not to be very tenable, since almost all existing articulated parasites that adhere externally to other animals have strong feet, hooked at the end for that purpose. Now, the Trilobites certainly had no such strong crustaceous hooks to their feet, or these hooks would have long since been detected. The close affinity of Trilobites to *Bopyrus* does not prove a parasitical mode of life, for *Sphæroma* and other *Cymothoadæ* which, like Trilobites, have the power of coiling themselves up into a ball, are not parasitical, although so close in affinity to the parasitical genus *Cymothoa*. Nay, it has been said that the *Cymothoadæ* and *Epicarides* do not draw their nourishment directly from the animals to which they adhere; but, on the contrary, live entirely on the animalculæ brought to them in the water by the play of the branchiæ, near which they always take their post. Still the close connexion of Trilobites with *Bopyrus*, and their feet almost null, if not entirely so, induce me to think that these animals must have been to a certain degree sedentary. The flat under surface of their bodies, and the lateral coriaceous margin of several species, which is so analogous to that of *Chiton*, make it probable that they adhered with a soft articulated underside either to rocks or fuci. They appear to have been among *Crustacea* what the *Vermes* or white-blooded worms are among *Ametabola*,—often without eyes, and always without antennæ or distinct feet. If they had feet, as Audouin and Goldfuss imagine, and, as indeed is most probable, they must have been so small, so membranaceous, so soft, and so rudimentary, as almost to be useless to the animals for locomotion. The mouth, so analogous to that of *Apus*, makes us imagine that the Trilobites were carnivorous; and they may possibly have fed on *Acrita*, *Annelida*, or naked *Mollusca*. That they had to search for their food, and that they possessed some small power of locomotion, is to be inferred from their highly organized eyes; for no truly sessile animal is provided with sight. The *Balanus*, when it becomes sedentary, loses its eyes, as does also, in like case, the female *Coccus*. I imagine, therefore, that although the Trilobites were to a certain degree sedentary, more particularly the blind ones, they must have had some power of crawling over a flat surface; but whether they moved by rudimentary, soft, membranaceous feet, or whether it was by means of the undulation of setigerous segments, like the earthworm, or by wrinkling the under surface of the abdomen like a *Chiton*, are questions yet to be determined. One thing, moreover, is in my opinion clear, from their longitudinally trilobed form and lateral coriaceous margin, namely, that they had the power of adhering to a flat surface like a *Chiton*, *Bopyrus*, or *Coccus*. While thus sedentary, the hard, although thin, dorsal shell probably saved them in some degree from the attacks of fishes, just as that of *Chiton* protects such *Mollusca* from all fishes except the *Scaridæ*. The Trilobites probably (like *Ostreæ*, *Chitones*, *Cocci*, and other sedentary animals), adhered in masses one upon the other, and thus formed those conglomerations of individuals which are so remarkable in certain rocks.

CHAPTER XLVIII.

ENCRINITES AND ZOOPHYTES OF THE SILURIAN SYSTEM.

Crinoidea, Pl. 17 and 18. *Polyparia*, Pl. 15., 15 *bis.*, 16. and 16 *bis.* *Other Zoophytes and Nondescripts*, Pl. 26.—*Annelida of the Upper Cambrian Rocks*, Pl. 27.

THE examination of the Crinoidea and Zoophytes affords the same result as the previous inquiry into the characters of the higher grades of animals, and equally demonstrates the distinctness of the zoological types of the Silurian System.

In this chapter I have been assisted by Professor Phillips, Mr. König, M. Milne Edwards, Mr. W. S. MacLeay, and Dr. Beck; but the chief labour has devolved on Mr. Lonsdale, whose description of the corals is the condensed result of a long and critical analysis[1].

Crinoidea.—The continued application of a good naturalist is required to prepare a monograph of these curious tenants of the deep. Although they occur in nearly all the sedimentary deposits, ranging from the youngest to the oldest, one English work only, that of Miller, is exclusively devoted to their consideration. Availing himself of all the specimens which were accessible at the period when he wrote (1821), Miller established several new genera and species, and classed them according to their anatomical structure. As, however, the older rocks of which I treat were then little known, his list of their crinoidal contents is necessarily meagre, three species only of that age being described by him.

The subject has been since much extended in England, by the labours of Mr. Gilbertson and the writings of Professor Phillips, who gives a perspicuous account, and excellent figures of forty species of Crinoidea of the Carboniferous Limestone, seven of which only are figured in Miller's work.

My object being restricted to the illustration of the older rocks, I need not here advert to those works of foreigners and our countrymen, in which the species of Crinoidea peculiar to the younger formations are described, though I may be permitted to refer

[1] To illustrate the Silurian Rocks I presented a series of their fossils to the Geological Society, and my friend Mr. Lonsdale undertook the arduous task of comparing all the corals with their congeners in the Carboniferous Limestone of our own country, and with those of the transition rocks of the continent. I cannot too gratefully acknowledge my obligations to him for his unwearied exertions and their important results. (See p. 675 *et seq.*)

my readers to Goldfuss's beautiful work, in which they will find a detailed account of many Crinoidea of various epochs, some of which doubtless belong to the period of which we treat.

For my own part, I claim the merit of collecting good specimens, of registering them faithfully and then presenting good portraits of them; so that a mere comparison of their forms with those of the same class in the Carboniferous System, may suffice to show their distinctness. Yet, after all, as it is of the utmost importance in the establishment of an independent system of deposits, that we should appeal to authors conversant with each branch of fossils; the following account, contributed by Professor Phillips, must be perused with great interest.

In the meantime I may state, that Crinoidea are more abundant in the Wenlock formation than any other member of the Silurian System; by far the greater number of the forms described having been found in the limestone of that age near Dudley; but they also exist in other formations of the system, and are discernible from the uppermost to the lowest strata, and even in the Upper Cambrian Rocks, though usually in fragments.

"In assigning names to the following fourteen species of Crinoidea," says Professor Phillips, "no additions have been made to the genera previously described, except when a contrary course would have introduced obscurity, if not error. Whenever it has been found possible, by technical characters or general analogy of structure, satisfactorily or even probably to include species in Miller's genera, this has been done; the new genera proposed must of course be subject to correction by future researches, but the employment of them may serve to give distinctness to our conceptions of the structure of these singular fossils, and prepare the way to a more perfect classification.

Cyathocrinites (Miller).

Cyathocrinites tuberculatus, Miller. (*Crinoidea*, p. 88.) Pl. 18. f. 7.

Miller's figure is not very satisfactory as to the fingers, which in this specimen are admirable. The sutures are beautifully crenulated. The divisions of the pelvis are not traceable.

Cyathocrinites tuberculatus, jun., ut supra. Pl. 18. f. 6.

The pelvis in this younger specimen is not *clearly* divided, but has rather the aspect of a supra-columnar joint. The narrow rings near the pelvis, and the nodular surface of the lower part of the column are interesting points of structure.

Cyathocrinites goniodactylus, n. s. Phil. Pl. 17. f. 1.

Pelvic plates tuberculated; costals and scapulæ strongly ridged; arms and fingers dichotomous, externally and laterally angulated, smooth; last divisions of the fingers about 160?

Column not much larger than the fingers, bearing round branches near the base; columnar joints numerous, prominent in their round, sometimes muricated edges.

The cuneiform joint at the base of the arms rests immediately on the scapula.

Cyathocrinites capillaris, Phil. Pl. 17. f. 2.

Pelvic, costal and scapular plates ridged; arms and fingers dichotomous, the last divisions very long and capillary, angulated on the sides, round externally, smooth.

Column formed of many thin alternately prominent joints. The cuneiform joint at the base of the arms is separated from the scapula by one curved joint, as in *Cyathocrinites quinquangularis*, and *C. planus* of Miller.

It appears to me that, hereafter, these three species will not be ranked in the same genus with *Cyathocrinites rugosus* of Miller.

Cyathocrinites pyriformis, n. s. Phil. Pl. 17. f. 6.

Its analogy to *C. tuberculatus* is considerable; but in Miller's technical arrangement it ought probably to constitute a new genus. The great width, general equality and lateral union of the plates, till the arm divisions amount to twenty, constitute easy characters. The surface is marked with a faint irregular ornament not unlike *Cyath. tuberculatus*. The upper columnar joints are very thin.

Cyathocrinites rugosus, Miller, p. 89. Pl. 18. f. 1.

MARSUPIOCRINITES (Phil.).

Marsupiocrinites cœlatus, Phil. Pl. 18. f. 3.[1]

Pelvic plates unknown, (probably five); scapulo-costals five, wide, hexagonal, each excavated on the upper edge to receive a series of small wrinkled plates, finally terminating in four longitudinally sutured fingers. The bases of the arms are separated by five interscapular plates. The whole surface is crenulato-striate; the striæ assuming a radiated form on the scapular and interscapular plates.

The column (seen in part) appears to have been pentagonal. The twenty fingers composed of two rows of joints (whence the apparent longitudinal suture) had *perhaps* no lateral tentacula?

HYPANTHOCRINITES (Phil.).

Hypanthocrinites decorus, Phil. Pl. 17. f. 3.[2]

In this new genus the lowest plates clearly seen appear to correspond to the first costals of the genus *Actinocrinites*; the pelvic plates were probably small.

First costals (F) five, tumid, hexagonal, equal and similar, supporting five second costals (F′), and five truncato-cuneiform scapulæ (H). On the two lateral superior edges of the scapulæ rest two pentagonal arm-joints, each bearing a cuneiform hand-joint, which supports two longitudinally sutured fingers. The summit of the scapula bears a conical plate which divides the arms and fingers of each pair.

Between the five radiating costal rows are five large tumid diagonal intercostal plates (G). On these rest in part the arm-joints, and between them *two* other approximate plates somewhat conical in form, which divide the pairs of arms and fingers, and unite with long ribs which terminate near the mouth in large tubercular plates. Similar ribs are attached to the *single* conical plates which surmount each scapula. Thus the proboscis (probably contractile) which rises above the short plumose fingers, is surrounded with several rows of tubercles, the lower one being formed of ten.

The five large intercostals surrounding by their ten bordering plates (3*a*.), ornament the basis of this encrinite with five floriform disks of great regularity and beauty. The large

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[1] Believed to be a new genus, with analogies to *Rhodocrinites* of Miller, and *Actinocrinites tesseracondactylus* of Goldfuss. The name is taken from *μάρσυπος*, a purse or bag.

[2] The name of this new genus is taken from the floriform aspect of the basal portion of the body, (*ὑπὸ*, under; *ἄνθος*, a flower.)

specimen figured, is in this respect not quite so perfect as another from which the outline (fig. 3*a.*) is taken.

The column was probably short; its joints are prominent in the middle and thinnest near the body.

The arrangement of the lower plates in *Eucalyptocrinites* of Goldfuss, (Petrif., Pl. 64. f. 7.) is so very similar to that above noticed, that it is difficult to suppose the genera so entirely distinct as would be the case if *Eucalyptocrinites* be really, as Goldfuss supposes, destitute of a column. The upper part of the body of *Eucalyptocrinites* is not figured by Goldfuss, who ranks as pelvic, the plates corresponding to what are here compared to the first costals of *Actinocrinus*[1].

Actinocrinites, Miller.

Div. 1. Fingers longitudinally sutured, or composed of two rows of plates.

Actinocrinites moniliformis, Miller, p. 115. Pl. 18. f. 4.?

The pelvic plates are not very clearly seen in these specimens: the first and second costals and the scapula are, as represented in the drawing, unusually elongated and nearly of equal size; two broad plates (arms) attach themselves to each upper lateral edge of the scapula; the upper of these, similar in form to the scapula, supports externally one finger and internally a hand of two broad plates, which again throws off one and finally divides into two other fingers.

Thus there are forty very long and equal fingers; the manner of their ramification may be seen on the plate; each finger is formed of two rows of very numerous joints, and furnished with very expanded lateral tentacula.

The costal, intercostal, brachial, and interbrachial plates are more nearly equal in size than in any other species yet described; a broad rounded ridge traverses the costals to the base of the scapula, and, there bifurcating, runs along the arm and hand plates.

The column (which was the only part completely known to Miller) consists of joints which project in the middle, and at a distance from the body appear like beads; near the body they are thinner and alternately less and more prominent. This form of column is not sufficiently peculiar to furnish specific characters. Mr. Miller himself is in error when he speaks of this species as belonging also to the Mountain Limestone, and Goldfuss has unfortunately referred to this species as a syncnym of his *Cyathocrinus pinnatus,* from which in all that regards the body and fingers it is perfectly distinct.

Actinocrinites, Div. 2. Fingers composed of one row of joints.

Actinocrinites simplex, Phil. Pl. 18. f. 8.

The pelvic, costal, and other plates of the body agree with Miller's technical formula of *Actinocrinites*; otherwise the ten fingers, externally round, with wide plumose lateral tentacula, would have led me to doubt the propriety of including it in the genus. The surface is

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[1] Several specimens of this very remarkable species have recently been found in the Dudley Limestone, the finest of which, Pl. 17. f. 3., was lent to me by Mr. Cartwright of Dudley. Another specimen is the property of Mr. H. W. Inwood. When first discovered, the fossil seemed to convey the impression of two Encrinites clasped together, but Mr. J. Sowerby at once pointed out those distinctive characters which Professor Phillips has since had the kindness to describe. I must state, in justice to Mr. Sowerby, that without his discrimination of the different forms of Crinoidea, which he had selected and drawn with much fidelity and spirit, before they were examined by Professor Phillips, this portion of my work would have been much less perfect.—R. I. M.

smooth. The general resemblance of the fingers to those of *Cyathocrinus pinnatus* of Goldfuss is so great, that, were it not for the total absence of all trace of the *external finger without tentacula* which Goldfuss speaks of, I should have ranked them together.

The generic affinities of the remaining three species cannot be determined, because no part of the pelvis is seen in either of them. They are placed provisionally with *Actinocrinites.*

Actinocrinites? arthriticus (*nov. spec.*), Phil. Pl. 17. f. 8.

The anterior and external edges of the joints of all the (50?) fingers are boldly tuberculate. Of short lateral tentacula there is a trace at *b*. The column was muricated.

Actinocrinites? expansus (*nov. spec.*), Phil. Pl. 17. f. 9.

The arrangement of the characteristic plates of the body is unfortunately unknown. The fingers ultimately amount to about 80, being unequally produced and of unequal diameter. Their lateral faces of contact are flattened. The plated integument turns into the mouth after the divisions of the arm amount to 20.

Actinocrinites? retiarius, Phil. Pl. 17. f. 7.

This is named provisionally. Its twenty plumose fingers appear to characterize it, and there is no longitudinal suture in them, which easily distinguishes it from *A. icosidactylus.*

Dimerocrinites, Phil.

The two following species appear to me really different, generically, from *Actinocrinites,* both by the character of the intercostal plates and the *exact bifurcation of the hands and arms.* Though unable, at present, to characterize them completely, I propose the subgeneric name of *Dimerocrinites* (διμερὴς, bipartite), and have little doubt they will be eventually separated from *Actinocrinites.*

Dimerocrinites decadactylus, Phil. Pl. 17. f. 4.

Intercostal plates remarkably large (as in *Hypanthocrinites*), and bearing on their summits an interbrachial plate. Fingers ten, those of the same pair separated by a small plate at their base, longitudinally sutured (i. e. composed of two rows of joints) and laterally plumose. Column formed of thin joints which project in the middle.

Dimerocrinites icosidactylus, Phil. Pl. 17. f. 5.

The body of this must have resembled the preceding species very much. Its scapula gives origin to two arms, which again bifurcate into twenty fingers, composed of two rows of joints, furnished with lateral tentacula.

Columnar joints moniliform, and near the body thin.

Columns of Crinoidea. Pl. 18. f. 2. and f. 9.

Nothing certain being known of the other parts of the animals to which these belong, it would be premature to assign names to them[1].

The columnar joint, Pl. 18. f. 5., *may be* a part of *Rhodocrinites quinquangularis* of Miller. (N.B. From the Llandeilo Flags.)

Besides the fourteen species noticed above, Mr. Miller describes (p. 107) *Rhodocrinites verus* as occurring both in the 'Transition and Mountain Limestone.' I have not had the opportunity of examining good specimens of this Encrinite, which, (contrary to Mr. Miller's opinion, founded I believe on columnar joints) I venture to believe does not occur at all in Mountain Limestone. There are Encrinites *like it,* which I have placed in a new genus in my

[1] I would here observe, however, that although displaying little to please the naturalist, the cast f. 2. Pl. 18. is highly characteristic of the Caradoc formation.—R. I. M.

work on the Geology of Yorkshire. Among the 40 species of Crinoidea mentioned in that work from the Mountain Limestone, there is not one of the 14 here noticed from the Silurian System; and the distinction, thus evident when species are compared, would, I believe, appear still more striking if the state of knowledge on the subject were sufficiently advanced to allow of Mr. Miller's method of classification being entirely remodelled."

Corals[1]. *Described by* W. LONSDALE, F.G.S.

PLATES XV, XV *bis*, XVI AND XVI *bis*[2].

AULOPORA, Goldfuss.

Aulopora conglomerata (Goldfuss), Pl. 15. f. 9. nat. size.

Ref. Goldfuss, Petref. p. 83. Taf. XXIX. f. 4. 1826; De Blainville, Man. d'Actinol., p. 468. 1834; Milne Edwards, 2nd edit. Lamarck, t. ii. p. 324. 1836.

Formation and locality in England. WENLOCK LIMESTONE, *Dudley*.

Foreign locality and authority. *Bensberg*, Goldfuss.

Aulopora consimilis, sp. n. Lons. Pl. 15. f. 7. magnified twice.

A. encrusting, tubes round, close together, radiated, bifurcated; openings circular, raised, margin thick.

This fossil is singularly like *Aulopora compressa* of Goldfuss (Petref. p. 84. Taf. XXXVIII. f. 17.) found in the Oolitic series of Germany.

Formation and locality in England. WENLOCK LIMESTONE, *Dudley*.

Aulopora serpens (Goldfuss), Pl. 15. f. 6. nat. size.

Syn. and Ref. *Millepora*, Fougt. Linn. Amœn. Acad. t. i. p. 209. f. 26. 1745.

Tubipora serpens, Gmelin. Linn. 3754.

Milleporites repens, Knorr. Recueil, t. ii. p. 13. t. iii. p. 157.; Sup. Pl. VI[1]. 1775.

Catenipora axillaris, Lamarck, Anim. sans Vert. 1 edit. t. ii. p. 207. 1816; Lamouroux, Exp. Methodiq. p. 66. 1821.

Tubiporites serpens, Schlotheim, Petref. p. 367. 1820.

Tubipora axillaris, Parkinson, Outlines, p. 70. 1822.

Aulopora serpens, Goldfuss, Petref. p. 82. Taf. XXIX. f. 1. 1826; De Blainville, Man. d'Actinol. p. 468. Pl. LXXXI. f. 1. 1834; Milne Edwards, 2nd edit. Lamarck, t. ii. p. 323. 1836; Hisinger, Lethæa Suecica, p. 95. Tab. XXVII. f. 1. 1837.

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[1] The following list of Silurian corals has been prepared chiefly from the collections made by Mr. Murchison, but its compiler has had the advantage of examining valuable series of specimens belonging to the Rev. T. T. Lewis of Aymestry, Mr. Benjamin Bright of Brand Lodge, Malvern, Mr. Goodhall, and Mr. Bowerbank.

The list contains 62 species, 26 of which are supposed to be new, and the remainder have been found in the Eifel, Gothland, and other parts of Europe. It by no means includes all the corals of the Silurian formation of England; for in the rich slabs of Wenlock Limestone are many undetermined fossils; and the collections, which were examined while preparing the catalogue, contained numerous specimens, belonging apparently to unnamed species, but the state of preservation did not permit their characters to be ascertained.

[2] These plates have been lithographed by Mr. Scharf, with great care and strict attention to fidelity of character.

Alecto serpens, Alex. Brongniart, Tableau des Terr. p. 430. 1829; Steininger, 1831, Mém. Geol. Soc. Franc. t. i. p. 341. Pl. XX. f. 9. 1834.

Stomatopora serpens, Bronn. Lethæa Geognostica, p. 54. Taf. V. f. 10 *a* and *b*. 1835.

Formations and localities in England. WENLOCK LIMESTONE, *Lincoln Hill, Coalbrook Dale; Winslow Mill, Lindels, Fownhope, Woolhope; Dudley.* UPPER LIMESTONE OF THE CARADOC FORMATION; *Prolimoor Well, and Norbury, Salop.*

Foreign localities and authorities. *Shores of the Baltic,* Fougt; *Bursvik, Gothland,* Hisinger; *Eifel,* Bronn, Goldfuss, Schlotheim, Steininger; *Bensberg,* Knorr, Bronn; *Arnsberg,* Bronn.

Aulopora tubæformis (Goldfuss), Pl. 15. f. 8. nat. size, attached to *Cystiphyllum cylindricum.*

Syn. and Ref. Goldfuss, Petref. p. 83. Taf. XXIX. f. 2. 1826.

Alecto tubæformis, Steininger 1831, Mém. Soc. Geol. France, t. i. p. 341. 1834.

Formation and locality in England. WENLOCK LIMESTONE, *Benthall Edge.*

Foreign locality. *Eifel,* Goldfuss, Steininger.

ESCHARINA, Milne Edwards.

Escharina? angularis, sp. n. Lons. Pl. 15. f. 10. nat. size, 10 *a* magnified.

E. encrusting? disk-shaped, raised around the edge: cells distinct, angular, close together, radiating from a centre, parallel to the surface of the disk; openings of the cells not perfect.

Formation and locality. WENLOCK LIMESTONE, *Dudley.*

PTILODICTYA, g. n. Lons., Πτίλον, *pluma*; δίκτυον, *rete.*

Generic Characters.—Thin, elongated expansions, having on each surface small quadrangular cells not convex, which penetrate the coral obliquely, and are arranged with respect to the surface, along the middle of the specimen, parallel to the elongated direction of the coral, but on the sides obliquely from it. Surface, a very thin calcareous crust traversed by slightly raised ridges, marking the boundaries of the cells; towards the margin the crust thickens, the indications of the cells are less distinct, and at the edge are invisible; but cells are traceable close to the margin where the crust has been removed; opening of the cells small, transversely oval? no indication of a central partition parallel to the surface.

This fossil is considered by Goldfuss to be a *Flustra,* but it is placed by Milne Edwards among the doubtful species of that genus (2nd edit. Lamarck, t. ii. p. 229.). It differs essentially from *Flustra* in the thickening of the external crust, most probably not preserved in Goldfuss's specimens. From *Eschara* it differs in not having a central partition, and in the surface of the cells not being convex, but depressed as in *Flustra.* I have, therefore, ventured to propose the above name taken from the *feather-like* arrangement of the middle and lateral cells, and their *net-like* union.

Ptilodictya lanceolata, Lons. Pl. 15. f. 11, 11 *a* to 11 *c*.—11 nat. size, 11 *a* portion of the same magnified twice, 11 *b* a young specimen, 11 *c* the same magnified 3 times.

P. Expansion long, narrow, flat, slightly curved longitudinally, and thin gradually diminishing to a fine edge; middle cells narrow, small and about 10 rows; lateral cells larger and arranged in rows slightly arched from the middle to the edge, the cells themselves placed obliquely both with respect to the middle of the coral and the arch.

Syn. and Ref. *Flustra lanceolata,* Goldfuss, Petref. p. 104. Taf. 37. f. 2. 1826, 1833; Hisinger, Lethæa Suecica, p. 104. Tab. XXIX. f. 10. 1837.

The figures 11 and 11 *a*. Pl. 15. do not exactly agree with those in the above references, but the differences are probably due to the state of preservation not being the same.

Formation and locality in England. WENLOCK LIMESTONE, *Malvern Hills* (*western slopes of*).

Foreign localities and authorities. *Groningen*, Goldfuss; *Capelhamn and Hoburg in Gothland*, *Bursvik*, Hisinger.

Small fragments of probably young specimens of this species are occasionally found in the slabs of Wenlock Limestone; one of them is represented on Pl. 15. f. 11 *b*, 11 *c*.

GLAUCONOME, Goldfuss.

Goldfuss has described under the generic name of *Glauconome* five fossils, four of which, according to De Blainville (Man. d'Actinologie, p. 454.) and Milne Edwards (2nd Edit. Lamarck, t. ii. p. 193.), belong to the genus *Vincularia*, previously established by De France (Dict. Sc. Nat. tom. lviii. p. 214.). The fifth species, common at Dudley, possesses, however, characters essentially different from those of *Vincularia*, and even from those assigned to *Glauconome* by Goldfuss. Instead of the stem being impressed on all sides with rows of cells, it has them over only half the surface, the other half being striated longitudinally. It is probable that the position of the fossil in the matrix prevented that author from detecting the true characters of the coral. For this fossil it has been thought right to retain Goldfuss's name, but a modification in both the generic and specific characters has become necessary.

Gen. Char.—Stem stony, thin, elongated, oval, branched; cells disposed longitudinally and alternately in rows over one half the surface, the other half striated longitudinally. Nature of the covering and opening of the cells unknown.

Glauconome disticha (Goldfuss), Pl. 15. f. 12, 12 *a* to 12 *d*.—12, 12 *a* cellular surface nat. size, 12 *b* is 12 magnified twice, 12 *c*, 12 *d* striated surface nat. size and magnified twice.

G. Stem branched, the branches diverging nearly at right angles both from the central stem and from the lateral branches; four rows of long quadrangular cells on one side; the opposite side striated.

Ref. Goldfuss Petref. p. 217. Taf. LXIV. f. 15.

Formation and localities in England. WENLOCK LIMESTONE, *Lincoln Hill*, *Coalbrook Dale*, *Dudley*.

Foreign locality and authority. *Eifel*, Goldfuss.

HORNERA, Lamouroux.

Hornera crassa, sp. n. Lons. Pl. 15. f. 13, 13 *a* cellular surface nat. size and magnified thrice.

H. Branches short, *thick*, flat, dichotomosed; opening of the cells large, elevated, and irregularly disposed on one side; opposite side striated; internal structure not ascertained.

Formation and locality. WENLOCK LIMESTONE, *Dudley*.

FENESTELLA, Miller.

Professor Phillips having informed me that the late Mr. Miller of Bristol employed the word *Fenestella* to distinguish a mountain limestone coral possessing generic characters similar to those of the fossils represented Pl. 15. f. 15 to 19, I have conceived it my duty to adopt the name, though not published; and I have ventured to call one of the species *Fenestella Milleri*, as a tribute of respect to departed talent.

Gen. Char.—A stony coral, fixed at the base (f. 15, 15*.) and composed of branches which unite by growth and form a cup (f. 15 to 15 *c*). Externally the branches anastomose (f. 19.), or regularly bifurcate (f. 15, 16, 17, 18.); internally they form a net-work, the intervals being generally oval (f. 15, 18 *c*). One row of pores on each side of the branches externally, the openings being circular and projecting when perfect (f. 16 *a*, &c.). The branches, when regularly bifurcated, are connected by distant, transverse processes, in which no projecting pores are visible (f. 16 *a*). In well-preserved specimens of the base of apparently old corals, the pores or foramina on the side of one branch have united by growth to those on the side of the adjoining branch, and constitute solid bars, either stretching transversely and simply across the intervals, or uniting obliquely three and sometimes more together.

Figs. 15, *a*, *b*, *c*. partly exhibit the changes effected by growth in this genus, the figures with an asterisk being magnified.

Figs. 15, 15*. This specimen consists of several detached branches fixed to an organic body. The pores or foramina project from the sides of the branches, but are not united. In this specimen both the external and internal structure are exposed.

Figs. 15 *a*, 15 *a**, 15 *b*, 15 *b**. The foramina in several of the rows exhibited in these figures are united, and nearly level with the surface of the branches; in others they are not quite united, or are depressed in the centre.

Figs. 15 *c*, 15 *c**. The union of the foramina in this specimen is complete throughout, and the bars are all on a level with the branches.

It is very difficult to establish species from fragments, but the four following are believed to be distinct from each other.

Fenestella antiqua, Lons. Pl. 15. f. 16, 16 *a* nat. size and magnified twice.

F. Branches bifurcated, rather distant, transverse processes very apparent, giving the exterior a quadrangular net-work character; foramina or pores not numerous nor close. Nature of the interior reticulation not ascertained.

Syn. and Ref. *Gorgonia antiqua?* Goldfuss, Petref. p. 99. Taf. XXXVI. f. 3 *a*. 1826.

Formation and locality in England. WENLOCK LIMESTONE, *Dudley*.

Foreign locality and authority. *Eifel*, Goldfuss.

Fenestella Milleri, sp. n. Lons. Pl. 15. f. 17. magnified 2½ times.

F. Outer surface, branches very thin, knife-edged, close together, regularly bifurcated: pores on the sides of the branches very small, most apparent in the upper part: transverse processes thin, rather distant, not very distinct: opposite or inner side, regular net-work.

Formation and locality. WENLOCK LIMESTONE, *Dudley*.

Fenestella prisca, Lons. Pl. 15. f. 18, 18 *a* to 18 *c*.—18, 18 *a* nat. size and magnified thrice, 18 *b* external surface worn, 18 *c* inner surface of the same.

F. Branches externally slender, generally near each other, bifurcated; foramina numerous and close: in the internal net-work, the intervals are oval or oblong with rounded angles, and very variable in size.

The specimen (f. 18.) is from near the base of the coral, but in other specimens, apparently from the upper part, the foramina are equally numerous. The figures 15, &c. apparently belong to this species.

Syn. and Ref. *Retepora prisca*, Goldfuss, Petref. p. 103, Taf. XXXVI. f. 19. The worn specimen from Dudley, represented in Pl. 15. f. 18 *b*., strongly resembles Goldfuss's coral.

Formation and locality in England. WENLOCK LIMESTONE, *Dudley*.

Foreign locality and authority. *Eifel*, Goldfuss.

Fenestella reticulata, Lons. Pl. 15. f. 19, 19 *a* nat. size and magnified 2½ times.

F. Branches irregularly anastomosed: foramina large, rather distant: reticulation of the inner surface similar to that of the external.

Syn. and Ref. *Retepora reticulata?* Hisinger, Lethæa Suecica, p. 103. Tab. XXIX. f. 8.

Formation and locality in England. WENLOCK LIMESTONE, *Dudley*.

Foreign locality and authority. *Gothland?* Hisinger.

Discopora, Lamarck.

Discopora antiqua? (Milne Edwards), Pl. 15. f. 21, 21 *a* upper surface worn, nat. size and magnified, 21 *b* upper and under surfaces nat. size.

Syn. and Ref. *Cellepora antiqua,* Goldfuss, Petref. p. 27. Taf. IX. f. 8. 1826.

Membranipora antiqua, De Blainville, Man. d'Actinol., p. 447. 1834.

Discopora antiqua, Milne Edwards, 2nd Edit. Lamarck, t. 2. p. 253. 1836.

The opening of the cells is less regular in form and arrangement than in that given in Goldfuss's magnified figure; the indentations are also less distinct and regular. The specimens of this coral are generally much worn on the upper surface, and the opening of the cells is therefore not often visible; but where it has been preserved the upper wall is arched, as in the next species. The under surface is smooth or marked with concentric lines (f. 21 *b*.).

Formation and locality in England. Wenlock Limestone, *Dudley.*

Foreign locality and authority. *Eifel,* Goldfuss.

Discopora squamata, sp. n. Lons. Pl. 15. f. 23, 23 *a* nat. size and magnified.

D. Cells contiguous, more or less regularly disposed, opening not contracted, vertical, upper margin projecting, arched.

Formation and localities. Wenlock Limestone, *Dudley; Hurst Hill, Sedgley.*

Discopora? favosa, Lons. Pl. 15. f. 22, 22 *a* nat. size and magnified twice.

Syn. and Ref. *Cellepora favosa,* Goldfuss, Petref. p. 217. Taf. LXIV. f. 16.

This fossil presents an elevation in the centre as if composed of more than one layer of cells; but a similar specimen, when worn down vertically, consisted of a single layer.

Formation and locality in England. Wenlock Limestone, *Dudley.*

Foreign locality and authority. *Eifel,* Goldfuss.

Berenicea, Lamouroux.

Berenicea irregularis, Pl. 15. f. 20, 20 *a* nat. size and magnified.

B. Opening of the cells round, distant where the surface is flat, generally near together where it is uneven; more or less regularly disposed from a centre.

Formation and locality. Wenlock Limestone, *Dudley.*

Retepora, Lamarck.

Retepora infundibulum, sp. n. Lons. Pl. 15. f. 24 nat. size.

R. *Funnel-shaped*; branches united in a thick net-work, the interstices being small and variable in shape: inner surface two vertical rows of pores.

The arrangement of the pores is similar to that in *Fenestella,* but on the inner, and not the external surface. A very small fragment only of the interior has been examined.

Formation and locality. Wenlock Limestone, *Dudley.*

Eschara, Pallas, Lamarck.

Eschara? scalpellum, sp. n. Lons. Pl. 15. f. 25, 25 *a* nat. size and magnified twice, 25 *b* section.

E. *Lancet-shaped*: cells more or less oval, nearly opposite on the two surfaces: outer rows, cells smaller and more distant than in the other rows: edge of the coral when perfect, solid, faintly striated and sharp: outer covering and opening of the cells unknown.

This coral is placed in the genus *Eschara,* on account of the apparent thickening of the surface of the outer cells; and the cells being nearly opposite on the two sides. In some specimens the thickening of surface of the outer row is so great as nearly to obliterate the opening of the cells.

Formation and locality. Wenlock Limestone, *Dudley.*

Blumenbachium, König.

Blumenbachium globosum? (König.), Pl. 15. f. 26, 26 *a* nat. size and magnified twice.

Ref. Icones Fossilium Sectiles. Cent. Prima, p. 3. Tab. V. f. 69.

The specimen figured in Pl. 15. differs from that represented in the Icones Fossilium Sectiles. The rays are compound, and are indistinct in number, but exceed four. The surface is not distinctly punctured, the few pores which are visible having been produced probably by the unequal action of the acid, used in preparing the slab for sale. The interstices between the stars are also unequally furrowed. It has, nevertheless, not been thought advisable to consider the specimen as belonging to a distinct species.

Formation and locality. Wenlock Limestone, *Dudley.*

Gorgonia, Linnæus.

Gorgonia assimilis, sp. n. Lons. Pl. 15. f. 27 nat. size, 27 *a* portion magnified to show the striæ.

G. Axis round, branched, faintly striated longitudinally: branches anastomosed: no projecting papillæ, or impressed pores.

It is impossible to determine if this fossil be a true *Gorgonia*; but from its *great resemblance* to the axis of some existing species, I have ventured to place it in that genus.

Formation and locality. Wenlock Limestone, *Dudley.*

Pl. 15. f. 28, 28 *a* represent a portion of a coral which may be a *Gorgonia.* It was found in Encrinital Shale at Alfric, Malvern.

Ceriopora, Goldfuss.

Ceriopora granulosa (Goldfuss), Pl. 15. f. 29, 29 *a* nat. size and magnified.

The internal structure of this coral I have not ascertained.

Ref. Goldfuss, Petref. p. 217. Taf. LXIV. f. 13.

Formation and locality in England. Wenlock Limestone, *Dudley*, *Ledbury.*

Foreign locality and authority. *Eifel*, Goldfuss.

Heteropora, De Blainville, not Ehrenberg.

Heteropora crassa, sp. n. Lons. Pl. 15. f. 14, 14 *a* nat. size and portion magnified.

H. Branched, the branches *thick*, tubes small, radiating from a centre; transverse fracture concentric layers formed of two systems of tubes, one visible to the naked eye, the other microscopic, numerous and close together.

Formation and locality in England. Wenlock Limestone, *Benthall Edge.*

The specimen is in the collection of Mr. Goodhall.

Millepora, Linnæus.

Millepora repens (Hisinger), Pl. 15. f. 30, 30 *a* nat. size; the former is from a worn specimen.

Syn. and Ref. *Millepora*, Fougt, 1745., Linn. Amœn. Acad., t. i. p. 202. f. 15., 1749.

Millepora repens, Hisinger, Lethæa Suecica, p. 102. Tab. XXIX. f. 5., 1837.

In the regularity of the openings, this coral resembles the genus *Seriatopora*; but it differs from the *Seriatopora subulata*, (Lamk.), in being cellular and not solid in the centre.

Formation and localities in England. Wenlock Limestone, *Lincoln Hill, Coalbrook Dale, Benthall Edge, Dudley, Hurst Hill, Sedgley.*

Foreign localities and authorities. *Shores of the Baltic*, Fougt; *Gothland*, Hisinger.

Stromatopora, Goldfuss.

Stromatopora concentrica (Goldfuss), Pl. 15. f. 31 to 31 *d.*—31 nat. size, 31 *a* portion of the surface magnified, 31 *b* section of 31, 31 *c* part of 31 *b* magnified twice, 31 *d* small portion of a large specimen in which the very thinly laminated structure is obliterated.

Ref. Goldfuss, Petref., p. 22. Taf. VIII. f. 5., 1826; De Blainville, Man. d'Actinol., p. 413. Pl. LXX. f. 1., 1834.

Formations and localities in England. WENLOCK LIMESTONE, *Dudley; Lincoln Hill, Benthall Edge, Wenlock; Conygree Wood, Ledbury; West flank of the Malverns; Winslow Mill, Woolhope;* WENLOCK SHALE, *south end of Lower Lickey.*

A magnificent hemispherical specimen of this coral, fourteen inches in diameter, was found at Haven near Aymestry in Wenlock Limestone, by the Rev. T. T. Lewis.

Foreign locality and authority, *Eifel,* Goldfuss.

Stromatopora nummulitisimilis, sp. n. Lons. Pl. 15. f. 32, 32 *a* nat. size and magnified twice.

S. Small, very flattened spheroids, *similar to a nummulite* in shape, and composed of many thin concentric layers, formed around a nucleus, consisting generally of a joint of a crinoidal remain.

Formation and localities. WENLOCK LIMESTONE, *Crews' Hill near Alfrick, Worcestershire; Mathon Lodge, Malvern; and also at Lye near Aymestry* [1].

ALVEOLITES, Lamarck.

Alveolites? fibrosa, sp. n. Lons. Pl. 15. f. 1, 1 *a* nat. size.

A. Encrusting; layers concentric, thin, but of unequal thickness, tubes short, externally angular, internally round. No connecting foramina detected: surface of the tubes in each layer slightly concave.

It is not without hesitation that this fossil is placed in the genus *Alveolites.* The specimens first examined, presented only one layer of tubes ranging the whole thickness of the coral (f. 1 *a*), and they were believed to be a variety of *Favosites fibrosa.* (See *ante,* p. 612, *Turbo Corallii.*) The beautiful specimen in Pl. 15. f. 1, was afterwards added to the collection: and from regularity in the surface of each layer, I have been induced to remove the coral into the genus *Alveolites.* On examining several specimens of the different species of *Favosites,* so great a diversity was found in the range of the transverse divisions within the tubes, that no fracture could give the level uniformity of surface presented by the fossil here called *Alveolites fibrosa.*

Formations and localities. UPPER LUDLOW ROCK AND AYMESTRY LIMESTONE, *Larden, Churn Bank, or Palmer's Cairn near Ludlow.*

FAVOSITES, Lamarck.

Favosites alveolaris (De Blainville), Pl. 15 *bis.* f. 1, 1 *a,* 1 *b,* 2, 2 *a.*—1 segment of a hemispherical mass, nat. size, 1 *a* portion magnified twice, 1 *b* exhibits the internal lamellæ, 2 is from a larger variety, nat. size. The pores are well displayed upon the angles of this specimen, but near the base of one of the tubes are four pores on the surface of the plane.

The distinguishing specific character consists in the connecting foramina being on the angles of the tubes.

Syn. and Ref. *Calamopora alveolaris,* Goldfuss, Petref. p. 77. Taf. XXVI. f. 1, 1826.

Favosites prismaticus, Steininger, 1831, Mém. Soc. Geol. France, T. 1. p. 335, 1834.

Favosites alveolaris, De Blainville, Man. d'Actinol., p. 402, 1834; Goldfuss, Petref. Corrigenda, p. 245, Milne Edwards, 2nd Edit. Lamarck, t. 2. p. 320, 1836.

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[1] A mass eight inches long, seven broad and two thick, consisting almost entirely of this small coral, was found by the Rev. T. T. Lewis and myself at Crews' Hill, north of the Malvern Hills; and to the zeal of my friend in carrying this specimen when added to a well-loaded bag, the preservation of the mass entire is due. Mr. Lewis has since found the species in the Wenlock Formation near Mathon Lodge, Malvern.—R. I. M.

The size of the tubes of this species, as well as of *F. Gothlandica,* varies considerably. The difference in the development, and in the apparent position of the angular foramina, is likewise often so great, that detached portions of the same specimen might be thought specifically different. In the magnified portion (1 *a*) of f. 1, many of the variations in the character of the foramina are exhibited. Where (f. 1 *a**) the fracture has exposed the tubes with the sides in juxtaposition the foramina lock into each other, and alternate, and there are no interstices; but where (f. 1*a**) the angle of one tube is exposed, opposite to the angle of another, the foramina unite and interstices are visible for the passage of the intermediate foramina of two other tubes. In some parts of this specimen the foramina are scarcely discernible, even with a lens; while in others they stand out in bold relief, and are perceptible to the touch.

Small globular masses, having a honey-comb surface, are common at Dudley, Wenlock and other localities, and belong either to *F. alveolaris* or *F. Gothlandica.*

Formations and localities in England. MIDDLE AND LOWER LUDLOW ROCK, *Mocktree Hill, Aymestry, Tatton Edge;* WENLOCK LIMESTONE, *Wenlock, the Purlieux, Malvern, Haven near Aymestry, Leinthall Earls near Ludlow, Hurst Hill near Sedgley, West flanks of Malvern Hills, Abberley, Little Ridge, Easthope, Winslow Mill, Fownhope, Westhope, Woolhope;* CARADOC SANDSTONE, *Powis Castle, Cefn-y-garreg. Llandovery.*

Foreign localities and authorities. *Eifel,* Goldfuss, Steininger; *Groningen,* Goldfuss.

Favosites Gothlandica (Lamarck), Pl. 15 *bis.* f. 3, 3 *a*, 4.—3, 3 *a* nat. size and magnified one half; 4 is a section exhibiting change in the number of the connecting foramina.

It has been deemed advisable to include in one species, *F. Gothlandica* and *F. basaltica,* as the distinction, founded upon the sides of the tubes being perforated by two rows of pores or by one row, has not been found to be satisfactory. In f. 4. both characters are exhibited in the same specimen, and other similar instances have been noticed.

Syn. and Ref. *Coralloidea oblonga pentaedra,* Woodward Nat. Hist. Foss. T. 1. p. 136, 1729.

Corallium Gothlandicum, Fougt. 1745, Linn. Amœn. Acad. T. 1. p. 211. f. 27, 1749.

Astroïte demi-sphérique? Guettard, Mém. T. 2. pp. 438, 499, Pl. XVI. f. 2. Pl. XLV. f. 1, 1770.

Favosites Gothlandica, Lamarck, 1st Edit. Anim. sans Vert. T. 2. p. 206, 1816; Schweigger, Beobacht. VII., 1819; De France, Dic. Sc. Nat. T. 16, p. 298, 1820; Lamouroux, Expos. Méthodiq., p. 66, 1821; Parkinson, Outlines, p. 69; Org. Rem. vol. ii. p. 69, Pl. VIII. f. 3, 7, 1822; De Blainville, Man. d'Actinol., p. 402, Pl. LXII. f. 4, 1834, *F. Gothlandica* and *F. basaltica,* Milne Edwards, 2nd Edit. Lamarck, T. 2. p. 303, 1816.

Spongites favus, Schlotheim. Petref. p. 369, 1820.

Calamopora Gothlandica, C. basaltica, Goldfuss, Petref. p. 78, Taf. 26, f. 3, 4, 1826; (*Favosites corrigenda,* p. 245, 1833) Ehrenberg 1831, Abhandl. König. Akad. Berlin, 1832, p. 346. Hisinger, Lethæa Suecica, p. 96, Tab. XXVII, f. 4, 5, 1837.

Sarcinula angularis, Fleming, Brit. Anim. p. 508, 1828.

Favosites prismaticus, Steininger, 1831, Mém. Soc. Geol. France, T. 1, p. 335, 1834.

Formations and localities in England. MIDDLE LUDLOW ROCK, *Aymestry, Tatton Edge, Downton-on-the-Rock;* LOWER LUDLOW ROCK, *Sitch Wood, Ledbury, Westwood Common, Wenlock;* WENLOCK LIMESTONE, *Wenlock, Wren's Nest, Dudley, Evenhay;* CARADOC SANDSTONE, (Upper calcareous beds) *Daniel's Wood, Tortworth.*

Foreign localities and authorities. *Gothland,* Schlotheim, Lamarck, Goldfuss, Hisinger;

Shores of the Baltic, Fougt.; *Nietzwitz in Lithuania* Guettard; *Osmundsberg in Dalacarlia,* Hisinger, *Groningen,* Goldfuss; *Eifel,* Goldfuss, Schlotheim; *Lake Erie and Drummond Island,* Goldfuss.

Favosites multipora, sp. n. Lons. Pl. 15 *bis.* f. 5, 5 *a* to 5 *c.* nat. size, 5 under surface, 5 *a* vertical section, 5 *b* detached tubes showing the pores, 5 *c* weathered upper surface.

F. discoid, under surface grooved concentrically, but marked with the lower terminations of the tubes; upper surface flat, covered with the scale-like openings of the tubes. Tubes hexagonal, composed of two narrow opposite planes, and four broad ones, variable in their proportions; position vertical or slightly curved towards the base; sides pierced by *numerous pores* irregularly disposed and not uniform in size; interior traversed by horizontal septa.

This species is distinguished by the number of the pores, which in some places give the tubes the net-work character of *Alveopora.* From that genus, however, this fossil is distinguished by the transverse horizontal septa. A specimen of the cast of the upper surface contained in the collection, bears a singular resemblance to a shagrin fish-skin, f. 5 *c.*

Formation and locality. WENLOCK LIMESTONE, *Marloes Bay.*

Favosites fibrosa (Goldfuss), Pl. 15 *bis.* f. 6, 6 *a* to 6 *f.*—6 vertical section nat. size, 6 *a* tubes magnified showing the transverse lamellæ, 6 *b* transverse section of a globular specimen with indications of the angular foramina, 6 *c* another in which they are very distinct, 6 *d* portion of the same magnified 3 times, 6 *e* and 6 *f* a vertical radiating specimen nat. size and magnified.

Syn. and Ref. *Millepora ramis vagis punctis sparsis?* Fougt. 1745, Amœn. Acad. T. 1. p. 201, fig. 12, 1749.

Calamopora fibrosa, Goldfuss, Petref. pp. 82, 215, Taf. LXIV. f. 9, 1826.

Favosites fibrosa, Goldfuss, Petref. Corrigenda, p. 245, 1833.

Chaetetes? Fischer, Oryc. de Moscou, Tab. XXXVI. 1830.

Favosites microporus, Steininger, 1831, Mém. Soc. Geol. France, T. 1. p. 337, 1834.

This species appears to have a great geological range in the Silurian System. It is also abundant, and the varieties incident upon growth are numerous. Some specimens are globular, others are cylindrical, and many are branched. The connecting angular foramina are occasionally well displayed, either in parts or over the whole of a specimen; but they are oftener not to be detected, and the fossil then strongly resembles the *Chaetetes* of Fischer. At Golden Grove, Old Radnor, Botville, and other localities, occurs a slender-branched coral, composed of fine angular tubes, radiating from an imaginary axis (7 nat. size, 7 *a* magnified). I have not been able to detect satisfactorily connecting foramina; but from a careful comparison of the specimens with others belonging to thick-branched varieties of *Favosites fibrosa,* in which the connecting foramina are partially exposed, no perceptible difference has been observed. In the impure limestone of Bala, a similar fossil is found. In the mountain limestone of Steeraways small fragments of a coral not distinguishable from this variety have also been noticed.

Formations and localities in England. UPPER LUDLOW, *Hanway, and Birches Common near Ludlow;* MIDDLE AND LOWER? LUDLOW ROCK, *Aymestry, Caynham Camp;* WENLOCK LIMESTONE, *Chain Bridge near Usk; Haven near Aymestry, Old Radnor;* CARADOC SANDSTONE, *Horderly and Wittingslow, Salop, Ankerdine Hill, Llandovery;* LLANDEILO FLAGS, *Rorrington near Shelve, Salop.*

Foreign localities and authorities. *Eifel,* Goldfuss, Steininger; *Bensberg,* Goldfuss; *Lexington* in *Kentucky* and *Buffalo Creek, Canada,* Goldfuss.

Favosites spongites (Goldfuss), Pl. 15 *bis.* f. 8, 8 *a* to 8 *e.*—8 upper surface nat. size, 8 *a* and 8 *b* vertical section nat. size and magnified, 8 *c* vertical section of a cylindrical variety, 8 *d* and 8 *e* terminations of the tubes on the outer surface.

Syn. and Ref. *Alveolites suborbicularis,* Lamarck, Anim. sans Vert. 2. p. 186, 1816; De Blainville, Man. d'Actinol., p. 404, 1834; Steininger, 1831, Mém. Soc. Geol. de France, t. 1. p. 334. Pl. XX. f. 4, 1834; Milne Edwards, 2nd Edit. Lamarck, t. 2. p. 286, 1836.

Escharites spongites, Schlotheim, Petref. p. 345, 1820.

Calamopora spongites, Goldfuss, Petref. p. 80. Taf. XXVIII. f. 1, 1826. *Favosites,* Goldfuss, Corrigenda, p. 245, 1833.

This fossil is retained among the *Favosites,* because it possesses connecting lateral foramina; and because it does not consist, in the specimens which have been examined, of concentric, encrusting layers of short tubes, the essential character, according to Lamarck, of the genus *Alveolites.*

The specimen f. 8. is in the collection of Mr. Goodhall; and that represented in f. 8 *c.* is in the collection of Mr. Bowerbank. The former is from Benthall Edge, the latter from Wenlock.

The fossil figured by Goldfuss, Taf. XLIV. f. 10., and assigned to this species, is common in the slabs of limestone at Dudley. (see Pl. 15 *bis.* f. 9, 9 *a*, 9 *b.*)

Formation and localities in England. Wenlock Limestone, *Benthall Edge, Lindells, near Fownhope.*

Foreign localities and authorities. *Eifel,* Schlotheim, Steininger; *Sweden, Bensberg, Dollendorf,* Goldfuss; *Dusseldorf,* Lamarck, De Blainville; *Drummond Island,* Goldfuss.

Favosites polymorpha (Goldfuss), Pl. 15. f. 2 nat. size.

Syn. and Ref. *Calamopora spongites,* Goldfuss, p. 80. Taf. XXVIII. f. 2 *b*, 1826; Hisinger, Lethæa Suecica, p. 97. Tab. XXVII. f. 7.

Favosites, Goldfuss, Corrigenda, p. 245.

Alveolites reticulata, De Blainville, Man. d'Actinologie, p. 404, 1834.

Goldfuss in his description of *Calamopora* (Favosites) *spongites,* says, that it is probably a variety of *C. polymorpha* (p. 81.). It is, therefore, considered as such in this list; and by including it in that species, all the fossils having this peculiar branched form are brought together, and separated from *F. spongites,* var. *α.* (Goldfuss), which thus becomes the type of a well-defined distinct species.

Formation and localities in England. Ludlow Rocks, *Ludlow, Aymestry.*

Foreign locality and authority. *Bensberg,* Goldfuss.

Syringopora. Goldfuss.

Syringopora reticulata (Goldfuss), Pl. 15 *bis.* f. 10, 10 *a* nat. size and the termination of the tubes magnified.

Syn. and Ref. *Tubiporites subulatus?* Schlotheim, Petref. p. 368, 1820.

Syringopora reticulata (Goldfuss), Petref. p. 76. Taf. XXV. f. 8, 1826; De Blainville, Man. d'Actinol., p. 353, 1834 Milne; Edwards, 2nd Edit.; Lamarck, t. 2. p. 328, 1836; Hisinger, Lethæa Suecica, p. 95. Tab. XXVII. f. 2, 1837.

Harmodites parallela. Fischer[1], Oryc. de Moscow, T. XXXVII. f. 6, 1830. Bibliographia Palæonthologica, p. 341, 1834.

Harmodites radians. Bronn, Lethæa Geognostica, p. 51. Taf. V. f. 7, 1835.

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[1] Fischer's genus *Harmodites* is of anterior date to Goldfuss's genus *Syringopora*; but the latter having been adopted by naturalists, it is retained in this list.

Formation and locality in England. Wenlock Limestone, *Gleedon Hill, Wenlock.* The specimen figured is in the collection of Mr. Bowerbank, and was found at Wenlock.

Foreign localities and authorities. *Government of Moscow,* Fischer; *Olne* (Belgium), Goldfuss, Milne Edwards; *Gothland,* Hisinger; *Sweden?* Schlotheim.

Of these foreign localities, Olne is considered by Von Dechen (German trans. De la Beche's Man.) to be carboniferous limestone; but Goldfuss states that it is transition, and he constantly distinguishes between Bergkalk and Uebergangskalk. Hisinger, Bronn, and Fischer mention *S. reticulata* as found at localities where other Silurian (transition) fossils occur. Dumont also enumerates *S. ramulosa,* stated by Goldfuss to be found at Olne, among his lists of transition or Silurian fossils.

Syringopora bifurcata, sp. n. Lons. Pl. 15. f. 11, 11*a,* 11*b.*—11 upper surface and vertical section, 11 *a* under surface, 11 *b* tube magnified.

S. Branched, *bifurcated,* distance between bifurcations short; the branches also anastomose, or are united by intermediate transverse tubes. Surface of branches smooth or wrinkled; longitudinal striæ sometimes visible around the upper part of the tubes; opening of the tubes nearly round; internal structure very irregular.

The growth of this coral, probably from the action of temporary currents, is singular. The matrix of the specimen is a hard grey limestone, and the slab was about six inches square and an inch and a half thick in the deepest part, gradually thinning off towards the edge. The whole of the under surface was covered with horizontal, ramifying tubes, represented in Pl. 15. f. 11 *a*; but the branches, where space had permitted free growth, regularly bifurcated. The upper surface exhibited tubular openings more or less connected, and this part of the specimen resembled an *Aulopora.* On breaking the slab, vertical, anastomosed or united tubes were exposed (f. 11.) ramifying from the lower to the upper surface; and a connexion could, in some places, be traced between the horizontal branch and the opening on the top of the specimen.

Formation and locality. Wenlock Limestone, *Dudley.*

Syringopora filiformis? (Goldfuss), Pl. 15 *bis.* f. 12 nat. size.

Ref. Goldfuss, Petref. p. 113. Tab. XXXVIII. f. 16.; De Blainville, Man. d'Actinol., p. 353, 1834; Milne Edwards, 2nd Edit. Lamarck, t. 2, p. 328, 1836.

Formations and localities in England. Ludlow Rocks, *Ristley Wood near Newent;* Wenlock Limestone, *Eastnor Park, Ledbury, Prescoed Common, Usk, Aston Ingham near Newent.*

Foreign locality and authority. *Groningen,* Goldfuss.

Syringopora cœspitosa?, Goldfuss, Pl. 15 *bis.* f. 13 nat. size, from Mr. Bowerbank's collection.

Ref. Goldfuss, Petref. p. 76. Taf. XXV. f. 9.

Formation and localities in England. Wenlock Limestone, *Wenlock, Valley of Woolhope.*

Foreign locality and authority. *Paffrath,* beyond *Cöln,* Goldfuss.

Catenipora, Lamarck.

Catenipora escharoides (Lamarck), Pl. 15 *bis.* f. 14, 14 *a* nat. size, 14 *b* casts of the tubes magnified.

Syn. and Ref. *Millepora,* Fougt, 1745; Linn. Amœn. Acad. t. 1. p. 207. f. 20. 1749.

Tubipora catenulata, Gmelin, Linn. p. 3753; Parkinson, Outlines, p. 70. 1822.

Tubularia catenulata, Knorr, Recueil, t. 2. pp. 16, 57, 58. Tab. F, IX. F, IX.* f. 4. (*Catenipora tubulosa,* Lamouroux, Exp. Methodiq. p. 65. *note.* 1821) t. 3. p. 158, Supp. Tab. VI. *a.* f. 1. 1775.

Millepora catenularia, Esper. Petrificata, Tab. V.; Pflanzenthiere, Erster Theil, s. 260 *note*. 1795.

Chain coral, Parkinson, Org. Rem. vol. ii. p. 20. Pl. III. f. 4, 5, 6. 1808.

Catenipora escharoides Lamarck, 1st Edit. Anim. sans Vert. tome 2. p. 207. 1816; Lamouroux, Expos. Methodiq. p. 65. 1821; Schweigger, Beobacht. Tab. VII. 1819; Goldfuss, Petref. p. 74. Taf. XXV. f. 4. 1826; Steininger, 1831, Mém. Soc. Geol. France, t. 1. p. 341. 1831; Ehrenberg, 1831, Abhand. 1831, König. Akad. Berlin. p. 344. 1832; De Blainville, Man. d'Actinol. p. 352. Pl. LXII. f. 1. 1834; Milne Edwards, 2nd Edit. Lamarck, t. 2. p. 322. 1836; Hisinger, Lethæa Suecica, p. 94. Tab. XXVI. f. 9, 10. 1837.

Tubiporites catenarius, Schlotheim, Petref. p. 366. 1820.

Halysites[1] ———, Fischer, Oryc. de Moscow, 1830; *Halysites escharoides*, Bronn, Lethæa Geognostica, p. 52. 1835.

In the series of specimens procured by Mr. Murchison, the tubes vary considerably in size, independently of the age of the bed; and in a specimen, in which they are not more than one-thirtieth of an inch in diameter within the walls of the tubes, the rows or lamellæ are contorted, and very rarely anastomosed. The tubes, in the small varieties, are also in many instances equally oval with those in the larger. It has therefore not been thought necessary to preserve the distinction of two species, *C. escharoides* and *C. labyrinthia*, the latter having been founded on the greater size of the tubes, the contorted arrangement of the rows, and their rarely anastomosing.

Formations and localities in England. Middle Ludlow Rock, *Aymestry, Tatter Edge near Downton on the Rock;* Wenlock Limestone, *Lincoln Hill, Wenlock, Dudley, Fownhope, Newswood in Eastnor Park, Netherlye near Aymestry, Woolhope; Little Ridge, Easthope, West flanks of Malvern Hills;* Wenlock Shale and Upper beds of Caradoc, *Hughley, Salop, South end of Lickey;* Llandeilo Flags, *Robeston Wathen, and Sholeshook in Pembrokeshire.*

An hemispherical mass sixteen inches in diameter was found at Netherlye, Aymestry, in Wenlock Limestone by the Rev. T. T. Lewis.

Foreign localities and authorities. *Shores of the Baltic,* Fougt; *Gothland*, Knorr, Alex. Brongniart, Goldfuss, Schlotheim, Hisinger; near *Ratofka, Government of Moscow,* Fischer; *Eifel,* Schlotheim, Steininger, Goldfuss; *Drummond Island in Lake Huron,* Bigsby.

Porites, Lamarck: sub-genus of *Madrepora*, Ehrenberg.

The first of the following species is placed in this genus on the authority of Ehrenberg, and the remainder because they have only twelve rays. It is probable, that it will be found necessary, hereafter, to place some of the species in a distinct genus.

Porites pyriformis, (Ehrenberg,) Pl. 16. f. 2, 2 *a* to 2 *e*.—2, 2 *a* upper surface nat. size and magnified, 2 *b*, 2 *c* horizontal section nat. size and magnified, 2 *d* vertical section with the transverse lamellæ, 2 *e* vertical section without them.

Syn. and Ref. *Millepora subrotunda*, Fougt, 1745; Linn. Amœn. Acad., t. 1. p. 203. f. 24. 1749.

Heliolithe pyriforme, Guettard, Mém., t. 3. p. 454. Pl. 22. f. 13, 14. 1770.

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[1] Fischer's generic name of *Halysites* is of anterior date to that of *Catenipora* of Lamarck; but the latter having been generally adopted by zoologists, it has been considered advisable to retain the use of it.

Madreporites stellatus, Schlotheim, Petref., p. 362, 1820.

Astrea porosa, Goldfuss, Petref., p. 64. Taf. XXI., f. 7. 1826; Hisinger, Lethæa Suecica, p. 98. Tab. XXVIII. f. 2. 1837.

Astrea interstincta, Hisinger, Esquisse, Petref. Suède, 2nd Edit. p. 36. 1831.

Madrepora Porites, Ehrenberg, 1831; Abhandl. König. Akad. Berlin. p. 344. 1832.

Heliopora pyriformis, De Blainville, Man. d'Actinologie, p. 392. 1834; Steininger, Mém. Soc. Geol. France, t. 1. p. 346. 1834; Milne Edwards, 2nd Edit. Lamarck, t. 2. p. 437 *note*. 1836.

Heliopora interstincta, Bronn, Lethæa Geognostica, vol. i. p. 48. Tab. V. f. 4. 1835.

Formations and localities in England. AYMESTRY LIMESTONE, OR MIDDLE LUDLOW ROCK, *Aymestry, Tatter Edge;* WENLOCK LIMESTONE, *Wenlock Edge, Lincoln Hill, Benthall Edge, Haven near Aymestry, Lindells, Winslow Mill and Fownhope, in the Valley of Woolhope, Newswood, Eastnor Park, and Ledbury;* WENLOCK SHALE, *Delves Green, Walsall;* CARADOC SANDSTONE, *Marloes Bay, Pembrokeshire.*

Foreign localities and authorities. *Shores of the Baltic,* Fougt; *Gothland,* Schlotheim, Hisinger; *Eifel,* Schlotheim, Goldfuss, Steininger; near *Bensberg,* Goldfuss.

Porites tubulata, sp. n. Lons. Pl. 16. f. 3, 3 *a* to 3 *f*.—3, 3 *a* upper surface nat. size and magnified twice, 3 *b* vertical weathered surface, 3 *c*, 3 *d* transverse section nat. size and magnified, 3 *e* vertical section, 3 *f* a small variety nat. size.

P. Hemispherical, stars circular, margin crenated and projecting, rays 12; interstices short lamellæ; transverse section, stars well-defined, rays often indistinct, interstices, lamellæ irregularly united; vertical section, stellular tubes with transverse septa, interstices, lamellæ obliquely united. Under surface rugose, or strongly marked by inequalities of growth; the stellular tubes sometimes exhibited distinctly from the substance of the coral.

Formations and localities. WENLOCK LIMESTONE, *Valley of Woolhope, Benthall Edge, Ledbury, Woodside near Nash Scar, Fownhope, Western flank of Malvern Hills, between Asten Ingham and May Hill.*

Porites petalliformis, sp. n. Lons. Pl. 16. f. 4 nat. size, 4 *a* section parallel to the surface nat. size.

P. Hemispherical, star circular, excavated; interstices irregularly laminated, the first row of lamellæ resembling in arrangement the *petals of a flower*. Under surface rugose. Vertical section, with tubes; transverse septa, interstices, lamellæ obliquely united.

Formation and locality. WENLOCK SHALE, *Delves Green, Walsall.*

Porites expatiata, sp. n. Lons. Pl. 15. f. 3, 3 *a* nat. size and stars magnified.

P. Irregularly lobed, or *spread out*, in layers alternating with sedimentary matter; stars small united, undefined, rays 12; no interstices.

Formations and localities. MIDDLE LUDLOW ROCK, *Aymestry;* WENLOCK LIMESTONE, *Lincoln Hill, Colebrook Dale, Benthall Edge, Wenlock, Aston Ingham near May Hill, Lindells, Woolhope.*

Porites inordinata, sp. n. Lons. Pl. 16 *bis*. 12, 12 *a* to 12 *c*.—12 nat. size, 12 *a* stars magnified, 12 *b* casts of the stars, 12 *c* transverse sections of the stems.

P. Branched; branches bifurcated, slender, cylindrical, straight, or curved; stars impressed, *not regularly disposed*, sometimes crowded, sometimes distant, rays twelve, centre united papillæ, interstices reticulated. Internal structure indistinct.

This beautiful fossil generally presents a yellow or cream-coloured crust, exhibiting the above character, and investing a nucleus of grey carbonate of lime. This crust, however, cannot be separated mechanically in the same manner as in recent corticiferous corals. It is insoluble in muriatic acid; and in the flame of a taper preserves its structure, but assumes a ferruginous colour. Fused with carbonate of soda, it forms a pale greenish enamel. Its developement is apparently due to decomposition. In some specimens it is very thin (see centre stem, f. 12 *c*), in others of great relative thickness, and in this case the inner boundary is generally irregular in outline (upper stem, f. 12 *c*). Occasionally the change has penetrated nearly to the centre of the coral, which then consists of insoluble, reticulated, yellowish fibres, or interrupted lamellæ; and an interval is presented between the matrix and the fossil (right hand stem, f. 12 *c*).

Formation and locality. *Llandeilo Flags, Robeston Walthen, Pembrokeshire.*

Porites discoidea, sp. n. Lons. Pl. 16. f. 1 nat. size.

P. *Disk-shaped*, stars not defined, composed of interrupted *lamellæ*.

This specimen is apparently much worn, and from the disposition of the rays it is difficult to count them accurately, but they appear to be twelve in number.

The specimen is in the collection of Mr. Bowerbank.

Formation and locality. WENLOCK LIMESTONE, *Wenlock*.

MONTICULARIA, Lamarck.

Monticularia conferta, sp. n. Lons. Pl. 16. f. 5, 5 *a*.—5 upper surface nat. size, 5 *a* vertical weathered surface.

M. Encrusting or expanded in lobes; central axes *close-set*, irregular in size, yet large in proportion to the distance between them; round when single, but several are often united; indications of radiating lamellæ few; under surface when free, uneven, smooth or marked by irregularities of growth.

Formation and localities. WENLOCK LIMESTONE, *Benthall Edge, and Gleedon Hill, near Wenlock.*

ASTREA.

Ehrenberg, in his memoir on the zoophytes of the Red Sea, confines the genus *Astrea* to those corals, the animals of which possess the following characters: "pallio stellas contiguas distinente nullo, disci ipso margine prolifero, ore divisione spontanea bipartito;" and he places those which have contiguous stars, but are quadripartite, "ore divisione spontanea quadripartito," in the genus *Favosites*. This arrangement I have not been able to adopt, with reference to the latter genus, which has been used in this catalogue for corals of a very different description (see *F. Gothlandica*, &c.), and in conformity with the application of approved authorities. In the genus *Astrea*, have therefore been placed the fossils, which exhibit a natural subdivision of the old star, leaving the final determination of their proper arrangement to those who are qualified to make the necessary separations.

Astrea ananas, De Blainville, Pl. 16. f. 6, 6 *a* to 6 *f*.—6 nat. size, 6 *a* to 6 *f* developement of young stars, nat. size.

Syn. and Ref. *Madrepora*, Fougt, 1745; Linn. Amœn. Acad. t. 1. p. 196. fig. 8. 1749.

Madrepora ananas, Linn. 10th Edit. t. 1. p. 797. 1758; Gmelin, p. 3764; Parkinson, Org. Rem. vol. 2. p. 40. Pl. V. f. 1. 1808.

Madrepora hexagonatus ?, Schlotheim, Petref. p. 360. 1820.

Cyathophyllum ananas, Goldfuss, Petref. p. 60. Tab. XIX. f. 4. 1826; Milne Edwards, 2nd Edit. Lamarck, t. 2. p. 429. 1836.

Astrea (*Favastrea*) *Baltica*, De Blainville, Man. d'Actinologie, p. 375. 1834.

Fig. 6 *a* to 6 *d* beautifully illustrate the subdivision of the old star, and the gradual developement of four young ones. Fig. 6 *a* exhibits the cross lines, marking the subdivision of the animal;

f. 6 *b* the first indications of the star; f. 6 *c* the formations of the stars considerably advanced; and f. 6 *d* the perfectly complete stars. In some instances there are only three young stars, (f. 6 *e*, 6 *f*), and in others only two (upper part of f. 6). Fig. 6 *a*, &c. are from the same specimen.

Formation and locality in England. WENLOCK LIMESTONE, *Dudley*.

Foreign localities and authorities. *Eifel, Bensberg, Winterberge* near *Grund, Finland,* Schlotheim; *Gothland,* Fougt; *Namur,* Goldfuss; between *Colonster* and the *Chaussée de Beaufays, Hucergne, Province of Liège,* Dumont.

CARYOPHYLLIA, Lamarck.

Caryophyllia flexuosa (Lamarck), Pl. 16 f. 7, 7 *a*, 7 *b* nat. size.

Syn. and Ref. *Madrepora,* Fougt, 1745; Linn. Amœn. Acad., t. i. p. 199. fig. 13. n. 5. 1749.

Madrepora flexuosa, Linn. 10th Edit. t. i. p. 796. 1758; Gmelin, p. 3770; Esper. Petreficata, Tab. VI. 1791.

Caryophyllia flexuosa, Lamarck, Anim. sans Vert. 1st Edit. t. 2. p. 227; Steininger, 1831, Mém. Soc. Geol. France, t. 1. p. 342. 1834; Milne Edwards, 2nd Edit. Lamarck, t. 2. p. 352. 1836.

In the two edit. of Lamarck, though the coral is not stated to be fossil, Fougt's figure is referred to. Some confusion has arisen from fossils of different formations, and a recent species, having been assigned to Linnæus's *Madrepora flexuosa.* In the 10th edit. of the Systema Naturæ, and in that of Gmelin, the *Madrepora flexuosa* is confined to the fossil found on the shores of the Baltic, and figured in the Amœnitates Academicæ. Subsequent authors have, however, associated with it a recent coral; and a fossil found in the mountain limestone was called by Parkinson first *Madrepora* and afterwards *Caryophyllia flexuosa* (Org. Rem., t. 2. p. 51. Outlines, p. 73.). But it apparently belongs to a different genus. It is proposed to confine Linnæus's original specific name to the coral which occurs in the Silurian or equivalent strata, and which possesses the generic character of *Caryophyllia* as limited by Ehrenberg; "stellæ palliique divisione perfecta, dichotoma." This character is shown in the section represented in f. 7 *a*. At the line of subdivision there is generally an inequality in the external surface, but the same longitudinal striæ may be traced continuously from the undivided stem to the divided branches.

Formation and locality in England. WENLOCK SHALE, *Malvern*.

Foreign localities and authorities. *Shores of the Baltic,* Fougt; *Eifel,* Steininger.

ACERVULARIA, Schweigger.

Acervularia Baltica (Schweigger), Pl. 16 f. 8, 8 *a* to 8 *e*.—8, 8 *a* upper and under surface, 8 *b* vertical section, 8 *c* to 8 *e* varieties, all nat. size.

Syn. and Ref. *Madrepora,* Fougt, 1745, Linn. Amœn. Acad., t. 1. p. 195. fig. 9. 1749.

Madrepora ananas, Linn. 10th Edit., p. 797. 1758; Gmelin, p. 3764.

Acervularia Baltica, Schweigger, Beobach. VI. 1819.

Astrea (*Favastrea*) *Baltica,* De Blainville, Man. d'Actinologie, p. 375. 1834.

It is presumed that this is the fossil represented by Fougt, though he does not allude in his description to the elevated ridges, which give an apparent boundary to the stars. This character, however, is much stronger in some specimens than in others (f. 8 *c* to 8 *e*). Internally the fossil exhibits the union of the stars mentioned by Fougt, "a latere invicem coagmentata et quasi conglutinata." (f. 8 *b*.) The increase or reproduction was not by a natural subdivision of the animal, and therefore this fossil does not belong to the *Astrea* of Ehrenberg. In general outline the var. 8*e* strongly resembles the *Cyathophyllum helianthoide* of Goldfuss, but it differs in the rays being narrow not broad, and in the bladder-like or rugose surface, which is not alluded to by that author, or represented in his figures.

Formation and localities in England. WENLOCK LIMESTONE, *Wenlock, Dudley.*

Foreign locality. *Shores of the Baltic,* Fougt.

CYATHOPHYLLUM, Goldfuss.

Only those turbinated corals, which present a central structure resembling the chambers of a *Nautilus,* have been placed in the genus.

Cyathophyllum turbinatum (Goldfuss), Pl. 16. f. 11, 11 *a* reduced one-third. Fig. 11 *a* is from a specimen in Mr. Goodhall's collection.

Syn. and Ref. *Madrepora turbinata,* Fougt, 1745, Linn. Amœn. Acad. t. 1. p. 190, f. 2, 3, 7. 1749; Esper. Petrificat. Tab. 2. f. 1–4. 1791—1797; Parkinson, Org. Rem. vol. 2. p. 25–27. Pl. IV. f. 1–3. 1808.

Caryophylloïde simple, Guettard, Mém., tome iii. p. 453, 454. Pl. XXII. f. 7, 11. 1770.

Hippurites, Knorr, t. ii. part 2. p. 58. Tab. XX. 1775.

Turbinolia turbinata, Lamarck, Anim. sans Vert. 1st Edit. t. ii. p. 231. 1816; Schweigger Beobach. Tab. VI. 1819; Lamouroux, Expos. Methodiq. p. 51. 1821; De France, Dic. des Sc. Nat., t. 56. p. 91. 1828; Steininger, 1831, Mém. Soc. Geol. France, t. 1. p. 344. 1831; Hisinger, Lethæa Suecica, p. 100. Tab. XXVIII. f. 6, 7, 8. 1837.

Hippurites turbinatus, Schlotheim, Petref., p. 351. 1820.

Cyathophyllum turbinatum, Goldfuss, Petref. p. 56. Taf. XVI. f. 8. 1826; Milne Edwards, 2nd Edit. Lamarck, t. 2. p. 428. (remark to *C. ceratites*) 1836; Hisinger, Lethæa Suecica, p. 102. Tab. XXIX. f. 1. 1837.

Caryophyllia turbinata, Alex. Brongniart. Tableau des Terr. p. 431. 1829.

Formations and localities in England. WENLOCK LIMESTONE, *Wenlock, Lincoln Hill, Coalbrook Dale, Kinsham,* 5 *miles west of Aymestry, Ledbury, and West flank of Malvern Hills, Dudley, Valley of Woolhope;* WENLOCK SHALE AND UPPER BEDS OF CARADOC, *Prolimoor Well.*

Foreign localities and authorities. *Gothland,* Fougt, Knorr, Hisinger, Alex. Brongniart; *Eifel,* Schlotheim, Steininger, Milne Edwards, Goldfuss, Alex. Brongniart; *Bensberg,* Goldfuss; *Alleberg in Westgothia,* Hisinger; *Richelle, Liège,* Dumont.

Cyathophyllum angustum, sp. n., Lons. Pl. 16. f. 9 nat. size.

C. conical, centre *narrow,* the plates close together and irregular; vesicular side-structure very broad in proportion to the centre, cells small and nearly regular in size.

The section represented in Pl. 9, f. 16 is not parallel throughout to the axis of the coral, only the lower part showing the true centre.

Formation and locality. CARADOC SANDSTONE, (upper calcareous beds of,) *Coal-moors, Lickey.*

Cyathophyllum cæspitosum (Goldfuss), Pl. 16. f. 10 reduced one-third.

Ref. Goldfuss Petref. p. 60. Taf. XX. f. 2. 1826. The figures referred to in Guettard (Mém. Tab. 34, 36 and 37.) appear to be doubtful.

Formation and locality in England. WENLOCK LIMESTONE, *Wenlock.*

Foreign localities and authorities. *Eifel and Bensberg,* Goldfuss; *Chokier Seilles, Prov. de Liège,* Dumont.

Cyathophyllum dianthus, Goldfuss, Pl. 16. f. 12, 12 *a* to 12 *e* nat. size;—in the upper part of f. 12

are two young germs, in which the star is only developed in part, 12 *d* represents perfectly formed young corals.

Syn. and Ref. *Madrepora*, Fougt, 1745, Linn. Amœn. Acad. t. i. p. 196. f. 10. 1749.

Madrepora truncata. Linn. 10th Edit. t. i. p. 795. 1758; Parkinson, Org. Rem. vol. ii. p. 47. Pl. V. f. 2. 1808.

Strombodes truncatum, Schweigger, Beobacht. Tab. VI. 1819.

Madreporites truncatus, Schlotheim, Petref. p. 355. 1820.

Cyathophyllum dianthus, Goldfuss Petref. p. 54. Taf. XV. f. 13, Taf. XVI. f. 1. 1826; Ehrenberg, 1831, Abhandl. Akad. Berlin. 1832, p. 312; Milne Edwards, 2nd Edit. Lamarck, t. ii. p. 427. 1836.

Formations and localities in England. Wenlock Limestone, *Ledbury*, *Haven near Aymestry*, *Wenlock Edge.*

Foreign localities and authorities. *Shores of the Baltic*, Fougt; *Eifel*, Goldfuss, Schlotheim; *Hucogne*, *Prov. of Liège*, Dumont.

Cystiphyllum, Lons., Κύστις vesica, φύλλον folium.

Turbinated, or cylindrical, fixed, single, or united in groups by secretion from the animal while living. Externally, striated; internally, composed of small *bladder-like* cells. No distinct centre. Terminal cup deep, surface uneven conforming to the shape of the cells, and traversed by interrupted striæ.

This separation from the *Cyathophylla* of Goldfuss appears to be justified by the singularity of the internal structure, and the absence of a distinct centre.

Cystiphyllum Siluriense. Lons., Pl. 16 *bis.* f. 1, 1 *a*, 2, nat. size, f. 2 from Mr. Bowerbank's collection.

C. Turbinated, fixed, externally strongly striated, internally composed of cells irregular in form, arrangement, and the thickness of the partitions.

Syn. and Ref. *Cyathophyllum vesiculosum*, Goldfuss, Petref., p. 58. Taf. XVII. f. 5. Taf. XVIII. f. 1. 1826.

Goldfuss's specific character having been adopted to mark the genus, it has been thought necessary to change the specific name.

Formation and localities in England. Wenlock Limestone, *Wenlock*, *Dudley.*

Foreign locality and authority. *Eifel*, Goldfuss.

Cystiphyllum cylindricum, sp. n. Lons., Pl. 16 *bis.* f. 3, 3 *a*, 3 *b* nat. size.

C. Cylindrical, straight or curved, fixed; externally rugose and striated; internally wholly vesicular; terminal cup deep, surface large protuberances, traversed by dotted rays; no distinct centre.

Formation and locality. *Wenlock Limestone*, *Benthall Edge.*

Strombodes, Schweigger.

Strombodes plicatum (Ehrenberg). Pl. 16 *bis.* f. 4, 4 *a* to 4 *e.*—4, 4 *a* reduced one-third, 4 *b*, 4 *c* nat. size.

Syn. and Ref. *Cyathophyllum plicatum*, Goldfuss, Petref. p. 59. Taf. XVIII. f. 5. 1826; Milne Edwards, 2nd Edit. Lamarck, t. ii. p. 431. 1836.

Strombodes plicatum, Ehrenberg, 1831, Abhandl. König. Akad. Berlin. p. 312. 1832.

This coral is essentially distinguished from *Cyathophyllum* and *Cystiphyllum* by internal structure, the centre consisting not of transverse plates, resembling the septa of a *Nautilus*, or of bladder-like cells, but of lamellæ contorted spirally. In the description of *Strombodes* by Schweigger and other authors, this structure is not mentioned; it is presumed, nevertheless, that the fossil here represented is a *Strombodes*, and that it is the *S. plicatum* of Goldfuss.

Fig. 4. is from a specimen in the collection of Mr. Bright, Brand Lodge, Malvern.

Formation and locality in England. WENLOCK LIMESTONE, *Western slopes of the Malvern Hills.*

Foreign localities and authorities. *Sweden*, Goldfuss; *Awirs, between Colonster and the Chaussée de Beaufays*, Dumont.

CLADOCORA, Ehrenberg.

Cladocora sulcata, sp. n. Lons. Pl. 16 *bis*. f. 9, 9 *a*, 9 *b* nat. size.

C. strongly *furrowed*; terminal star, rays thick; internal structure, lamellæ not symmetrical. On one side of the specimen is a deep cicatrice, presenting no connexion with the interior structure of the stem, but appears to be the point from which a lateral branch has been detached. On the other side (9 *a*) is a small shoot strongly united to the stem by a thick deposit of apparently the original matter of the coral. This specimen is in Mr. Goodhall's cabinet.

Formation and locality. WENLOCK LIMESTONE, *Benthall Edge.*

LIMARIA, Steininger.

Limaria clathrata (Steininger), Pl. 16 *bis*. f. 7, 7 *a*, *b*.—7 nat. size, 7 *a*, 7 *b* magnified representations of the openings in different states of contraction and preservation.

Syn. and Ref. *Millepora ramis vagis, punctis imbricatis*? Fougt, 1745, Linn. Amœn. Acad. p. 202. fig. 14. 1749.

L. clathrata, Steininger, 1831, Mém. Soc. Geol. France, t. i. p. 339. Pl. XX. f. 6. 1834.

Formation and locality in England. WENLOCK LIMESTONE, *Dudley.*

Foreign locality and authority. *Eifel*, Steininger.

In the opening or mouth of the tubes, this coral presents great diversity of aspect, due apparently to the degree of contraction and the state of preservation. In the specimen from Shropshire figured in Pl. 16 *bis*, the triangular form given by Steininger is well shown in some parts; while in others, the mouths are merely transverse lines, slightly waved and close together; the surface in both cases being more or less rough, according to its relative perfection. In some portions of the same specimen the branches are confluent or anastomose, and therefore belong to the *L. clathrata* of Steininger; but in others they are long, round and disconnected, and if found separately they might be supposed to belong to his second species, *L. fruticosa.*

In some well-preserved specimens the mouth is open and triangular, the lower part projecting like the raised portion of a coarse file.

Limaria fruticosa (Steininger), Pl. 16 *bis*. f. 8, 8 *a* —8 nat. size, 8 *a* mouth magnified.

Ref. Steininger, 1831. Mém. Soc. Geol. France, t. i. p. 339.

Formation and localities in England. WENLOCK LIMESTONE, *Wenlock, Ledbury; Lincoln Hill and Colebrook Dale, Dudley, Nash Scar, Presteign, Abberley Hills.*

Foreign locality and authority. *Eifel*, Steininger.

TURBINOLOPSIS, Lamouroux.

Turbinolopsis bina, sp. n. Lons., Pl. 16 *bis*. f. 5, 5 *a* nat. size and vertical lamellæ magnified.

T. turbinated: external cast, perpendicular striæ crossed by transverse lines more or less distinct; internal cast, lamellæ disposed in pairs connected irregularly by transverse distant processes, most numerous towards the base of the cast; lamellæ of each pair also united by close-set processes, thicker and more prominent than the other set.

Formations and localities. LUDLOW ROCKS AND AYMESTRY LIMESTONE, *Bringwood Chase* *and Downton on the Rock near Ludlow, Botville near Church Stretton.* Wenlock Limestone and Shale, *Newswood, Eastnor Park and West flank of Malvern Hills near Presteign.* Caradoc Sandstone, *Marloes Bay, Pembrokeshire; Goleugoed, Llandovery, Bog Mine Shelve, Salop.*

In the Caradoc Sandstone of the Lickey, casts are found of more than one distinct species, probably belonging to this genus, but the specimens which have been examined were too imperfect to be satisfactorily determined. One of these casts is represented in Pl. 16 *bis*. f. 6, 6 *a*.

Cyclolites, Lamarck.

Cyclolites lenticulata, Lons. Pl. 15. f. 5, 5 *a*.—5 under surface, 5 *a* upper, 5 *b* section.

C. oval, thin; under surface faint, concentric striæ, traversed by radii; upper surface, broad, tuberculated lamellæ; centre depressed.

Syn. and Ref. *Madrepora, radiis dentatis*, Fougt, 1745, Linn. Amœn. Acad. t. 1. p. 194. fig. 5. 1749.

Madrepora porpita, Gmelin, p. 3756; Esper. Petrif. Tab. 1. f. 1—3. 1797.

Cyclolites numismalis, Lamarck, Anim. sans Vert. t. ii. p. 233. 1816; Schweigger, Beobach. VI. 1816; De Blainville, Man. d'Actinol. p. 335. Pl. LI. fig. 1. 1834; Milne Edwards, 2nd Edit. Lamarck, t. ii. p. 367. 1836.

Porpites lenticulatus, Schlotheim, Petref. p. 350. 1820.

Some confusion having arisen from the *Madrepora porpita* of Gmelin, the fossil of the Baltic, the *Fungia numismalis* of Goldfuss, a coral rag fossil, (see Count F. Mandelsloh, Mém. sur la Constitution géologique de l'Albe du Wurtemberg,) and a recent coral having been included in Lamarck's species *Cyclolites numismalis*, it has been thought advisable to adopt Schlotheim's specific name.

Formation and locality in England. Upper Silurian Rocks, *Marloes Bay*, clearly overlying the equivalent of the *Wenlock Limestone*, in strata of about the age of the middle Ludlow Rock.

Foreign localities and authorities. *Shores of the Baltic*, Fougt; *Gothland*, Schlotheim.

Cyclolites præacuta, Lons. Pl. 15. f. 4 nat. size.

C. oval, very thin: under surface, faint concentric striæ: upper surface, lamellæ sharp-edged, smooth: centre not visible.

Syn. and Ref. *C. numismalis*, Hisinger, Lethæa Suecica, p. 100. Tab. XXVIII. f. 5.

Hisinger has adopted his specific name from Lamarck, but for the reason already given, it has been considered advisable to propose another. This fossil differs also in the form of the lamellæ on the upper surface, from the *Madrepora porpita* of Gmelin and Fougt, the *C. numismalis* of Lamarck. In *C. præacuta* they are sharp-edged and smooth, in *C. lenticulata* or *numismalis* they are broad and tuberculated.

Formation and locality in England. Upper Silurian Rocks, *Marloes Bay.* Same position as *C. lenticulata.*

Foreign locality. *Shores of Gothland*, and very rarely in the limestone rocks, Hisinger.

Verticillipora, De France.

Verticillipora? abnormis, sp. n. Lons. Pl. 16 *bis*. f. 10, 10 *a* to 10 *d* nat. size. 10 *a* section through the centre of 10, 10 *b* surface pores magnified, 10 *c* apparently younger specimens with a central cavity, 10 *d* part of the surface removed, exhibiting the vertical tubes and an indication of concentric crusts similar to those at the base of f. 10.

V. irregularly branched; centre, hollow, or filled; branches composed of fine contiguous tubes, traversed by distant septa, and arranged for the greater part parallel to the axis, or slightly diverging from it: surface fine net-work.

This fossil resembles externally De Blainville's figure, Man. d'Actinol., Pl. LXVI. f. 1, of *Verticillipora cretacea* (De France), but no trace has been observed of the peculiar internal structure represented by De Blainville in fig. 1 *a*. It has nevertheless been thought more advisable to place the fossil in the genus *Verticillipora* than to make a new one. The specimens were found by Dr. Cook, of Tortworth.

Formation and locality. Upper Silurian Rocks, (*Ludlow and Wenlock*, compressed) *Purton Passage*.

Cnemidium, Goldfuss.

Cnemidium tenue, sp. n. Lons. Pl. 16 *bis*. f. 11, 11 *a*, 11 *b*.—11 magnified twice, 11 *a* exhibits the centre gravity and the horizontal tubes, 11 *b* surface pores magnified still larger.

C. mammillated or tubular, central gravity large, substance of the fossil thin, radiating horizontal canals or pores distinct and numerous.

Formation and locality. Wenlock Limestone, *Dudley*.

Graptolites.

PLATE 26, FIGS. 1, 2, 3 AND 4.

These fossils have been alluded to as good tests of the age of the strata in which they occur. (pp. 206, 309, 326, 401.) It has further been shown, that they are usually found in deposits, which from their structure were well suited to the habits of the family of "sea pens," of which they form a genus. They were named *Graptolites* by Linnæus, and have since been partially described under different names by Wahlenberg, Schlotheim, Hisinger, Nillsson and Bronn. The Danish naturalist Dr. Beck, who is preparing a monograph of them, has supplied me with the following sketch. From his remarks it appears that one of the species, very characteristic of the Upper Silurian Rocks, (Pl. 26. f. 12.) occurs abundantly in Norway and Sweden. Dr. Beck intended to name this species *Graptolithus virgulatus*, but not yet having printed his monograph, he authorizes me to use any other term, and therefore I adhere to the name of *G. Ludensis*, which was adopted before I received the description of the learned Dane[1]. (see p. 206.) It does not, however, appear certain that there is any real distinction between this fossil of the Ludlow Rocks and the *Prionotus sagittarius*, Hisinger, (*Orthoceratites serratus*, Schlotheim). The fossil, fig. 3., is not adverted to by Dr. Beck. It seems most to resemble *Prionotus Folium*, (Hisinger), but differs from that species in the number of foliations, and I therefore venture to suggest the name of *Graptolithus foliaceus*. This species was found in the calcareous flags of Meadow Town near Shelve, Salop (Llandeilo Flags). Fig. 4., of the same plate, being unknown to Dr. Beck, he has, as above stated, named it after me. The *Graptolithus Murchisonii* occurs in the Lower Silurian Rocks, and volcanic grits of the Llandrindod Hills, Radnorshire. (p. 326.)

These pen-like, serrated fossils have a great vertical range in the older or "Protozoic" rocks, being found from the lower part of the Ludlow formation, down to very ancient beds in the Cambrian System, in which they were collected for example by Professor Sedgwick in Abereiddy Bay,

[1] Mr. Lyell, during a recent tour in Denmark, obligingly obtained for me the description of Dr. Beck.

North Pembroke. They there prove by their position, that the lines of slaty cleavage coincide with the original laminæ of deposit, along which these fossils are arranged, p. 461[1].

Note on Graptolites. By Dr. Beck.

" *Graptolithus,* Linn. Iter Scan. Wahlenberg. Hisinger, &c. *Esquisse d'un Tab. des Petr. de la Suède,* p. 28.

" *Orthoceratites,* Wahlenberg, Schlotheim, Nacht. Pet. 1. p. 56 to 8, f. 3.

" *Priodon,* Nilsson, Bronn, Lethæa Geognostica.

" *Lomatoceras,* Bronn, ib. p. 55.

" *Prionotus Nilsson,* Hisinger Lethæa Suecica, p. 113, 114.

" Very different opinions have been entertained as to the place which the Graptolites hold in the series of living beings, but that of Professor Nilsson may come nearest to the truth, who conceives the Graptolite to be a polyparium of the ceratophydian family. Yet I am more inclined to regard them as belonging to the group *Pennatulinæ,* the Linnæan *Virgularia* being the nearest form in the present state of nature to which they may be compared.

" I am now acquainted with six or seven species of Graptolites, all occurring in the oldest fossiliferous strata, where they are associated with Trilobites, Orthoceratites, &c. Of the species above alluded to, five belong to Scandinavia, and, of the other two, one is peculiar to Bohemian and the other to French strata. The three specimens given me by Mr. Murchison belong to two species, No. 1 and 2 being identical and agreeing with a Norwegian species which in my monograph I have named *Graptolithus virgulatus*; but as the memoir is still unpublished, Mr. Murchison may change the name if he thinks it desirable. The species, No. 4., is new, and Mr. Murchison's name is adopted."

Generic characters of Graptolithus.

Class *Polypi.*

Order. Qy. *Octactinia,* Ehrenberg ?

Family. *Pennatulides ?*

Genus. *Graptolithus,* Linn.

" *Polyparium indivisum, elongatum, sublineare, acuminatum, obtusiusculum, statu fossili compressissimum, serratum.*

" *Polypi alternantes cum tubulo communi centrali communicantes, in fossili statu sæpissime secati, rarius bifarii, oblongi, acuminati.*

" When the stem is cut off, the distinct bodies of the single polypes are seen alternating and showing different forms when cut in different directions.

" In the first edition of his Systema Naturæ (1736), Linnæus published a generic group under the name Graptolithus. The first species he described several years afterwards in his travels in Scania (p. 147.), where also a rude figure is given. This is the most common form of graptolites in the Scandinavian transition formations, and as described and named first may be taken as the typical form of the genus. When Linnæus introduced specific names this species of graptolite was

[1] *Graptolites* have recently been found in rocks of the Silurian epoch in Ireland. Capt. Portlock, R.E., has just published, in the first volume of the illustrations of the Ordnance Survey of Ireland, a figure of a beautiful specimen, probably the same species as our *G. Ludensis.*

also named for the first time in the XIIth edition of the Syst. Nat. vol. iii. p. 174. No. 7. as *G. scalaris*.

"In the last-mentioned work the genus Graptolithus is reproduced; but several fossil bodies, and even some inorganic markings and veins in rocks being united as species under the same generic denomination, the real typical form was nearly lost by this intermixture. This confusion was carried still further in the XIIIth edition by Gmelin, where even all the true graptolites were omitted. Wahlenberg restored the genus, all the forms given by him being those fossil bodies which belong to the typical species of the transition formations, but he only gave a superficial account of the subject. Schlotheim referred them to the genus *Orthoceratites*, and several other authors who followed added no original matter. Professor Nilsson of Lund undertook a monograph of the species of graptolites found in Sweden. But he was prevented by circumstances, into which I need not here enter, from continuing his investigations on fossil remains, and some brief remarks only were published by him upon this interesting genus in the proceedings of the Physiographical Society of Lund. In that notice he proposed a new name for the genus, altering it to that of *Priodon*, a name not only objectionable as being unnecessary, but as having been already employed by Cuvier for a genus of *Acanthopterygian* fishes of the family *Teuthidæ*.

"Since that time no attempt has been made to write a monograph. Professor Bronn of Heidelberg in his Lethæa Geognostica, again, however, changed the name of the genus to *Lomatoceras*, a name already given to an insect[1]."

NONDESCRIPTS.

Spongarium Edwardsii. Pl. 26. f. 10.

This singular fossil has not been described by any English naturalist. I had not, indeed, met with any one who could throw light upon its probable origin, until, in 1836, I showed it to Dr. Milne Edwards, who was then on a visit to this country; on which occasion he took a sketch of the specimen, and has since favoured me with the following description, extracted from his note-book.

"The nature of the orbicular fossil is very problematic. At first sight it might be taken for a cartilage of *Velella*, or for some marine plant bearing an analogy to *Zonaria pavonia* (D'Agarth), or still more probably for a *Cyclolite* of Lamarck, all the superior portion of which may be supposed to have disappeared in the stony matrix, and the inferior surface of which only has remained visible. In fact, many small ridges or obtuse cristæ may be observed on it, which, radiating from a common centre, are crossed by salient circular lines, similar rather to membranaceous folds than ribs (côtes). On examining, however, more closely these objects, we perceive that all these analogies are erroneous; for the radiating ribs of this fossil are not straight lines, between which, in proportion as they widen out, other and similar lamellæ are developed (as in the *Cyclolites*, &c.); but they ramify irregularly, in extending from the central point.

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[1] In consequence of the views of Dr. Beck, and sanctioned by the advice of Mr. Lonsdale, I have inserted the Graptolites in the list of *Polyparia*, between the genera *Limaria* and *Cladocora* (see p. 711).

A beautifully illustrated book on the Swedish fossils has recently been published by Hisinger, in which the generic name of Nilsson "*Prionotus*" has been continued. The highly useful work of Bronn was, I regret to say, unknown to me till too late to be referred to in the description of many of the other fossils.—R.I.M.

"This fossil is most analogous to a very singular body described by Lamarck under the name of *Spongia Labellum.* The *Spongia Labellum* cannot remain among the Sponges, properly so called, but ought to form the type of a particular genus. It is composed of rather slender, foliaceous laminæ, arranged in an infundibuliform manner, and formed of cylindrical, longitudinal and slender shoots (tigelles), which ramify and anastomose among each other, and are covered by a kind of parenchymatous membrane which occupies equally the meshes left by this tissue.

"In short, I believe that this fossil of the Ludlow Rocks ought to form the type of a particular genus in the great family of *Sponges,* and may be characterized provisionally as follows, until the structure of the body is studied.

"A foliaceous, orbicular body, attached by its centre, and presenting a great number of salient, divergent ridges, which divide successively into several centrifugal branches, and appear to be covered by a membrane having circular and concentric folds."—*Translation and Extract of a letter from Dr. Milne Edwards.*

Loc. *Bircher Common, near Aymestry,* where it was found in the Upper Ludlow Rock by the Rev. T. T. Lewis.

Cophinus dubius, Pl. 26. f. 12.

This is a nondescript fossil concerning the origin of which no naturalist has yet given a decisive opinion. It has been referred with doubts to the family of soft *Zoophytes, Crinoidea,* and to *Mollusca*; so wide from each other are the guesses as to its place in the natural order[1]. All we can say with certainty is, that it has *the shape of an inverted four-sided pyramid, with a column-like rounding off at each corner, and 4 intercolumniations or sides, transversely situated, producing the appearance of basket-work*; whence, whatever it may prove to be, the fossil is provisionally named, at the suggestion of Mr. König, *Cophinus* (wicker basket). This curious body has been adverted to in the text (p. 181.) as occurring in positions more or less *vertical* in the uppermost strata of the Ludlow Rock, from which I infer that the animal was attached by the end of the inverted cone, while the finely levigated muddy sediment accumulated around the columns or stems.

I am indebted to Mr. W. Evans not only for collecting the best specimens of *Cophinus* with which I am acquainted, but also for directing my attention to the vertical position of the fossil in the Upper Ludlow Rock. As the drawing in the wood-cut was taken from an imperfect and broken specimen, I have in this plate given a more perfect representation of the fossil.

Ischadites Königii, Pl. 26. f. 11.

These curious fossils are so grouped together, that I always compared them with "packed or pressed figs;" and Mr. König, to whom I referred them, thus speaks of them. "I am of opinion that they may be considered to belong to the family of *Ascidiæ.* Like the *Leucophthalmus* of the Icones Sectiles (Cent. 1. f. 1.), they seem to form a group of globular, coriaceous, and, it may be added, pedicled bodies, for in one of them the cicatrix for the insertion of the pedicle distinctly appears. As, however, no traces of branchial and intestinal apertures are apparent on the surface exposed to view, it would be rash to constitute this fossil a genus, or to assign it a place in any of the known genera of the order of the naked Mollusca, to which *Leucophthalmus* unquestionably belongs."

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[1] When the Chapters on the Ludlow Rock were printing, I was led to consider the *Cophinus* a soft Zoophyte, allied to "Sea Pens." See p. 206.

Unable to acquire more knowledge concerning the affinities of this fossil, I simply refer to the figure, in which the beautiful tesselation of its surface is expressed; and feeling that any name, which does not mislead, is better than no name, I have called it *Ischadites,* from ἰσχὰς, a dried or potted fig, the specific name being furnished by my friend Mr. König, who, as above stated, has described animals somewhat analogous. (See *Leucophthalmus, Icones Fossiles,* Cent. 1. f. 1.)

Loc. *Ludlow* (Lower Ludlow Rock). Found by Dr. Lloyd, to whom I am so deeply indebted for many of the fossils engraved in this work[1].

Polymeres Demetarum, Pl. 26. f. 13.

This fossil, which occurs in dull black shale with the *Ogygia Murchisoniæ,* Pl. 25. f. 3, consists of a cylindrical, longitudinally divided tube, cut transversely into short pieces or segments, the edges of which are inclined. The joints are parallel and cylindrical, and instead of forming regular circles, are bent into several arcs: both surfaces are smooth. The tubes in various specimens are crushed transversely, obliquely, or longitudinally according to their position in the rock, and in the same direction as the trilobites and other organic remains of the mass. As the segments appear to be entire cylinders, the tubes may be the remains of animals resembling *Iulus* or *Oniscus.* It is probable that the matrix was once filled with pyrites, which in decomposing has left only black oxyd of iron and stellated groups of crystals of gypsum.

Loc. *Pensarn or Mount Pleasant on the left bank of the Towy, near Caermarthen.*

These tubular bodies were discovered with the *Ogygia Murchisoniæ* in the above locality. I have named them after the county in which they occur[2].

FUCOIDS.

To the figures of fossils, whose place in the natural kingdom is not easily determined, I might have added the drawings of certain indistinct fucoids. The best preserved, however, of these specimens does not express more than the small figure already given by Mr. Yates in the Transactions of the Geological Society, vol. ii. New Series, Pl. 27. The specimens I collected were examined by Mr. Robert Brown and Dr. Greville, but neither of these eminent botanists are able to say much more than that they are fucoid-like bodies.

They chiefly occur in Caradoc Sandstone, or in the beds of passage between that formation and the Wenlock Shale. They are found in the latter position on the eastern side of the Lower Lickey Hills, and in true Caradoc Sandstone at Ankerdine Hill, Worcestershire: the species at these two localities are distinct.

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[1] The *Cornularius Serpularius,* Schloth., of the Wenlock Limestone, and of which four figures are given Pl. 26. figs. 5 to 9. is fully described, p. 627, though without being placed in its natural position in the animal kingdom. In like manner, the *Tentaculites,* Schloth., of which four species are described, pp. 613, 628, 643. Pl. 5. f. 33. Pl. 12. f. 25. Pl. 19. figs. 15 and 16., is not yet referred to any known animal, and is therefore arranged in the general table with the other forms whose place is uncertain.

[2] Demetæ, Caermarthenshire.

Having previously alluded to certain convoluted forms in the Cambrian Rocks of Llampeter, p. 363, which were not then referred to any known organized body, I have now to acquaint my readers that having submitted them to Mr. W. MacLeay, he has pronounced them to have been "sea worms," and has favoured me with the following description, prefaced by a short general view of their place in the animal kingdom. The *Serpulites longissimus*, a well-known fossil of the Upper Ludlow Rocks (see pp. 200 and 608.), with the nature of which we were previously unacquainted, is thus assigned to its proper place among the *Annelida*. See p. 699. Mr. MacLeay has permitted me to affix specific names to the forms in the Cambrian Rocks described by him; viz.

Nereites Cambrensis, so named from the rocks in which it occurs.

——— *Sedgwickii*, from the geologist who illustrates the Cambrian System.

Myrianites Macleayii, after the naturalist who describes these fossils.

Nemertites Ollivantii, after their discoverer. (See p. 363 and Table p. 714.)

Loc. *Llampeter, Caermarthenshire*. In the schistose building-stone of that place, in which they were found by the Rev. A. Ollivant, Professor of Llampeter College.

Note on the Annelida. By W. S. MacLeay, M.A. F.L.S. &c.

These animals differ from true *Annulosa* in being hermaphrodite, and in general red-blooded[1]. They are soft vermiform animals of an articulated structure, and which form the immediate connexion between such *Vertebrata* as *Amphioxus* and *Myxine*, and such *Annulosa* as *Porocephalus* and other white-blooded *Vermes*, which have the sexes distinct.

I divide the *Annelida* as follows:

ANNELIDA.

NORMAL GROUP.		
POLYPODA. Marine animals, having their body provided with distinct feet.	NEREIDINA.	Animals free, having a distinct head provided with either eyes or antennæ or both.
	SERPULINA.	Animals sedentary, and having no head, provided with eyes or antennæ.
ABERRANT GROUP.		
APODA. Body without feet or a distinct head.	LUMBRICINA.	Animals without eyes or antennæ. Body externally setigerous for locomotion. Articulation distinct.
	NEMERTINA.	Animals aquatic, without eyes or antennæ. Body not externally setigerous. Articulation indistinct.
	HIRUDINA.	Animals provided generally with eyes but not with antennæ. Body not externally setigerous. Articulation distinct.

[1] Milne Edwards is said in the public journals to have discovered that some *Annelida* are not provided with red blood, but the distinguished Savigny stated the same fact so long ago as the year 1823, for in his *Système des Annelides* he places *Clepsine* among his *Hirudinées*. Nay, even Cuvier, who first distinctly pointed out the group under the name of *vers à sang rouge*, has said that their blood is only generally red. Although hermaphrodites, many of them require a reciprocal coitus.

NEREIDINA, MacLeay.

These are the most perfect in their structure of all *Annelida*, as they possess numerous organs and have a distinct head, which is generally provided with eyes and antennæ. Some of them, after the manner of *Serpulina*, inhabit tubes, which tubes are membranaceous, and formed by a transudation from their body; but in general the *Nereidina* are naked, and they are always agile animals freely moving about in search of their prey. Aristotle calls them, "Σκολόπενδραι θαλάσσιαι παραπλήσιαι τῷ εἴδει ταῖς χερσαίαις," (Lib. ii. c. 121.); and it is true that they are wonderfully like Centipedes. The fossil impressions in the Llampeter Rocks, are too indistinct to enable us to determine very accurately the genera and species of *Nereidina* which there occur, more particularly as the generic characters in this group depend on such minute distinctions as are afforded by a study of the mouth, antennæ and eyes. I shall therefore consider the impressions fig. 1. and fig. 2. to belong to the

Genus NEREITES. A genus which comes very near to Savigny's genus *Lycoris* in its external appearance, only the segments of the body are here perhaps more slender and in proportion longer than usual.

Spec. 1. *Nereites Cambrensis*. Murch. *n. s.*

The body of this species seems to have consisted of about 120 segments. The feet were half the length of a segment of the body, and the cirri of the feet were longer than such segment.—Plate 27. Fig. 1.

Spec. 2. *Nereites Sedgwickii*. Murch. *n. s.*

Body much more slender than that of *N. Cambrensis*, and apparently consisting of a greater number of segments. These segments have the feet attached to them apparently inconspicuous, although the cirri are very distinct. Plate 27. fig. 2.

N.B. The impression now under consideration was clearly that of an animal, as will appear by the figure, where the worm has evidently, before coiling, with difficulty trailed itself along in the mud, in a way, which any one accustomed to collect these *Annelida* will at once recognise.

Genus MYRIANITES.

Body linear, very narrow, and formed of very numerous segments with indistinct feet and short cirri.

Spec. 1. *Myrianites MacLeaii*. Murch. *n. s.*—Plate 27. Fig. 3.

N.B. The softness of the texture of the foregoing three species of *Annelida* and the perfection of the impression in fig. 1. make it very remarkable, that if articulated feet existed in the Trilobites, some vestiges of them, even although membranaceous, should not have come down to us more perfect than those figured by Goldfuss. (See Ann. Scienc. Nat. vol. xv. Pl. 2. f. 8. and pp. 665, 667 *ante.*)

SERPULINA, MacLeay.

These are sedentary animals without eyes or antennæ. They live in tubes which are either a natural transudation of their body, and are either membranaceous or calcareous, or their tubes are semifactitious, being then composed of an agglutination of particles of sand or other small substances. The calcareous nature of the tube in some *Serpulina* is very advantageous for their preservation, and has thus enabled us to see that such animals occurred frequently in the Upper Silurian Rocks.

Genus SERPULITES.

Spec. 1. *Serpulites longissimus*. Murch. *n. s.* Pl. 5. f. 1.

(See previous description of this very characteristic fossil of the Upper Ludlow Rock, p. 608.)

Nemertina, MacLeay.

The *Nemertina* are white-blooded worms like some of the *Hirudina* or *Leeches.* In this group, however, the character of articulation becomes most indistinct. Rudolfi has placed *Gordius* along with *Nemertes* (Ent. Syst. 572.); and if *Gordius* goes into the group of *Nemertina,* it is possible that *Filaria* may also. *Nemertes Borlasii,* is a long black sea-worm, which is said to suck Testaceous *Mollusca.* The articulations of its body become visible when it is contracted. If the long vermiform impression in the Cambrian Rocks of Llampeter, Plate 27. f. 4, belong to organic substances, it can only be referred to some animal between *Gordius* and *Nemertes,* although probably nearer the former genus. As yet, however, *Gordii* are only known to occur in fresh water, whereas this fossil production, if it belong to the animal kingdom, was evidently like *Nemertes,* a native of the sea.

Genus NEMERTITES ?

Animal marine, with the linear body, of a *Gordius* or *Filaria.*

Spec. 1. *Nemertites Ollivantii.* Murch. *n. s.*—Plate 27. Fig. 4.

Postscript.—I have said, that much examination is required to establish accurate comparisons between the Silurian Rocks of England and of other countries. We may, however, observe, that as a certain number of Silurian shells have a wide range in foreign lands, so it may be hoped, that subsequent inquiry will lead to many more identifications. If, indeed, the lists here presented are appealed to, we should say, that the fossils of the Upper Silurian Rocks only, particularly those of the Wenlock formation, had hitherto been much examined by continental authors, since nearly all the forms in their works which we have been able to assimilate to those of our own country, occur in the Upper Silurian group. Thus, while scarcely more than five or six of the Lower Silurian fossils can be compared with published foreign species, we find among the latter a considerable number of Trilobites, Mollusks and Corals, which are common in our Wenlock formation, and a few in the Ludlow Rocks. This comparison is particularly applicable to the Corals: a certain proportion of them have been figured from calcareous rocks in Sweden, Norway and Germany, which are thus placed in direct parallel with the Wenlock limestone. As, however, the fossils of the Upper Ludlow Rock seem to have been little more discovered than those of the Lower Silurian group, are we hence to infer that these fossiliferous deposits, which in England and Wales exhibit transitions or passages from the Silurian system, both in ascending and descending order, are of rare occurrence on the continent, or that the deficiency results from inadequate examination? Further inquiry can alone determine this point.

In regard, however, to the diffusion of Silurian deposits over still more distant regions, I may add, that I am more than ever convinced of their existence in Southern Africa. (See p. 585.) Captain (now Sir James) Alexander, whose travels have been referred to, p. 653, has recently laid before me a collection of rock specimens collected by himself, and I have no scruple in affirming that the brownish coloured sandstone, which rises to the highest points of the Cedar Mountains, north of the Cape Colony, is a "Lower Silurian" Rock; for it is loaded with casts of an *Orthis,* very closely resembling the *Orthis callactis,* associated with *Bellerophon acutus, Tentaculites annulosus,* Schloth., and many crinoidal stems, &c. Thus, while the *Homalonoti* and other fossils found in the ravines and on the slopes of these mountains led me to suppose that they were composed of Upper Silurian Rocks, this fresh importation of specimens in convincing me that the axis of the chain is Lower

Silurian (mineralogically, indeed, true Caradoc Sandstone), demonstrates a succession similar to that of our own country, and completes the parallel of these South African formations with those of England[1].

To whatever extent such identifications may hereafter reach, I hope that, in the mean time, the present contribution may, to some extent, enable foreign geologists to compare their older fossiliferous or "Protozoic" strata with those of Great Britain.

Allusion has already been made, p. 643, to the substitution of the word *Leptæna* for *Productus*. I must also observe, that upon comparing certain descriptions of the rocks with the subsequent pages in which the organic remains are described, the reader will detect a slight want of agreement in the names of a few other fossils; a discrepancy caused by changes made during the progress of the work. Again, the vertical range of three or four fossils through various deposits is incompletely given in the descriptive part; but such omissions are, it is hoped, corrected in the following table of the Organic Remains.

Obs. To the description of the *Crinoidea* (p. 671.) by Professor Phillips, I omitted to add the names of some of the persons who had contributed to the illustration of this work by the loan of specimens. The beautiful fossil *Cyathocrinites goniodactylus* (Pl. 17, f. 1.), was selected from the choice cabinet of my friend the Marquis of Northampton. This specimen exhibits very distinctly the round branches near its root or base, by which the animal was attached. The remarkable *Actinocrinites ? expansus* (Pl. 17, f. 9.), belongs to Mr. B. Bright. Mrs. Downing communicated the specimens (Pl. 17, f. 4, 6 and 8, and Pl. 18, f. 3 and 7.); and the other forms, with the exception of *Hypanthocrinites decorus*, alluded to p. 673, are to be seen in the cabinets of Mr. Bright, Mr. H. W. Inwood, and myself.—*R. I. M.*

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[1] It may further be stated, that among the fossils from the Cedar Mountains, is a true *Calymene Tristani*, Brongn., and a fragment of the head of *Homalonotus Herschelii* (nob.), so large, that the whole animal can scarcely have been less than the *Asaphus tyrannus*, var. *ornata*, nob. Pl. 24.

TABULAR LIST OF ORGANIC REMAINS IN THE OLD RED SANDSTONE AND SILURIAN ROCKS.

Tabular List of the Organic Remains in the Old Red Sandstone and Silurian Rocks, commencing with fishes and terminating with zoophytes. The formation in which each species occurs is indicated by an *. Every fossil to which no author's name is attached is considered to be a new species, being figured for the first time in this work. Of these, the fishes are described by M. Agassiz, the crustaceans by Mr. Murchison, the shells by Mr. J. de C. Sowerby, the encrinites by Professor Phillips, and the corals by Mr. Lonsdale. Mr. Broderip, Mr. W. Macleay, Dr. Milne Edwards, and Mr. König, have also contributed.

(The following abbreviations of authors' names are employed in the table. *Ag.*, Agassiz. *Brongn.*, Alexander Brongniart. *Dalm.*, Dalman. *De Blainv.*, De Blainville. *Ehr.*, Ehrenberg. *His.*, Hisinger. *Kön.*, König. *Lam.*, Lamarck. *Lamx.*, Lamouroux. *Mill.*, Miller. *M. C.*, Mineral Conchology of Sowerby. *Sow.*, Sowerby. *Pent.*, Pentland. *V. Buch*, Von Buch. *Schweig.*, Schweigger. *Stein.*, Steininger. *Val.*, Valenciennes.)

Number of species.	Genus and Species.	Description and Figure in this work.		Old Red Sandstone (middle and lower beds only.)	Silurian Rocks.						
					Upper.					Lower.	
		Plate and Figure.	Page.		Upper Ludlow Rock.	Aymestry Limestone.	Lower Ludlow Rock.	Wenlock Limestone.	Wenlock Shale.	Caradoc Sandstone.	Llandeilo Flags.
	PISCES.										
1	Cephalaspis Lyellii, *Ag.*	I. 1 to 8. II. 1, 2 and 3.	589	*	..	..	..	..	..	..	..
2	——— rostratus, *Ag.*	II. 4 and 5.	592	*	..	..	..	..	..	..	..
3	——— Lewisii, *Ag.*	II. 6.	593	*	..	..	..	..	..	..	..
4	——— Lloydii, *Ag.*	II. 7 to 9.	594	*	..	..	..	..	..	..	..
1	Cheiracanthus Murchisoni, *Ag.*	not figured.	601	*	..	..	..	..	..	..	..
2	——— minor, *Ag.*	———	—	*	..	..	..	..	..	..	..
1	Cheirolepis Traillii, *Ag.*	———	—	*	..	..	..	..	..	..	..
2	——— uragus, *Ag.*	———	—	*	..	..	..	..	..	..	..
1	Ctenacanthus ornatus	II. 14.	597	*	..	..	..	..	..	..	..
1	Dipterus macrolepidotus, *Sedgw. & Murch.*	not figured.	599	*	..	..	..	..	..	..	..
1	Diplopterus, *Ag.*	———	601	*	..	..	..	..	..	..	..
1	Holoptychus Nobilissimus	II. *bis.* 1 and 2.	599	*	..	..	..	..	..	..	..
1	Onchus arcuatus, *Ag.*	II. 10 and 11.	596	*	..	..	..	..	..	..	..
2	——— semi-striatus, *Ag.*	II. 12 and 13.	—	*	..	..	..	..	..	..	..
3	——— Murchisoni, *Ag.*	IV. 9 to 11.	607	..	*	..	..	..	..	..	..
4	——— tenuistriatus, *Ag.*	IV. 57 to 59.	—	..	*	..	..	..	..	..	..
1	Osteolepis macrolepidotus, *Val. & Pent.*	not figured.	601	*	..	..	..	..	..	..	..
2	——— microlepidotus, *Val. & Pent.*	———	—	*	..	..	..	..	..	..	..

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Number of species.	Genus and Species.	Description and Figure in this work. Plate and Figure.	Page.	Old Red Sandstone (middle and lower beds only.)	Silurian Rocks. Upper. Upper Ludlow Rock.	Aymestry Limestone.	Lower Ludlow Rock.	Wenlock Limestone.	Wenlock Shale.	Lower. Caradoc Sandstone.	Llandeilo Flags.
1	Ptychacanthus ?	I. 9. and 10.	597	*	..	..	..	..	..	..	..
1	Pterygotus problematicus	IV. 4 and 5.	606	..	..	..	*	..	..	..	..
1	Plectrodus mirabilis	IV. 14 to 26.	—	..	*	..	..	..	..	..	..
1	Thelodus parvidens	IV. 34 to 36.	—	..	*	..	..	..	..	..	..
1	Sphagodus pristodontus	IV. 1, 2, 3 & 6.	—	..	*	..	..	..	..	..	..
1	Sclerodus pustuliferus	IV. 27 to 32, & 60 to 62.	—	..	*	..	..	..	..	..	..
1	Coprolites of Plectrodus, &c.	IV. 46 to 55.	607	..	*	..	..	..	..	..	..
	CRUSTACEA.										
1	Homalonotus Knightii, *Kön.*	VII. 1 & 2.	651	..	*	..	..	..	..	..	..
2	——— Ludensis	VII. 3 & 4.	—	..	*	..	..	..	..	..	..
3	——— Herschelii	VII. *bis.* 2.	652	..	* ?	..	..	..	..	..	..
4	——— delphinocephalus, (Trimerus delphinocephalus ? *Green.*	VII. *bis.* 3 *a*, *b*, *c* & *d*.	651	..	..	..	*	*	..	..	..
1	Calymene Blumenbachii, *Brongn.*	VII. 5 to 7.	653	..	..	*	*	*	..	..	..
2	——— ? Downingiæ	XIV. 3 *a* & *b*.	655	..	..	..	..	*	..	..	..
3	——— tuberculata	XIV. 4.	656	..	..	..	..	*	..	..	..
4	——— macrophthalma, *Brongn*	XIV. 2.	655	..	..	..	..	*	..	..	..
5	——— variolaris, *Brongn.*	XIV. 1.	—	..	..	..	..	*	..	..	..
6	——— ? punctata, *Wahl.*	XXIII. 8.	—	..	..	..	..	..	..	*	..
1	Asaphus caudatus, *Brongn.*	VII. 8 *a*.	654	..		*	*	*	*	..	..
2	——— tuberculato-caudatus	VII. 8 *b*.	—	..	..	..	..	*	..	..	..
3	——— sub-caudatus	VII. 10.	655	..	*	*	..	..	..	..	..
4	——— longi-caudatus	XIV. 11 to 14.	656	..	..	..	..	..	*	..	..
5	——— Cawdori	VII. 9.	655	..	*	..	..	..	..	..	..
6	——— flabellifer, *Stein.*	not figured.	654	..	..	..	..	*	..	..	..
7	——— Stokesii	XIV. 6.	656	..	..	..	..	*	..	..	..
8	——— Powisii	XXIII. 9 *a*, *b* & *c*.	661	..	..	..	..	..	..	*	..
9	——— ? duplicatus	XXV. 8.	—	..	..	..	..	..	..	*	..
10	——— Vulcani	XXV. 5.	663	..	..	..	..	..	..	..	*
11	——— Corndensis	XXV. 4.	—	..	..	..	..	..	..	..	*
12	——— Buchii, *Brongn.*	XXV. 2.	662	..	..	..	..	..	..	..	*
13	——— Tyrannus	XXV. 1 *a* & *b*.	—	..	..	..	..	..	..	..	*
14	——— Tyrannus, *var.* ornata	XXIV.	—	..	..	..	..	..	..	..	*
1	Acidaspis Brightii	XIV. 15.	658	..	..	..	..	*	..	..	..
1	Bumastus Barriensis	VII. *bis.* 3 *a* to *d*. XIV. 7.	656	..	..	..	..	*	..	..	..
1	Paradoxides 2-mucronatus	XIV. 8 and 9.	658	..	..	..	..	*	..	..	..
2	——— 4-mucronatus	XIV. 10.	—	..	..	..	..	*	..	..	..
1	Illænus ? perovalis	XXIII. 7 *a* & *b*.	661	..	..	..	..	..	..	..	..
1	Trinucleus Caractaci	XXIII. 1 *a* to *f*.	659	..	..	..	..	..	..	*	*
2	——— fimbriatus	XXIII. 2.	660	..	..	..	..	..	..	*	..
3	——— radiatus	XXIII. 3 *a* & *b*.	—	..	..	..	..	..	..	*	*
4	——— Lloydii	XXIII. 4.	—	..	..	..	..	..	..	*	..
5	——— nudus	XXIII. 5.	—	..	..	..	..	..	..	*	..
6	——— Asaphoides	XXIII. 6.	—	..	..	..	..	..	..	..	*
1	Ogygia Murchisoniæ	XXV. 3 *a* & *b*.	664	..	..	..	..	..	..	..	*
1	Agnostus pisiformis ? *Brongn.*	XXV. 6 *a* & *b*.	—	..	..	..	..	..	..	..	*

Number of species.	Genus and Species.	Description and Figure in this work.		Old Red Sandstone (middle and lower beds only.)	Silurian Rocks. Upper.					Silurian Rocks. Lower.	
		Plate and Figure.	Page.		Upper Ludlow Rock.	Aymestry Limestone.	Lower Ludlow Rock.	Wenlock Limestone.	Wenlock Shale.	Caradoc Sandstone.	Llandeilo Flags.
	ANNELIDA.										
1	Serpulites longissimus	V. 1.	608	..	*	..	..	..	..	..	..
1	Spirorbis tenuis	VIII. 1. XI. 8.	616	..	..	..	*	*	..	..	..
	Obs. Other Annelida occur in the upper Cambrian Rocks. See pp. 699, 700.										
	MOLLUSCA.										
	Ord. Heteropoda.										
1	Bellerophon carinatus	III. 1 *d*, 4.	604	*	*	..	..	..	..	..	..
2	——— striatus	III. 12 *e*.	—	*	..	..	..	..	..	..	..
3	——— globatus	III. 15. IV. 50.	604, 613	*	*	..	..	..	..	..	..
4	——— trilobatus	III. 16.	604	*	..	..	..	..	..	..	..
5	——— ——— var.	XXI. 21.	643	..	..	..	..	..	..	*	..
6	——— expansus	V. 32.	613	..	*	..	..	..	..	..	..
7	——— Aymestriensis	VI. 12.	616	.	..	*	..	..	..	..	..
8	——— dilatatus	XII. 23 & 24.	627	..	..	..	..	*	..	..	.
9	——— Wenlockensis, (B. apertus, in the text)	XIII. 21.	627	..	..	..	..	*	..	..	..
10	——— bilobatus	XIX. 13.	643	..	..	..	..	..	..	*	*
11	——— acutus	XIX. 14.	643	..	..	..	..	..	..	*	..
	Ord. Cephalopoda.										
1	Nautilus undosus	XXII. 17.	642	..	..	..	..	..	..	*	..
1	Lituites tortuosus	XI. 3.	622	..	..	..	*	..	..	..	..
2	——— giganteus	XI. 4.	—	..	..	*	*	*	..	..	..
3	——— articulatus	XI. 5 and 7.	—	..	..	..	*	..	..	..	..
4	——— ? Ibex (see Orthoceras Ibex) ..	XI. 6.	—	..	..	..	*	..	..	..	..
5	——— ? Biddulphii	XI. 8.	626	..	..	..	*	*	..	..	..
6	——— ? Cornu-arietis, *α*	XX. 20.	643	..	..	..	..	..	*	..	..
7	——— ——— *β*	XXII. 18.	—	..	..	..	..	..	..	..	*
1	Phragmoceras arcuatum	X. 1.	621	..	..	..	*	..	..	..	..
2	——— ——— *β*	XI. 1.	—	..	..	..	*	..	..	..	..
3	——— ? nautileum	X. 2 and 3.	622	..	..	..	*	..	..	..	..
4	——— ventricosum (Orth. ventricosus *Stein.* ?)	X. 4, 5 and 6.	621	..	..	..	*	..	..	..	..
5	——— compressum	XI. 2.	—	..	..	..	*	..	..	..	..
1	Cyrtoceras læve	VIII. 21.	—	..	*	..	*	..	..	..	..
1	Orthoceras semipartitum	III. 9 *a*.	604	*	..	..	..	..	..	..	..
2	——— tracheale	III. 9 *b*.	—	*	..	..	..	..	..	..	..
3	——— bullatum, (O. striatum ? text)	V. 29.	—	*	*	..	*	..	..	..	..
4	——— Ibex (O. annulatus, *His.*) ..	V. 30.	613	..	*	..	*	..	.	..	..
5	——— articulatum, (see Lituites articulatus)	V. 31.	—	..	*	..	*	..	..	..	..
6	——— Mocktreense	VI. 11.	616	..	..	*	*	..	..	..	..
7	——— gregarium	VIII. 16.	619	..	..	..	*	..	..	..	..
8	——— distans ?	VIII. 17.	—	..	..	..	* ?	..	..	..	..
9	——— dimidiatum	VIII. 18.	620	..	..	..	*	..	..	..	..
10	——— pyriforme	VIII. 19 & 20.	—	..	..	*	*	..	..	..	..
11	——— Ludense	IX. 1 *a*.	619	..	..	..	*	..	..	..	..
12	——— ——— var.	IX. 1 *b*.	—	..	..	..	*	..	..	..	..

Number of species.	Genus and Species.	Description and Figure in this work. Plate and Figure.	Description and Figure in this work. Page.	Old Red Sandstone (middle and lower beds only.)	Silurian Rocks. Upper. Upper Ludlow Rock.	Silurian Rocks. Upper. Aymestry Limestone.	Silurian Rocks. Upper. Lower Ludlow Rock.	Silurian Rocks. Upper. Wenlock Limestone.	Silurian Rocks. Upper. Wenlock Shale.	Silurian Rocks. Lower. Caradoc Sandstone.	Silurian Rocks. Lower. Llandeilo Flags.
13	Orthoceras imbricatum, *Wahl.*	IX. 2.	620	..	*	..	..	..	..	..	..
14	——— filosum	IX. 3.	—	..	..	..	*	..	..	..	..
15	——— virgatum	IX. 4.	—	..	*	*	*	..	*	..	..
16	——— annulatum, *M. C.* (O. undulatus, *His.*)	IX. 5.	632	..	..	..	*	*	*	*	..
17	——— (Ormoceras? Stokes), Brightii	XII. 21.	626	..	..	..	..	*	..	..	..
18	——— eccentricum	XIII. 16.	631	..	..	..	*	*	..	..	..
19	——— fimbriatum	XIII. 20.	632	..	..	..	*	*	..	..	..
20	——— Nummularius, (O. crassiventris? *Wahl.*)	XIII. 24.	—	..	..	..	..	..	*	* ?	..
21	——— attenuatum	XIII. 25.	—	..	..	..	..	..	*	..	..
22	——— canaliculicatum	XIII. 26.	—	..	..	..	*	*	..	..	..
23	——— conicum	XXI. 21.	642	..	..	..	..	..	..	*	..
24	——— approximatum	XXI. 22.	—	..	..	..	..	..	..	*	..
25	——— bisiphonatum	XXI. 23.	—	..	..	..	..	..	..	*	..
26	——— trochlearis, *His.*?	not figured.		..	..	..	..	*	..	..	..
1	Conularia quadrisulcata, *M. C. & Miller.*	XII. 22.	626	..	..	..	..	*	..	..	..
	Ord. Gasteropoda.										
1	Buccinum? fusiforme	XX. 19.	642	..	..	..	..	..	..	*	..
1	Pleurotoma articulata	V. 25.	612	..	*	..	..	..	..	..	..
2	——— corallii	V. 26.	—	..	*	*	..	..	..	..	..
1	Terebra? sinuosa	VIII. 15.	619	..	..	..	*	..	..	..	..
1	Turritella gregaria	III. 1 *f.*	603	*	..	..	..	..	..	..	..
2	——— obsoleta	III. 7 *a* & 12 *f. g.*	—	*	..	..	..	..	..	..	..
3	——— conica	III. 7 *b* & 8.	604	*	..	..	..	..	..	..	..
4	——— cancellata	XX. 18.	642	..	..	..	..	..	..	*	..
1	Littorina striatella	XIX. 12.	—	..	..	..	..	..	..	*	..
1	Turbo Williamsii	III. 6.	603	*	..	..	..	..	..	..	..
2	——— corallii	V. 27.	612	..	*	*	..	..	..	..	..
3	——— carinatus	V. 28.	—	..	*	*	..	..	..	..	..
4	——— cirrhosus	XIII. 22.	631	..	..	..	*	..	..	..	..
5	——— Pryceæ	XXI. 19.	642	..	..	..	..	..	..	*	..
1	Trochus helicites	III. 1 *e* & 5.	603	*	*	..	..	..	..	..	..
2	———? lenticularis	XIX. 11.	642	..	..	..	..	..	..	*	..
1	Pleurotomaria undata	VIII. 13.	619	..	..	..	*	..	..	..	..
2	——— Lloydii	VIII. 14.	—	..	..	..	*	..	..	..	..
3	——— angulata	XXI. 20.	641	..	..	..	..	..	..	*	..
1	Euomphalus carinatus, (Inachus sulcatus? *His.*)	VI. 10.	616	..	..	*	..	*	*	..	..
2	——— sculptus	XII. 17.	626	..	..	*	*	*	..	..	..
3	——— discors, *M. C.*	XII. 18.	—	..	..	..	..	*	..	..	..
4	——— rugosus, *M. C.*	XII. 19.	—	..	..	..	..	*	..	..	..
5	——— funatus, *M. C.*	XII. 20.	—	..	..	*	*	*	*	*	..
6	——— alatus	XIII. 28.	631	..	..	..	..	..	*	..	..
7	——— tenuistriatus	XXII. 14.	641	..	..	..	..	..	..	..	*
8	——— perturbatus	XXII. 15.	—	..	..	..	..	..	..	..	*
9	——— Corndensis	XXII. 16.	—	..	..	..	..	..	..	..	*
1	Natica glaucinoides? *M. C.*	III. 14.	603	*	..	..	..	..	..	..	..
2	——— parva	V. 24.	612	..	*	*	*	..	..	..	..

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1	Nerita spirata, *M. C.*, var	XII. 15.	625	..	..	..	..	*	*	..	..
2	——— ? Haliotis	XII. 16.	—	..	..	*	..	*	..	..	..
1	Pileopsis vetustatis	not figured.	616	..	..	*	..	..	..	..	..
1	Patella ? implicata	XII. 14 *a.*	625	..	..	..	..	*	..	..	..
	CONCHIFERA.										
	Ord. Brachiopoda.										
1	Lingula cornea	III. 3.	603	*	..	..	..	..	..	..	..
2	——— minima	V. 23.	612	..	*	..	..	..	..	..	..
3	——— Lewisii	VI. 9.	615	..	..	*	..	..	..	..	..
4	——— ——— small var	....	—	..	..	..	..	..	*	..	..
5	——— lata	VIII. 11.	618	..	..	..	*	..	..	..	..
6	——— ? striata	VIII. 12.	619	..	..	..	*	..	..	..	..
7	——— attenuata	XXII. 13.	641	..	..	..	..	..	..	..	*
1	Pentamerus Knightii, *M. C.*	VI. 8.	615	..	..	*	*	*	..	..	..
2	——— lævis, *M. C.*	XIX. 9.	641	..	..	..	..	..	..	*	..
3	——— oblongus	XIX. 10.	—	..	..	..	..	..	..	*	..
1	Terebratula Navicula	V. 17.	611	..	*	*	..	..	..	..	..
2	——— canalis	V. 18.	—	..	..	..	*	..	..	..	..
3	——— lacunosa, (T. borealis, *V. Buch.*)	V. 19. XII. 10.	—	..	*	..	*	*	..	..	..
4	——— Nucula	V. 20.	—	*	*	*	*	* ?	..	..	..
5	——— pulchra	V. 21.	612	..	*	..	..	..	..	..	..
6	——— pentagona	V. 22.	—	..	*	..	..	..	..	..	..
7	——— Wilsoni, *M. C.*	VI. 7.	615	..	..	*	*	*	..	..	..
8	——— crispata	XII. 11.	624	..	..	..	..	*	..	..	..
9	——— imbricata, (T. marginalis, *Dalm.*)	XII. 12.	—	..	..	..	..	*	*	..	..
10	——— ——— var. abbreviata	XIII. 27.	631	..	..	..	..	..	*	..	..
11	——— cuneata, *Dalm.*	XII. 13.	625	..	..	..	..	*	..	..	..
12	——— bidentata, *His.*	XII. 13 *a.*	—	..	..	..	..	*	..	..	..
13	——— deflexa	XII. 14.	—	..	..	..	..	*	..	..	..
14	——— læviuscula	XIII. 14.	631	..	..	..	..	..	*	..	..
15	——— brevirostris	XIII. 15.	—	..	..	..	..	..	*	..	..
16	——— sphærica	XIII. 17.	—	..	..	..	..	..	*	..	..
17	——— crebricosta	XIII. 18.	—	..	..	..	..	..	*	..	..
18	——— Stricklandii	XIII. 19.	—	..	..	..	..	* ?	*	..	..
19	——— interplicata	XIII. 23.	—	..	..	..	..	..	*	..	..
20	——— Unguis	XXI. 13.	640	..	..	..	..	..	..	*	..
21	——— neglecta	XXI. 14.	641	..	..	..	..	..	..	*	..
22	——— tripartita	XXI. 15.	—	..	..	..	..	..	..	*	..
23	——— furcata	XXI. 16.	640	..	..	..	..	..	..	*	..
24	——— decemplicata	XXI. 17.	641	..	..	..	..	..	..	*	..
25	——— pusilla	XXI. 18.	—	..	..	..	..	..	..	*	*
1	Orthis lunata	III. 12 *d.* V. 15.	611	*	*	*	*	.	..	..	..
2	——— orbicularis	V. 16.	—	..	*	..	..	..	..	..	..
3	——— rustica	XII. 9.	624	..	..	..	..	*	..	..	..
4	——— hybrida	XIII. 11.	630	..	..	..	..	*	*	..	..
5	——— filosa	XIII. 12.	—	..	..	..	..	*	*	..	..
6	——— canalis	XIII. 12 *a.* XX. 8.	—	..	..	..	..	*	*	*	*

Number of species.	Genus and Species.	Description and Figure in this work.		Old Red Sandstone (middle and lower beds only.)	Silurian Rocks.						
					Upper.					Lower.	
		Plate and Figure.	Page.		Upper Ludlow Rock.	Aymestry Limestone.	Lower Ludlow Rock.	Wenlock Limestone.	Wenlock Shale.	Caradoc Sandstone.	Llandeilo Flags.
7	Orthis antiquata	XIII. 13.	630	..	..	..	..	..	*	..	..
8	—— callactis, *β. Dalm.*	XIX. 5.	639	..	..	..	..	..	..	*	..
9	—— alternata	XIX. 6.	638	..	..	..	..	..	..	*	*
10	—— bilobata	XIX. 7.	640	..	..	..	..	..	..	*	*
11	—— testudinaria	XX. 9 and 10.	—	..	..	..	..	..	..	*	*
12	—— vespertilio	XX. 11.	—	..	..	..	..	..	..	*	*
13	—— grandis	XX. 12 and 13.	638	..	..	..	..	..	..	*	..
14	—— expansa	XX. 14.	—	..	..	..	..	..	..	*	..
15	—— virgata	XX. 15.	639	..	..	..	..	..	..	*	..
16	—— Actoniæ	XX. 16.	—	..	..	..	..	..	..	*	*
17	—— triangularis	XX. 17.	640	..	..	..	..	..	..	*	..
18	—— semicircularis	XXI. 7.	639	..	..	..	..	..	..	*	*
19	—— Flabellulum (O. callactis? *Dalm.*).	XXI. 8.	—	..	..	..	..	..	..	*	*
	—————— var.	XIX. 8.	—	..	..	..	..	..	..	*	..
20	—— Pecten? *Dalm.*	XXI. 9.	638	..	..	..	..	..	..	*	*
21	—— anomala (Anomites anomala, *Schloth.*	XXI. 10.	—	..	..	..	..	..	..	*	*
22	—— ? costata	XXI. 11.	639	..	..	..	..	..	..	*	..
23	—— protensa	XXII. 8 and 9.	638	..	..	..	..	.	..	*	*
24	—— lata	XXII. 10.	640	..	..	..	..	..	..	*	*
25	—— radians	XXII. 11.	639	..	..	..	..	..	..	*	..
26	—— compressa	XXII. 12.	638	..	..	..	..	..	..	*	*?
1	Spirifer ptychodes (Delthyris ptychodes, *Dalm. and His.*)	III. 13.	603	*	*	..	..	..	..	..	..
2	——trapezoidalis (Cyrtia trapezoidalis, *Dalm. and V. Buch.*)	V. 14.	610	..	..	*	*	*	*	..	..
3	—— interlineatus	VI. 6.	614	..	..	*	*	..	..	..	..
4	—— radiatus, *M. C.*	XII. 6.	624	..	..	..	*	*	*	*	..
	—————— var.	XXI. 5.	638	..	..	..	..	..	..	*	..
5	—— octoplicatus, *M. C.*	XII. 7.	624	..	..	..	..	*	..	..	..
6	—— crispus (Delthyris crispa, *Dalm.*).	XII. 8.	—	..	*	*	..	*	*	..	..
7	—— ? Pisum	XIII. 9.	630	..	..	..	..	..	*	..	..
8	—— ? sinuatus (Ter. sinuata, *Sow.* in Linn. Trans.; Delthyris cardiospermiformis, *Dalm.*; Sp. sinuata, *V. Buch.*)	XIII. 10.	—	..	..	..	..	*	*	..	..
9	—— (Orthis?) plicatus	XXI. 6.	638	..	..	..	..	..	..	*	*
10	—— (Orthis?) lævis	XXI. 12.	—	..	..	..	..	..	..	*	..
11	—— (Orthis?) liratus	XXII. 6.	—	..	..	..	..	..	..	*	*
12	—— (Orthis?) alatus	XXII. 7.	—	..	..	..	..	..	..	..	*
1	Atrypa didyma (Ter. didyma, *Dalm.*) ..	VI. 4.	614	..	*	*	*	*	..	..	..
2	—— affinis (Ter. affinis, *M.C.* and *V. Buch.*; A. reticularis, *Dalm.*; Terebratulites priscus, *Schloth.*)	VI. 5.	—	..	*	*	*	*	*	*	..
3	—— obovata	VIII. 8 and 9.	618	..	..	..	*	*	..	..	..
4	—— ? galeata, *Dalm.*	VIII. 10. XII. 4.	—	..	..	..	*	*	*	..	..
5	—— tenuistriata	XII. 3.	623	..	..	..	..	*	*	..	..
6	—— aspera, *Dalm.* (Terebr. aspera, *Schloth.*)	XII. 5.	—	..	..	..	..	*	*	..	..
7	—— compressa	XIII. 5.	629	..	..	..	..	*	*	..	..
8	—— depressa	XIII. 6.	—	..	..	..	..	..	*	*	..

Number of species.	Genus and Species.	Description and Figure in this work. Plate and Figure.	Page.	Old Red Sandstone (middle and lower beds only.)	Silurian Rocks. Upper. Upper Ludlow Rock.	Aymestry Limestone.	Lower Ludlow Rock.	Wenlock Limestone.	Wenlock Shale.	Silurian Rocks. Lower. Caradoc Sandstone.	Llandeilo Flags
9	Atrypa rotunda	XIII. 7.	629	..	..	..	..	..	*	..	..
10	——— linguifera	XIII. 8.	—	..	..	..	..	..	*	*	..
11	——— orbicularis	XIX. 3 and 4.	637	..	..	..	..	..	*	*	..
12	——— hemisphærica	XX. 7.	—	..	..	..	..	..	..	*	..
13	——— crassa	XXI. 1.	636	..	..	..	..	..	..	..	*
14	——— undata	XXI. 2.	637	..	..	..	..	..	..	..	*
15	——— Lens	XXI. 3.	—	..	..	..	..	..	..	*	*
16	——— ? plana	XXI. 4.	—	..	..	..	..	..	..	*	..
17	——— polygramma	XXI. 4 *a.*	—	..	..	..	..	..	..	*	..
18	——— globosa	XXII. 2 *b.*	—	..	..	..	..	..	..	*	..
19	——— ?	XXII. 3.	—	..	..	..	..	..	..	..	*
20	——— ?	XXII. 4 and 5.	—	..	..	..	..	..	..	..	*
1	Leptæna lata, *V. Buch*	III. 10*b*. V. 13.	610	*	*	*	..	..	..	..	..
2	——— Lepisma ? *Dalm.*	VIII. 7.	618	..	..	..	*	..	*	..	..
3	——— euglypha (Productus euglyphus, *Dalm.*)	XII. 1.	622	..	..	..	*	*	*	*	..
4	——— depressa (P. depressa, *M. C. Dalm. and His.*)	XII. 2.	623	..	..	..	*	*	*	*	* ?
5	——— transversalis, *Dalm.*	XIII. 2.	629	..	..	..	..	..	*	..	..
6	——— lævigata	XIII. 3.	—	..	..	..	..	..	*	..	..
7	——— minima	XIII. 4 and 4 *a.*	—	..	..	..	..	..	*	..	..
8	——— sericea (striatella ? *Dalm.*)	XIX. 1 and 2 *a.*	636	..	..	..	..	..	..	*	*
	——— var.	XIX. 2.	—	..	..	..	..	..	..	*	..
9	——— complanata	XX. 6.	—	..	..	..	..	..	..	*	..
10	——— tenuistriata	XXII. 2 *a.*	—	..	..	..	..	..	..	*	..
11	——— duplicata	XXII. 2.	—	..	..	..	..	..	..	*	*
1	Orbicula rugata	V. 11.	610	..	*	..	* ?	..	..	..	..
2	——— striata	V. 12.	—	..	*	..	..	..	..	..	..
3	——— ? punctata (in the text erroneously O. granulata)	XX. 5.	636	..	..	..	..	..	..	*	..
	Ord. Monomyaria.										
1	Avicula rectangularis	III. 2.	603	*	..	..	..	..	..	..	..
2	——— retroflexa ? *His.*	V. 9.	609	..	*	..	*	..	..	..	..
3	——— lineata	V. 10.	610	..	*	*	..	..	..	..	..
4	——— reticulata	VI. 3.	614	..	..	*	*	*	..	..	..
5	——— orbicularis	XX. 2.	635	..	..	..	..	..	..	*	..
	——— var.	XX. 3.	—	..	..	..	..	..	..	*	..
6	——— obliqua	XX. 4.	—	..	..	..	..	..	..	*	..
	Ord. Dimyaria.										
1	Modiola semisulcata	VIII. 6.	617	..	..	..	*	..	..	..	..
2	——— antiqua	XIII. 1.	628	..	..	..	..	..	*	..	..
1	Nucula ? ovalis	V. 8.	609	..	*	..	..	..	..	..	..
2	——— lævis	XXII. 1.	635	..	..	..	..	..	..	..	*
1	Arca Eastnori	XX. 1.	—	..	..	..	..	..	..	*	..
1	Cucullæa antiqua	III. 1 *b* and 12 *a.*	602	*	*	..	..	..	..	..	..
2	——— Cawdori	III. 11.	—	..	* ?	..	..	..	..	..	..
3	——— ovata	III. 12 *b.*	—	*	..	..	..	..	..	..	..
1	Cardiola fibrosa	VIII. 4.	617	..	..	*	*	..	..	..	..

Number of species.	Genus and Species.	Description and Figure in this work. Plate and Figure.	Page.	Old Red Sandstone (middle and lower beds only.)	Silurian Rocks. Upper. Upper Ludlow Rock.	Aymestry Limestone.	Lower Ludlow Rock.	Wenlock Limestone.	Wenlock Shale.	Lower. Caradoc Sandstone.	Llandeilo Flags.
2	Cardiola interrupta (Cardium? Cornucopiæ, *Goldf.*)	VIII. 5.	617	..	..	*	*	..	..	..	..
1	Cardium striatum	VI. 2.	614	..	..	*	*	..	..	..	..
	——— var.	....	—	..	..	*	..	..	..	..	..
1	Pullastra lævis	III. 1 *a.*	602	*	..	..	..	..	..	..	..
2	——— complanata	V. 7.	609	..	*	..	..	..	..	..	..
1	Psammobia rigida	VIII. 3.	617	..	..	..	*	..	..	..	..
1	Cypricardia ? cymbæformis (Cardites carpomorphus ? *Dalm.*)	III. 10 *a.*	602	*	*	..	..	..	..	..	..
	——— var.	V. 6.	609	..	*	..	..	..	..	..	..
2	——— ? amygdalina	V. 2.	—	..	*	..	..	..	..	..	..
3	——— ? impressa	V. 3.	—	..	*	..	..	..	..	..	..
4	——— ? undata	V. 4.	—	..	*	..	*	..	..	..	..
5	——— ? retusa	V. 5.	—	..	*	*?	*	..	..	..	..
6	——— ? solenoides	VIII. 2.	617	..	..	..	*	..	..	..	..
1	Mya rotundata	VI. 1.	613	..	..	*	..	..	..	..	..
	CRINOIDEA[1].										
1	Cyathocrinites tuberculatus, *Mill.*	XVIII. 6 and 7.	671	..	..	..	..	*	..	..	..
2	——— goniodactylus	XVII. 1.	—	..	..	..	..	*	..	..	..
3	——— capillaris	XVII. 2.	—	..	..	..	..	*	..	..	..
4	——— pyriformis	XVII. 6.	672	..	..	..	..	*	..	..	..
5	——— rugosus, *Mill.*	XVIII. 1.	—	..	..	..	..	*	..	..	..
1	Marsupiocrinites cælatus	XVIII. 3.	—	..	..	..	..	*	..	..	..
1	Hypanthocrinites decorus	XVII. 3.	—	..	..	..	..	*	..	..	..
1	Actinocrinites moniliformis, *Mill.*	XVIII. 4.	672	..	..	..	..	*	..	..	..
2	——— simplex	XVIII. 8.	—	..	..	..	..	*	..	..	..
3	——— ? arthriticus	XVII. 8.	674	..	..	..	..	*	..	..	..
4	——— ? expansus	XVII. 9.	—	..	..	..	..	*	..	..	..
5	——— ? retiarius	XVII. 7.	—	..	..	..	..	*	..	..	..
1	Dimerocrinites decadactylus	XVII. 4.	—	..	..	..	..	*	..	..	..
2	——— icosidactylus	XVII. 5.	—	..	..	..	..	*	..	..	..
	POLYPARIA.										
1	Aulopora conglomerata, *Goldf.*	XV. 9.	675	..	..	..	..	*	..	..	..
2	——— consimilis	XV. 7.	—	..	..	..	..	*	..	..	..
3	——— serpens, *Goldf.*	XV. 5.	—	..	..	..	..	*	*	*?	..
4	——— tubæformis, *Goldf.*	XV. 8.	676	..	..	..	..	*	..	..	..
1	Escharina ? angularis	XV. 10.	—	..	..	..	..	*	..	..	..
1	Ptilodictya lanceolata	XV. 11.	—	..	..	..	..	*	..	..	..
1	Glaucomene disticha, *Goldf.*	XV. 12.	677	..	..	..	..	*	..	..	..
1	Hornera crassa	XV. 13.	—	..	..	..	..	*	..	..	..
1	Fenestella antiqua	XV. 16.	678	..	..	..	..	*	..	..	..
2	——— Milleri	XV. 17.	—	..	..	..	..	*	..	..	..

[1] N.B. Columns and plates of Crinoidea occur in all the Silurian formations from the Upper Ludlow Rock to the base of the Llandeilo Flags, Pl. IV, 56, XVIII, 2, 5, and 9, XX, 19, and also in the underlying Cambrian Rocks, but clearly determinable species have as yet been found in the Wenlock Limestone only.—R. I. M.

Number of species.	Genus and Species.	Description and Figure in this work.		Old Red Sandstone (middle and lower beds only.)	Silurian Rocks.						
					Upper.					Lower.	
		Plate and Figure.	Page.		Upper Ludlow Rock.	Aymestry Limestone.	Lower Ludlow Rock.	Wenlock Limestone.	Wenlock Shale.	Caradoc Sandstone.	Llandeilo Flags.
3	Fenestella prisca	XV. 15, 18.	678	..	..	..	..	*	..	..	..
4	———— reticulata	XV. 19.	—	..	..	..	..	*	..	..	..
1	Discopora antiqua ? *M. Edw.*	XV. 21.	679	..	..	..	..	*	..	..	..
2	———— squamata	XV. 23.	—	..	..	..	..	*	..	..	..
3	———— ? favosa	XV. 22.	—	..	..	..	..	*	..	..	..
1	Berenicea irregularis	XV. 20.	—	..	..	..	..	*	..	..	..
1	Retepora infundibulum	XV. 24.	—	..	..	..	..	*	..	..	..
1	Eschara ? scalpellum	XV. 25.	—	..	..	..	..	*	..	..	..
1	Blumenbachium globosum ? *Kön.*	XV. 26.	680	..	..	..	..	*	..	..	..
1	Gorgonia assimilis	XV. 27.	—	..	..	..	..	*	..	..	..
2	———— ? (not named)	XV. 28.	—	..	..	..	..	..	*	..	..
1	Ceriopora granulosa, *Goldf.*	XV. 29.	—	..	..	..	..	*	..	..	..
1	Heteropora crassa	XV. 14.	—	..	..	..	..	..	..	..	..
1	Millepora repens, *His.*	XV. 30.	—	..	..	..	..	*	..	..	..
1	Stromatopora concentrica, *Goldf.*	XV. 31.	—	..	..	..	..	*	*	..	..
2	———— nummulitisimilis	XV. 32.	681	..	..	..	..	*	..	..	..
1	Alveolites ? fibrosa	XV. 1.	—	..	*	*	..	..	..	..	..
1	Favosites alveolaris, *De Blainv.*	XV *bis*. 1, 2.	—	..	..	*	*	*	*	*	..
2	———— Gothlandica, *Lam.*	XV *bis*. 3, 4.	682	..	..	*	*	*	*	*	..
3	———— multipora	XV *bis*. 5.	683	..	..	..	..	*	*?	..	..
4	———— fibrosa, *Goldf.*	XV *bis*. 6, 7.	—	..	..	*	*	*	*	*	..
5	———— spongites, *Goldf.*	XV *bis*. 8, 9.	—	..	..	..	..	*	..	..	..
6	———— polymorpha, *Goldf.*	XV. 2.	684	..	*	*	..	?	..	..	..
1	Syringopora reticulata, *Goldf.*	XV *bis*. 10.	—	..	..	..	..	*	..	..	..
2	———— bifurcata	XV *bis*. 11.	685	..	..	*	..	*	..	..	..
3	———— filiformis ? *Goldf.*	XV *bis*. 12.	—	..	..	..	..	*	..	..	..
4	———— cæspitosa ? *Goldf.*	XV *bis*. 13.	—	..	..	..	..	*	..	..	..
1	Catenipora escharoides, *Lam.*	XV *bis*. 14.	—	..	..	*	*	*	*	*	*
1	Porites pyriformis	XVI. 2.	686	..	..	*	*	*	*	..	..
2	———— petalliformis	XVI. 4.	687	..	..	..	..	..	*	..	..
3	———— tubulata	XVI. 3.	—	..	..	..	..	*	..	..	..
4	———— expatiata	XV. 3.	—	..	..	*	..	*	..	..	..
5	———— inordinata	XVI *bis*. 12.	—	..	..	..	..	..	..	..	*
6	———— discoidea	XVI. 1.	688	..	..	..	..	*	..	..	..
1	Monticularia conferta	XVI. 5.	—	..	..	..	..	*	..	..	..
1	Astræa ananas, *De Blainv.*	XVI. 6.	—	..	..	..	..	*	..	..	..
1	Caryophyllia flexuosa, *Lam.*	XVI. 7.	689	..	..	..	..	..	*	..	..
1	Acervularia Baltica, *Schweig.*	XVI. 8.	—	..	..	..	..	*	..	..	..
1	Cyathophyllum turbinatum, *Goldf.*	XVI. 11.	690	..	..	..	..	*	*	*	..
2	———— angustum	XVI. 9.	—	..	..	..	..	..	*	*	..
3	———— cæspitosum ? *Goldf.*	XVI. 10.	—	..	..	..	..	*	*	*	..
4	———— dianthus, *Goldf.*	XVI. 12.	—	..	..	..	..	*	*	*	..
1	Cystiphyllum Siluriense	XVI *bis*. 1, 2.	691	..	..	..	..	*	..	..	..
2	———— cylindricum	XVI *bis*. 3.	—	..	..	..	..	*	..	..	..
1	Strombodes plicatum, *Ehr*	XVI *bis*. 4.	—	..	..	..	..	*	..	..	..
1	Cladocora sulcata	XVI *bis*. 9.	692	..	..	..	..	*	..	..	..
1	Graptolithus Ludensis (Prionotus sagittarius, *His.*)	XXVI. 1, 2.	694	..	..	..	*	..	*	..	..
2	———— foliaceus	XXVI. 3.	—	..	..	..	..	..	..	..	*
3	———— Murchisonii, *Beck.*	XXVI. 4.	—	..	..	..	..	..	..	*	*
1	Limaria clathrata, *Stein.*	XVI *bis*. 7.	692	..	..	..	..	*	..	..	..

4 x 2

Number of species.	Genus and Species.	Description and Figure in this work. Plate and Figure.	Page.	Old Red Sandstone (middle and lower beds only.)	Silurian Rocks. Upper. Upper Ludlow Rock.	Aymestry Limestone.	Lower Ludlow Rock.	Wenlock Limestone.	Wenlock Shale.	Lower. Caradoc Sandstone.	Llandeilo Flags.
2	Limaria fruticosa, *Stein.*	XVI *bis*. 8.	692	..	..	..	..	*	*	..	..
1	Turbinolopsis bina	XVI *bis*. 5.	—	..	..	*	*	*	*	*	..
2	————— ?	XVI *bis*. 6.	693	..	..	..	..	..	..	*	..
1	Cyclolites lenticulata	XV. 5.	—	..	..	*	*	..	..	..	..
2	——— præacuta (C. numismalis, *His.*).	XV. 4.	—	..	..	*	*	..	..	..	..
1	Verticillipora ? abnormis	XVI *bis*. 10.	—	..	..	..	..	* ?	..	..	..
1	Cnemidium tenue	XVI *bis*. 11.	694	..	..	..	..	*	..	..	..
	SEDIS INCERTÆ.										
1	Tentaculites tenuis	V. 33.	613	..	..	..	*	..	..	..	..
2	——— ornatus	XII. 25.	628	..	..	..	..	*	..	..	..
3	——— scalaris, *Schloth.*	XIX. 15.	643	..	* ?	..	..	..	..	*	..
4	——— annulatus, *Schloth.*	XIX. 16.	—	..	..	..	..	..	..	*	..
1	Cornulites serpularius, *Schloth.*	XXVI. 5 to 9.	627	..	..	..	..	*	..	..	..
1	Ischadites Königii	XXVI. 11.	697	..	..	..	*	..	..	..	..
1	Cophinus dubius	XXVI. 12.	697	..	*	..	..	..	..	..	..
1	Spongarium Edwardsii	XXVI. 10.	696	..	*	..	..	..	..	..	..
1	Polymeres Demetarum	XXVI. 13.	698	..	..	..	..	..	..	..	*
	Besides the above-mentioned Organic Remains of the old Red Sandstone and Silurian System, certain convoluted bodies in the Cambrian Rocks are described by Mr. W. MacLeay as *Annelida* (p. 698.), the specific names being assigned by myself. They are										
1	Nereites Cambrensis	XXVII. 1.	700	..	..	..	..	..	..	..	..
2	——— Sedgwickii	XXVII. 2.	—	..	..	..	..	..	..	..	..
1	Myrianites MacLeayii[1]	XXVII. 3.	—	..	..	..	..	..	..	..	..
1	Nemertites Ollivantii	XXVII. 4.	701	..	..	..	..	..	..	..	..

RECAPITULATION.

	No. of Genera.	No. of Species.
Pisces	15	24
Crustacea	10	37
Annelida	5	6
Mollusca (ord. Heteropoda)	1	11
——— (ord. Cephalopoda)	6	41
——— (ord. Gasteropoda)	13	34
Conchifera (ord. Brachiopoda)	8	107
——— (ord. Monomyaria)	1	6
——— (ord. Dimyaria)	10	21
Crinoidea	5	14
Polyparia	35	65
Sedis incertæ	6	9
Total	115	375

DESCRIPTION OF THE SECTIONS.

PLATE 29[1] *TO* 37.

PLATE 29.

Fig. 1. From the Cotteswold Hill near Cheltenham on the east, to Haffield Camp near Ledbury, Herefordshire, on the west; showing a conformable succession of all the formations, from the Inferior Oolite to the base of the New Red System. The subdivisions of the lias and of the upper portion of the New Red System (including the Keuper Sandstone), are the chief objects. The Lower New Red Sandstone, properly so called, is not developed; the New Red System being terminated by a conglomerate partially filled with syenite. The Old Red Sandstone in unconformable strata, rises from beneath the New Red conglomerate. See p. 14 *et seq.*

Fig. 2. From the Hawkston Hills, Shropshire, to the Peckforton Hills, Cheshire; indicating the position of a basin of lias around Prees and Cloverly. See p. 22 *et seq.*

Fig. 3. From Lyth Hill near Shrewsbury, to Prees; explaining the succession of strata from the coal-measures to the lias, including the subdivisions of the New Red System. The coal-measures passing upwards into the Lower New Red Sandstone, constitute the newest member of the Carboniferous System, contain fresh-water limestone, are highly dislocated, and repose upon the Cambrian Rocks. See p. 39.

Fig. 4. Shows a peculiar conglomerate at the base of the New Red Sandstone, (Rosemary Rock, Worcester). The Lower Silurian Rocks of Ankerdine Hill are in unconformable contact. See pp. 53, 415.

Fig. 5. Lower New Red Sandstone and Upper Coal-measures at Wellbatch, near Shrewsbury, resting on Cambrian Rocks as in f. 3. See pp. 93 *et seq.*

Fig. 6. Upper coal and fresh-water limestone at Uffington, near Shrewsbury, resting unconformably on Cambrian Rocks as in figs. 3 and 5. See pp. 81, 92.

Fig. 7. Upper coal and freshwater limestone at Pontesbury, passing under Lower New Red Sandstone and calcareous conglomerate, and resting upon the quartz rock of the Stiper stones. See pp. 81, 83 *et seq.*

Fig. 8. Section of the upper coal and limestone strata, as seen near Pontesbury where affected by a fault. The details of the Shrewsbury coal seams, and their relations to the included limestone, are here expressed on a larger scale than in the other sections. See p. 90.

Fig. 9. Upper coal-measures of the Shrewsbury field, resting upon Silurian Rocks at Bauseley and Bragginton, showing further how the same coal-measures pass under the Lower New Red Sandstone of Pecknall near Alberbury, the whole surmounted by calcareous conglomerate, the equivalent of the Magnesian Limestone or Dolomitic Conglomerate. See pp. 29, 82.

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[1] There is no Pl. 28. in this work, the subject of Pl. 27. being that which terminates the illustration of the Organic Remains and immediately precedes Pl. 29. This was caused by the desire to place the folding plates of sections after the single plates of the Organic Remains; the former having been numbered at an early period, in order to pass the work through the press.

Fig. 10. From the south end of the Dudley coal-field across the Clent Hills, to prove that the coal-measures pass upwards into the Lower New Red Sandstone in Worcestershire, as well as in Shropshire, the last-mentioned formation being overlaid in both counties, by calcareous conglomerates. N.B. The thick or 10 yard coal of Dudley is lost by a fault, and has not yet been proved beneath the Lower New Red, though there is little doubt of its existence. See pp. 47, 506, and Pl. 37, figs. 1 and 6.

Fig. 11. From Apley Terrace on the S.E., to Wrockardine on the N.W., traversing in descending order. 1st. Lower New Red Sandstone. 2nd. The coal and ironstone measures of Coal Brook Dale. 3rd. Carboniferous Limestone; the whole resting unconformably on various members of the Silurian System. Some trap rocks (greeestone, basalt, &c.), penetrate the coal-field, and other trap rocks (syenite and felspar rock), pierce the Lower Silurian Rocks at the Wrekin, &c. The Caradoc Sandstone in contact with the Wrekin trap, is converted into quartz rock. See pp. 61, 103.

Fig. 12. From Apley on the E.N.E., to Tasley, near Bridgenorth on the W.S.W.; exposing a full development of the Lower New Red Sandstone and its passage downwards, into the upper coal with freshwater limestone. See pp. 61, 100.

Fig. 13. From Wolverhampton on the east, to Bagley Rough and the Severn on the west; exhibiting a trough of New Red Sandstone between the coal-fields of Staffordshire and Coalbrook Dale. Many granitic and other boulders of northern origin encumber the surface of this tract. The oblique face of the fault at Wolverhampton is specially worthy of remark. See pp. 41, 61, 503.

Fig. 14. Anticlinal of the Carboniferous Limestone of Lilleshall, in the direction of the chief trappean eruptions of the adjacent coal-field, and parallel to the strike of the Silurian Rocks.

Fig. 15. From Lilleshall House (the new mansion of the Duke of Sutherland) on the east, to the village and hill of Lilleshall on the west, pointing out a succession from the calcareous (dolomitic) conglomerate of the New Red Sandstone, through the Lower New Red Sandstone, down to the coal-measures and Carboniferous Limestone. The syenitic trap of Lilleshall Hill, penetrates the Lower Silurian Rocks, as at the Wrekin. See pp. 48, 235.

Fig. 16. From Ketley on the east, to Ercal Hill on the west; showing how the Carboniferous Limestone supports the coal-measures. The coal-measures are much penetrated by trap, and have been affected by powerful faults, the lower coal having been thrown up nearly to the surface in the centre of the field. On the sides of Ercal Hill the Caradoc Sandstone is converted into quartz rock. See pp. 103, 110, 233.

Fig. 17. Section across the Broseley district of the Coal Brook Dale field; showing, as in f. 16., how the coal-measures have been upheaved through the Lower New Red Sandstone, and how they are eventually cut out by the rise of the Silurian Rocks (Wenlock Limestone, &c.), and various bosses of trap. The phenomenon of altered sandstone on the sides of the Wrekin, is again exhibited. The faults in this and the preceding figure are inserted by his permission from drawings of Mr. Prestwich. See pp. 110, 233.

PLATE 30.

Fig. 1. Section from the Titterstone Clee Hill on the south-west, to the banks of the Severn on the north-east, exhibiting a central axis of Old Red Sandstone. On the south-western side of this axis, the ascending series of strata is unbroken, from the Carboniferous Limestone of Oreton

to the productive coal-field, through a large development of Millstone Grit. To the north-east the section passes, first across the trap and broken coal-measures of Kinlet, and thence through a poor coal-field, which as it approaches the banks of the Severn, sinks conformably beneath the Lower New Red Sandstone of Chelmarsh, Higley, Alveley, &c. See pp. 60, 113, 117, 121, 131.

Fig. 2. Section at Bewdley, to show the unconformable relations of New Red Sandstone to the carboniferous grits of the Forest of Wyre. See pp. 54, 134.

Fig. 3. From the hills north of Shatterford to Kidderminster, showing a central, elevated trough of Old Red Sandstone with cornstone. A dyke of trap appears at Shatterford, throwing off the coal upon its eastern flank. Lower New Red Sandstone overlies the coal conformably on the north, whilst other and superior members of the New Red System, flank and dip away from the Old Red Sandstone to the south, in *un*conformable positions. See pp. 54, 137, 178.

Fig. 4. Repetition of the phenomena seen at the eastern end of f. 1., showing passage of coal-measures into Lower New Red Sandstone, with courses of impure limestone (Borle Brook.). See p. 60.

Fig. 5. Faults producing a conical mass of Carboniferous Limestone at the escarpment south of the Cornbrook coal-field of the Clee Hills. See p. 120.

Fig. 6. General Section across the Clee Hills, showing on the south an ascending series from the Old Red Sandstone with cornstone, through the Carboniferous Limestone and Millstone grit, to the productive coal-field. Basalt rises through the centre of these hills, capping the coal of Cornbrook and the Old Red Sandstone of Titterstone Clee. In the Brown Clee Hills the Old Red Sandstone (with zones of Cornstone), supports the coal-measures without the intervention of Carboniferous Limestone; the Millstone grit or "hill rock" being alone interposed. The Old Red Sandstone is thrown up between the Clee Barf and Abdon Barf. The minor faults in the Clee Barf are not given, but those of Abdon Barf being upcasts towards the basaltic summit, are noticed.

Fig. 7. Section across the Knowlbury coal-basin (Titterstone Clee Hill), showing the dislocations by which it has been thrown into the form of a basin. The sudden expansion of the coal between certain faults is a remarkable phenomenon. See pp. 114, 117.

Fig. 8. The relations of the coal and basalt at the Hoar Edge, (Titterstone Clee), and a cone of trap with dislocated coal-measures discovered in sinking a trial shaft. See pp. 113, 128.

Fig. 9. Relations of Coal-measures and Lower New Red Sandstone on the banks of the Severn, at Higley and Stanley, showing an upcast fault of the former near the river, and a further elevation of Old Red Sandstone on the west. (N.B. The Higley grindstone in the Lower New Red was formerly supposed to be Old Red Sandstone.) See pp. 133.

Fig. 10. Showing a thin zone of coal-measures north of Newent, interposed between the Old and New Red Sandstone. See p. 153.

Fig. 11. Great upcast of Old Red Sandstone in Fan-sir-gaer (Caermarthen-fans), to 800 feet above its level in the adjacent hill of Carreg-ogof. The line of fault runs nearly from north to south. See p. 165, and Map.

Fig. 12. Repetition of upcast similar to phenomena in f. 11., but to a less extent; the Carboniferous Limestone not being removed on the side elevated. See pp. 157, 165.

Fig. 13. Fault in the Old Red Sandstone near Lydney, Gloucestershire.

Fig. 14. General section across the Oswestry coal-field, from the Lower New Red Sandstone of the plains of Shropshire, to the mountains of Lower Silurian Rocks near Llansylin. The faults

affecting the Oswestry coal increase in intensity on the rise. The coal is seen to be worked in recent shafts through the Lower New Red Sandstone. The Millstone grit and Carboniferous Limestone are largely developed, but the Old Red Sandstone and younger Silurian Rocks are wanting. See pp. 64, 141 *et seq.*

PLATE 31.

Fig. 1. From the Millstone Grit and Carboniferous Limestone, forming the edge of the South Welch coal basin near Abergavenny, to the Upper Silurian Rocks of Radnorshire, which constitute the Begwm and Pains Castle hills on the left bank of the Wye. In this section the vale of the Usk has been the scene of a powerful dislocation, to the north-west or upcast side of which is the remarkable and lofty outlier of Carboniferous Limestone "Pen-cerrig-calch" (borders of the Black Forest). This section is chiefly designed to exhibit the enormous development of the Old Red System in this part of England (Herefordshire), and its subdivision into 1. Conglomerate and sandstones. 2. Cornstones, marls and sandstone. 3. Tilestone, &c. Although this section traverses a contortion of the Ludlow Rocks, near their junction with the Old Red Sandstone, (the line of the Ludlow and Brecon anticlinal), the prevalent arrangement along the Begwn and Clyro Hills, exhibits a *perfectly conformable* passage from the one system into the other. See Map and pp. 156, 163, 171, 176 *et seq.*, 336 *et seq.*

Fig. 2. Section of the Upper Silurian Rocks as they appear in the neighbourhood of Ludlow, explaining the subdivisions of the Ludlow and Wenlock formations on a larger scale than in the other figures. See pp. 196 *et seq.*

Fig. 3. From the coal-field of the Titterstone Clee Hills to the Cambrian Rocks of the Longmynd, exhibiting a succession of the Ludlow and Wenlock formations rising from beneath the Old Red Sandstone and underlaid by the Caradoc Sandstone, the latter being fully developed on the banks of the Onny, though in hills of low altitude. The volcanic axis of Caer Caradoc breaks in upon the sequence of the Lower Silurian Rocks and no Llandeilo Flags are visible. See pp. 124, 174, 179, 196, 216 *et seq.*, 256 *et seq.*

Fig. 4. From the coal measures and basalt of the Brown Clee Hills to the quartz rock of the "Stiper Stones" (north-eastern end of the mining tract of Shelve); passing over the same succession of Old Red Sandstone and Silurian Rocks as in f. 3., with examples of the conversion of Caradoc sandstone into quartz rock by the outburst of volcanic matter. (Caer Caradoc.) Trap is seen protruding at many points through the Cambrian Rocks, and copper and lead ores occur occasionally near the contact. A remarkable outlier of Ludlow Rocks is seen at Botville, near Church Stretton, in a vertical position on the north-western face of the trap of Caer Caradoc. See pp. 122, 174, 196, 216, 220, 231 *et seq.*

Fig. 5. Section across the Ludlow promontory, exposing in its centre the valley of elevation of Wigmore Lake. A double upcast is seen to the south-east and a single upcast to the north-west, the descending series from each flank being Old Red Sandstone, Ludlow Rocks, Wenlock Limestone, and Shale, the latter occupying the centre of the denudation. This is a striking point of the great Ludlow and Brecon anticlinal which is traceable by Old Radnor, and the Wye at Erwood, and reappears to the south-west near Brecon. See Map and pp. 196 *et seq.*, 238.

Fig. 6. Traverse from five miles north of Brecon to the hills of Llwyn Madoc passing over the "Brecon anticlinal," a ridge composed of Ludlow Rocks which at Castel Madoc are thrown

into a double flexure and dip beneath the Old Red Sandstone of Mynidd Epynt and Brecon. A complete section of the Upper Silurian Rocks is exposed in descending the escarpment of that tract to the vale of the Irthon (Cwm-craig-dhu).

The Brecon anticlinal is the continuation of that of Ludlow explained in f. 5. See Map and pp. 336 *et seq.*

Fig. 7. Traverse of the same "Brecon anticlinal," as in f. 6., where it has diminished to a single ridge, having a powerful fault on its north-western face. See pp. 338 *et seq.*

Fig. 8. Traverse of the same anticlinal where still more diminished, one mile from its termination. The fault here is on the south-eastern face. See p. 338.

Fig. 9. Traverse of the same anticlinal at Corn-y-fan, where it terminates in a single rock flanked by Old Red Sandstone, which is violently dislocated on the south-eastern face. See p. 337.

PLATE 32.

Fig. 1. From the Caradoc, on the E.S.E., to the valley of the Severn in the W.N.W., across the Cambrian Rocks of the Longmynd or great mineral axis of west Salop into the adjoining parts of Montgomeryshire. The Silurian System lies to the south-east, as expressed in Pl. 31. figs. 3 and 4. On the north-western flank of the Longmynd and Linley Hills appears the striking ridge of quartz rock called the "Stiper Stones," succeeded by the dislocated and mineralized region of Shelve and Cornden, where the Lower Silurian rocks (Caradoc and Llandeilo) undulate conformably with bedded trap rocks, and are also pierced by intrusive masses of trap. A trough of Upper Silurian Rocks is exposed towards the vale of the Severn, with a cone of intrusive trap and altered rocks at Nant-cribba. The most productive lead veins lie between the Stiper Stones and the Cornden, and occur exclusively in the *stratified deposits* near the intrusive trap rocks. See pp. 223, 256 *et seq.*, 268 *et seq.*, 300 *et seq.*

Fig. 2. A second traverse across the same mining district in another parallel, showing still more clearly the distinction between the bedded trap, formed contemporaneously with the Lower Silurian strata and the intrusive trap which has pierced and altered them. The great trough of unaltered Upper Silurian Rocks on the W.N.W. is well exhibited in the Long Mountain. At the western extremity of the section, the trap dyke of Welch Pool penetrates beds of Caradoc sandstone and impure limestone. See pp. 223, 268 *et seq.*

Fig. 3. A third traverse of the same mineral tract further to the S.S.W.; to show that the anticlinal and synclinal lines of Nos. 1 and 2 are not continuous to any great distance, but change with each short outburst of intrusive trap rock. See pp. 268 *et seq.*

Fig. 4. Unconformable relations of the Upper Limestone of the Caradoc formation to the Cambrian rocks of Linley; also showing veins of copper ore running through the strata of *both systems.* See p. 258.

Fig. 5. Transverse section of the Breidden Hills, marking their eruptive character, the Silurian schist and sandstone on their flanks being much dislocated and altered. See pp. 587 *et seq.*

Fig. 6. On the south-eastern flank of the Breidden Hills, near Middleton, proving that the stratified masses contiguous to points of eruptive trap are penetrated by mineral veins: a repetition of evidence similar to that which is offered in figs. 1, 2 and 3. See pp. 587 *et seq.*

Fig. 7. General relations of the Breidden Hills to the country on their flanks at their north-eastern extremity. Stratified trap alternates with Lower Silurian schist and sandstone (Bauseley Hill) in vertical beds, while intrusive trap appears in Brimford Wood. The coal-field of Bragginton

and Coed Way (full of faults) rests on the edges of the Silurian rocks and passes conformably under the Lower New Red Sandstone and Dolomitic Conglomerate of Pecknall and Alberbury. See pp. 587 *et seq.*

Fig. 8. Alteration and dislocation of the New Red Sandstone, as seen at Pim Hill, upon the line of the eruptive axis of the Breidden Hills. This spot is between the great outburst of trappean matter and the dykes composed of the same at Acton Reynolds. (See Map for the extension of this line of dislocation into Staffordshire.) See pp. 587 *et seq.*

Fig. 9. General section from the Long Mountain across the Vales of the Severn, Ffirnwy and Tannat, to the south-eastern flanks of the Berwyn mountains, near Llanrhaidr, explaining how the strata of the Silurian System are extended by a number of undulations over so wide an area.

In proceeding from the south-east, the Caradoc sandstone and its impure limestone are seen to rise from beneath the Upper Silurian Rocks at Powis Castle. Troughs of Upper Silurian rocks (mudstone) succeed. The Caradoc Sandstone re-appears upon the left bank of the Fyrnwy (Allt-y-maen) and is continued by rapid undulations to the vale of the Tannat. The Llandeilo Flags with *Asaphus Buchii, Encrinites* and other fossils, and forming the *base of the Silurian System*, rise from beneath the Caradoc formation and pass down into the slaty Cambrian schists of the Berwyns.

This section, so important in the verification of the order of succession, may be considered the prolongation of figs. 1 and 2. The north-western part of it, including all the tract between the Ffyrnwy and the Berwyns, was inserted by Professor Sedgwick, in company with whom the author first examined that district. See pp. 300, 306 *et seq.*

PLATE 33.

Fig. 1. From the Longmynd on the north-east, to the hills on the right bank of the Ithon, near Llanbadarn fynidd, exposing a vast trough of Upper Silurian rocks and Old Red Sandstone; the Silurian rocks resting unconformably at either end upon Cambrian rocks, the connecting Lower Silurian strata being wanting. The great outlier of Old Red Sandstone which occupies Clun Forest, exhibits on most sides conformable passages into the Ludlow Rock. See pp. 258, 300, 311 *et seq.*

Fig. 2. From the south-east of Kington to the north-west of Nash Scar near Presteign; showing a regular succession through the Ludlow formation, as it appears in Herrock Hill, to the Wenlock Limestone and Caradoc Sandstone. These formations being upon a line of volcanic eruption, the limestone is for the most part unstratified and crystalline, and the sandstone is heaved up in a mural form with an outlier of Old Red Sandstone on the north-west. Another line of dislocation is seen at Kington, near the junction of the Old Red Sandstone and Upper Ludlow Rock. See pp. 311 *et seq.*

Fig. 3. Traverse of the trappean hills (chiefly Hypersthene Rock and greenstone) of Stanner and Old Radnor, showing how their eruption has dislocated and altered the Ludlow and Wenlock formations. (Thin veins of lead ore appear on the sides of the trap of Old Radnor.) See p. 318.

Fig. 4. From the Old Red Sandstone on the right bank of the Arrow near Kington, across the hills of Hanter and Old Radnor, exhibiting the trap bursting through the Ludlow and Wenlock formations, with slight traces of the Caradoc sandstone; all the strata being highly dislocated, and in parts much altered. Passing to the W.N.W., the section exposes the denudation of the vale of Radnor, and a fine development of Upper Silurian rocks (chiefly the Ludlow formation) in the mountains of Radnor Forest. See pp. 318 *et seq.*

Fig. 5. Traverse across the trappean or volcanized district of Llandrindod and Gelli, to the Cambrian rocks on the west; showing thin-bedded and contemporaneous beds of trap, repeatedly alternating with Lower Silurian rocks (Caradoc and Llandeilo), and rugged knolls of intrusive trap bursting through all the stratified masses and throwing them into anticlinal and synclinal forms. The mineral waters of Llandrindod issue from pyritous and altered shale in contact with the trap. See pp. 324 *et seq.*

Fig. 6. Across the Llandegley rocks (same district as No. 5.) indicating repeated alternation of bedded trap and Caradoc sandstone. Bosses of unstratified greenstone appear near Llandegley village, and the mineral waters of that place issue from the pyritous and altered strata. See pp. 324 *et seq.*

Fig. 7. Great transverse section exposed on the banks of the Wye between the hills of Old Red Sandstone on the south-east to the slaty Cambrian rocks of Rhaydr on the north-west. Strong ridges of Upper Silurian rocks are exposed, together with a small dislocated tongue of Old Red Sandstone, the north-eastern extremity of the great expanse of that system in Mynidd epynt. Lower Silurian rocks are thrown up on the sides of the eruptive trap of Carneddau near Builth (the southern termination of the chain traversed in figs. 5 and 6.); while Upper Silurian Rocks, chiefly their lower members, are repeated in a trough between the Carneddau and the Cambrian rocks of Dol-fan. The Cambrian rocks appear in great undulating masses, chiefly dipping to the north-west, and are in most parts affected by slaty cleavage. The mineral waters of the Park Wells, near Builth, like those of Llandrindod and Llandegley, issue from dislocated and altered strata in contact with trap. See pp. 317, 224 *et seq.*

PLATE 34.

(Caermarthenshire.) See pp. 347 to 369.

Fig. 1. From the Cwm dwr near Trecastle, to Llandovery, showing a passage from the tilestones of the Old Red Sandstone into the Upper Silurian Rocks, and great undulations between the Upper and Lower Silurian Rocks. The subdivisions of the Silurian System are better seen in figs. 3 and 5. See pp. 347 *et seq.*

Fig. 2. From the left bank of the Towy, south of Llandovery, to the vale of Dole-cothi, being a traverse across part of the Cambrian rocks exposed by the new road to Llampeter, showing large concretions of quartzose grit, which mark the bedding and undulation of imperfect slates which are affected at intervals by oblique cleavage lines. The position of the veins of quartz and pyrites excavated by the Romans at Gogofau is indicated. (N.B. This section should have been placed to the left hand of f. 1. to complete the descending series.) See pp. 347, 360.

Fig. 3. From the junction of the Old Red Sandstone and Upper Silurian Rocks in the escarpment of Mynydd bwlch-y-groes (a continuation of Mynydd epynt) to the hills of Cerrig-gwynion, where the Lower Silurian Rocks pass into the slaty schists of the Cambrian System. In this section the Caradoc Sandstone is well exposed in bold flexures and occupies the hills of Noeth-grüg, the Llandeilo flags occupying the space between Cefn-y-garreg and Cerrig-gwynion. The strata are affected by an oblique slaty cleavage. See pp. 352 *et seq.*

Fig. 4. Cambrian rocks of Cerrig-mwyn and Nant-y-moen, containing productive veins of lead ore. See p. 366.

Fig. 5. From the Millstone Grit and Carboniferous Limestone of the South Welch coal basin to the Towy at Llangadock, showing conformable passages from the Carboniferous System into

the Old Red Sandstone, and from the latter into the Upper Silurian Rocks. The greater part of this section is exposed on the banks of the river Sowdde, which flowing in a rocky channel affords a clear view of the cornstones and tilestones, and the junction of the latter with the equivalent of the Ludlow Rocks (at Pont-ar-lleche, or the bridge upon the tilestones). The trap of Blaen-dyffrin-garn, on the left bank of the Sowdde, penetrates the Lower Silurian Rocks. See pp. 175, 182, 348 and 355.

Fig. 6. From the Millstone Grit and Carboniferous Limestone of the South Welsh coal basin to the banks of the Towy, north of Llandeilo, exposing the relations of the outlier of Carboniferous Limestone called Castell-cerrig-cennen, and the Silurian Rocks in vertical and closely compressed masses.

The Llandeilo Flags are well exposed, and a band of Caradoc Sandstone is interposed between them and the Upper Silurian Rocks.

Fig. 7. From the Millstone Grit and Carboniferous Limestone of the South Welsh coal basin, near the sources of the Lwchor, to the hills north-west of Llandeilo, principally to exhibit a full succession of the Llandeilo flags with stony beds of limestone near the lower limits of that formation (Grüg). See pp. 349 *et seq.*, 355 *et seq.*

Fig. 8. Transverse section from south-east to north-west (similar to figs. 6 and 7.), from Llandibie in the South Welsh coal-field, to the hills of Aberglasslyn on the right bank of the Towy; showing a thin zone of Upper Silurian Rocks rising from beneath the Old Red Sandstone near Golden Grove, and a full extension of the Lower Silurian (principally Llandeilo flags) between that place and Aberglasslyn. To the north-west of Aberglasslyn is a passage downwards from the base of the Llandeilo flags into crinoidal grits, and shale or beds intermediate between the Silurian and Cambrian Systems. (The river Towy flows in a great longitudinal denudation.) See pp. 355 *et seq.*

Fig. 9. From the Millstone Grit and Carboniferous Limestone of Llangyndeyrn to the hills of Cambrian schist, north-west of Caermarthen, showing a small zone of Upper Silurian Rocks, and a peculiar band of Lower Silurian schist on the left bank of the Towy, with fossils of the Llandeilo flags. See p. 358.

Fig. 10. Arch of cornstone in the Old Red Sandstone at Llanstephan Castle, near the mouth of the Towy. See p. 176.

Fig. 11. Traverse from the Old Red Sandstone to the Cambrian schist, a few miles south-west of Caermarthen, showing a line of fault along the junction of the Upper Silurian Rocks with the Old Red, accompanied by outbursts of trap and a peculiar mineral development of the Silurian System. See p. 366.

PLATE 35.

(Pembrokeshire.) See pp. 370 to 408.

Fig. 1. General transverse section across Pembrokeshire from Pennyholt Stack on the south to Fishguard on the north, exposing the formations in descending order from the Carboniferous Limestone to the slaty rocks of the Cambrian System, with a broken trough of culm measures, numerous protrusions of trap, and many dislocations of the strata.

In this section the Silurian Rocks are ill exposed, and in the neighbourhood of Haverfordwest only. The Cambrian Rocks exhibit in one part the peculiar phenomenon of a coincidence between the laminæ of deposit and the lines of slaty cleavage.

Highly altered rocks are seen on the flanks of the trap Trafgarn; and near that of Johnston the Carboniferous Limestone is in an inverted position, appearing to overlie the coal-measures.

Fig. 2. From Milling to Williamston, showing in the northern half of the section a regular descending series of the younger formations, from the productive coal or culm seams, to the Carboniferous Limestone inclusive, and in the southern half the same strata contorted, broken and reversed, with a mass of eruptive trap which pierces the Old Red Sandstone.

Fig. 3. Relations of Lower Coal Measures to Silurian Rocks at Slebech. See p. 372.

Fig. 4. Succession of strata from the north of Narbeth to Amroth, showing the full development and regular order of all the formations from the Silurian System to the culm measures inclusive. See pp. 372, 390.

Fig. 5. Section similar to f. 4. in exhibiting the succession from the Old Red Sandstone to the coal measures, with a full development of the Carboniferous Limestone and Millstone Grit, but differing in showing a break between the Silurian Rocks and the Old Red Sandstone. The upper Silurian Rocks are entirely omitted, while the Llandeilo Flags are very largely expanded near Llampeter-felfrey. See pp. 396 *et seq.*

Fig. 6. Passage from the Old Red Sandstone to the Silurian Rocks near Tavern Spite (Cyffic) in the eastern extremity of Pembrokeshire, with a fine exhibition of the limestone of the Llandeilo Flags at Clog-y-frain, in the adjacent county of Caermarthen.

The River Taaf flows in a gorge formed by the great transverse dislocations of the Lower Silurian Rocks. See pp. 358, 396.

Fig. 7. Coast section of the central portion of St. Bride's Bay, showing the contortions and fractures of the culm measures, and how they rest in some places upon Millstone or Coal Grit, and in others upon Silurian and Cambrian Rocks.

The central or dotted portion represents the lower and unproductive coal grits and sandstones, which are prolonged to Haroldston's Nose from the Poor Field near Haverford-west. See p. 373 *et seq.* 380.

Fig. 8. Relations of the culm beds at Nolton to the Lower Silurian Rocks, showing very little unconformability between them. See pp. 375, 377.

Fig. 9. Relations of culm measures and underlying sandstones and grit to Cambrian Rocks, showing, like f. 8., very little unconformability. At Brawdy, on the contrary, culm rests on Millstone Grit, which is unconformable to the Cambrian Rocks. See map, and pp. 375 *et seq.*

Fig. 10. Great transverse coast section of the Silurian System as exposed in Broad Sound (principally in Marloes Bay) from the Old Red Sandstone on E.S.E. to the Cambrian Rocks on the W.N.W., showing the regular emergence of the Ludlow, Wenlock, Caradoc, and Llandeilo formations. Intrusive trap bursts through the Upper Silurian Rocks (junction of Wenlock and Ludlow) in Marloes Bay; trap rocks, both interstratified and intrusive, alternate with the Cambrian Rocks of Skomer Island and the adjacent promontory. A slaty cleavage prevails throughout the Lower Silurian Rocks, and is partially seen in the upper. See pp. 392 *et seq.*

Fig. 11. Coast section of the Llandeilo Flags, in Musclewick Haven, Marloes; showing their unconformable junction with the Old Red Sandstone. Slaty cleavage traverses these flags obliquely. Faults are marked in the Old Red Sandstone. Eruptive trap overflows the Llandeilo Flags. See p. 394.

PLATE 36.

(Abberley and Malvern Hills, Valley of Woolhope, May Hill, Tortworth, Usk and Chepstow.)

Figs. 1, 2, 3 & 4 are transverse sections of the Abberley Hills, to show the manner in which the coal measures, Old Red Sandstone, and Silurian Rocks are dislocated and thrown into reversed positions along this axis of trappean elevation.

Fig. 1. Traverse of the Abberley Hills at the Hundred House, showing vertical and disjointed masses of Old Red Sandstone, Ludlow Rocks, and Wenlock Limestone to the west of the axis of trap. To the east is the New Red Sandstone of the Vale of Worcester. To the north-west is the coal of Abberley, being a portion of the carboniferous tract of the Forest of Wyre, the beds of which have the appearance of dipping under the Silurian Rocks. See pp. 135, 409, 420 *et seq.*

Fig. 2. Traverse on the south side of the Tenbury road, to show the trap protruding in a cone, and the Ludlow Rocks in a reversed position, the Old Red Sandstone underlying them and the coal measures in disjointed patches. See pp. 135, 409, 420 *et seq.*

Fig. 3. Traverse across the prominent mass of trap of the Abberley ridge, called Woodbury Hill, still further explaining how the Ludlow Rocks have been placed in an inverted position by the eruption of volcanic matter. Another mass of trap (syenitic greenstone) appears at Brockhill on the Teme, cutting through the Old Red Sandstone. The cornstone formation of the Old Red is well developed on the right bank of the Teme, and an overlying and elevated patch of coal lies on the western flank of Woodbury Hill. See pp. 135, 409, 420 *et seq.*

Fig. 4. Fourth traverse across the Abberley Hills near their southern end (north of Martley), where the trap disappearing from the surface, the Ludlow and Wenlock formations are exposed in a more completely reversed position than in any of the previous sections, namely, at angles of 40° and 45° beyond verticality the Ludlow Rocks distinctly dipping under the Wenlock Limestone, the latter being much fractured. See pp. 409, 421 *et seq.*

Fig. 5. Silurian Rocks occupying the ridge which connects the Abberley and Malvern Hills, consisting of a dome of Caradoc Sandstone in Old Storridge Hill, overlaid conformably by the Wenlock and Ludlow formations, the whole passing beneath the Old Red Sandstone. In this section all these formations have regained their regular positions. To the east the Caradoc Sandstone is flanked unconformably by the New Red Sandstone, the conglomerates of which appear to have been partially upheaved and dislocated. See pp. 52, 415, 422.

Fig. 6. Transverse section of the same ridge, south of f. 5., showing a similar and unbroken ascending succession from the Caradoc Sandstone of Cowley Park to the Old Red Sandstone of Cradley, Herefordshire. A boss of syenite, the northern prolongation of the Malvern Hills, is flanked by Caradoc Sandstone on the west, and impure limestones, probably the upper band of that formation, on the east. See pp. 411, 415.

Fig. 7. Across the syenitic ridge of the Malverns, at North Hill, from the New Red Sandstone of Worcestershire to the Old Red Sandstone of Herefordshire. The Silurian strata in immediate contact with the syenite (near Mathon Lodge), are bent back and reversed, while in receding from the intrusive rock, the beds resume their natural positions. The New Red Sandstone of Great Malvern is partially dislocated on the edge of the syenite, and inclined at 30°. See pp. 52, 183, 411, 415, 423.

Fig. 8. Great transverse section of the Malvern and Ledbury Hills, showing how the outburst of

the syenite has altered and dislocated the strata in contact, and also exposing a regular ascending development of Silurian Rocks, from the base of the Caradoc Sandstone to the Ludlow Rocks inclusive. On the west are great undulations of the Wenlock Limestone, which, rising in domes near Ledbury, is flanked by a thin ridge of Ludlow Rock. As in the previous sections, the Old Red Sandstone lies to the west, the New Red to the east. See pp. 183, 411, 415, 423.

Fig. 9. Transverse section across the valley of Woolhope, showing a regular and unbroken succession in ascending order, on both flanks, from a nucleus of the Caradoc formation through the Upper Silurian Rocks to the Old Red Sandstone.

In this section the only member of the Caradoc formation visible is the impure limestone (on which the village of Woolhope stands) forming the stratum above the sandstone. See pp. 427 *et seq.*

Fig. 9 *b*. Second traverse of the valley of Woolhope near its centre, to show that with a greater amount of elevation, the Caradoc Sandstone, properly so called, is exposed in the culminating point of the central dome (called Haugh Wood), the impure limestone being there denuded, though well exposed on its lower edges. The Wenlock and Ludlow formations are seen in their regular places, but on the western face they are highly inclined and fractured, and the junction with the Old Red Sandstone is obscured by gravel and silt in the denudation of the Wye. See pp. 427 *et seq.*

Fig. 10. This section is merely a repetition of the same phenomena as in f. 9., and was engraved through inadvertence.

Fig. 11. Low dome of Upper Silurian Rocks at Gorstey Common, marking the prolongation of the Woolhope anticlinal. See p. 442.

Fig. 12. From Newent to Aston Ingham, showing how the Woolhope and May Hill anticlinal is marked by upheaved and broken masses of Wenlock Limestone.

The thin and poor coal field of Newent is seen on the east, overlaid by New Red Sandstone. See p. 442.

Fig. 13. Traverse of the same anticlinal at May Hill, from the New Red Sandstone of Huntley to the coal basin of the Forest of Dean, exhibiting a succession in ascending order from the Caradoc Sandstone to the Millstone Grit near Mitchel Dean. See p. 443, 445.

Fig. 14. Section showing the nature of the same axis in a very diminished form at Flaxley, where the May Hill ridge subsides, flanked by the New and Old Red Sandstones. See p. 444.

Fig. 14 *bis*. Arch of Old Red Sandstone near Newnham, marking the continuation of the same anticlinal. See p. 445.

Fig. 15. The same anticlinal, at Haydon Green, south-west of Newnham, marked by an upcast of Ludlow Rock. See p. 445.

Fig. 16. The same anticlinal, as indicated by an arch in the Old Red Sandstone of the Milk-maid Rock, on the right bank of the Severn. See vignette, p. 446.

Fig. 17. The same anticlinal, as it reappears at Purton Passage on the left bank of the Severn, where a low dome of Upper Silurian Rocks throws off the Old Red Sandstone to the south and north, flanked in the latter direction by lias in an unconformable position. See p. 454.

Fig. 18. General transverse section of the Tortworth district, Gloucestershire, from the inferior oolite of the hills above Wotton-under-edge to Aust Cliff on the Severn.

This section shows that the axis of elevation, which is traceable in a single line from Woolhope to Purton Passage, here branches off into two lines, both being marked by the protrusion of trap. An elevated basin of Old Red Sandstone is seen to be covered by Carboniferous Limestone with broken and unconformable patches of lias and bands of Dolomitic Conglomerate. The Silurian Rocks are partially seen only in the eastern line of elevation, but are clearly exhibited at Whitfields on the west.

The Old Red Sandstone is overlaid by Dolomitic Conglomerate near Thornbury, and between that place and the Severn by Carboniferous Limestone, New Red Sandstone, and Lias. The "bone beds" or base of the lias cap the low cliffs of Aust, which are composed of red and green gypseous marls, &c. See pp. 447 *et seq.* and map.

Fig. 19. Descending order of the strata exposed by the road descending from Tortworth Green to Falfield. A thin zone of Upper Silurian Rocks dips under the Old Red Sandstone, and small arches of Lower Silurian Rocks, rising in the vale, are flanked on the west by Old Red Sandstone. See pp. 447, 455.

Fig. 20. Traverse from Thornbury to Wickwar across the two axes exhibited in f. 18., but in a more southern parallel. The eastern line of elevation is marked by the highly inclined position of the Old Red Sandstone, flanked on the east by unconformable strata of New Red Sandstone, which are surmounted by lias and inferior oolite. The western elevation is seen in Milbury Heath, where the Old Red Sandstone is thrown up "en dôme." The Carboniferous Limestone and coal of Cromhall occupy a trough between these ridges of Old Red Sandstone. The Dolomitic Conglomerate forms an irregular fringe, adherent to the edges of the inferior strata, though at Thornbury it is very slightly unconformable to the underlying Old Red Sandstone, the conglomerate of the one appearing almost to graduate into that of the other. See pp. 447 *et seq.*

Fig. 21. Section of certain alternations of grit and impure limestone, which occupy the intermediate space between the chief mass of Carboniferous Limestone and the productive coal-field of Cromhall (Lower Limestone Shale). See p. 452.

Fig. 22. From Oldbury and Kington on the North to Old Down on the South, showing the fault on the south-eastern face of the western branch of the Tortworth anticlinal, near its termination. The Old Red Sandstone is thrown up on one side against the Carboniferous Limestone, and dips under it on the other. See p. 461.

Fig. 23. Silurian Group of Usk. The transverse section across this tract exhibits Silurian Rocks on both banks of the river Usk. In the centre is a dome of Caradoc Sandstone overlaid by Wenlock Limestone. The Ludlow formation is pretty fully developed, and the whole is surrounded by Old Red Sandstone, which in this figure is represented as dipping under the Carboniferous Limestone and Millstone Grit of the South Welsh coal basin, near Pontypool, &c. Numerous large boulders encumber the surface on the *exterior* of this Silurian elevation, but none are found within its inner area.

The Castle of Usk stands on a point of Upper Ludlow Rock, at its junction with the Old Red Sandstone. See pp. 438 to 441.

Fig. 24. Section in descending order from Chepstow to Usk, exposing in succession the Carboniferous Limestone more fully expanded than in any other part of this region, with its subordinate divisions of Upper and Lower Limestone Shale. The latter is seen to graduate into the Old Red Sandstone, which is also fully developed; the Upper Sandstone and Conglomerate being underlaid by cornstones, and the latter by marls, flagstones, and tiles, which graduate, in descending order, into the Ludlow Rock. A small patch of Dolomitic Conglomerate overlies the Carboniferous Limestone. See pp. 159, 438 to 441, and 453.

PLATE 37.

(Dudley, Wolverhampton, Wallsall and Lickey.) See pp. 463 to 508.

Fig. 1. Great transverse section across the coal-field of Dudley, from the Lower New Red Sandstone of Sandwell Park on the east, to rocks of the same age near Kings' Swinford on the west; showing an upcast of the coal at each flank of the field, by which the intermediate tract of carboniferous strata is exposed. Domes of Wenlock Limestone, near Dudley, rise through the coal measures, thus separating one portion of the field from the other; and the same rock, when not upraised, is found beneath the coal at Dudley Port. See Map and woodcuts, p. 464.

The Lower New Red Sandstone of West Bromwich has been penetrated by the Earl of Dartmouth, and at a depth of more than 300 yards, coal 10 to 12 feet thick was found beneath it, though in a troubled condition, and with some protrusions of trap. This spot is three-quarters of a mile distant from what was in ancient times considered the limit of the coal-field. Since the plate was engraved Lord Dartmouth has met with the 10-*yard coal* under the red sandstone, by driving works westwards or towards the coal-field. See Appendix, p. 728.

The precise character of the eastern boundary fault of the old coal-field is taken from a shaft section of Mr. G. Bennett. The faults forming the Dudley trough are traversed obliquely. Towards the western edge of the field the trap of Barrow Hill rises in a conical form, with radiating dykes, the coal strata on its flanks being dismembered and altered, and the tract between it and Kings' Swinford powerfully affected by faults. See woodcut, p. 500.

Coal has not yet been worked beneath the Lower New Red Sandstone of Himley and Kings' Swinford, on the western side of the field, but trials to reach it are now in progress. In this section, the 10-yard and lower coal, as well as the underlying Silurian Rocks, are exhibited. See pp. 464, 487, 480 *et seq.*

Fig. 2. From the coal-field near Tipton, across Kettle Hill and the Wren's Nest, showing a dome-like elevation of the Wenlock Limestone, and the lower carbonaceous sandstone and grit of Gornals resting on Silurian shale.

To the west, the Ludlow Rocks rise at Turner's Hill, flanked by a thin band of poor coal measures, which is overlaid by the Lower New Red Sandstone of Himley. See pp. 464 *et seq.*, 482.

Fig. 3. From the New Red Sandstone of the Barr Beacon on the east, to the Lower New Red near Wolverhampton on the west; exhibiting Wenlock Limestone and shale near Wallsall, which plunging rapidly beneath the coal measures, constitute the "limestone" or boundary "fault." The trap of Pouk Hill appears in the centre, with highly dislocated strata on its flanks. The western edge of the coal-field is marked by a peculiarly oblique fault, as proved near Wolverhampton.

The iron-stone and lower coals are alone displayed in this portion of the coal-field. See pp. 464 *et seq.*, 480, 489, 503.

Fig. 4. From the edge of the 10-yard coal-field near Ettingshall on the east to the New Red Sandstone west of Sedgeley, exposing the gradual outcrop of upper and lower coal measures on slopes of Upper Silurian Rocks. The latter rising into undulating and broken domes, throw off to the west a thin band of coal measures, which is surmounted by conformable Lower New Red Sandstone. The Ludlow Rocks are well exposed in Sedgeley Beacon and Turl's Hill, including a course of Aymestry limestone. The Wenlock Limestone is fully developed in the southern end of Hurst Hill, and in a highly dislocated condition. See pp. 481, 487.

Fig. 5. Section across the Hayes near the south-western end of the Dudley coal-field, exposing a narrow ridge of Ludlow Rocks, including beds of limestone, flanked by highly inclined coal measures. See p. 483.

Fig. 6. Section to prove, that as the 10-yard coal ranges up to the southern limit of the coal-field and is lost by a fault only, there is every reason to conclude, that the same thick coal will be found at a lower level beneath the Lower New Red Sandstone and beyond the fault. The extent of the fault is of course hypothetical. See p. 506.

Fig. 7. From the trap of Lickey Beacon on the west and by north, across the Lower Lickey quartz ridge on the east and by south; showing how the altered Caradoc Sandstone, and an overlying band of impure limestone, pass beneath a thin course of coal, and the latter under the Lower New Red Sandstone. See pp. 57, 492 *et seq.*

Fig. 8. From the hill south of Lickey Beacon, on which Lord Plymouth's monument is placed, to the Lower Lickey quartz ridge, to show a dip of the quartz rock directly the reverse of that in fig. 7. (a parallel distant half a mile only). The Lower New Red Sandstone at its junction with the quartz rock shows symptoms of having been partially disturbed, as in Pl. 36. figs. 5 and 7.

(In figs. 7 and 8, the numerous joints transverse to the laminæ of deposit which characterize the quartz rock are indicated by dotted lines.) See pp. 57, 492 *et seq.*

Fig. 9. Nucleus of trap (compact felspar rock) between Kendal End and Barnt Green, marking the termination of the Lower Lickey Ridge, and explaining that the quartz rock here, as at the Caradoc and Wrekin, (Pl. 29. f. 11. and Pl. 31. f. 4.) is a Lower Silurian Sandstone altered by volcanic action. See p. 495.

APPENDIX.

A.

Keuper Marl and Sandstone and Bunter Sandstone.

ALTHOUGH the subdivision of the Keuper or Upper Formation of the New Red System into overlying and underlying marl, with a subordinate bed of sandstone, is accurately given in the section attached to the Map and in Pl. 29. f. 1., and is also laid down upon the Map, the details were not completely worked out when the chapters on it were printed. The range and fossil contents of this thin-bedded sandstone (surmounted by red and green marls and underlaid by saliferous and gypseous marls) have since been pointed out by Mr. H. E. Strickland and myself, and our memoir thereon is now printing in the Transactions of the Geological Society. (See also Proceedings of the Geological Society, vol. ii. p. 563.) In that memoir we offer a number of transverse sections in Worcestershire and Warwickshire, which not only explain the position and contents of the Keuper Sandstone as subordinate to the *Red Marl*, but show that the whole formation is immediately underlaid by light coloured and red sandstone (that of Ombersley, Bromsgrove and Warwick), which is charged with peculiar plants (*Echinostachys oblongus*, Brongn. and others), and with fishes' teeth, remains of Saurians, &c., discovered by Dr. Lloyd of Leamington. This sandstone of Bromsgrove and Warwick is the New Red Sandstone (*Bunter Sandstein*) and is represented in this work by the rocks of Grinshill and Hawkstone in Shropshire. The Red Sandstone and conglomerate of Coventry and Allesley with silicified coniferous wood, described by Dr. Buckland, Geol. Proc., vol. ii. p. 439, and which I have recently examined, is of the same age.

The Keuper Sandstone is not only distinguished from the subjacent red sandstones by its position *in the overlying* marls and by its thin beds, but also by its peculiar fossils, among which are *Posidonomya minuta*, *Hybodus Keuperi*, and an undescribed species of Saurian, and by not containing the plants of the *Bunter Sandstone*. I have to correct an expression made use of at page 30, where I say that the Red Marl is never inclined at a greater angle than 15° in Gloucestershire or Worcestershire; since the early chapters were printed I found, on examining the country with Mr. Strickland, that, upon the line of elevation of Inkberrow, the Keuper at Walls' Farm dips 25°. (See our joint Memoir.)

B.

Pitchford (Bitumen, &c.).

The bituminous exudations at this place have been briefly alluded to, p. 94, in describing the Shrewsbury coal-field. I am informed by the Earl of Liverpool, to whom the property belongs, that the bitumen is no longer collected for medicinal or other purposes. I perceive by reference to Gough's edition of Camden's Britannia, that *salt* as well as coal works formerly existed at Pitchford, and, it is added, that they were destroyed by water. (see Phil. Trans. No. 228.) I have, I trust, clearly shown that the coal measures of this tract are of extreme tenuity, because fundamental rocks of high antiquity rise near to the surface. Though probably worthy of notice in early days, when carbonaceous deposits, however poor, were worked, if only of easy access, it is manifest that in the present times, when so many valuable coal seams are wrought in the neighbourhood, the attempt to open coal-pits near Pitchford would be ruinous. The salt alluded to was probably made from a salt well issuing from the carbonaceous rocks ?.

In readverting to the origin of the bitumen which abounds in this part of the region, both in coal strata, as at Pitchford, and at Coal Brook Dale (see p. 204), and also in the ancient Cambrian Rocks of the Longmynd, Lyth and Haughmond Hills, where it issues from cracks, and often near points of intrusive trap; I may add, that the view which I took (see pp. 265 and 266) is completely confirmed by subsequent observation at the Shelve Mines. (See F., p. 732.)

C.

Newent Coal-field.

In the diagram, p. 155., which represents a fault near the mineral spring of Newent, the subjacent strata on the east are supposed to be thrown up, and thus the coal beds are hypothetically exhibited as lying nearer to the surface than on the western side of the fault. I beg my readers to place no reliance on this merely *possible* case, and to bear in mind, that if beds of coal should ever be detected beneath the New Red Sandstone to the east of Newent, they are just as likely to occur in *depressed* as in upheaved positions. This point can be determined alone by trials. I have adduced abundant reasons to dissuade any one from embarking in coal works to the *north* or *south* of Newent, it being demonstrated that the coal-field *thins out entirely* in those directions between the New and Old Red Sandstone. (See p. 154.)

D. (1.)

Coal-fields under the New Red Sandstone of the Central Counties.

In corroboration of my belief that productive coal measures would be found beneath the New Red Sandstone of the central counties, I have to announce that the enterprise of the Earl of Dartmouth, so much alluded to in the previous pages, (pp. 58, 466, 476, 507,) has been completely successful, and that 10 yard coal of the best quality has been won beneath the Red Sandstone of West Bromwich. The shafts first sunk proved to be upon a line of dislocation which, as I have previously explained, is the prolongation of the upcast of the Silurian Rocks of Walsall and Tame Bridge, viz. from N.N.E. to S.S.W.; whence I always supposed that the trial drifts made to the East and N.E. were not likely to prove advantageous. These workings confirmed, indeed, the speculations of the geologist, in bringing to light the existence of some points of trap-rock, accompanying broken unproductive coal measures and Silurian Rocks. The latter, when followed to the N.E., were found to be simply covered by the Red Sandstone, to the entire exclusion of the coal strata. No sooner, however, was a drift carried to the West or towards the old coal-field, than it was successful (see p. 508); the thick coal having been already followed for about 200 yards to the West and S.W. without disturbance, dipping gently with the slope of the ground towards Oldbury, and rising slightly to the West. Having thus proved the value of the ground, Lord Dartmouth has leased it to Messrs. Eaton and Salter, to both of whom I am indebted for much obliging information, and to the latter for having preserved so accurately, under his Lordship's direction, the produce of the trial shafts, accompanied by illustrative plans and sections. New shafts (the Victoria Pits) are opening about 1000 yards to the West of the first sinkings, and, judging from the untroubled appearance of the Red Sandstone through which they are passing, I am disposed to think that this speculation will altogether be most fortunate, and that the plateau extending westwards from Christchurch will be found to contain below it one of the least disturbed and, consequently, most valuable parts of the South Stafford Coal-field.—(Nov. 8, 1838.)

I may further add, that in making a tunnel under the Wyrley and Essington Canal, on the line of the Birmingham and Liverpool Railroad, north of Wolverhampton, after cutting away the gravel and red clay, (probably a part of the Lower New Red,) the workmen came upon coal, smut, &c., cropping out towards the Wolverhampton basin. This fact, communicated to me by Mr. John Barker of Wolverhampton, tends to confirm my belief that the Staffordshire and Shropshire coal-fields are simply upcast portions of the same carbonaceous tract, and that coal may hereafter be worked in the intervening space, though probably at a considerable depth beneath the Red Sandstone.

I have previously explained to my readers, that to attempt such trials with any reasonable prospect of success, they should feel certain that the Red Sandstone which they may endeavour to penetrate, is really the *Lower New Red*; and further, that their first operations are not commenced at too great a distance from the boundary fault of a good coal-field. To search for coal far to the east, for example, of the Staffordshire coal-field, particularly in those parts where older rocks are thrown up through the cover of New Red Sandstone without the trace of coal, would be very absurd: similar endeavours, on the contrary, to penetrate the Lower New Red Sandstone in the vicinity of tracts, such as the Bredon and adjoining hills of Leicestershire, where the old slaty rocks (Cambrian) are flanked by zones of Carboniferous Limestone and coal, is clearly an operation to be encouraged. On this point, indeed, I may now speak confidently, from the result of a highly successful trial made (unknown to me) since the pages relating to this subject were written; for Mr. George Stevenson, the celebrated mining-engineer, has actually penetrated the New Red Sandstone adjacent to the Bredon Hills, and is now working a coal-field of much greater value than any which has been naturally thrown up to the surface in that neighbourhood. In this case Mr. Stevenson applied, with his well-known energy, the same means by which he had been accustomed to sink through the Magnesian Limestone and Lower Red Sandstone of the northern counties.

The tract alluded to in Leicestershire, and which is thus proved to be one of great importance in supplying the inland districts with coal, was last year re-examined by Professor Sedgwick, who had previously explained the prominent relations of its older rocks, and he informs me that he found the Red Sandstone which there overlies the coal-measures to be in every respect analogous to the formation I have described in Shropshire, Staffordshire, and Worcestershire, i. e. containing much calcareous sandstone and grit, with traces of plants and coal in its lower members; while the upper coal-measures present a thin band of apparently "fresh-water limestone," similar to that which I have pointed out in the same position in the Shrewsbury, Coal Brook Dale, and other coal-fields. (See pp. 83. *et seq.*)

D. (2.)

Outcrops of the Dudley Coal.

The lowering of the roads during the last summer near Dudley has exposed the outcrop of the bottom beds of the coal measures. About half a mile from the town, on the road to Birmingham, such an outcrop had been long visible, and is indeed noticed by Mr. Kier in his account of this tract; but by cutting through the rising ground in question, the coal-beds have been completely exposed, and are seen to rest at their western extremity upon the shale of the Wenlock (Dudley) Limestone, the beds of which, rising gently from beneath the town and the Castle Hill, are suddenly arched, and plunge to the E.N.E. at an angle of 30°, surmounted conformably by coal measures. So conformable, indeed, are these Silurian and carboniferous rocks, and so much do they appear to graduate into each other, that it is obvious the one must have been deposited upon the other in the manner expressed in the upper woodcut, p. 465., the curvature and inclination of both having been caused by upheaval from beneath (lower woodcut, p. 465.). The carboniferous beds in question consist, in ascending order, of shale, grit, and sandstone, with ironstone concretions, overlaid by a seam of coal and shale; then follow alternations of shale, ironstone, sandstone, and grit, including the *Espley Rock* of the miners (p. 476.), the whole covered by coal, which dips under thin bedded, yellowish grit and sandstone, and passes under the productive coal-field.

Again, at Shaver's End, above Dudley, the new cuttings beyond the turnpike-gate have laid bare two coal seams, which are thrown off sharply to the N.E., and with great undulations to the S.E., the light-coloured carboniferous sandstone appearing in a broken, uneven-edged mass between them. These highly-disrupted relations of the lowest beds of the coal-field are just what we should expect to find in this part of the district, where volcanic action has been so rife, and has repeatedly forced up the inferior strata to the surface, the points of the volcanic rock often piercing them.

Having revisited the Devil's Elbow, near Netherton, alluded to p. 499, I conceive that the hard rock cut through by Brewin's tunnel is one of these points of eruptive trap: it throws off the coal measures to the S.E. in the manner described by Mr. W. Mathews, while the sandstones and grits which lie towards Netherton Church are arched over the trap in separate hillocks.

D. (3.)

No Coal in the Old Red Sandstone.

It was stated in a note, p. 189 *ante*, that although unknown in the region described in this work, certain coal-seams do occur in the Old Red Sandstone of the South of Scotland. Although this was the opinion of some modern observers, it would now appear that a certain Red Sandstone of Berwickshire which was supposed to be Old Red, is the Lower New Red, and hence the carboniferous strata associated therewith do not offer any exception to the general distribution of coal in the series of British deposits. As yet, therefore, we have no example of a coal-bearing stratum in the Old Red Sandstone.—(See Geology of Berwickshire, by Mr. D. Milne; a memoir read before the British Association for the Advancement of Science, 1838.)

E.

Joints.

It was my intention to have followed out a plan, first suggested to me by Professor Phillips, of registering in a table the differences in the direction and inclination of all the faces of joints in rocks of different composition and age; but though my field-books are full of data, I am not prepared to offer them to the public.—(See Phillips's Guide, p. 173.)

F. (1.)

Shelve and Corndon Hills, &c.;—Lead Mines, Bitumen, &c., in the Silurian Rocks of—Antiquities of.

The mines of these hills have been treated of at some length in reference to their geological relations pp. 227 *et seq.* They are, however, of too great importance not to be also noticed in an economical point of view, as will appear from the following table of their produce in 1835.

	Tons of Lead.
Bog Mine	1554
Snailbatch	1300
Grit and Gravel	685
Total of Shelve Mines	3,539

Mr. John Taylor informs me that the present produce of lead in the United Kingdom may amount to from 47,000 to 50,000 tons.

We thus see that the little Shropshire tract on which I have previously dwelt with so much *geological* interest, has hitherto produced a thirteenth or fourteenth part of the total produce of the British Lead Mines. The ore is of very superior quality, for at the Bog Mine each ton produces fifteen hundred weight of lead, and at the Snailbatch, Grit, &c., about fourteen hundred weight; while the average of the kingdom may perhaps be estimated at not more than thirteen hundred weight.

The reader who seeks for more information concerning the former condition of the Snailbatch Mine, will find an instructive short sketch of it in the memoir of Mr. A. Aikin, "On the Occurrence of *Witherite* or *Carbonate of Barytes*" in the vein-stones of that mine. (Geol. Trans., Old Series, vol. iv. First Series, p. 438.) The vein of lead ore at that period (1811) varied from twelve to thirty feet in dimensions, and the greatest depth of the works was one hundred and eighty yards.

I possess little information concerning that mine, although I have often examined the features of the surface around it.

Of the Bog and Grit Mines I met, I have already spoken (as much as seemed needful for geological purposes); but as my friend Mr. Joseph Walker, one of the proprietors of the Bog Mine, has offered me information which I did not possess when the chapter on that tract was printed, I willingly add the following extract of a letter to him from Mr. W. Jones of Chester.

"The present depth of the Bog engine-shaft is 293 yards, and the lowest level 265 yards. In the upper workings, above the adit or boat-level, which is 105 yards deep, there are three distinct veins to the eastward, but two of these unite at about ten fathoms under the adit level. Thus united, they are crossed about the middle of the mine by the other vein, which in the upper part of the mine, or towards the Stiperstones, is called the 'South Vein,' and to the west, after it has crossed the other vein, will consequently be on the north side. The main vein is from 2 to 3 feet wide, and the other, which crosses it, from 6 inches to 1 foot. The two branches of the main vein not only join each other on the line of bearing, but hade towards each other and unite downwards, so that at the 20-fathom level and below we have only two veins. We have pursued this level within about 250 yards of the Stiperstones, but the work has been suspended for some time in consequence of the vein being very small and poor. I know of none of the veins in this country that have been worked up to the Stiperstones, but I have little or no doubt that they do not break through them, though undoubtedly the Snailbatch vein has been found on the other side of the Stiperstones, but whether in a continuous line, or thrown on one side, I am not prepared to say."

Those who have perused my chapter on this tract will have perceived, that I spoke of some of the lead veins having been worked up to the flank of the Stiperstones, where they were found to be deflected and cut off. I had this information from an old miner, and I have no doubt that my general view in supposing the Stiperstones to be a great wall or rider bounding this mining tract on the east-south-east is substantially correct. That a small branch or poor vein of lead should have been found (in a shifted position) on the eastern side of the Stiperstones near Snailbatch, is by no means remarkable, but rather in analogy with many examples in other tracts. See account of the Cerrig-mwyn mines, p. 366. As a matter of fact, it is, however, well known that there is no other trace of a lead vein (however small) in the Linley, Pulverbatch, and Longmynd Hills to the east and south-east of the Stiperstones, while copper veins are there in abundance. I therefore adhere to my original position, leaving chemists to speculate on it,—namely, that in a tract highly convulsed by volcanic action there are two distinct metalliferous tracts, neatly separated from each other by a wall of quartz rock, which I have shown to be sandstone fused and altered by heat.—(See Note, p. 8, on the origin of the word Stiperstones.)

In relation to the "warm water vein" of lead ore in the Shelve district, (see p. 280), I am informed by Mr. Joseph Walker, that, upon re-opening the works to follow that vein, he convinced himself from actual examination that the water was there much hotter than in any other part of the mining ground. He also observed much mineral pitch or bitumen in the vein stuff and on the sides of the vein. Any doubts, therefore, which might have existed as to the presence of bitumen in these old rocks is entirely dispelled. There is much trap and altered rock around this spot, and the phenomenon is therefore confirmatory of my views, p. 276.

The rugged tract of the Corndon and Shelve Hills will be rendered doubly attractive by the forthcoming work of the Rev. C. H. Hartshorne, alluded to p. xxxii, in which the reader will find an account of *Druidical circles, Stones of worship*, &c., on Stapeley Hill and at the foot of Corndon.

F. (2.)

Heblands, near Bishop's Castle.

Through inadvertence a point of trap rock which bursts through the Silurian strata at about one mile N. of Bishop's Castle has not been mentioned in the text, though I have twice examined it in former years. It is a hard, whitish, compact felspar rock, the eruption of which has altered the contiguous strata to some extent, giving rise to coats of impure serpentine, veins of calcareous spar, crystals of iron pyrites, breccia, and indurated schist. It is marked upon the map, and may be considered as the extreme southern point of the volcanic tract of Shelve or Corndon.

F. (3.)

Mines of Gogo-fau, Caermarthenshire, and Gogo, Salop.

I have to thank the Rev. H. C. Hartshorne for having directed my attention to a letter in the Cambrian and Caledonian Quarterly Magazine, vol. v. p. 321, in which the late Mr. T. Parker describes the Roman Mines of Gogo-fau (see p. 367). It appears that this author detected a few traces of galena, and therefore he concluded that "lead was the substance sought after; but from the unconnected irregularity of the works, one part having scarce any reference to another, it must," he says, "be considered as a *bunching mine*, which in some degree accounts for the wideness of the excavations, and that so soon as one bunch or mass of ore was cleared away they broke the ground in all directions in search of another, finding no string or metallic leader, as in more regular mines, to guide their course."

Again, in a learned historical inquiry into the situation of the gold mines of the ancient Britons, the mines of Gogo-fau are also described (Cambrian Register, vol. iii. p. 41), and the author states, that Sir Joseph Banks and several other persons who visited these caves or galleries were of opinion that they had been worked for gold. The reader will there find a good explanation of the manner in which the water was conducted to stream the works in question, and some ingenious speculation on the antiquities, both British and Roman, around Cynfil-Caio, with a version of the legend of the Five Saints (Llan-pump-Saint) differing from that which I have given.

In his excellent statistical account of the parish of Llanymynych, (Cambrian Register, vol. i. p. 265,) the Rev. Walter Davies gives some curious information respecting the great mine of the *Ogo*, which runs from West to East, in the promontory of Carboniferous limestone before described (see p. 145), and which is clearly proved to have been a Roman work from the remains found within it. Besides various ores of copper and lead, Mr. Davies alludes to calamine and blende as of occasional occurrence, but states that the mines are now exhausted of their wealth.

G.

Bowlders transported by Ice.

The chapters on superficial detritus were in the press when Mr. Lyell favoured me with the perusal of a most instructive letter from Captain Bayfield, R.N., now employed in surveying the coasts and rivers of our North American colonies, which so strikingly corroborates the views I have attempted to establish concerning the method by which our English bowlders and the associated shells have been deposited, that, with Mr. Lyell's permission, I annex an extract. After a graphic sketch of the geological features of the region, Captain Bayfield thus alludes to the case in question.

"The bed of the St. Lawrence below Lake St. Peters is full of immense bowlders of primary rocks, most of them (but not all) rolled or water-worn, or with their edges worn off by atmospheric agency, (for I do not believe that all the blocks which appear to be so, have been really water-worn). See pp. 540 *et seq.* These are principally derived from the Tertiary beds, for they abound in them, even among the shells, and at all levels; and as the terraces are worn away, the bowlders are left at the foot of the cliffs, and sticking out of sand and clay. *Torrents bring them down the steep water-courses at the melting of the snows; and when they reach the St. Lawrence, the ice moves them every spring.* I have seen a granite bowlder, 15 feet in length by 10 in width and depth, transported many yards along a meadow by this agent; and last spring I watched the lake ice (Lake St. Peter), which takes 2 or 3 days to pass Quebec every spring, and had the pleasure to observe several bowlders of considerable size, and many small stones, sand, earth, reeds and plants on their way down the river, drifting at a rate measurable by the excess of every ebb tide over the preceding flood. The latter flows $4\frac{3}{4}$ hours, at the rate of 3 knots; the former about $7\frac{1}{2}$ hours, at 4 knots. Any bowlders thus transported are liable to be dropped at various points along *the bed of the river*, as the ice gives way to the increasing temperature of the air and water in the spring of the year."

After showing how freshwater shells, seeds, plants, &c. are similarly transported and tranquilly deposited along with large blocks of stone, amid marine shells, Captain Bayfield gives practical illustrations of the power of the ice of one season in removing large bowlders and deep stakes, which he had caused to be placed in certain positions. These were entirely carried away and replaced by other bowlders, while in the same season a mass of granite, containing 1500 cubic feet, and which he had particularly marked, was transported several hundred yards from its observed position. Again, in speaking of the bowlders which occur in the younger Tertiary deposits, he says, "They are found in the cliffs at different levels, not resting upon each other, but as if they had been dropped there at widely different times, during a long period, in which a quiet deposition of clay, sand and gravel had been going on, and in which the various genera of testacea had lived and died. Some of the shells are of course broken, and some of the valves are separated, as is the case in the bottom of the present seam; but many have both valves together, although they separate when taken up, because the ligament no longer exists. All idea of these shells (together with the sand, clay and bowlders) having been drifted together into their present positions must be given up at once, when I state the fact, that the *Terebratulæ psittaceæ*, which you know are so fragile that the smallest stones would be sufficient to destroy them, if carried along with a moderate degree of violence by moving water, are found with their valves together, and their long and brittle teeth entire as when they were living."

"The whole of the facts, which I have neither time nor space to dwell upon in this letter, lead me to infer that these numerous erratic blocks, from whatever source originally derived, have been dropped from time to time (from ice floes) on the bed of the Tertiary sea."—Extract of a Letter from Captain Bayfield, R.N., to Mr. Lyell, November 1837.

H.

Landslips.

Besides the landslips of Ludlow and Woolhope, one has been partially adverted to, which occurred near Buildwas on the Severn, 12 miles east of Shrewsbury. The reader will find this landslip, "The Birches," described in Gough's edition of Camden's Britannia, vol. ii. p. 418. It took place on the 26th of May 1773. The ground was much heaved up and down, 18 acres being moved, leaving a chasm 12 to 14 yards wide. The course of the Severn was impeded by the mass which was advanced into it, and the river was flooded back. According to Dr. Gough, shocks of earthquake, and which he compared to those of Calabria, were felt during two days, throughout the adjacent country.

I.

Silurian Rocks of Cumberland and the adjacent tracts.

In the course of this summer (1828) and since the greater part of this book was printed, I made a rapid survey of Cumberland and the adjacent parts of Lancashire and Yorkshire, in which Professor Sedgwick and Professor Phillips had indicated the existence of some equivalents of the Silurian Rocks. (See the small map of England engraved in the corner of the large one.)

The great mass of the slaty rocks of that region belongs unquestionably to the Cambrian system, and Professor Sedgwick is disposed to think that the fossiliferous limestone of Coniston-water-Head is of the same age as that of Bala. True Silurian Rocks, however, and of considerable dimensions, are interposed between the Cambrian Rocks and the Old Red Sandstone, particularly along the southern boundary of the former. Such are largely developed, for example, between Kendal and Kirkby Lonsdale, reposing near the former place on Cambrian Rocks, and at the latter dipping under the Old Red Sandstone of the valley of the Lune.

My attention was first called to that district by my friend the Rev. J. H. Fisher, vicar of Kirkby Lonsdale, and, on recently visiting him, I added some fossils to a collection previously sent to me by him. Other specimens are to be seen in the New Museum of Kendal, and Professor Sedgwick possesses some which I have not seen.

Orthoceratites occur, particularly *O. annulatum*, Pl. 9, f. 5, *O. gregarium*, Pl. 8, f. 16, and *O. eccentricum*, Pl. 13, f. 16. Among the shells in the uppermost beds are casts resembling *Avicula retroflexa*, Pl. 5, f. 9, and *Cypricardia amygdalina*, Pl. 5, f. 2; and in the same beds near Kendal, *Atrypa affinis*, Pl. 6, f. 5, *Leptæna sericea*, Pl. 19, f. 1, some forms of *Orthis*, &c., one nearly resembling *O. canalis*. On the whole, the shells collected near Kirkby Lonsdale seem to indicate Upper Silurian, and those of the underlying strata near Kendal (which I examined, however, in great haste) Lower Silurian. Professor Sedgwick will elucidate this subject, when all the fossils collected shall have been properly examined and compared. The transverse section from the Old Red Sandstone at Kirkby Lonsdale, through the Silurian System, to the old slaty rocks and the intrusive granite of Shap, is particularly clear and instructive.

K.

Fossil Footsteps in the New Red Sandstone.

I may state, that the impressions of the feet of some unknown animal have been recently discovered by Dr. O. Ward on the surface of the New Red Sandstone at Grinshill, Salop (see p. 40), and that the specimens (which I have not yet seen,) are deposited in the public Museum at Shrewsbury. I must also add, that prints or footsteps of the *Cheirotherium* have been discovered in the red sandstone which occupies the promontory of Cheshire, between the Dee and the Mersey. The most clearly-distinguished slabs are in the museum of the Liverpool Institution: Dr. Buckland gave a notice of them at the meeting of the British Association at Newcastle, and I understand that Sir Philip Egerton is preparing a more detailed account. In the mean time, sections illustrating the strata have been communicated to the Geological Society by Mr. J. Cunningham, while these pages are going through the press.

THE END.

INDEX.

*** No organic remains are cited in the Index, except the genera of Fishes and Crustaceans, and the *new* genera of Shells and Zoophytes, a reference to every fossil species which is figured being given in the table, p. 703, *et seq.*

ERRATA (Additional).

P. 688, l. 8, *for* Robeston Walthen *read* Robeston Wathen.
P. 697, l. 23, *for* transversely situated *read* transversely striated.

FINIS.

Printed by Richard and John E. Taylor, Red Lion Court, Fleet Street.

OLD RED SANDSTONE

(FISHES)

Pl. 1

F. 1 2 3. Cephalaspis Lyellii (Agass.)
4. Scales of the side mag.d
5. back do
6. tail do

7. Scales of the head mag.d see Pl. 2, f. 1
8. Portion of the disc of the head.
9. Spine of Ptychacanthus (Ag.)
10. The same mag.d

OLD RED SANDSTONE.

(FISHES.)

Pl. 2.

Fig. 1 2 3 Cephalaspis Lyellii. (Agass.)
4. 5 rostratus. (Ag.)
6 Lewisii. (Ag.)
7 8 Lloydii. (Ag.)
10 11 Onchus arcuatus. (Ag.)
12 13 semistriatus. (Ag.)
14 Ctenacanthus ornatus. (Ag.)

OLD RED SANDSTONE.

(FISHES.)

F. 1. Holoptychus Nobilissimus (Aguss.) ½ nat. size.
2. A ventral scale of f. 1 nat. size.
3. Tuberculated scale of Holoptychus. (Ag.)

F. 4. Processes beneath the scales of Holoptychus. (Ag.)
5. Part of operculum of d°.
6. Surface of f. 5 mag^d.

F. 7. 11. Fragments of Ichthyolites.
8. 9. Tooth of Holoptychus or [illegible]lichthys? Ag.
10. Fragment of scale of Holoptychus. Ag.

OLD RED SANDSTONE.

(SHELLS.)

F. 1 a [illegible] laevis.
b & 2 a [illegible] antiqua.
c [illegible] Nucula.
[illegible] carinatus.
[illegible]

F. 1 f Turritella gregaria.
2 Avicula rectangularis
3 Lingula cornea.
6 Turbo Williamsii.
7 a 12 f. g Turritella [illegible]

F. 7 b 8 Turritella conica.
9 a Orthoceras semipartitum.
b — tracheale.
10 a Cypricardia cymbaeformis.
5. 12 c Leptaena lata.

F. 11 Cucullaea Cawdori.
12 b — — ovata.
d. Orthis lunata.
e. Bellerophon striatus
h. Orthoceras .....

F. 13. Spirifer ptychodes. (Dalm.)
14. Natica glaucinoides.?
15. Bellerophon globatus.
16. — trilobatus.
17. 17ª mag.ᵈ Agnostus pisiformis? ([illegible])

UPPER LUDLOW ROCK.

(FISHES, &c.)

F. 1, 2, 3. Skin or Shagreen of Sphagodus (Agass.)
4, 4^a mag^d. 5. Portions of Pterygotus problematicus (Ag.)
6. Tooth of Sphagodus pristodontus.
7, 8, Shell?
9, 10, 11. Onchus Murchisoni, (Ag.)
12, 13, Onchus?

F. 14-16, 20, 21, 25, 26, Plectrodus mirabilis, (Ag.)
17 & 33. Teeth.
18, 19, 22-24, Plectrodus pleiopristis, (Ag.)
27-32, 60-62, Sclerodus pustuliferus, (Ag.)
34-36, Thelodus parvidens, (Ag.)
37-39, Indeterminable.

F. 40-45, Rays of fins, probably Onchus.
46-55, Coprolites and their contents.
47, 48, Orbicula rugata.
49, Lingula minima.
50 Bellerophon globatus?
51. Turritella.

F. 52, 53. Orthoceras semipartitum.
56, Mag^d. Crinoidal cast in Coprolite, f. 55.
57-59 Onchus tenuistriatus.
63, Onchus.
64 Icthyodorulite.
65, 66. Palatal bones of Sclerodus, f. 30.

UPPER LUDLOW ROCK.

(SHELLS)

F. 1, Serpulites longissimus.
2, Cypricardia amygdalina.
3, ——— impressa.
4, ——— undata.
5, ——— retusa.
6, ——— cymbaeformis var.
7, Pullastra complanata.

F. 8, Nucula? ovalis.
9, Avicula retroflexa? (Hisinger)
10, ——— lineata.
11, Orbicula rugata.
12, ——— striata.
13, Leptaena lata (V. Buch).
14, Spirifer trapezoidalis (Dalm.)

F. 15, Orthis lunata.
16, ——— orbicularis.
17, 17a, Terebratula navicula.
18, ——— canalis.
19, ——— cuneata (Dalm.)
20, ——— nucula.
21, ——— pulchra.

F. 22, Terebratula pentagona.
23, Lingula minima.
24, Natica parva.
25, Pleurotoma articulata.
26, ——— corallii.
27, Turbo corallii.
28, ——— carinatus.

F. 29, Orthoceras bullatum.
30, ——— ibex.
31, ——— articulatum.
32, Bellerophon expansus.
33, Tentaculites tenuis.
33a, The same mag.d

AYMESTRY LIMESTONE.

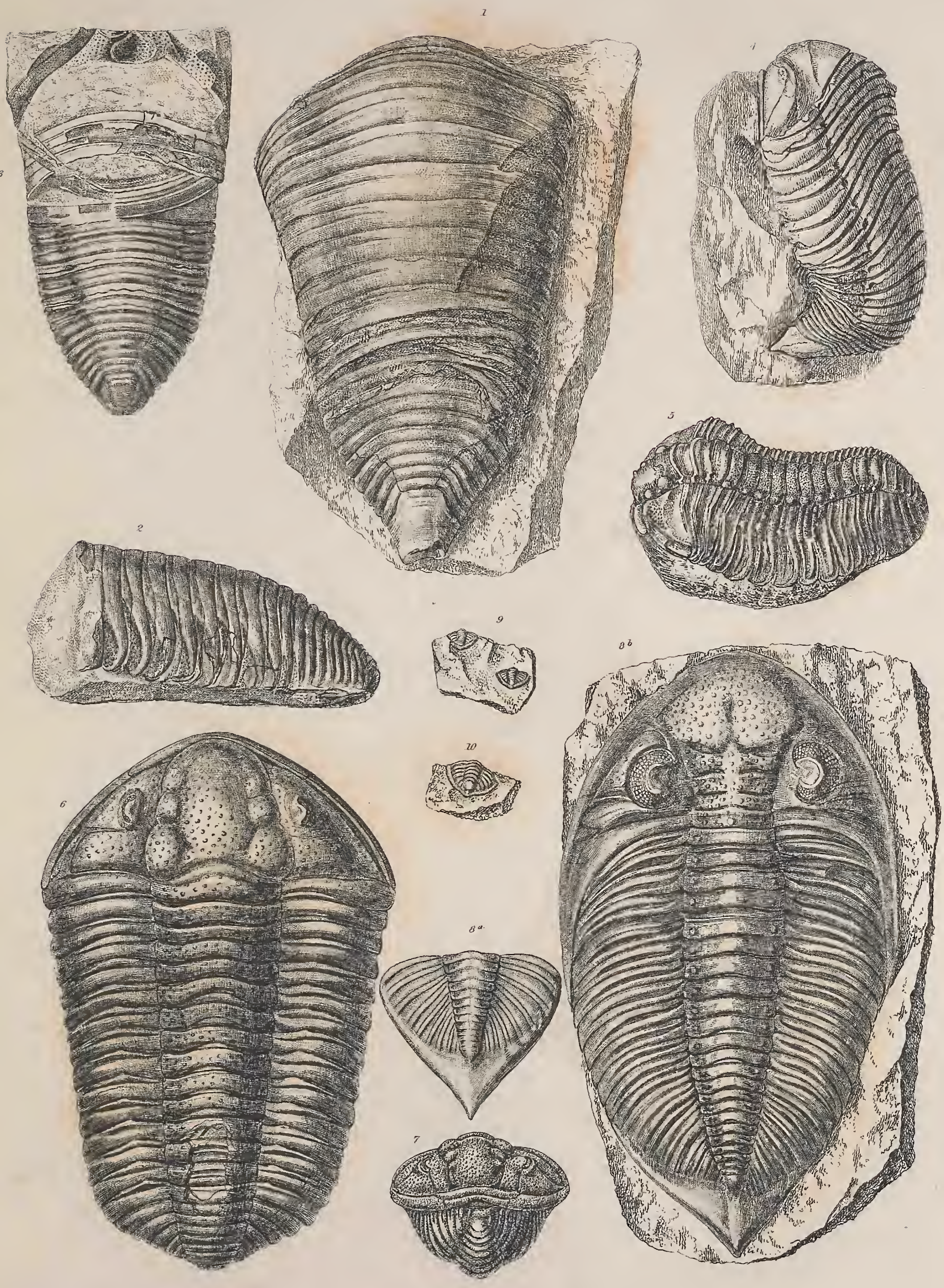
(SHELLS.)

F. 1. *Mya rotundata.*
2. *Cardium striatum.*
3. *Avicula reticulata.*
4. *Atrypa didyma* (Dalm.)
5. — — *affinis* (M. C.)
6. *Spirifer interlineatus.*

F. 7. *Terebratula Wilsoni* (M. C.)
8ᵃ *Pentamerus Knightii* (M. C.) 8ᵇ Sil. [illegible]
9. *Lingula Lewisii.*
10. *Euomphalus carinatus.*
11. *Orthoceras Mocktreensis*
12. *Bellerophon Aymestriensis.*

LUDLOW ROCKS.

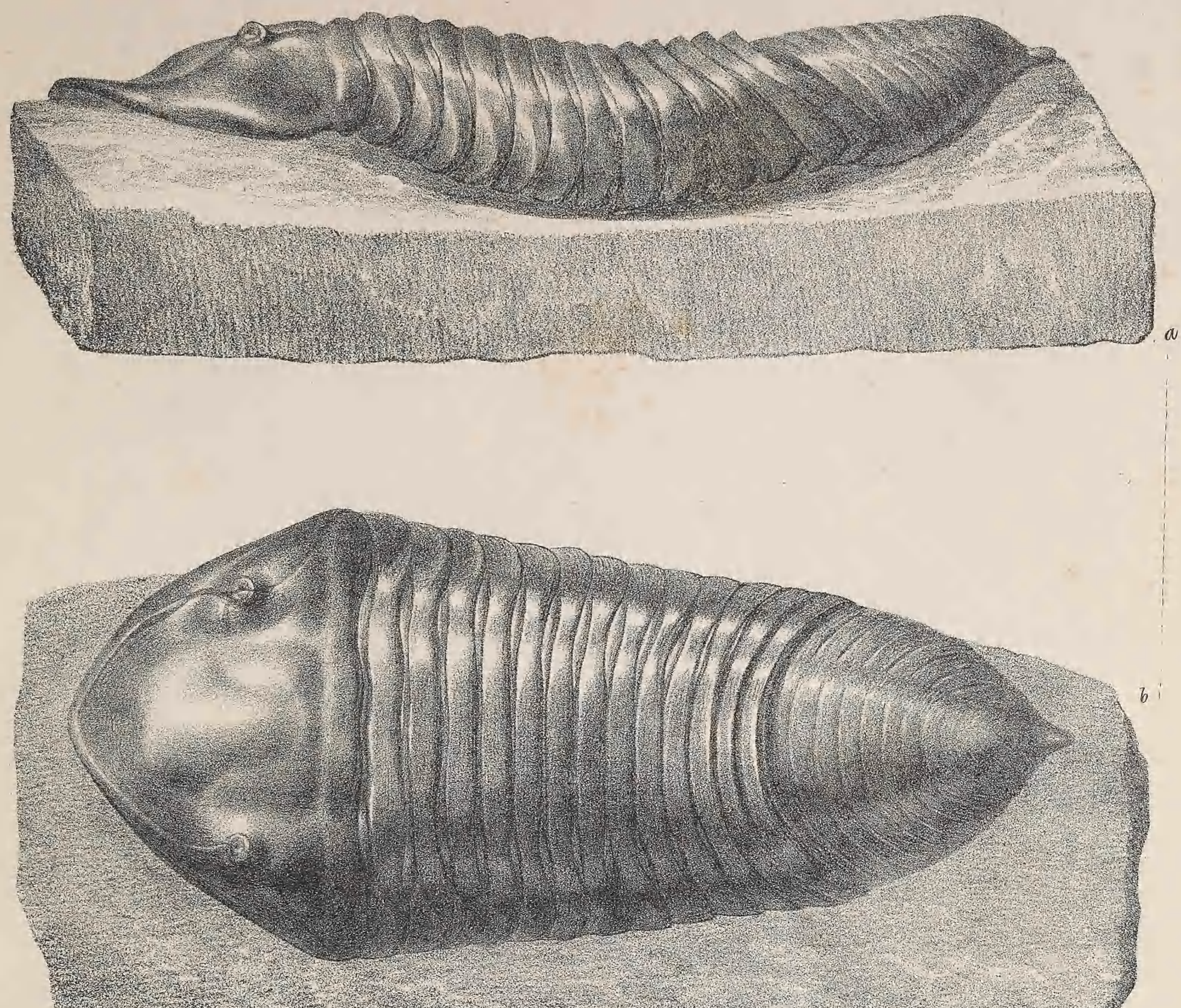
(TRILOBITES)



F. 1. 2. Homalonotus Knightii.
3. 4. ———— Ludensis.
5. 7. Calymene Blumenbachii (Brong.)
6. ———— major.

F. 8ª Asaphus caudatus (Brong.)
8ᵇ ———— tuberculato-caudatus
9. ———— Cawdori.
10. ———— sub-caudatus.

Fig 1.



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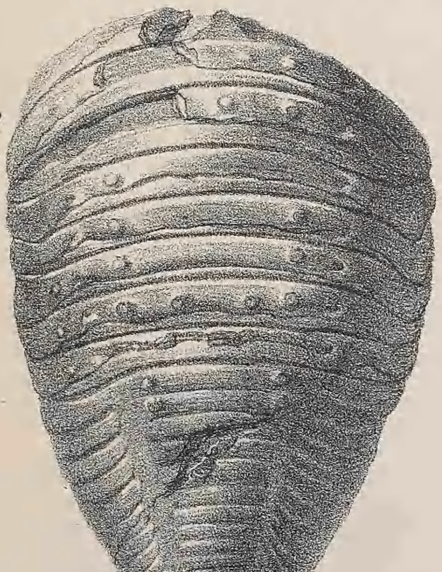


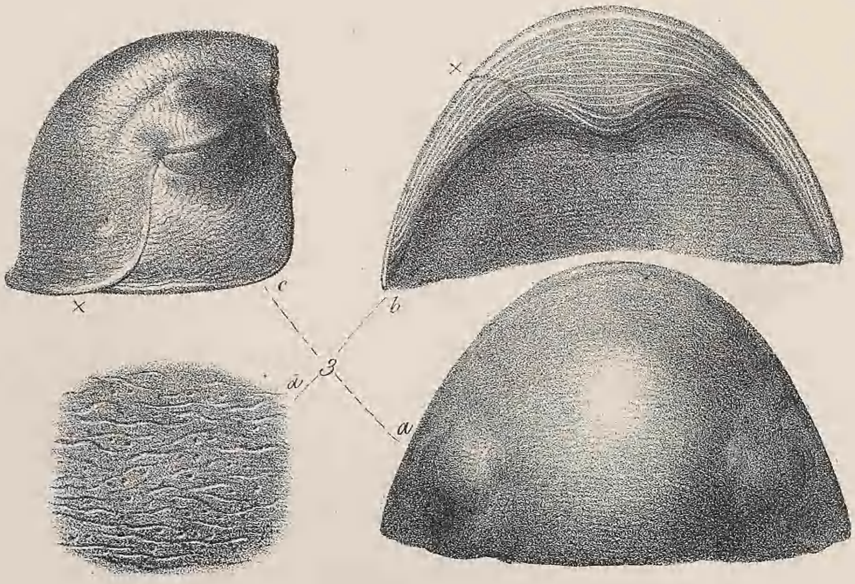


Fig. 1. Homalonotus delphinocephalus.
2. Homalonotus Herschelii.
3. a. b. c. d. Bumastus Barriensis.

Lithog. from Nature by G. Scharf

LOWER LUDLOW ROCK.

(SHELLS.)

Pl. 8.

F. 1. Spirorbis Lewisii b. mag^d
2. Cypricardia? solenoides
3. Psammobia rigida
4. Cardiola fibrosa
5. — interrupta (Cardium? cornucopiæ Goldf.)
6. Modiola semisulcata

F. 7. Leptæna Lepisma (Dalm.)
8. 9. Atrypa comata
10. — galeata (Dalm.)
11. Lingula lata.
12. — striata.
13. Pleurotomaria undata.
14. — Lloydii

F. 15. Terebra? sinuosa.
16. Orthoceras gregarium.
17. — distans.
18. — dimidiatum.
19. 20. — ? pyriforme.
21. Cyrtoceras læve.

LOWER LUDLOW ROCK.

(SHELLS.)

1, 1ª Orthoceras Ludense α.
1ᵇ — — β.
2, — — imbricatum (Wahl.)
3. Orthoceras fibrosum.
4 — — virgatum.
5. — — annulatum (Sow.)

LOWER LUDLOW ROCK.

(SHELLS.)

F. 1. *Phragmoceras arcuatum.*

2. 3. ——— *?nautileum.*

4. 5. 6. ——— *ventricosum* (*Orthoceratites ventricosus*, Steininger.)

LOWER LUDLOW ROCK.

(SHELLS.)

F. 1 Phragmoceras arcuatum β

2 — compressum.

3 Lituites tortuosus.

F. 4 Lituites giganteus.

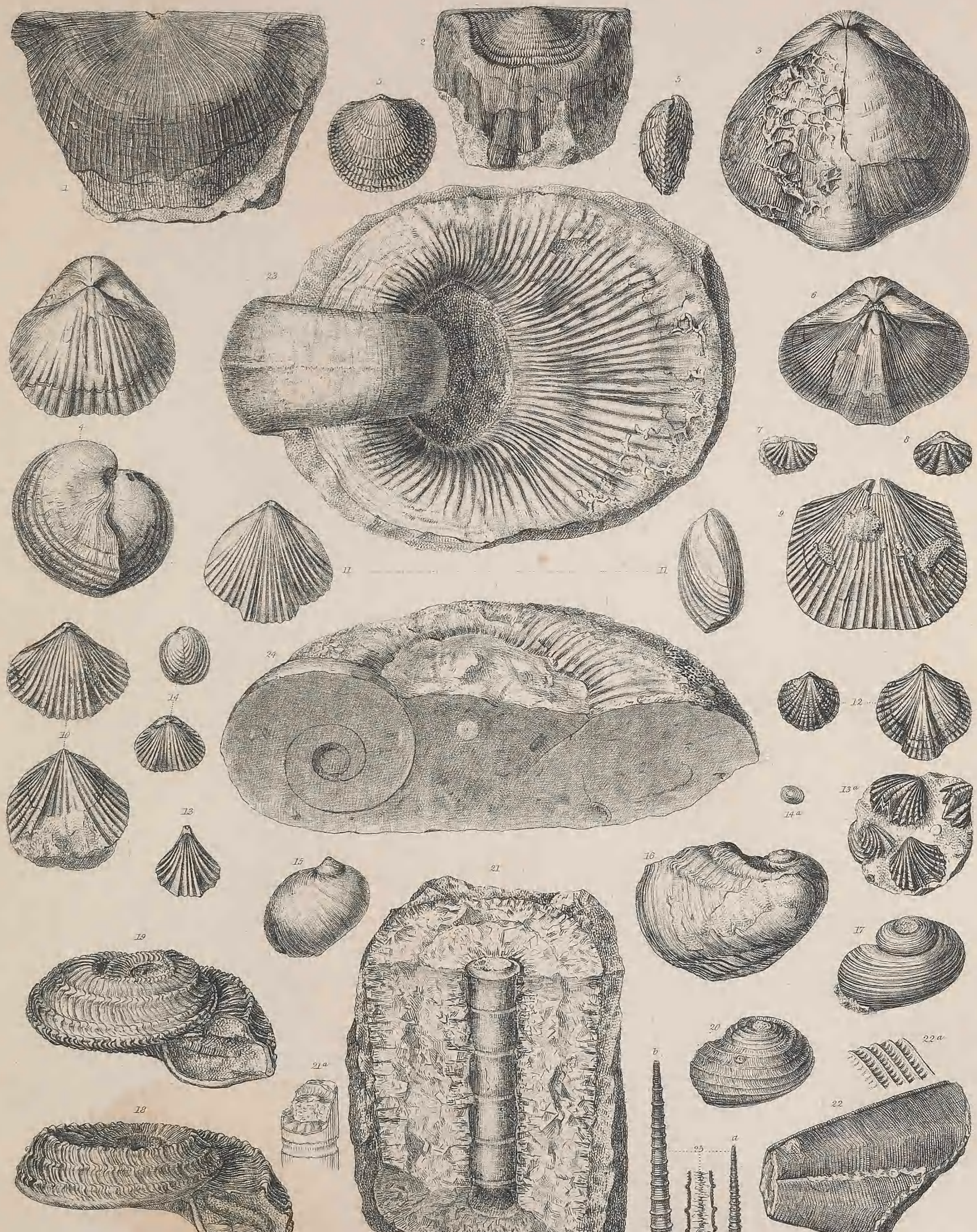
F. 5. 7. Lituites articulatus

6. — — Ibex.

8. — — Biddulphii.

WENLOCK LIMESTONE.

(SHELLS.)



F. 1. Leptæna euglypha. (Dalm.)
2. depressa (M.C.)
3. Atrypa tenuistriata.
4. galeata (Dalm.)
5. aspera (Schloth.)
6. Spirifer radiatus (M.C.)
7. octoplicatus (M.C.)

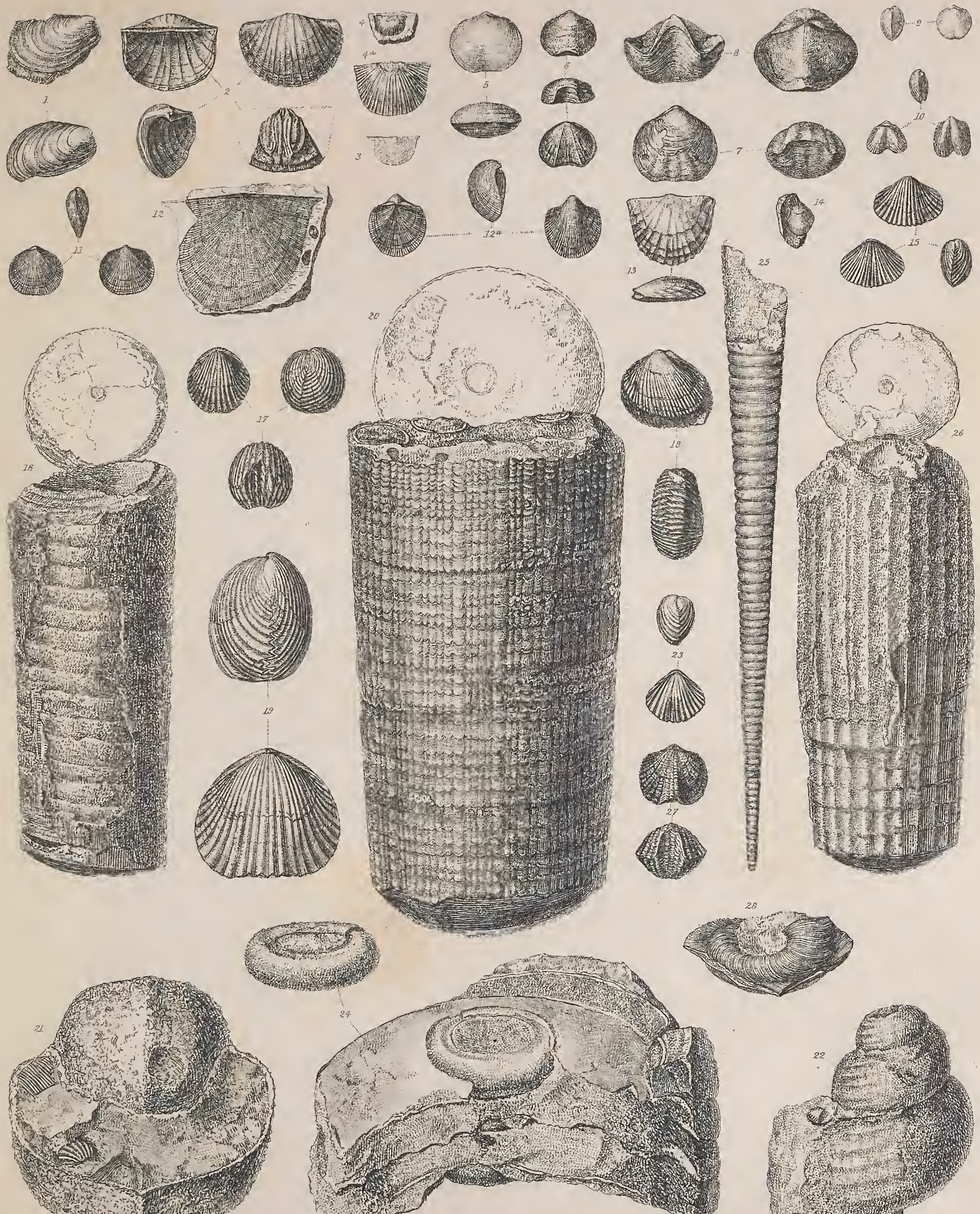
F. 8. Spirifer crispus, (Dalm.)
9. Orthis rustica.
10. Terebratula biennosa, (Schloth.)
11. crispata.
12. imbricata.
13. cuneata (Dalm.)
13^a bidentata (His.)

F. 14. Terebratula deflexa.
14^a Patella? implicata.
15. Nerita spirata (M.C.) var.
16. —— Haliotis.
17. Euomphalus sculptus.
18. discors (M.C.)
19. —— rugosus (M.C.)

F. 20. Euomphalus funatus (M.C.)
21. Orthoceras (Ormoceras? Stokes) Brightii.
21^a Siphuncle of D^o.
22. Conularia quadrisulcata (Miller)
22^a Surface of D^o. mag^d.
23, 24. Bellerophon dilatatus.
25. Tentaculites ornatus, b, mag^d.

WENLOCK SHALE.

(SHELLS.)



E. 1 Modiola antiqua.
2. Leptaena transversalis (Dalm.)
3. ——— [illegible]
4. [illegible]
5 Atrypa compressa
6. ——— depressa

F. 7. Atrypa reticularis.
8 ——— linguifera.
9 Spirifer? Pisum.
10 ——— sinuatus (Sowerby)
11. Orthis hybrida
12 ——— filosa

F. 12a Orthis canalis
13 ——— antiquata.
14. Terebratula laevicula
15. ——— brevirostris.
17. ——— sphaerica
18. ——— crebricosta.

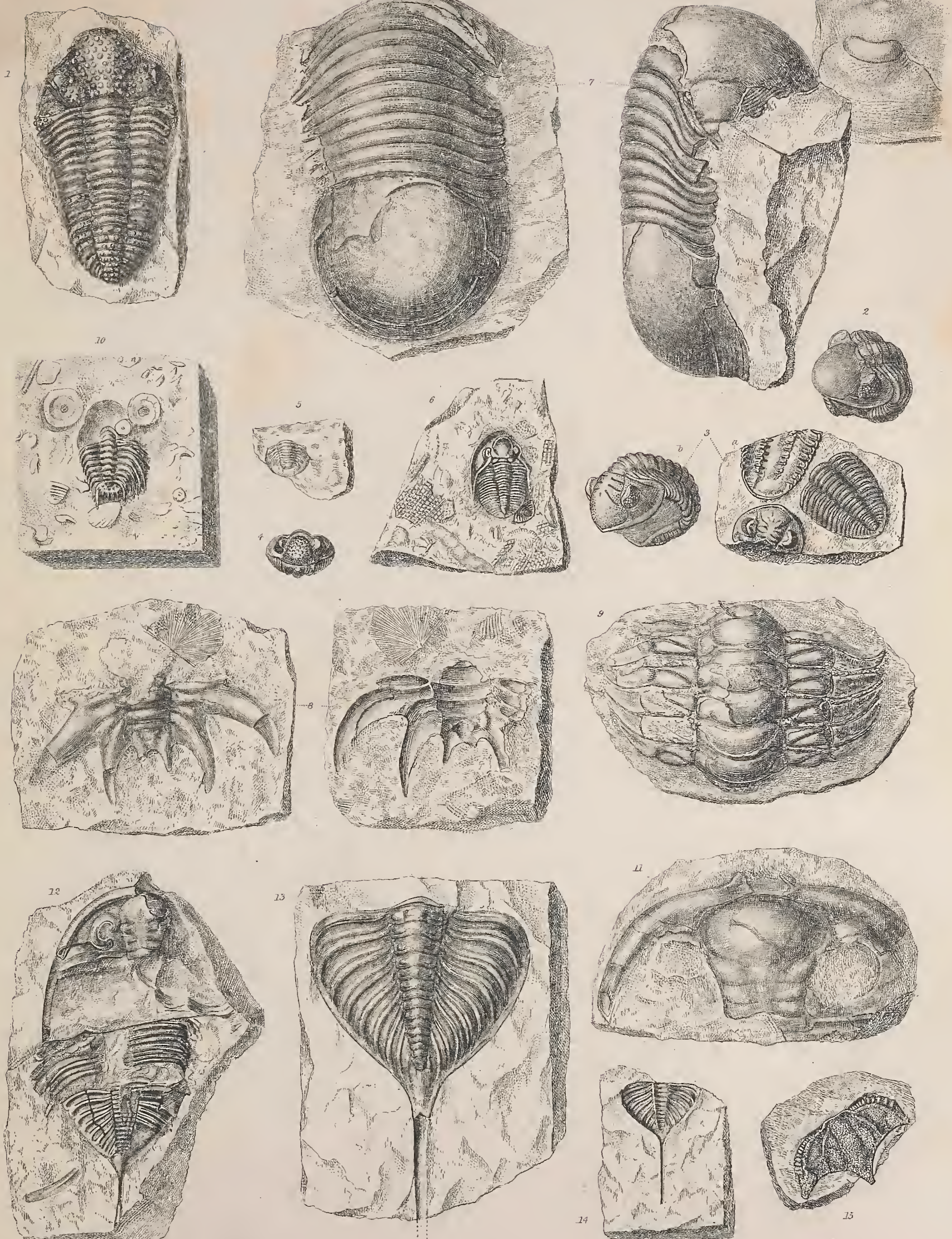
E. 19. Terebratula Stricklandii.
23. ——— interplicata
27. ——— imbricata, var. abbreviata.
16. Orthoceras excentricum
20. ——— fimbriatum.

F. 24. Orthoceras Nummularius
25. ——— attenuatum.
26. ——— canaliculatum.
21. Bellerophon Wenlockensis.
22. Turbo cirrhosus.
28. Euomphalus alatus (Wahl.)

WENLOCK LIMESTONE.

(TRILOBITES.)

Pl. 14



F. 1. *Calymene variolaris (Park.n)*

2, ——— *macrophthalma (Brong.)*

3^a & 3^b ——— *Downingiæ*

4, ——— *tuberculata*

5, ——— *indeterminable.*

F. 6. *Asaphus Stokesii*

11-14 ——— *longi-caudatus.*

7 *Bumastus Barriensis.*

8, 9 *Paradoxides bimucronatus*

10 ——— *quadrimucronatus.*

F. 15, *Acidaspis Brightii*

LUDLOW ROCKS.

CORALS.

Lithog. from Nat. by G. Scharf   Printed by C. Hullmandel.

1. 1a. Alveolites fibrosa.
2. Favosites polymorpha.
3. 3a. Porites expatiata.
4. Cyclolites praeacuta.
5. 5a. 5b. C. lenticulata.
6. Aulopora serpens.
7. A. consimilis.
8. A. Tubaeformis.
9. Aulopora conglomerata.
10. Escharina? angularis.
11. 11a. to 11c. Ptilodictya lanceolata.
12. 12a. to 12d. Glauconome disticha.
13. 13a. Hornera crassa.
14. 14a. Heteropora crassa.
15. 15a. to 15c. 18. 18a. to 18c. Fenestella prisca.
16. 16a. F. antiqua.
17. Fenestella Milleri.
19. 19a. F. reticulata.
20. 20a. Berenicea irregularis.
21. 21a. 21b. Discopora antiqua.
22. 22a. D? favosa.
23. 23a. D. squamata.
24. Retepora infundibulum.
25. 25a. 25b. Eschara scapellum.
26. 26a. Blumenbachium globosum?
27. 27a. Gorgonia assimilis.
28. 28a. Gorgonia?
29. 29a. Coriopora granulosa.
30. 30a. Millepora repens.
31. 31a. to 31d. Stromatopora concentrica.
32. 32a. S. nummulitisimilis.

WENLOCK ROCKS.

Pl. 16 bis

(CORALS).

Lithog. from Nat. by G. Scharf.

Printed by C. Hullmandel.

1. 1 a. 1 b. 2. 2 a. *Favosites alveolaris.*
3. 3 a. 4. *Favosites Gothlandica.*
5. 5 a. to 5 c. *Favosites multipora.*
6. 6 a. to 6 f. *Favosites fibrosa.*
7. 7 a. *Favosites fibrosa.*
8. 8 a. to 8 e. *Favosites spongites.*
9. 9 a. 9 b. *Favosites spongites.*
10. 10 a. *Syringopora reticulata.*
11. 11 a. 11 b. *Syringopora bifurcata.*
12. *Syringopora filiformis?*
13. *Syringopora caespitosa.*
14. 14 a. 14 b. *Catenipora escaroides.*

WENLOCK ROCKS.

(CORALS)

Lithog. from Nat. by G. Scharf.

Printed by C. Hullmandel.

1. Porites discoidea.
2. 2a. to 2e. Porites pyriformis.
3. 3a. to 3f. Porites tubulata.
4. 4a. Porites petalliformis.
5. 5a. Monticularia conferta.
6. 6a. to 6f. Astrea ananas.
7. 7a. 7b. Caryophyllia flexuosa.
8. 8a. to 8e. Acervularia Baltica.
9. Cyathophyllum angustum.
10. Cyathophyllum cæspitosum.
11. 11a. Cyathophyllum turbinatum.
12. 12a. to 12e. Cyathophyllum dianthus.

WENLOCK ROCKS. 1 to 5. 7 to 11. Pl. 16 bis.

CARADOC SANDSTONE 6. LLANDEILO FLAGS 12.

(CORALS)

Lithog. from Nat. by G. Scharf. Printed by C. Hullmandel.

1. 1 a. 2. *Cystiphyllum Siluriense.*
3. 3a. 3b. *Cystiphyllum cylindricum.*
4. 4a. to 4c. *Strombodes plicatum.*
5. 5a. *Turbinolopsis bina.*
6. 6a. *Turbinolopsis.*
7. 7a. 7b. *Limaria clathrata.*
8. 8a. *Limaria fruticosa.*
9. 9a. 9b. *Cladocora sulcata.*
10. 10 a to 10 d. *Verticillipora? abnormis.*
11. 11a. 11b. *Cnemidium tenue.*
12. 12a. to 12 c. *Porites? inordinata.*

WENLOCK LIMESTONE.

(CRINOIDEA.)

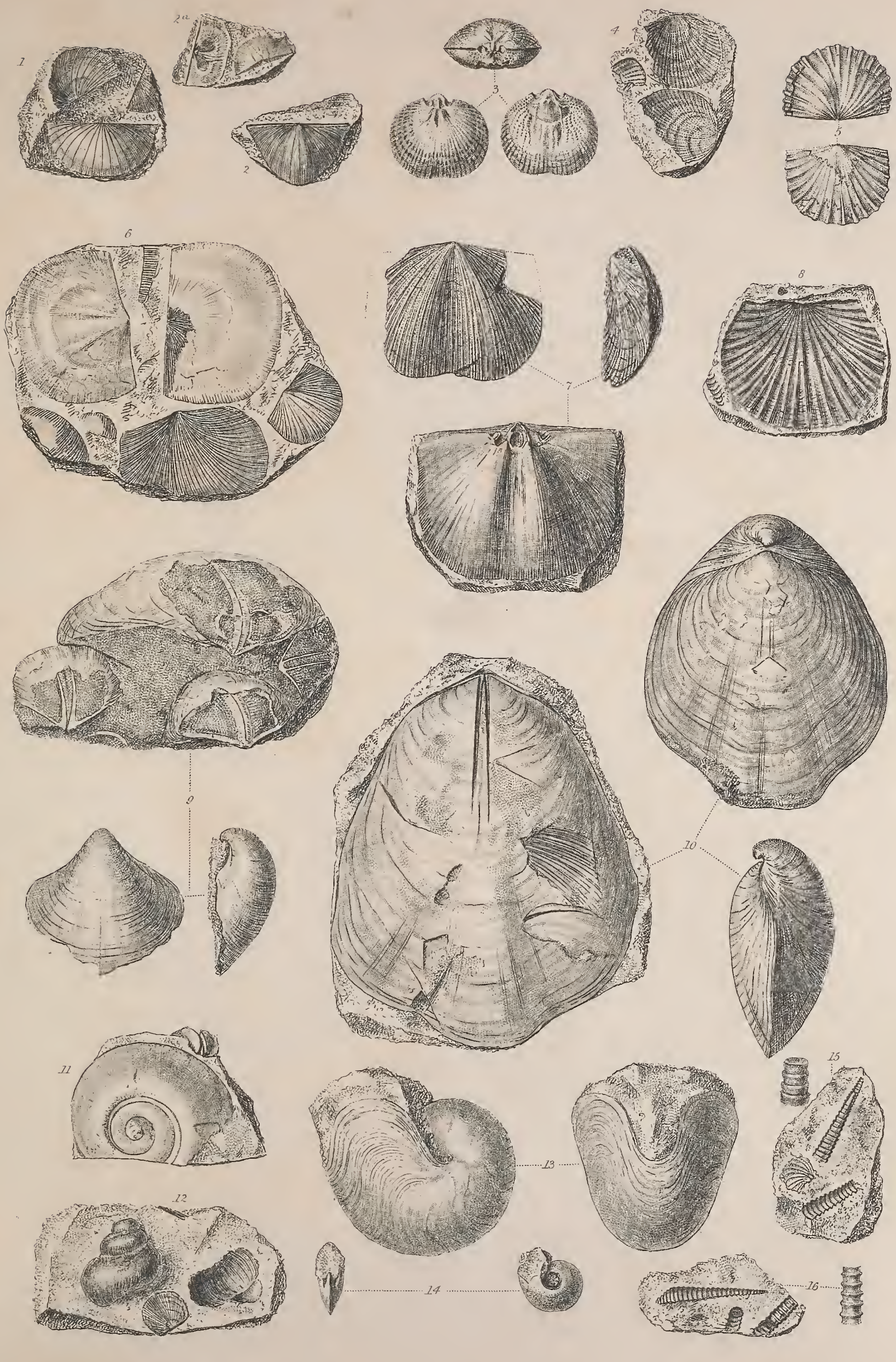
F. 1. *Cyathocrinites goniodactylus.*	I. 3. *Hypanthocrinites decorus.*	F. 7. *Actinocrinites ? retiarius.*
2. ——— *capillaris.*	4. *Dimerocrinites decadactylus.*	8. ——— *? arthriticus.*
6. ——— *pyriformis.*	5. ——— *icosidactylus.*	9. ——— *? expansus.*

F 1. Cyathocrinites rugosus (Mill.)
7. ——— tuberculatus (Mill.)
6. ——— D^o junior
3. Marsupiocrinites cælatus

F 4. Actinocrinites moniliformis (Mill.)
8. ——— simplex
5. Rhodocrinites quinquangularis (Mill.)
2, 9. Columns of indeterminable Crinoidea.

CARADOC SANDSTONE.

(SHELLS)



F. 1. 2ª. Leptæna sericea.
2, ———— var.
3. 4. Atrypa orbicularis.
5. Orthis calliactis β. (Dalm.)

F. 6. Orthis alternata.
7. ——— bilobata.
8. ——— Flabellulum, B.
9. Pentamerus lævis (M.C.)

F. 10. Pentamerus oblongus.
11. Trochus lenticularis.
12. Littorina striatella
13. Bellerophon bilobatus

F. 14. Bellerophon acutus
15. Tentaculites scalaris (Schloth.)
16. ———— annulatus (Schloth.)

CARADOC SANDSTONE.

(SHELLS)

F. 1a 1b. *Arca Eastnori.*
2. *Avicula orbicularis.*
3. ——— var.
4. ——— *obliqua.*

F. 5. *Orbicula punctata (granulata in Descr.)*
6. *Leptaena complanata.*
7. *Atrypa hemisphaerica.*
8. *Orthis canalis.*

F. 9. 10. *Orthis testudinaria? Dalm.*
11. ——— *Vespertilio.*
12. 13. ——— *grandis.*
14. ——— *expansa.*

F. 15. *Orthis virgata.*
16. ——— *Actoniae.*
17. ——— *triangularis.*
18. *Turritella cancellata.*

F. 19. *Buccinum? fusiforme.*
20. *Lituites Cornu-Arietis, a.*

CARADOC SANDSTONE.

(SHELLS)

F. 1. Atrypa crispa.
2. —— undata.
3. —— Lens.
4. —— ? plana.
4a. —— polygramma.
5. Spirifer radiatus (M.C.) var.

F. 6. Spirifer ? plicatus.
12. —— ? lævis.
7. Orthis semicircularis.
8. —— Flabellulum. s.
9. —— Pecten ? (Dalm.).
10. —— anomala ? (Schloth.).

F. 11. Orthis costata.
13. Terebratula Unguis.
14. —— neglecta.
15. —— tripartita.
16. —— furcata.
17. —— decemplicata.

F. 18. Terebratula pusilla.
19. Turbo ? Pryceæ.
20. Pleurotomaria angulata.
21. Orthoceras conicum.
22. —— approximatum.
23. —— bisiphonatum.

LLANDEILO FLAGS.

(SHELLS)

F. 1. Nucula ? laevis.
2. Leptæna duplicata.
2a ——— tenuistriata
2b. Atrypa globosa.
3. Atrypa (internal cast)

F. 4. 5. Atrypa (internal cast).
6. Spirifer ? liratus
7. ——— ? alatus.
8, 9. Orthis protensa.
10 ——— lata

F. 11. Orthis radians
12. ——— compressa.
13. Lingula attenuata
14. Euomphalus tenuistriatus.
15. ——— perturbatus

F. 16. Euomphalus corndensis.
16a. The same mag. d.
17. Nautilus (Clymene? Münster) undosus.
18. Lituites Cornu-arietis β.

CARADOC SANDSTONE.

(TRILOBITES.)

F. 1, *Trinucleus Caractaci.*
2. —— *fimbriatus.*
3. —— *radiatus.*

F. 4, *Trinucleus Lloydii.*
5. —— *nudus*
6. —— *Asaphoides.*

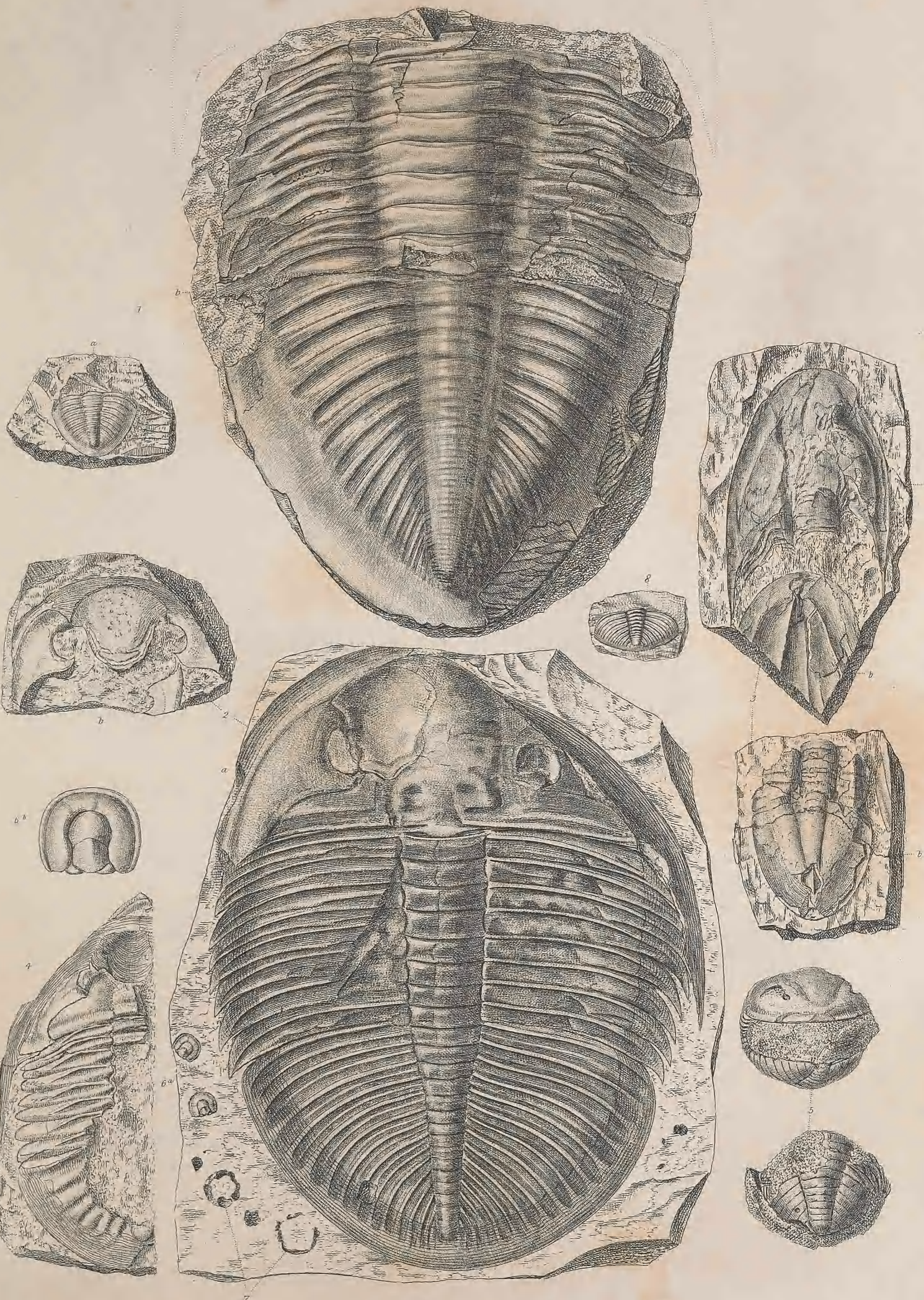
F. 7, *Illænus perovalis*
8, *Calymene punctata,* (Wahl.)
9, *Asaphus Powisii.*

Asaphus Tyrannus, (var. ornatus)

LLANDEILO FLAGS.

(TRILOBITES.)

Pl. 25.



F. 1. Asaphus Tyrannus.
2. ——— Buchii (Brong.)
4. ——— Corndensis;
8 ——— duplicatus.

F. 3 Asaphus Vulcani,
5, Ogygia Murchisoniæ;
6. Agnostus pisiformis? (Brong.)
7 Imperfect crinoidal casts.

MISCELLANEOUS.

Pl. 26.

F.1, 2. Graptolithus ludensis   3   foliaceus   4.   Murchisoni (Beck)

F.5, 6. Cornulites serpularius (Schloth.) nat. size.   9. Portions of d° mag^d   10. Spongarium Edwardsii.

F.11. Ischadites Kœnigii.   12. Cophinus dubius.   13. Polymeres Denelarus.

2

Nereites Sedgwickii.

1

Nereites Cambrensis.

3

Myrianites Macleayii.

4

Nemertites Ollivantii.

G. Scharf del. et lithog.

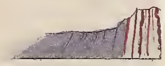
Printed by C. Hullmandel.


fig. 1.
W.
Hatfield Camp
Red Marley Dabitot
Corsewood Hill
Apperley
Combe Hill
Cheltenham
Battle Down
Cotteswold Hills
E
Old Red Sandst.
Conglomerate (Base of New Red)
Red Sandstone
Red Marl or Keuper
Red & Green Marl
Lower Lias Shale
Lias Shale
Fine Oolitic Gravel and Sand covering Lias
fig. 2.
Peckforton Hills
Salt Springs
Whitchurch
Prees
Hawkstone Hills
New Red Sandstone
Veins of Copper & Sulph. of Barytes &c.
Red and Green Marls of New Red Sandst
gravel & bowlders
Lower Lias Shale covered by northern Gravel
Marlstone of Lias
Red & Green Marls (Keuper)
Sandstones
Copper ores & manganese
New Red Sandstone
fig. 3.
N b E.
Prees
Brockhurst Hill
Grinshill
Hardwick Grange
Battlefield
Shrewsbury
Nobold
Pulley Common
Lyth Hill
S b W.
Marlstone of Lias
Lower Lias Shale
Red and green Marls
Light Coloured Sand
Red Sandstone & calcareous conglomerates obscured by northern gravel
Lower New Red Sandstone
Cambrian Rocks & Trap
fig. 9.
Breidden Hills
Pecknal
Alberbury
Gravel covering New Red Sandst
Severn Riv.
Trap Rocks.
Upp. Silurian Rocks
Coal measures.
Lower New Red Sandstone
Calc Conglomerate (Limestone)
New Red Sandstone
fig. 8.
(Enlarged Section)
Fault of Limest. and Coal (Pontesford)
Nills Hill
Pontesbury
Gravel
Coal measures & Limest.
Quartz Rock
fig. 6.
Severn
Uffington
Haughmond Hill
Limest. and Coal reposing on Cambrian Rocks
fig. 5.
Red Hill
Wellbatch
Lyth Hill
Coal measures under Lr. New Red Sandstone
Cambrian Rocks & Trap
fig. 4.
N.W.
Ankerdine Hill
Rosemary Rock
S.E.
Old Red Sandst.
Caradoc Sandst.
Base of New Red Sandstone
fig. 11.
Lea Rock
THE WREKIN
1320
Little Wenlock
Coalbrook Dale
Lincoln Hill
Severn
Jackfield
Coughley
Severn
Apley Park
Apley Terrace
Trap
Trap
Trap
Poor Coal measures on Wenlock Shale
Wenlock Limest.
Ironstone & Coal measu
Upper Coal and P.W. Limest
Lower New Red Sandstone
fig. 10.
The Clent Hills
S.
Calcot Hill
Walton Hill
St. Kenelms
Hunnington
Homer Hill
N.
New Red Sandst obscured by Gravel
Trap Rocks
Calcareous Conglomerate
Lower New Red Sandst.
10 Yard & Lower Coals
fig. 16.
Ercal
Steeraways
Lawley
N Dowley
Nedge Hill
Trap.
Trap.
Carbonif. Limest.
Trap under the Coal tract
Coal Measures
Lower New Red
fig. 13.
Bagley Rough
Severn
Apley Terrace
Badger
Patingham
Tettenhall
Wolverhampton
Coal measures
partially covered by Northern Bowlders
of New Red Sandstone
Calcareous Conglomerate
Gravel & Bowlders
fig. 12.
W.S.W.
Tasley
Stanley
Severn
Apley
E.N.E.
Old Red Sandst
F. Water Limest and Coal
Lower New Red Sandst.
fig. 15.
Lilleshall
Lilleshall House
Lr. New Red Sandst
Trap
Lower Silurian Rocks
Coal measures (unproductive)
Lower New Red Sandst.
New Red Sandst.
fig. 16.
Limestone (Lilleshall)
fig. 17.
N.W.
WREKIN
1320
Little Wenlock
Benthall Edge
S of Broseley
Coal measures
Dean
Coal measures
New Red
Cross Head
Severn
S.E.
Trap
Trap
Trap
Wenlock Limest.
Lower Ludlow Rock
Aymestry Limest.
Upp. Ludlow Covered by Old Red
Coal Measures
New Red Sandst
Rodk. I. Murchison

f

ov

fig. 9.



Trap Ro

fig. 11.

fig. 16.

fig. 15.

l. 30.

dst.

0 f^t

fig. 1.

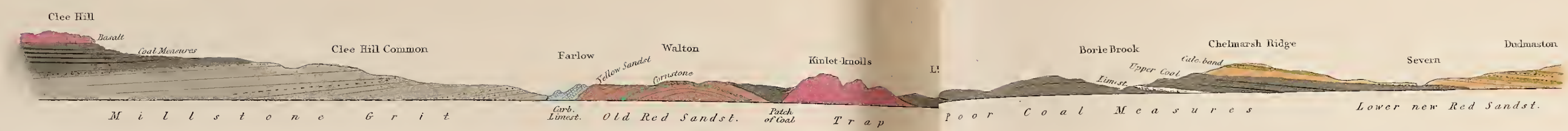


fig. 2.

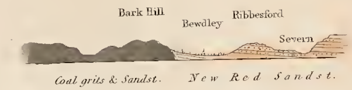


fig. 3.

fig. 4.

fig. 5.

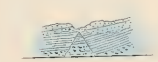


fig. 6.

fig. 7.

fig. 8.

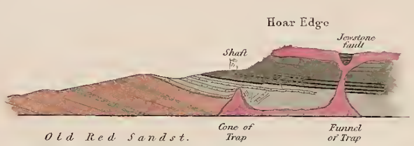


fig. 9.

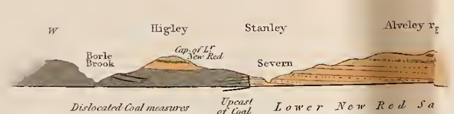


fig. 10.

fig. 11.

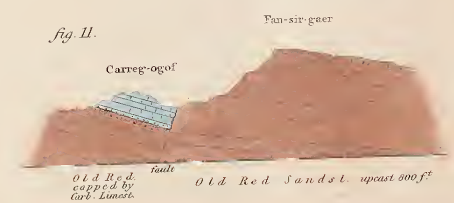
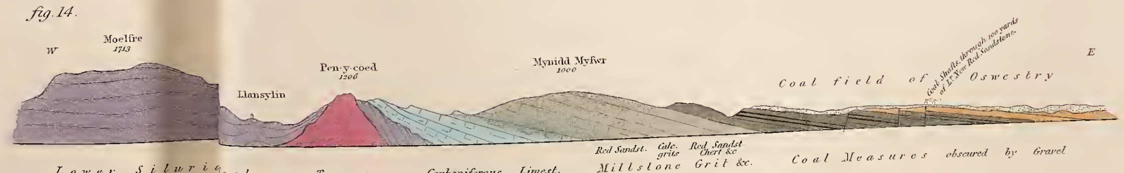


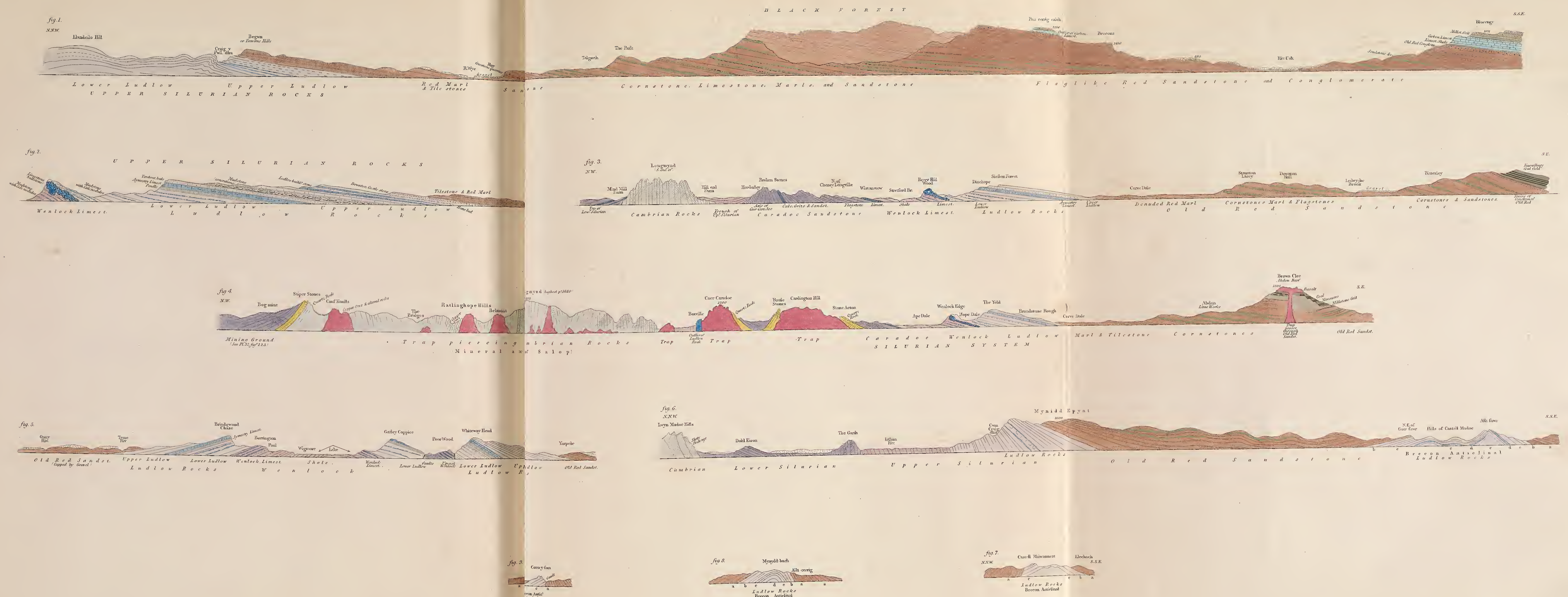
fig. 13.

fig. 12.

fig. 14.



Rodk. I. Murchison



Rod. I. Murchison

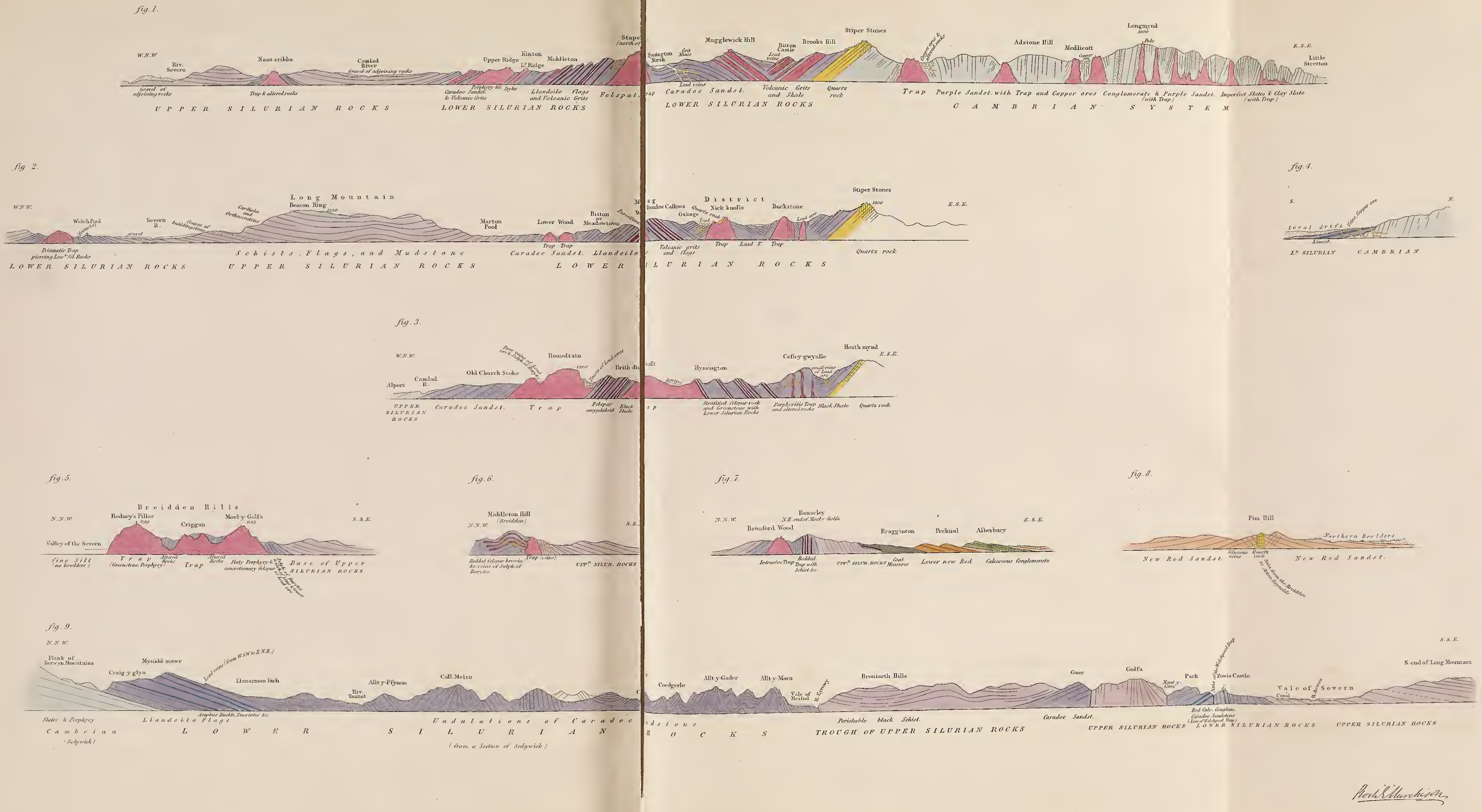


fig. 1.
W.N.W.
Riv. Severn
Nant-cribba
Camlad River
Upper Ridge
Kinton
Lr. Ridge
Middleton
Stapeley
Hyssington Marsh
Mugglewick Hill
Ritton Castle
Brooks Hill
Stiper Stones
Adstone Hill
Medlicott
Longmynd
Little Stretton
E.S.E.
Trap & altered rocks
Caradoc Sandst. & Volcanic Grits
Llandeilo flags and Volcanic Grits
Caradoc Sandst.
Volcanic Grits and Shale
Quartz rock
Trap
Purple Sandst. with Trap and Copper ores
Conglomerate & Purple Sandst.
Imperfect Slates & Clay Slate
UPPER SILURIAN ROCKS
LOWER SILURIAN ROCKS
LOWER SILURIAN ROCKS
CAMBRIAN SYSTEM
fig. 2.
W.N.W.
Welch Pool
Severn R.
Long Mountain
Beacon Ring
Marton Pool
Lower Wood
Bitton or Meadowtown
Bromlow Callows
Oakage
District
Nick knolls
Buckstone
Stiper Stones
E.S.E.
Prismatic Trap piercing Lowr. Sil. Rocks
Schists, Flags, and Mudstone
Caradoc Sandst.
Volcanic grits and flags
Trap
Lead V.
Quartz rock
LOWER SILURIAN ROCKS
UPPER SILURIAN ROCKS
LOWER SILURIAN ROCKS
fig. 3.
W.N.W.
Alport
Camlad R.
Old Church Stoke
Roundtain
Hyssington
Cefn-y-gwynlle
Heath mynd
E.S.E.
UPPER SILURIAN ROCKS
Caradoc Sandst.
Trap
Felspar amygdaloid
Black Shale
Stratified felspar rock and Greenstone with Lower Silurian Rocks
Porphyritic Trap and altered rocks
Black Shale
Quartz rock
fig. 4.
S.
N.
Local drift
Lr. SILURIAN
CAMBRIAN
fig. 5.
N.N.W.
Breidden Hills
Rodney's Pillar
Criggion
Moel-y-Golfa
S.S.E.
Valley of the Severn
Fine Silt (no bowlders)
Trap (Greenstone, Porphyry)
Altered Rocks
Trap
Altered Rocks
Slaty Porphyry & concretionary felspar
Base of Upper SILURIAN ROCKS
fig. 6.
Middleton Hill (Breidden)
N.N.W.
Bedded felspar breccia &c. veins of Sulph. of Barytes.
Trap (veins)
UPPr. SILUR. ROCKS
fig. 7.
N.N.W.
Bauseley
Brimford Wood
Bragginton
Pecknal
Alberbury
E.S.E.
Intrusive Trap
Bedded Trap with Schist &c.
UPPr. SILUR. ROCKS
Coal Measures
Lower new Red
Calcareous Conglomerate
fig. 8.
Pim Hill
Northern Bowlders
Siliceous veins
Quartz rock
New Red Sandst.
New Red Sandst.
fig. 9.
N.N.W.
Flank of Berwyn Mountains
Craig-y-glyn
Mynidd-mawr
Llanarmon fach
Riv. Tanat
Allt-y-Ffynon
Coll. Melyn
Coedgerle
Allt-y-Gader
Allt-y-Maen
Vale of Meifod
Broniarth Hills
Gaer
Golfa
Park
Powis Castle
Vale of Severn
S. end of Long Mountain
S.S.E.
Slates & Porphyry
Cambrian (Sedgwick)
Llandeilo Flags
Undulations of Caradoc Sandstone
LOWER SILURIAN ROCKS
(from a Section of Sedgwick)
Perishable black Schist.
TROUGH OF UPPER SILURIAN ROCKS
Caradoc Sandst.
UPPER SILURIAN ROCKS
LOWER SILURIAN ROCKS
UPPER SILURIAN ROCKS
Rodk. I. Murchison

f.

w.

L

fig. 1.

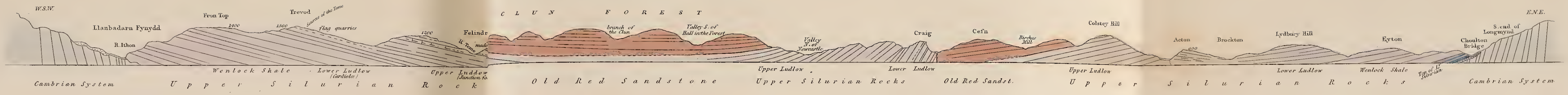


fig. 2.

fig. 3.

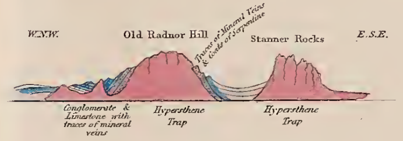


fig. 4.

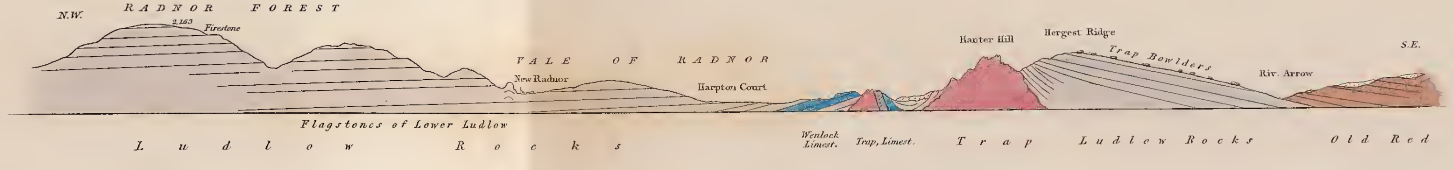


fig. 5.

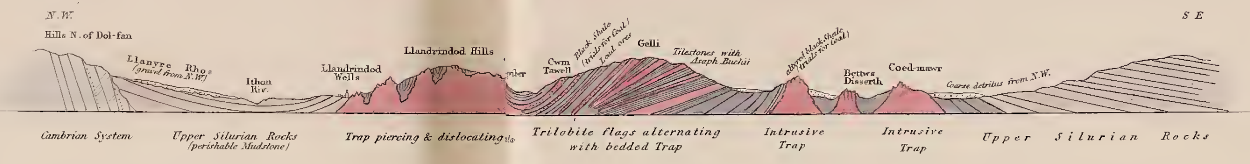


fig. 6.

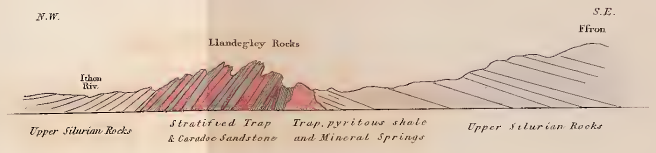
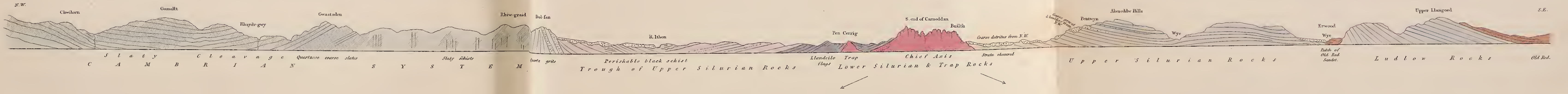


fig. 7.



Rod. I. Murchison

fig. 1.

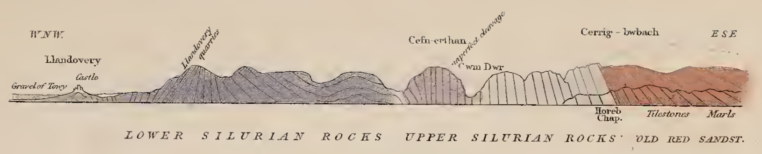


fig.

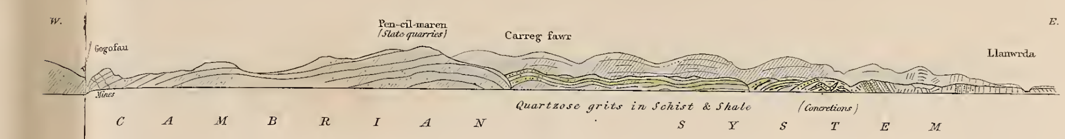


fig. 3.

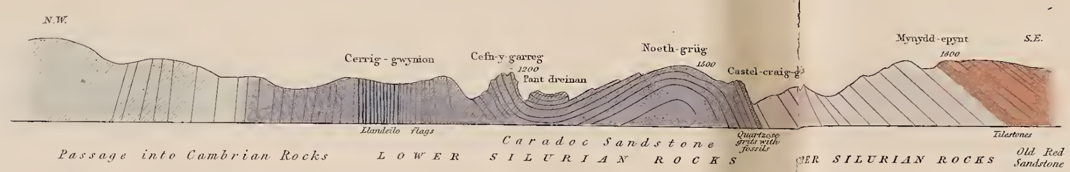


fig. 4.

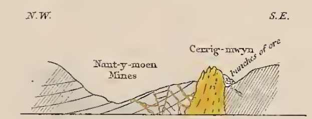


fig. 5.

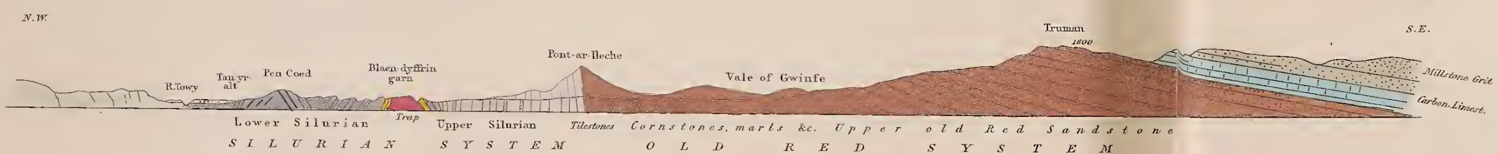


fig. 6.

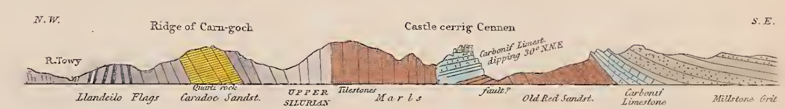


fig. 7.

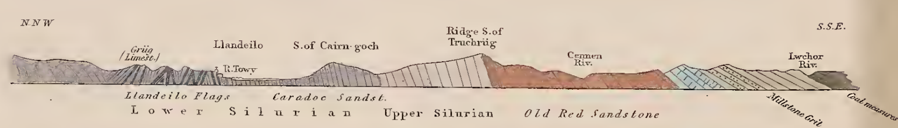


fig. 8.

fig. 9.

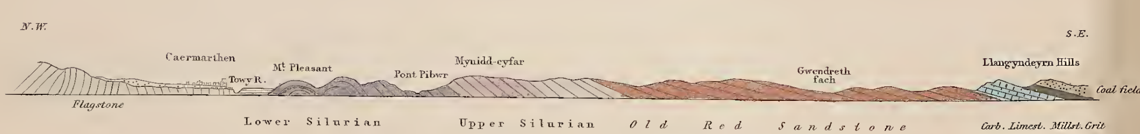


fig. 10.

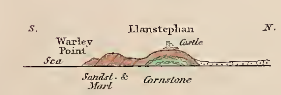
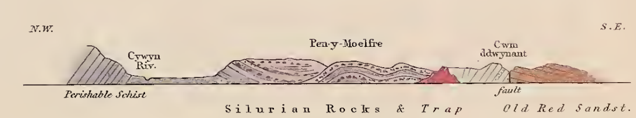


fig. 11.



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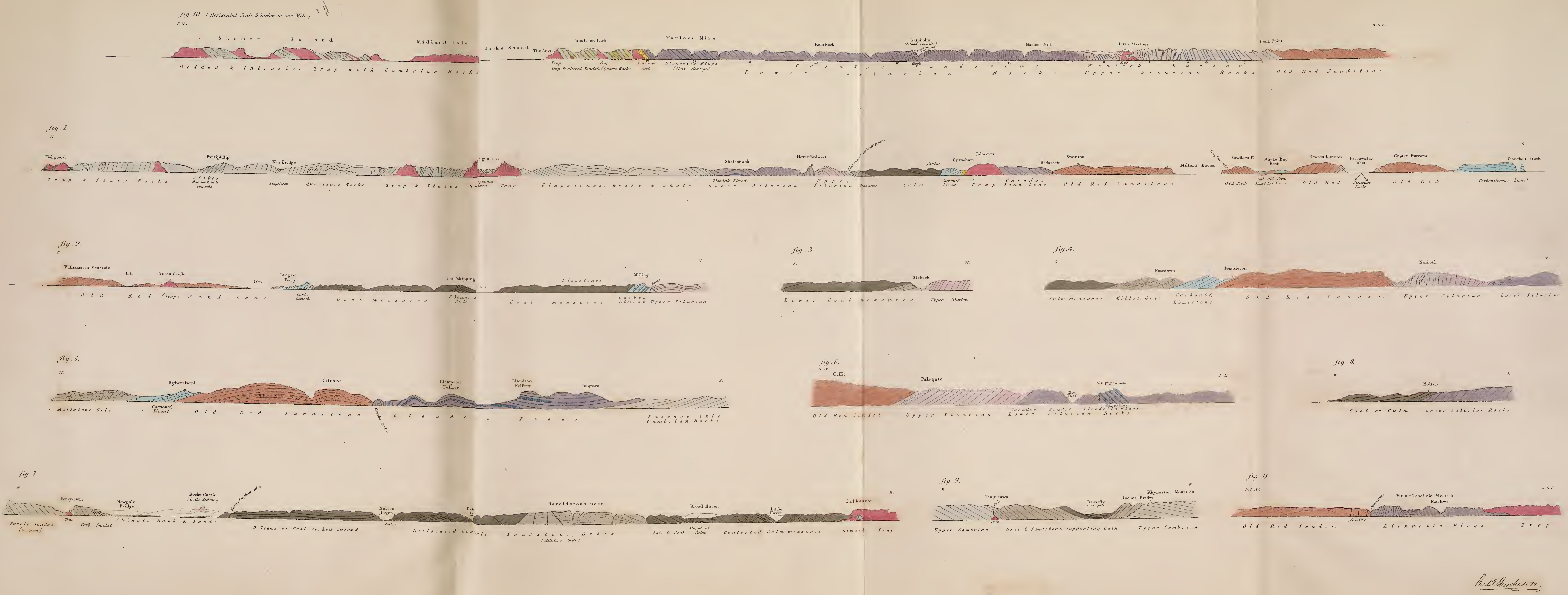


fig. 10. (Horizontal Scale 5 inches to one Mile.)
E.N.E.
Skomer Island
Midland Isle
Jacks Sound
The Anvil
Wooltack Park
Marloes Mire
Gateholm
Marloes Mill
Little Marloes
Hook Point
W.S.W.
Bedded & Intrusive Trap with Cambrian Rocks
Trap & altered Sandst. (Quartz Rock)
Encrinite Grit
Llandeilo Flags
(Slaty cleavage)
Caradoc Sandstone
Wenlock
Ludlow
Lower Silurian Rocks
Upper Silurian Rocks
Old Red Sandstone
fig. 1.
N.
Fishguard
Pantiphilip
New Bridge
Sholeshook
Haverfordwest
Cranenham
Johnston
Redstock
Stainton
Milford Haven
Sandorn Pt
Angle Bay East
Newton Burrows
Freshwater West
Gupton Burrows
S.
Trap & Slaty Rocks
Slates
Flagstones
Quartzose Rocks
Trap & Slates
Trap
Flagstones, Grits & Shale
Llandeilo Limest.
Lower Silurian
Upper Silurian
Culm
Carbonif. Limest.
Trap
Caradoc Sandstone
Old Red Sandstone
Old Red
Old Red
Silurian Rocks
Old Red
Carboniferous Limest.
fig. 2.
S.
Williamston Mountain
Pill
Benton Castle
River
Langum Ferry
Landshipping
Flagstones
Milling
N.
Old Red (Trap) Sandstone
Carb. Limest.
Coal measures
Coal measures
Carbon. Limest.
Upper Silurian
fig. 3.
S.
Slebech
N.
Lower Coal measures
Upper Silurian
fig. 4.
S.
Rosedown
Templeton
Narbeth
N.
Culm measures
Millst. Grit
Carbonif. Limestone
Old Red Sandst.
Upper Silurian
Lower Silurian
fig. 5.
N.
Egbwyslwyd
Cilrhiw
Llampeter Felfrey
Llandewi Felfrey
Pengare
S.
Millstone Grit
Carbonif. Limest.
Old Red Sandstone
Llandeilo Flags
Passage into Cambrian Rocks
fig. 6.
S.W.
Cyffic
Palegate
Clog-y-fraen
N.E.
Old Red Sandst.
Upper Silurian
Caradoc Sandst.
Llandeilo Flags
Lower Silurian Rocks
fig. 8.
W.
Nolton
E.
Coal or Culm
Lower Silurian Rocks
fig. 7.
N.
Pen-y-cwm
Newgale Bridge
Roche Castle (in the distance)
Nolton Haven
Haroldston's nose
Broad Haven
Little Haven
Talbenny
S.
Purple Sandst. (Cambrian)
Carb. Sandst.
Shingle Bank & Sands
9 Seams of Coal worked inland
Dislocated Coal
Shale
Sandstone, Grits (Millstone Grit)
Shale & Coal
Contorted Culm measures
Limest.
Trap
fig. 9.
W.
Pen-y-cawn
Brawdy
Roches Bridge
Rhynaston Mountain
E.
Upper Cambrian
Grit & Sandstone supporting Culm
Upper Cambrian
fig. 11.
N.N.W.
Musclewick Mouth
Marloes
S.S.E.
Old Red Sandst.
faults
Llandeilo Flags
Trap
Rodk I. Murchison

fig. 1.

N.

fig

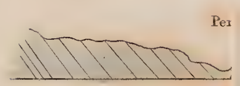
S.

fig

N.

fig. 7.

N.



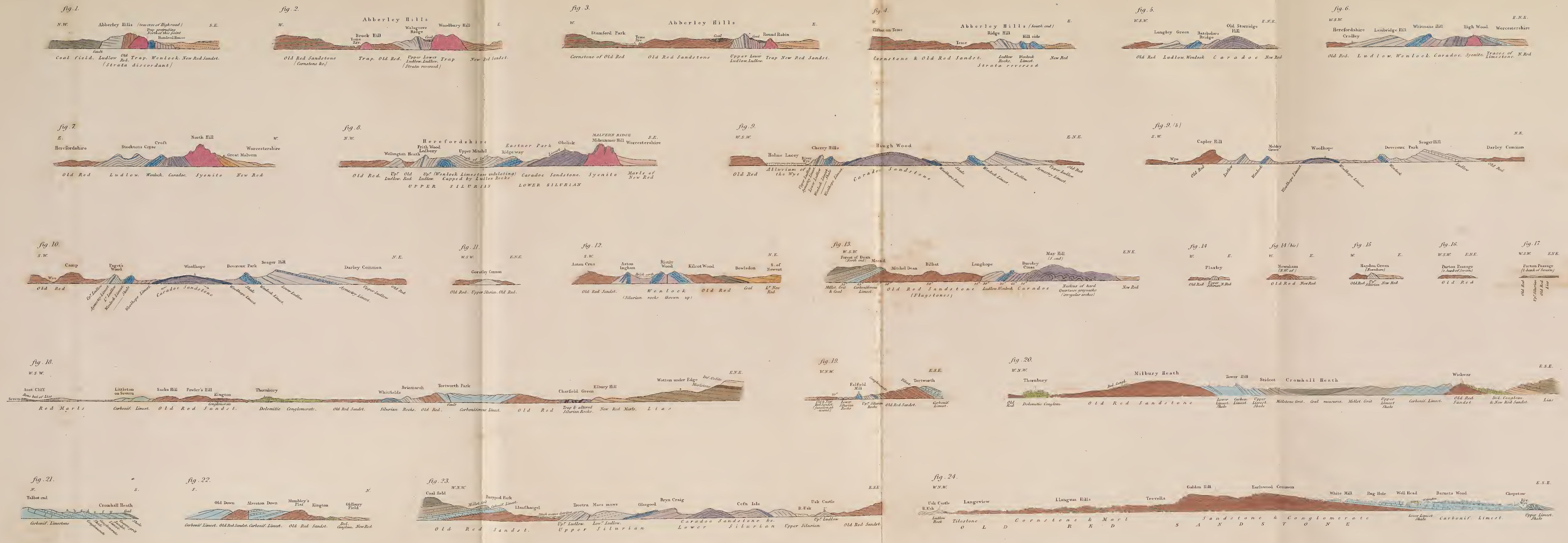


fig. 1.
N.W.
Abberley Hills
S.E.
Coal field. Ludlow. Old Red. Trap. Wenlock. New Red Sandst.
(Strata discordant)
fig. 2.
W.
Abberley Hills
Brock Hill
Walsgrove Ridge
Woodbury Hill
E.
Old Red Sandstone (Cornstone &c.)
Trap. Old Red.
Upper Lower Ludlow. Ludlow. (Strata reversed)
Trap
New Red Sandst.
fig. 3.
W.
Stamford Park
Abberley Hills
Round Robin
E.
Cornstone of Old Red
Old Red Sandstone
Upper Lower Ludlow. Ludlow.
Trap New Red Sandst.
fig. 4.
W.
Clifton on Teme
Abberley Hills (South end)
Ridge Hill
Hill side
E.
Cornstone & Old Red Sandst.
Strata reversed
New Red
fig. 5.
W.S.W.
Longley Green
Old Storridge Hill
E.N.E.
Old Red
Ludlow. Wenlock.
Caradoc
New Red
fig. 6.
W.S.W.
Herefordshire
Cradley
Lonbridge Hill
Whitmans Hill
High Wood.
Worcestershire
E.N.E.
Old Red. Ludlow. Wenlock. Caradoc. Syenite.
N. Red
fig. 7.
E.
Herefordshire
Stocktons Copse
Croft
North Hill
Great Malvern
Worcestershire
W.
Old Red Ludlow. Wenlock. Caradoc. Syenite New Red
fig. 8.
N.W.
Herefordshire
Wellington Heath
Frith Wood
Ledbury
Upper Mitchell
Ridge way
Eastnor Park
Obelisk
MALVERN RIDGE
Midsummer Hill
Worcestershire
S.E.
Old Red.
Caradoc Sandstone.
Syenite
Marls of New Red
UPPER SILURIAN
LOWER SILURIAN
fig. 9.
W.S.W.
Holme Lacey
Cherry Hills
Haugh Wood
E.N.E.
Old Red
Alluvium of the Wye
Caradoc Sandstone
fig. 9. (b)
S.W.
Capler Hill
Wye
Woolhope
Devereux Park
Seager Hill
Darley Common
N.E.
fig. 10.
S.W.
Camp
Pagets Wood
Woolhope
Devereux Park
Seager Hill
Darley Common
N.E.
Wye
Old Red
Caradoc Sandstone
fig. 11.
W.S.W.
Gorstley Common
E.N.E.
fig. 12.
S.W.
Aston Crux
Rustly Wood
Kilcot Wood
Bowlsdon
N.E.
Old Red Sandst.
Wenlock
(Silurian rocks thrown up)
Old Red
fig. 13.
W.S.W.
Forest of Dean
Mitchel Dean
Bilbut
Longhope
May Hill
E.N.E.
Old Red Sandstone (Flagstones)
Caradoc
New Red
fig. 14
W.
Flaxley
E.
fig. 14 (bis)
W.
Newnham
E.
fig. 15
W.
Haydon Green
E.
fig. 16.
W.S.W.
Purton Passage
E.N.E.
Old Red
fig. 17
W.S.W.
Purton Passage
E.N.E.
fig. 18.
W.S.W.
Aust Cliff
Littleton on Severn
Sacks Hill
Fowler's Hill
Kington
Thornbury
Whitfields
Brinmarch
Tortworth Park
Charfield Green
Elbury Hill
Wotton under Edge
E.N.E.
Red Marls
Carbonif. Limest.
Old Red Sandst.
Dolomitic Conglomerate.
Old Red Sandst.
Silurian Rocks.
Old Red.
Carboniferous Limest.
Old Red
New Red Marls.
Lias
fig. 19.
W.N.W.
Falfield Mill
Tortworth
E.S.E.
Old Red Sandst.
fig. 20.
W.N.W.
Thornbury
Milbury Heath
Tower Hill
Stidcot
Cromhall Heath
Wickwar
E.S.E.
Dolomitic Conglom.
Old Red Sandstone
Millstone Grit.
Coal measures.
Millst. Grit
Carbonif. Limest.
Old Red Sandst.
Lias
fig. 21.
N.
Talbot end
Cromhall Heath
S.
Carbonif. Limestone
fig. 22.
S.
Old Down
Alveston Down
Mumbley's Plat
Kington
Oldbury Field
N.
Carbonif. Limest.
Old Red Sandst.
Carbonif. Limest.
Old Red Sandst.
New Red
fig. 23.
W.N.W.
Coal field
Llandhangel
Treetra
Glasgood
Bryn Craig
Cefn Isla
Usk Castle
E.S.E.
Old Red Sandst.
Upper Silurian
Caradoc Sandstone &c.
Lower Silurian
Upper Silurian
Old Red Sandst.
fig. 24.
W.N.W.
Usk Castle
Langeview
Llanguan Hills
Trevella
Golden Hill
Earlswood Common
White Mill
Well Head
Barnets Wood
Chepstow
E.S.E.
Tilestone
Cornstone & Marl
Sandstone & Conglomerate
OLD RED SANDSTONE
Carbonif. Limest.

fig. 1

N.W.

Coal f

fig. 7.

E.

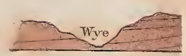
Herefords

Old

fig. 10.

S.W.

. Camp

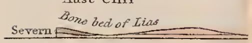


Old Red

fig. 18.

W.S.W.

Aust Cliff



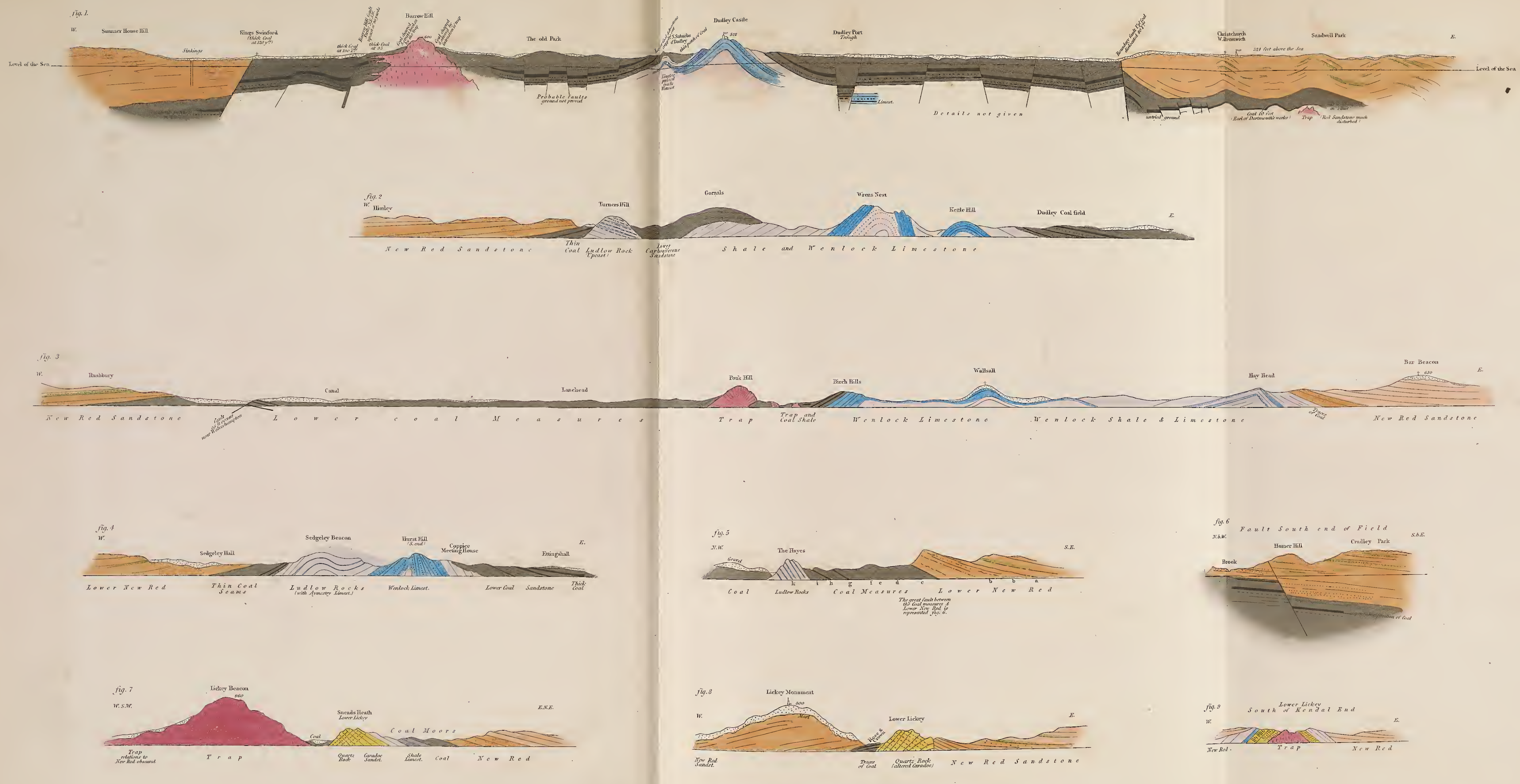
Red Mar

fig. 21.

N.

Talbot end.

Carbonif. Limestone



Rod. I. Murchison

Level of the Sea

fig. 3

W.

N e w