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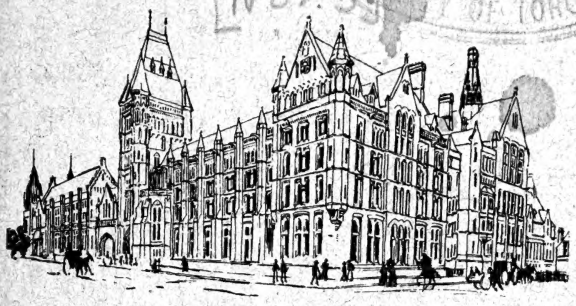

THE PALÆONTOLOGY OF THE LANCASHIRE COAL MEASURES.

PART I.

BY

H. BOLTON, F.R.S.E.,

Curator of the Bristol Museum.

Reprinted from the
Transactions of the Manchester Geological and Mining Society,
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THE PALÆONTOLOGY OF THE LANCASHIRE COAL MEASURES.

By Mr. H. Bolton, F.R.S.E., The Museum, Bristol.

PART I.

The present paper contains the results of a series of observations carried on over a period of years upon the character, and vertical and geographical range of the fossils of the Lancashire Lower Coal Measures. The opportunity to further prosecute the study has ceased with the writer's removal from Manchester, and it seems desirable that the results so far as they have proceeded should be made available for other workers in the same field. The observations now recorded have been obtained by field work, and a careful examination of all collections to which access could be gained. Mainly, however, they are the result of examination and determination of the large collection of Lower Coal Measure fossils in the Manchester Museum, Owens College, made while the writer was an Assistant Keeper at that institution. So far as possible an attempt has been made to compile a list of all the animal fossils known, their horizon, and the locality where they are known to occur. Such a compilation, if accurate and fairly complete, will be of service as showing the range in time, and the geographical distribution within the known limits of the Lancashire Lower Coal Measures. The difficulties attending the task have increased of late years, owing to the working out of the coal in many places, and the consequent abandoning of the mines, which have speedily become choked up by roof falls and the accumulation of water.

The Lancashire Lower Coal Measures consist of beds of shales with thin ironstones, sandstones, flags, and thin coals, having a total thickness of 1,000 to 1,800 feet

The coal seams in descending order are as follows:—

PASTURE, BASSEY, AND OTHER THIN COALS.

Ft.	in.		
1	0	Upper Mountain Mine.	
0	2	Fireclay Coal.	
0	8	Upper Foot Mine	Mountain 4 ft.
2	6	Lower Mountain Mine	
0	8	Lower Foot Mine.	
2	0	Salts Mine.	
0	10	First Coal.	

It will be noticed that none of the coals are of great thickness, the chief being the Mountain Four Feet, which has been worked under a variety of names in the Burnley and Colne districts.

The Lower Mountain Mine, better known as the Gannister, has been very generally worked, and to a still less degree, the Upper Mountain Mine, and the Salts or Bassey seams.

The remarkable series of names which have been applied to the various seams in different districts, and at various times, has been dealt with in a previous paper by the author, and needs no further reference here.*

With the exception of one horizon, and the occasional occurrence of bands of Carbonicola (Anthracosia) in the shales, the beds are but moderately fossiliferous in point of species, although at times prolific in numbers.

Fossils are most abundant in the black shales which overlie the coal seams, and scanty in the coarse sandstones, flags and grits.

In this paper it may appear that fossils are most often found in the shales which lie in close relation to the coal seams, but this apparent segregation is doubtless due in

* "The Nomenclature of the Seams of the Lancashire Lower Coal Measures."—*Trans. Manch. Geol. Soc., Vol. XXV., Part XVI.*

great measure to the fact that fossils are more readily obtainable from the roadways and roofs of the seams than from surface exposures, where they readily crumble away.

Surface exposures are fairly plentiful in cloughs and stream courses, but unfortunately both shales and fossils readily disintegrate when thus exposed, and little can be made of the latter.

Even if got out whole, the specimens are apt to fall in pieces on drying, unless they have been extracted from ironstone nodules or ironstone bands which occur in the shale.

The presence of iron pyrites is also a fertile cause of destruction.

The roof shales of the Upper Foot or Bullion seam contain great numbers of flattened spheroidal masses of earthy carbonate of lime with an outer crust of iron sulphide or pyrites, usually in a very stable condition. These "bawm-pots," as they were once called by the colliers, are richly fossiliferous, and must not be confounded with the more irregular masses known as "bullion balls," which occur in the coal itself, and consist of carbonised and well preserved plant tissues.

In the accompanying pages all the animal fossils of the Lancashire Lower Coal Measures, other than the gasteropoda and cephalopoda, are fairly completely recorded—so far as they are known up to the present time.

The gasteropod and cephalopod groups have been partially omitted, because the former is in great confusion —few definite species being recognised and several undescribed—the latter (cephalopod) group, including a number of species of *Orthoceras*, to which the same remark will apply.

Any attempt to record species of these groups, except such common forms as *Goniatites Listeri*, would inevitably be rendered nugatory when revision takes place, whilst likely in the meantime to prove misleading.

The lowest group represented by fossils is that of Vermes, the highest that of Amphibia, whilst the most prolific in point of species and numbers are the Mollusca and Pisces.

Vermes.

Worm castings and tracks are occasionally abundant in the coarse grits. They are well seen in a coarse, yellow sandstone, lying about 70 feet above the Upper Mountain Mine at Hoyle Hey Clough, Old Meadows, and Broadclough Heights, near Bacup.

Arenicola carbonaria, Binney.

Upholland Flags everywhere. (Salter, Geol. Surv. Mem., Geology of the Country round Oldham, p. 35.)

Spirorbis carbonarius, Murch.

Pimbo Lane (Over Gannister), Bispham Colliery (above Mount. Mine). (Salter, *op. cit.*, p. 35.)

Spirorbis pusillus.

As Microconchus, recorded by E. W. Binney and Professor Hull, from over the Lower Mountain (Bassey, H.B.) Mine, at Billinge. (Hull, Geol. Surv. Mem., Geology of the Country around Wigan, p. 10).

Brachiopoda.

Discina orbicularis.

Examples of this species have been obtained from the roof of the Four Feet Mine at Colne. *(W466, e. coll. Wild, M.M.)

* This and succeeding similar references indicate the Register numbers and the name of the collection in which the specimens quoted occur in the Manchester Museum, Owens College.

It is interesting to note that the same species occurs in the "marine band" of the Middle Coal Measures, at Ashton Moss Colliery, Audenshaw. The specimen from this locality is—(L2620, e coll. Cairns, M.M.).

Lingula mytiloides, or L. Credneri.

It seems impossible to say which of these two species is the one occurring so abundantly throughout the shales of the Lower Coal Measures.

The species is most common in the shales lying between the Lower Mountain mine or Gannister and the top bed of the Rough Rock. It is most easily found in the black shales, both in the coal measures and in those of the millstone grit series below.

Lingula mytiloides or L. Credneri occurs in the lowest shales of the Lower Coal Measures throughout Rossendale. Examples are in the Dugdale Collection, M.M.

Greens Clough, near Portsmouth, in shales over the Upper Rough Rock. E. coll. Dugdale, M.M.

Carre Heys, Colne, over the Mountain Four Feet (W 505 e. coll. Wild, M.M.).

Kersley Moor, horizon not known. M.M.

Pimbo Lane (over Gannister). (Salter, Geol. Surv. Mem., Geology of the Country around Oldham, p. 35).

Lingula sp. Occurs in association with Posidonia (Posidoniella), over the Gannister coal at Billinge. (Hull Geol. Surv. Mem., Geology of the Country around Wigan, p. 10).

Eagley Shore Bridge, north of Bolton, below the Gannister coal. (Op. cit., p. 34.)

PELECYPODA.

Carbonicola (Anthracosia) robusta.

This species is rare in the Lower Coal Measures. It is recorded by Hull as follows:—Above the Gannister coal at

Bradshaw Brook, half-a-mile below Bradshaw. (Hull, Geol. Surv. Mem., Geology of the County around Bolton-le-Moors, p. 34.) Below the Gannister coal at Eagley Shore Bridge, north of Bolton. (Hull, op. cit., p. 34.)

In black shale, above shale bed coal (Bassey Mine) at Rushton Colliery, near Blackburn. (Dr. Wheelton Hind, Monog. Carbonicola, &c., Pt. II., p. 159.)

Carbonicola (Anthracosia) rugosa.

A specimen of this species has been recorded from Cant Clough, near Burnley, by Dr. Wheelton Hind, in his Monog. on Carbonicola, &c., by whom it is doubtfully referred to the Yoredales. The horizon from which the specimen came is much more likely to be the Lower Coal Measures.

Carbonicola (Anthracosia) acuta.

This species has been recorded from the roof of the Mountain Mine at Bankhouse, Shaw, near Oldham. The valves are curiously elongated, and seem to approach C. aquilina. (W. 539 e. coll. Wild, M.M.)

Shales over Lower Mountain or Gannister seam, at Stacksteads colliery, near Bacup. Found by the late John Lord, and in his collection.

Dr. Hind, in his diagrams of the Wigan and Blackburn district (op. cit., p. 159), indicates that this species occurs, in the one case (Wigan) between the Rough Rock and the Lower Foot Coal, and in the other (Rishton, near Blackburn) immediately over the Shale Bed coal (Bassey or Salts seam) in association with C. aquilina and C. robusta.

The horizon is probably the same in both cases, and identical with that given here for C. aquilina in the Rossendale district.

In the diagram of the coal measures in the Oldham district, Dr. Hind records C. acuta over the First Coal of

the Holcombe Brook series (Bolton), from the Gannister or Lower Mountain Mine, in association with A. subconstricta, and from the 40 yards or Upper Mountain Mine at Burrs, half-a-mile north of Bury, in association with C. aquilina, Anthracomya Williamson, and A. Wardi.

Over Gannister coal, Broadfield, east of Rochdale. (Salter, Geol. Surv. Mem., Geology of the Country around Oldham, p. 61.)

Over Gannister, Pimbo Lane, Bispham Colliery. (Salter, Geol. Surv. Mem., Geology of the Country around Oldham, p. 35.)

Carbonicola (*Anthracosia*) *acuta var. rhomboidalis.*

This species is represented by (L. 2066) in the Kay-Shuttleworth collection in the Manchester Museum, Owens College. The specimens are from Burnley, but the horizon is not stated. It may be either Lower or Middle Coal Measures.

Carbonicola (*Anthracosia*) *acuta var ovalis.*

Above the Gannister coal at Bradshaw Brook, half-a-mile below Bradshaw. (Hull, Geol. Survey Mem., Geology of the Country around Bolton-le-Moors, p. 35.)

Above the 40 yards or Upper Mountain Mine at Burrs, half-a-mile north of Bury. (Op. cit., p. 35.)

Over Gannister coal at Bagslate Moor, $1\frac{1}{2}$ miles north of Rochdale. (Salter, Geol. Surv. Mem., Geology of the Country around Oldham, p. 61.)

Carbonicola (*Anthracosia*) *subconstricta.*

"Mussel-band" below the Mountain Four Feet seam, Burnley. Examples are in the Kay-Shuttleworth Collection, M.M.

Over Gannister or Mountain Mine in the Oldham district, associated with C. acuta. (Dr. Hind's Monog., p. 161.)

Carbonicola (Anthracosia) nucularis.

This species is recorded by Dr. Hind in his Monog. on Carbonicola, &c. (p. 63 and p. 159), as occurring in the Lower Mountain Mine, Wigan.

Carbonicola (Anthracosia) aquilina.

This species is essentially the Carbonicola of the Lancashire Lower Coal Measures. It occurs in vast numbers in the shale immediately overlying the Bassey or Salts mine at Greave and Oaken Cloughs, near Bacup. It also occurs at Grime Bridge Clough. Specimens from Oaken Clough are in the Dugdale Collection, M.M.

Also at Helpet Edge, Saddleworth. Specimens are mostly in the form of internal and external casts. The species must have covered large banks of mud judging from its abundance at the localities named, it also ranges upwards to the shales under the Upper Mountain Mine. Carbonicola aquilina is probably the species recorded by C. Dugdale from his No. 6 bed of the Lower Coal Measures. (C. Dugdale, Trans. Man. Geol. Soc., Vol. XIX.)

Associated with C. acuta and C. robusta above Shale Bed coal (Bassey or Salts seam) at Rishton Colliery, near Blackburn.

Above the 40 yards or Upper Mountain Mine associated with C. acuta, Anthracomya Williamsoni, and A. Wardi at Burrs, half-a-mile north of Bury.

Carbonicola (Anthracosia) sp.

Over Mountain Four Feet Seam at Carre Heys, Colne. (W. 658 e coll., Wild, M.M.)

Anthracomya Williamsoni.

This species is recorded by Dr. Wheelton Hind from the Upper Mountain Mine, Burrs, half-a-mile north of Bury.

(Monog. Carbonicola, &c., Pt. II.; Mem. Palaeont. Soc., p. 100 and p. 161.) Specimen in the Jermyn Street Museum.

Anthracomya Wardi.

The same horizon is given by Dr. Wheelton Hind for this species as the last, namely:—Upper Mountain Mine, Burrs, half-a-mile north of Bury. (Op. cit. p. 106.) Specimen in the Jermyn Street Museum.

Anthracomya sp.

Above the Upper Mountain Mine at Burrs, half-a-mile north of Bury. (Hull, Geol. Surv. Mem., Geology of the County around Bolton-le-Moors, p. 35.)

Bispham Colliery, over Gannister coal. (Salter, Geol. Surv. Mem., Geology of the Country around Oldham, p. 35.)

Naiadites (Anthracoptera).

Naiadites modiolaris.

I have not seen a specimen of this species from the Lower Coal Meaures, but it is recorded by Dr. Wheelton Hind, from "30 feet below the Arley Mine, Rochdale." (Op. cit., p. 133.)

Naiadites quadrata.

This species is recorded by Dr. Wheelton Hind, from Bunker's Hill, west of Rochdale, 30 feet below the Arley Mine. (Op. cit., p. 141.)

Naiadites crassa.

This species was first recorded from the Lower Coal Measures by the late C. Dugdale under the name of Myalina crassa var modioliformis. It occurs in 50 feet of black shale under the Woodhead Hill rock and immediately above the ten-inch coal.

At Troughgate, near Bacup, a band of shale, two feet thick and full of this shell, was cut through in the railway cutting. The band was hard enough to take a polish, and was locally known as "*Troughgate Marble.*"

Examples are in the Dugdale Collection, M.M., and the museum of the Bacup Natural History Society.

Naiadites sp.

Naiadites, the species of which are not mentioned, are stated by Dr. Hind to occur in the Oldham district, immediately over the First Coal above the Millstone Grit, and also high up in the Gannister Series. (Monog. Carbon., &c., p. 161.)

Above the Upper Mountain Mine at Burrs, half a mile north of Bury. (Hull, Geol. Surv. Mem., Geology of the Country around Bolton-le-Moors, p. 35.)

S. antiquus, Hind.

Roof of Mountain Four Feet, Carre Heys, near Colne. (W 626 and W 627, e coll. Wild, M.M.)

Lower Coal Measures of Burnley. (L 2081, e coll. Kay-Shuttleworth, M.M.)

The specimen (W 627) was figured by Mr. Geo. Wild as "Anthracosia, new angular species." Trans. Manch. Geol. Soc., Vol. XXI., Pl. II., fig. 7. (W 626) is associated with ostracods.

Posidoniella (Posidonomya).

Posidoniella laevis.

This pretty little shell has long been known to Lancashire collectors as Posidonia Gibsoni. It is especially characteristic of the roof shales of the Upper Foot or Bullion Mine and the Mountain Four Feet, where it occurs in great numbers, almost everywhere where these seams are exposed. It also ranges down to the Yoredale shales in the Todmorden Valley, where it was first found.

Recorded specimens are as follows :—

Posidonia Gibsoni, Brown. A specimen so named is in the Manchester Museum. Pimbo Lane (over Gannister coal), Bispham Colliery. (Salter, Geol. Surv. Mem., Geology of the Country around Oldham. p. 35.)

Roof of Mountain Four Feet, Townhouse, Brierfield, near Colne (W 633, e coll. Wild, M.M.).

Roof of Mountain Four Feet Mine, Trawden, near Colne (W 636, e coll. Wild, M.M.).

Roof of Upper Foot or Bullion Coal, Sholver, near Oldham (W 630, e coll. Wild, M.M.). (W 628) from the same locality is associated with Goniatites Gilbertsoni.

Roof of Mountain Four Feet, Burnley. (L 2084, e coll. Kay-Shuttleworth, M.M.)

Found in No. 10 bed of C. Dugdale, at Greens Clough, near Portsmouth. The horizon is low down in the series. Specimens in the Dugdale collection, M.M.

Roof of Mountain Four Feet, and Bullion Seam at Sharneyford, Reaps Clough, and Heighter Hey, near Bacup. Specimens in the Dugdale collection, M.M., and Museum of the Bacup Natural History Society.

Roof of Upper Foot or Bullion Seam at Dearnley, near Rochdale. (W 635, e coll. Wild, M.M.)

Over Gannister coal, Pimbo, near Wigan. (Dr. Hind: Monog. carbonif. Lamellibranchiata, p. 25, Pal. Soc., 1897.)

In shale nine feet above Bullion or Upper Foot Seam in Oakenclough, opposite a house called Pasture Bottom. Collected by the Author. As Monotis laevis recorded from Shore Edge, four miles north of Oldham, above the Gannister coal. (Salter. Geol. Surv. Mem., Geology of the Country around Oldham, p. 62.)

Posidoniella minor.

This species is a smaller form than the last and often confounded with it, and has an equally wide range.

Roof of Mountain Four Feet, at Trawden, near Colne. (W 629, e coll. Wild, M.M.)

In shale above the Upper Rough Rock at Tower Clough, Cliviger. Collected by the Author, and e. coll. Dugdale, M.M.

Roof of Bullion or Upper Foot seam, Heighters Hey, near Sharneyford. (e coll. Dugdale, M.M.)

In shales below the Old Lawrence or Tumbling Cob rock, and above the Gannister or Lower Mountain Mine at Heighters Hey, near Sharneyford. Collected by the Author.

Roof of Bullion or Upper Foot Seam throughout Rossendale. Collected by the Author, and collections in the Museum of the Bacup Natural History Society.

Posidoniella subquadrata.

This species is very rare, and so far is only recorded from two Lancashire localities. As the shales at these localities are very fossiliferous, careful search will almost certainly result in the finding of more.

Roof of Mountain and Four Foot Seam at Colne.

Roof of Bullion or Upper Foot Seam at New Hey, near Rochdale. (P 1779 e coll. Dawkins, M.M.)

Roof of Bullion Seam at Dearnley, near Rochdale. (Dr. Hind, *op. cit.*, p. 101.)

Posidoniella laevigata.

As Posidonia lævigata recorded by Salter from above the Bullion Coal at Sholver, two miles north-east of Oldham. (Salter. Geol. Mem. Surv., Geology of the Country around Oldham, p. 62.)

Posidoniella sp.

As Posidonia from over the Gannister coal at Billinge. (Hull Geol. Surv. Mem., Geology of the Country around Wigan, p. 10.)

Monotis (?) obtusa.

From Count Hill, north-east of Oldham, from above Gannister coal. (Salter. Geol. Surv. Mem., Geology of Country around Oldham, p. 61.)

Aviculopecten papyraceus.

This species occurs in the greatest abundance in the shales over the Bullion or Upper Foot Seam and the Mountain Four Feet. Where found in the "bawm-pots" the shells are usually uncrushed and in splendid preservation. Occasionally in the shales south of Bacup (Sharneyford) a mass of what appears at first sight to be shale, three or four inches in thickness, is found to consist almost wholly of the thin flattened valves of this species. Roof of Mountain Four Feet Seam at Trawden, Colne. (W 639, e coll. Wild, M M.)

From above the Gannister Coal at Roebuck Low, half mile N.E. of Oldham; Ogden Mill, five miles N. of Oldham; Shore Edge, four miles N. of Oldham; Count Hill, N.E. of Oldham; Dog Hill, Oldham.

From above the Bullion Coal at Sholver, two miles N.E. of Oldham.

From above Gannister Coal at Lower Lomax, Bury. (Hull, Geol. Surv. Mem., Geology of the Country around Bolton-le-Moors, p. 35.)

Shaley Brow, over the Bullion Coal. (Salter. Geol. Surv. Mem., Geology of the Country around Oldham, p.35.)

Roof of Bullion or Upper Foot Seam, Dulesgate, near Todmorden. (P 801, e coll. Dawkins, M.M.)

Roof of Bullion or Upper Foot Seam throughout Rossendale. Collected by the Author.

Shales over Bullion or Upper Foot Seam at Heighter Hey, Sharneyford. (e coll. Dugdale, M.M.)

Roof of Mountain Four Feet at Burnley, Lancashire. (L2080 e coll. Kay-Shuttleworth.)

Roof of Bullion or Upper Foot Seam at Sholver, Oldham. (W643 e coll. Wild, M.M.)

And ditto, Moorside, Oldham. (W641 e coll. Wild, M.M.)

Ditto, at New Hey, near Rochdale. (e coll. Dawkins, M.M.)

Ditto, at Hough Hill, Stalybridge, in shales and "bawm-pots." (W642 e coll. Wild, M.M.)

Ditto, at Starring, Dearnley, near Rochdale. (W640 e coll. Wild, M.M.)

Ditto, at Cloughfoot, Rossendale. Coll. J. A. Lee, Museum of the Bacup Natural History Society.

Nucula sp.

Roof of Bullion or Upper Foot Seam at Carre Heys, Colne. (W652 e coll. Wild, M.M.)

"*Crassa minima.*"

Roof of Mountain Four Feet Seam at Carre Heys, Colne. (W648 e coll. Wild, M.M.)

Ditto, Bullion or Upper Foot Seam at Sholver, near Oldham. (W647 e coll. Wild, M.M.)

Ditto, at Hough Hill, Stalybridge. (W1212 e coll. Wild, M.M.)

"*Solenomya primæva.*"

Roof of Bullion or Upper Foot Seam, Carre Heys, Colne. (W650 e coll. Wild, M.M.)

GASTEROPODA.

In the earlier part of this paper mention was made of the present unsatisfactory position of the gasteropods of the coal measures. This is probably due to the fact that the

extreme rarity of specimens, and the difficulty of sufficiently clearing them from the matrix to determine their species, have acted as deterrents to investigators.

The few which do occur can be divided into three groups, according to their form. Those of least rarity are usually found flattened in the shales, and are turreted shells of from five to eight whorls, either with smooth surfaces or marked by transverse ridges. They have been classed with Buccinum, Turritella, Loxonema, Macrocheilus, Melania and Rissoa.

It is very probable that most of them will be found to fall ultimately into the families Melaniidae and Rissoidae.

The second group includes two or three forms in which the last or body chamber is much swollen, and the spire relatively inconspicuous. It includes forms apparently belonging to the genera Natica and Naticopsis. To the third group belong shells of a Bellerophon type. Seven species of the latter genus are recorded from the English Lower Coal Measures, and one (B. Urii) from the Middle series.

I have found gasteropod shells of a Melania type on two or three occasions in the shales lying between the Bullion or Upper Foot Seam, and the Upper Mountain Mine in the Rossendale district.

From "Bawm-pots" taken from the roof of the Bullion or Upper Foot seam in the Bacup district, I have obtained several specimens of a small shell—Raphistoma (?) ornata—and in several collections of fossils from the same horizon, but where the Bullion seam is joined to the Gannister to form the Mountain Four Feet, as at Carre Heys, Colne, is to be found a small but very perfect shell—Naticopsis globularis.

Both species were described and figured in the Manchester Memoirs, Vol. XLI. (1897), No. 6, by the writer.

The type specimens are in the Manchester Museum, and are registered as follows:—

Raphistoma (?) ornata, Bacup, Rossendale. (L. 3494, e coll. Bolton.)

Naticopsis globularis, Carre Heys, Colne. (W. 467, e coll. Wild.)

Cephalopoda.

Our knowledge of the cephalopoda of the coal measures is at present of the scantiest. They are mainly restricted to the Lower coal measures, if we except a very few, most of which are found in the remarkable "marine band" at Dukinfield. Whilst cephalopods were fairly abundant both in species and numbers during the marine phase of the Carboniferous Limestone, and also of large size, they show a great falling off in the succeeding Yoredale shales and Millstone Grit series.

A comparison of a series of cephalopod forms from the whole of the Carboniferous System shows that there was, with the passage from the purely marine conditions of the Carboniferous Limestone to the later littoral and lagunal conditions of the Millstone Grit and Coal measures, an equally progressive reduction in size, numbers, and species.

The inference seems clear that the altered conditions were unfavourable to cephalopod life, and resulted in starvation.

The occurrence of cephalopods in the Coal measures is restricted to those horizons which from their fossil contents indicate some return to the original marine conditions.

This is notably the case with the shales forming the roof of the Mountain Four Feet and Bullion Seams, where most of the cephalopods of the Coal Measures occur.

The genera are those of the Yoredales and Carboniferous Limestone.

Nautiloid forms are as follows :—

Ephipphioceras costatum.
,, clitellarium.
Coelonautilus subsulcatus.
,, quadratus.
Pleuronautilus falcatus.
Temnocheilus concavus.
,, carbonarius.

These occur rarely in the shales and "bawm-pots" over the Mountain Four Feet and Bullion Seams in the Burnley and Rossendale districts.

Examples of most of these species are, I believe, in the Manchester Museum.

The genus Orthoceras is represented by several species in the Lower Coal measures, all of which stand in great need of illustration and description. The specific names given by the older workers are of little value as guides, and some of the specific terms used by them are not recognised by later workers.

One form recorded from the shales about the Upper Mountain mine at Hoyle Hey Clough, near Bacup, has often to the writer's knowledge been recognised as O. teres, a species placed by Crick and Foord (Cat. Foss. Ceph., Part I., p. 121) in the Carboniferous Limestone of Scotland. A second species has received the name of O. cinctum, which is a synonym for O. discrepans of the Belgian Carboniferous Limestone.

Still another form is the Orthoceras obtusum of Brown, a species moderately common in the "bawm-pots" over the Mountain Four Feet and Bullion seams. This species is not

recorded by Messrs. Crick & Foord in their British Museum Catalogue. It is, however, so well defined a form that the specific name will probably stand.

An excellent figure of a specimen of this species from the Mountain Four Feet seam is given in Mr. Geo. Wild's paper "The Lower Coal Measures of Lancashire." (Trans. Manch. Geol. Soc., Vol. XXI.)

When the Orthoceratites of the Coal Measures are revised and described, it is the writer's belief that at least half-a-dozen species will be found to occur in the Lower Coal Measures. An undescribed species is recorded by Salter from Shore Edge, four miles north of Oldham, from the roof of the Gannister Coal. (Salter, Geol. Survey Mem., Geology of the Country around Oldham, p. 62.)

At least three species of Orthoceras occur in the "bawm-pots" already alluded to, and in the shales lying above the Upper Mountain Mine of the Rossendale district.

The Ammonoidea forms of the Cephalopod group, more familiarly known as Goniatites, are amongst the best known of Lower Coal Measure fossils, and where they occur in the "bawm-pots" are in splendid preservation. It is not, therefore, surprising that eight species are known. They can be found in many more localities than are recorded here, the fewness of localities being due to the fact that safe specific determination has only become possible of late years, and the older specimens are usually not localised. All the species may be looked for with a fair degree of certainty in the Burnley coalfield, in Rossendale, and along the band of Lower Coal measures which stretch from Littleborough by Dearnley and Rochdale to New Hey and Oldham.

The species known and their horizons and localities are as follows:—

Glyphioceras (Goniatites) sp. near truncatum.

An undescribed species, supposed to be closely allied to G. truncatus, is recorded by Salter from Roebuck Low, 1½ miles N.E. of Oldham, from over the Gannister Mine. (Salter, Geol. Surv. Mem., Geology of the Country around Oldham, p. 62.)

Glyphioceras (Goniatites) reticulatum.

Recorded by Hull as Goniatites Gibsoni, from above Lower Lomax, Bury, opposite Broad Oak Mill, from above the Gannister coal. (Hull, Geol. Surv. Mem., Geology of the Country around Bolton-le-Moors, p. 35.)

Glyphioceeas (Goniatites) diadema.

This species is recorded by Messrs. Crick and Foord from the Coal Measures of Rochdale. From the description of the specimens (C5908, Brit. Mus.) there is little doubt that the horizon is that of the Bullion or Upper Foot Seam.

Glyphioceras (?) (Goniatites) paucilobum.

This species is only recorded by Messrs. Crick and Foord from the Carboniferous Limestone of Yorkshire.

It is mentioned by Salter as also occurring at Sholver, two miles north-east of Oldham, over the Bullion coal. (Salter. Geol. Surv. Mem., Geology of the Country around Oldham, p. 62.)

Dimorphoceras (Goniatites) Gilbertsoni.

This species is generally known to collectors as "Goniatites atratus," and occasionally is found by hundreds in a single "bawm-pot." It can be found in all sizes from a pin's head up to others having a diameter of 15m.m. Larger specimens are rare. It occurs abundantly in the "bawm-pots" over the Mountain Four Feet seam in the Burnley district, and less frequently over the Bullion coal.

Specimens from Carre Heys and Trawden, near Colne, are in the Wild Collection of the Manchester Museum.

Examples from the Lower Coal Measures of Watersheddings, near Oldham, are in the Geo. Scott collection of the Museum of the Bacup Natural History Society.

It is recorded from Halifax by Messrs. Crick and Foord in association with D. discrepans and D. Looneyi. The latter ought therefore to be looked for over the Mountain Four Feet and Bullion seams in Lancashire localities.

Gastrioceras (Goniatites) carbonarium.

This species has unfortunately been long confused with the more familiar G. listeri, and often recorded as the latter. They are often found in association over the Mountain Four Feet and Bullion Seams, but G. carbonarium is the rarer of the two, and appears to be restricted to the horizon mentioned, whilst G. listeri ranges downwards to the bottom of the Coal Measures.

The distribution is general throughout the Burnley, Rossendale, and Oldham districts. A specimen from Burnley Moor (C68082) is in the British Museum collections, as also a second specimen (C2273) from Lancashire, with no locality.

Gastrioceras (Goniatites) Listeri.

We have already stated that this species occurs as a common fossil over a wide area. Almost all collections of Lancashire Coal Measure fossils contain several specimens of the species, chiefly obtained from the horizon mentioned.

It is recorded by Salter from the roof of the Gannister Coal at—

Shore Edge, four miles N. of Oldham.
Ogden Mill, five miles N. of Oldham.
Roebuck Low, one and a half miles N.E. of Oldham.

From the Bullion Coal of Sholver, four miles North of Oldham.

(Salter, Geol. Mem. Surv., Geology of the Country around Oldham, p. 62.)

Shaley Brow, Pimbo Lane (over the Bullion Coal). (Salter, Geol. Surv. Mem., Geology of the Country around Oldham, p. 25.)

Gastrioceras (Goniatites) coronatum.

This is a beautiful little shell, only recorded as yet from the roof of the Mountain Four Feet and Bullion Seams of Sharneyford, near Bacup, where it was found by the writer.

Specimens from the locality are in the British Museum, (C5938) and the Manchester Museum.

CRUSTACEA.

Crustacea are very feebly represented in the Lower Coal Measures, both in numbers and species. This is equally true of those forms familiarly known as Ostracoda as of higher forms.

The development of the Ostracoda group in the whole series of Lancashire Coal Measures is likely to prove an interesting study owing to the fact that specimens are rare in the Lower series, moderately abundant in the Middle Coal Measures, and practically swarm in the Upper series, the increase of genera and species proceeding with the increase of numbers.

The Ostracoda from the Lower Coal Measures are as follows :—

Estheria striata.

Recorded from bituminous coal of the Lower Coal Measures by Professor Rupert Jones (Pal. Soc. Mem., Fossil Estheriae, p. 24.)

Estheria striata, var. Beinertiana.

Bullion coal. Shaley Brow, near Billinge Hall. (Salter. Geol. Surv. Mem., Geology of the Country around Oldham, p. 35.)

Estheriæ.

Roof of Bassey or Salt's coal; also in shale over 40 yards (Upper Mountain Mine) coal, and in shale lying over the two inch coal. (Prof. Rupert Jones, op. cit., p. 29).

Roof of the Mountain Four Feet Mine at Carre Heys, Colne, associated with an example of Schizodus deltoideus. (W626, e coll. Wild, M.M.)

Beyrichia arcuata.

Below Gannister coal at Eagley Shore Bridge, north of Bolton. (Hull. Geol. Sur. Mem., Geology of the Country around Bolton-le-Moors, p. 34.)

Above Gannister coal at Bradshaw Brook, half-a-mile below Bradshaw. (op. cit., p. 34.)

Beyrichia sp.

In grey shale above the Bullion coal at Broad Oak Mill, Bury. (Salter. Geol. Surv. Mem., Geology of the Country around Oldham, p. 19.)

Below Gannister coal at Eagley Shore, north of Bolton. (Hull. Geol. Surv. Mem., Survey of the Country around Bolton-le-Moors, p. 34.)

Cypris or Cythere.

Over Lower Mountain Mine (Gannister Mine, H.B.), at Billinge. (Hull. Geol. Surv. Mem., Geology of the Country around Wigan, p. 10.)

Cytheropsis sp.

Over Bullion coal. Pimbo Lane, Bispham Colliery. (Salter. Geol. Surv. Mem., Geology of the Country around Oldham, p. 35.)

Pygocephalus Cooperi.

A single example of this rare and aberrant species was described by Huxley. It was found by Mr. George Wild above the Mountain Four Feet coal at Carre Heys, Colne, in

a bed of shale with nodules called the "Soapstone Bed." (W508, e coll. Wild, M.M.)

Only one other specimen is known, from the Middle Coal Measures of Medlock Park Bridge, Ashton-under-Lyne. This is also in the Manchester Museum.

Anthrapalaemon Etheridgii.

A specimen of the cephalothorax of this species was found in the Lower Coal Measures of Cant Clough, near Burnley, in 1884. It came into the writer's possession, by whom it was verified at the British Museum. The specimen was afterwards lost.

Cyclus Scotti.

The type specimen of this species was found by Mr. George Scott in shale over the Gannister coal at the Old Meadows Colliery, Bacup. It is now in the Manchester Museum. (L926, M.M.)

Prestwichia rotundata.

A specimen of this species is in the Kay-Shuttleworth collection (L2161) at the Manchester Museum. It was obtained from Padiham, near Burnley, and whilst its horizon is unknown the writer regards it as almost certainly in the Lower Coal Measures, and from the horizon of the next species, viz., the Mountain and Four Feet Mine.

Architarbus subovalis.

The type and only specimen of this species was described by Dr. Henry Woodward in 1872, where it is stated that it occurred in a clay-ironstone nodule from about four feet above the "four-feet mine," or "bone-coal" of Padiham.

This description seems to indicate the horizon as above the Mountain Four Feet, a supposition which is strengthened by the fact that the horizon of the species is placed by Mr. R. Etheridge in the Lower Coal Measures. (Etheridge. Fossils of the British Islands, Pl. I., p. 243.)

Pisces.

The fishes of the Lower Coal Measures are mainly represented by detached scales and teeth, whole fishes being extremely rare. A few have been found in the nodules overlying the Mountain Four Feet seam, and fragmentary remains in the ironstone nodules lying over the Bullion seam.

It is a curious fact that fish teeth, scales, &c., always occur in greatest profusion in the shales lying immediately upon the coal seams, and most of all in their lower layers, and even upon the upper surface of the coal itself.

Possibly this can be accounted for by the conditions being unfavourable to life in those waters which lay over the peaty mass representing the present coal seams after their subsidence.

Hybodopsis Wardi.

This rare species is represented by a mass of teeth and six bone fragments from over the Mountain Four-Feet of Colne. The specimen is in the Wild Collection (W978) of the Manchester Museum.

Only one other example is known. It is in the collection of Mr. John Ward, of Longton, Staffordshire.

Sphenacanthus hybodoides.

A tooth from the Lower Coal Measures (Mountain Four-Feet) of Colne is in the Wild Collection of the Manchester Museum (W452).

Acanthodes Wardi.

This species has been found in the shales over the Mountain Four Feet seam at Colne. (W1145 e coll. Wild, M.M.)

Lepracanthus colei.

An interesting example of this fish spine from over the Lower Mountain Mine (Gannister, H.B.) of Burnley is in the Wild collection at the Manchester Museum. The specimen possesses two rows of denticles on the hind border, with the denticles of opposite sides alternating. (W958 e coll. Wild, M.M.)

Gyracanthus formosus.

From the roof of the Upper Mountain Mine at Hapton, near Burnley. (L2170 e coll. Kay-Shuttleworth, M.M.)

Listracanthus spinatus.

This species is founded upon a spine enclosed in a "bawm-pot" from the roof of the Mountain Four Feet or Bullion seam, which was found by the writer in the collections of the Salford Royal Museum, at Peel Park. The locality is unknown, but undoubtedly Lancashire.

A second specimen was found by the writer in the roof of the Bullion mine, at Bacup.

With the exception of an unknown species of Listracanthus from the "marine band" of the Middle Coal Measures of Dukinfield, these are the only recorded occurrences of the genus in the English Coal Measures.

Strepsodus sauroides.

This species has been recorded from over the Lower and Upper Mountain Mines of the Hapton valley, near Burnley.

Also from the roof of the Bullion seam, Oldham. This latter specimen is in the Dawkins collection of the Manchester Museum.

Rhizodopsis sauroides.

As "Rhizodus granulatus" this species is recorded by Salter as follows:—

From Little Mine next below the Gannister (Lower Foot H.B.) at Helpet Edge, Ogden Mill, four miles north of Oldham.

From the same horizon at Crompton Moor, four miles north of Oldham. (Salter. Geol. Surv. Mem., Geology of the Country around Oldham, p. 62.)

From over the Gannister coal at Kenyon Fold, two miles north of Rochdale.

As "Rhizodus granulatus" by Hull, from over the 40 yards or Upper Mountain Mine at Burrs, half-a-mile north of Bury. (Hull. Geol. Surv. Mem., Geology of the Country around Bolton-le-Moors, p. 35.)

Scales and teeth have been found by the writer in ironstone nodules over the Mountain Four Feet and Bullion seams at Sharneyford and Hoyle Hey Clough, near Bacup.

As "Rhizodus granulatus" from Gannister beds above the Lower Yard coal (Gannister H.B.) at Rosegrove, Broadbottom, south of Mottram. (Salter. Geol. Surv. Mem., Geology of the Country around Oldham, p. 62.)

Megalichthys Hibberti.

From above the Upper Mountain Mine in Rossendale. (e coll. Dugdale, M.M.)

At Reaps Clough, near Bacup, from above the Upper Mountain Mine. (e coll. Dugdale, M.M.)

From Lower Coal measures at Hollingworth, near Rochdale, horizon not stated. (e coll. J. A. Lee, Museum of Bacup Natural History Society.)

Recorded by Salter from the following horizons and localities in Geol. Survey Mem., Geology of the Country around Oldham, pp. 35 and 62.

From Lower Foot Mine, at Count Hill, north-east of Oldham.

Over Gannister coal at Bagslate Moor, one and a half miles north of Rochdale.

From Gannister beds above the Lower Yard seam (Gannister, H.B.) at Rose Grove, Broadbottom, south of Mottram.

From roof of Gannister coal at Halliwell, one and a half miles north-west of Bolton.

Recorded by Hull (Geol. Surv. Mem., Geology of the Country around Bolton-le-Moors, p. 35), from roof of Gannister coal at Halliwell, one and a half miles north-west of Bolton.

Megalichthys pygæmus?

A beautiful specimen, showing the greater part of a cranial shield, is in the Wild Collection of the Manchester Museum (W852), and is doubtfully referred by me to this species. It is from the Lower Coal Measures of Hapton, near Burnley.

Cœlacanthus elegans.

From roof of Bullion or Upper Foot seam at Pasture Bottom, Oakenclough, near Bacup. Found by the writer.

As Cœlacanthus sp. of Salter, from Mountain Mine of Bispham Colliery. (Salter. Geol. Survey Mem., Geology of Country around Wigan, p. 35.)

Ditto, above Gannister coal, at Bradshaw Brook, half a mile below Bradshaw. (Salter. Geol. Survey Mem., Geology of the Country around Bolton-le-Moors, p. 35.)

Over Gannister coal at Kenyon Fold, two miles north of Rochdale. (Salter. Geol. Surv. Mem., Geology of the Country around Oldham, p. 62.)

Rhadinichthys monensis.

Recorded as "Palaeoniscus monensis," from the Gannister coal at Bagslate Moor, one and a half miles north of Rochdale. (Salter. Geol. Surv. Mem., Geology of the Country around Oldham, p. 62.)

Also from above the Lower Yard seam (Gannister, H.B.) at Rose Grove, Broadbottom, south of Mottram. (Op. cit., p. 62.)

Rhadinichthys Planti.

From Burnley, Lancashire; horizon unknown. (e. coll. Kay-Shuttleworth, M.M.)

Elonichthys semistriatus.

From roof of Bullion or Upper Foot seam at Pasture Bottom, Oakenclough, near Bacup. (Bolton. Trans. Man. Geol. Soc., Vol. XX.)

Elonichthys Aitkeni.

From "Soapstone Bed," four feet over Mountain Four Feet seam, Burnley. (e coll. Kay-Shuttleworth.)

From roof of Lower Foot coal, Bacup.

Elonichthys Egertoni.

As "Palæoniscus Egertoni" recorded by Salter from the Little Mine (Lower Foot, H.B.), next below the Gannister at Helpet Edge, Ogden Mill, four miles north of Oldham. (Salter. Geol. Surv. Mem., Geology of the Country around Oldham, p. 62.)

Also from the Gannister beds about the Lower Yard seam (Gannister, H.B.) at Rose Grove, Broadbottom, south of Mottram. (Op. cit., p. 62.)

Diplodus teeth.

From above the Mountain Mine of Bispham Colliery. (Hull. Geol. Surv. Mem., Geology of the Country around Oldham, p. 22; Salter, op. cit., p. 35.)

Coprolites.

Roof of Bullion coal, Littleborough. (W. 1101, e coll. Wild, M.M.)

Roof of Mountain Four Feet coal at Colne. (W. 428, e coll. Wild.)

Amphibia.

Hylonomus Wildi (A. S. Woodward).

The collections of Mr. George Wild from the "Soapstone Bed" over the Mountain Four Feet of Trawden, near Colne, contain microsaurian remains of considerable interest. These, first recognised as new by Mr. John Ward, of Longton, were afterwards described by Dr. A. Smith Woodward.

They are interesting, in so much that the family to which the species belonged had not hitherto occurred in Europe, although known from the coal measures of Nova Scotia. The specimen is in the Manchester Museum. (W. 1222, e coll. Wild.)

Microsaurian remains.

The Wild collection contains, in addition to the species mentioned, a specimen (W1130) from the "Soapstone Bed" over the Mountain Four Feet of Trawden, near Colne, which shows what is evidently the under portion of a small amphibian skull, as yet undescribed.

Range in Time.

An examination of the range in time of the various groups of fossils presents an interesting study, and yields valuable results. It will be noted by reference to the range table appended to this paper that fossils of any kind are scanty until the shales over the Gannister mine are reached.

The shales below and above the First coal have yielded but four species, three of which are mollusca, and one brachiopod. Of these four, two, Lingula mytiloides and Posidoniella minor, are common also to the millstone grit series below.

The shales over the Bassey or Salts Mine next in order have yielded Spirorbis pusillus, three species of Carbonicola, and an unknown species of Estheria.

So far, there is nothing in the fossils themselves which can be indicative of purely marine conditions.

This is seen to be hardly the case, however, when we consider the forms found in the beds above the Lower Foot Mine. Here the species have increased to eight, three of which are fishes. The occurrence of the latter point clearly to the incoming of a marine phase, which did not advance very far, judging by the fact that two of the forms are recorded from one locality each and the other from two.

The evidence of a marine phase is suddenly emphasised by the shales over the Gannister or Lower Mountain coal, from which no less than 30 species have been obtained.

Five of these are cephalopoda and eight fishes. The cephalopoda appear here for the first time, and are accompanied by twelve species of mollusca as contrasted with but two species in the shales below the Gannister.

The presence of the cephalopoda alone sufficiently stamps this horizon as of marine origin, and as they are accompanied by five species of Carbonicola, as against three over the Bassey mine, and two over the Lower Foot, we can reasonably assume that marine conditions were more favourable for the development of the latter genus than brackish or littoral.

From what has been written elsewhere it will be understood that the horizons above the Bullion and Mountain Four Feet mines are practically one, and it is on this joint horizon that life was most abundant both in species and numbers. Thirty-five species are known to occur, of which twenty-eight belong to the groups Pelecypoda, Cephalopoda, and Pisces.

The horizon above these two seams is one of considerable importance on account of its wide geographical range.

Speaking generally, it can be traced with the greatest ease over the whole of the Lower Coal Measure area in Lancashire and onwards into Yorkshire, where, as the Halifax Hard Bed, it is as readily recognisable as elsewhere.

Wherever it occurs it seems to yield the "bawm-pots" with their loads of animal remains, and the even more celebrated "bullion-balls," always rich in well preserved plant tissues.

In point of time the bullion balls are slightly, but not much, older than the "bawm-pots."

The great wealth of the shales above the Mountain Four Feet and Bullion seams lies in the lowest portion, and ranges as high as the "Soapstone Bed" of Trawden and Colne, which occurs about four to seven feet above the coal.

Higher than this there is a marked falling off in numbers and species.

From above the Fireclay coal no species have been recorded, largely, no doubt, owing to the fact that it is never worked and is difficult to find on exposures.

The shales over the Upper Mountain Mine show that the falling off in species noticed in the upper shales over the Mountain Four Feet and Bullion mines had continued. Thirteen species are known, only two of which are cephalopoda, seven being pelecypoda, and four fishes. The marked falling off of cephalopoda and fishes is evidently an indication of a return to more unfavourable and less marine conditions.

The thin coals and shales above the Upper Mountain Mine are very little known and have never been worked out. But two species of mollusca are known from them.

One feature which will probably strike the student is that animal life was more abundant immediately after the deposition of the thickest coals, and more scanty over the thin seams.

It is by no means improbable that this was due to more staple geographical conditions in the first case.

Geographically, the various life forms seem to have been most numerous in numbers and species along the north-eastern and northern portions of the Lancashire coal field, more especially in the latter. Over the rest of the area life forms are fairly evenly distributed.

In conclusion, the writer's endeavour has been to prove the horizon and geographical occurrence of each species as far as possible by reference to known specimens, and thus afford data for a better knowledge of the palaeontology, and also a starting point for future work.

The writer must also record his gratitude to Prof. W. Boyd Dawkins and Dr. W. E. Hoyle, of the Manchester Museum, for the facilities given to him whilst a member of the staff, and for continued interest and help.

	Vermes.	Brachiopoda.	Pelecypoda.	Gasteropoda.	Cephalopoda.	Crustacea.	Pisces.	Amphibia.
Shales below First Coal.. ..	—	1	2	—	—	—	—	—
,, above ,, ,, ...	—	—	1	—	—	—	—	—
,, ,, Bassey Mine ..	1	—	3	—	—	1	—	—
,, ,, Lower Foot Mine	—	1	2	—	—	2	3	—
,, ,, Gannister ,,	1	1	12	—	5	3	8	—
,, ,, Bullion ,,	—	—	8	1	14	3	4	—
,, ,, Mountain Four-Feet	—	2	7	1	12	4	6	2
,, ,, Fireclay Coal ..	—	—	—	—	—	—	—	—
,, ,, Upper Mountain Mine	—	—	7	—	2	—	4	—
Thin Coals above Upper Mountain Mine	—	—	2	—	—	—	—	—

	Under First Coal.	Above First Coal.	Over Bassey Mine.	Over Lower Foot Mine.	Over Gannister Mine.	Over Bullion Mine.	Over Mountain 4 ft. Mine.	Over Fireclay Coal.	Over Upper Mountain Mine.	Pasture and other thin coals.
VERMES.										
Arenicola carbonaria (*Binney*)	:	:	:	:	:	:	:	:	:	:
Spirorbis carbonarius (*McCoy*)	:	:	:	:	×	:	×	:	×	:
,, pusillus (*Martin*)..	:	:	×	:	:	:	:	:	×	:
BRACHIOPODA.										
Discina orbicularis (*Bolton*)	:	:	:	:	:	:	×	:	:	:
Lingula mytiloides (*Sow.*), or L. Credneri (*Geinitz*)	×	:	:	:	×	:	×	:	:	:
Lingula sp.	:	:	:	×	:	:	:	:	:	:
PELECYPODA.										
Carbonicola(Anthracosia)robusta(*Sow.*)	:	:	×	×	×	:	:	:	:	:
,, ,, acuta (*Sow.*)	:	×	×	:	×	:	:	:	×	:
,, ,, var ovalis(*Martin*)	:	:	:	:	×	:	:	:	×	:
,, ,, rugosa (*Brown*)	:	:	:	:	:	:	:	:	:	:
,, acuta, var rhomboidalis (*Hind*)	:	:	:	.	:	:	:	:	:	:

Carbonicola (Anthracosia) subconstricta (*Sow.*)	..	..	..	×	×	..	×	..	..	..
,, ,, nucularis (*Hind*)	..	..	..	×	..	..	..	..	..	..
,, ,, aquilina (*Sow.*)	..	..	×	..	..	..	..	..	×	..
,, ,, sp.	..	..	..	..	..	..	×	..	..	..
Anthracomya Williamsoni (*Brown*) ..	..	..	..	..	..	..	..	..	×	..
,, Wardi (*Salter*)	..	..	..	..	..	..	..	..	×	..
,, sp.	..	..	..	..	×	..	..	..	×	..
Naiadites modiolaris (*Sow.*)	..	..	..	..	..	..	..	..	..	×
,, quadrata (*Sow.*)	..	..	..	..	..	..	..	..	..	×
,, crassa (*Fleming*)	×	..	..	..	..	..	..	..	..	..
,, sp.	..	..	..	..	..	..	..	..	×	..
Schizodus deltoidens	..	..	..	..	..	..	×	..	..	..
Posidoniella lævis (*Brown*)	..	..	..	..	×	×	×	..	..	..
,, minor (*Brown*)	×	..	..	..	×	×	..	..	..	..
,, subquadrata (*Hind*) ..	..	..	..	..	..	×	×	..	..	..
,, lævigata	..	..	..	..	×	×	..	..	..	..
,, sp.	..	..	..	..	×	..	..	..	..	..
"Monotis(?) (Gervillia) obtusa" (*Brown*)	..	..	..	..	×	..	..	..	..	..
Aviculopecten papyraceus (*Sow.*) ..	..	..	..	..	×	×	×	..	..	..

	Under First Coal.	Above First Coal.	Over Bassey Mine.	Over Lower Foot Mine.	Over Gannister Mine.	Over Bullion Mine.	Over Mountain 4 ft. Mine.	Over Fireclay Coal.	Over Upper Mountain Mine.	Pasture and other thin coals.
"Nucula sp."	:	:	:	:	:	×	:	:	:	:
"Crassa minima"	:	:	:	:	:	×	×	:	:	:
"Solenomya primeva" (*Phillips*)	:	:	:	:	:	×	:	:	:	:
GASTEROPODA.										
Raphistoma (?) ornata (*Bolton*) .. .	:	:	:	:	:	×	:	:	:	:
Naticopsis globularis (*Bolton*)	:	:	:	:	:	:	×	:	:	:
CEPHALOPODA.										
Ephippoceras costatum (*Foord*)	:	:	:	:	:	×	×	:	:	:
,, clitellarium (*Sow.*)	:	:	:	:	:	×	×	:	:	:
Coelonautilus subsulcatus (*Phillips*) ..	:	:	:	:	:	×	×	:	:	:
,, quadratus (*Fleming*) ..	:	:	:	:	:	×	×	:	:	:
Pleuronautilus falcatus (*Sow.*)	:	:	:	:	:	×	×	:	:	:
Temnocheilus concavus (*Sow.*)	:	:	:	:	:	×	×	:	:	:
,, carbonarius (*Foord*) ..	:	:	:	:	:	×	×	:	:	:

Orthoceras teres (*Sow*)	..	..	..	..	..	..	..	..	×	..
,, cinctum (*de Konenck*)=O. discrepans (*de Konenck*)	..	..	..	..	..	..	..	..	×	..
,, obtusum (*Brown*)..	..	..	..	..	..	×	×	..	..	..
,, sp.	..	..	..	..	×	..	..	..	..	..
Glyphioceras (Goniatites) sp. near truncatum	..	..	..	..	×	..	..	..	..	..
Glyphioceras (Goniatites) reticulatum (*Phillips*)	..	..	..	..	×	..	..	..	..	..
,, ,, diadema (*Beyrich*)	..	..	..	..	..	×	..	..	..	..
,, (?) ,, paucilobum (*Phillips*)	..	..	..	..	..	×	..	..	..	..
Dimorphoceras Gilbertsoni (*Phillips*)..	..	..	..	..	..	×	×	..	..	..
Gastrioceras (Goniatites) carbonarium (*V. Buch*)	..	..	..	..	..	×	×	..	..	..
,, ,, Listeri (*Martin*)..	..	..	..	..	×	×	×	..	..	..
,, ,, coronatum (*Foord & Crick*)	..	..	..	..	..	×	×	..	..	..
CRUSTACEA.										
Estheria striata (*Münst.*)	..	..	..	..	..	..	..	..	..	..

	Under First Coal.	Above First Coal.	Over Bassey Mine.	Over Lower Foot Mine.	Over Gannister Mine.	Over Bullion Mine.	Over Mountain 4 ft. Mine.	Over Firedlay Coal.	Over Upper Mountain Mine.	Pasture and other thin coals.
Estheria var Beinertiana (*Jones*) ..	:	:	:	:	:	×	:	:	:	:
,, sp.	:	:	×	:	:	:	×	:	:	:
Beyrichia arcuata (*Bean*)	:	:	:	×	×	:	:	:	:	:
,, sp.	:	:	:	×	:	×	:	:	:	:
Cypris or Cythere	:	:	:	:	×	:	:	:	:	:
Cytheropsis	:	:	:	:	:	×	:	:	:	:
Pygocephalus Cooperi, *Huxley*	:	:	:	:	:	:	×	:	:	:
Anthrapalæmon Etheridgei (*Peach*)...	:	:	:	:	:	:	:	:	:	:
Cyclus Scotti (*Woodward*)..	:	:	:	:	×	:	:	:	:	:
Prestwichia rotundata (*Prestwich*)....	:	:	:	:	:	:	×	:	:	:
,, Birtwelli, *Woodward* ..	:	:	:	:	:	:	:	:	:	:
Architarbus subovalis, *Woodward* ..	:	:	:	:	:	:	×	:	:	:
PISCES.										
Hybodopsis Wardi, *Barkas*	:	:	:	:	:	:	×	:	:	:

Sphenacanthus hybodoides (*Egerton*)	..	..	..	..	..	..	×	..	..	..
Acanthodes Wardi (*Egerton*)	..	..	..	..	..	..	×	..	..	..
Lepracanthus colei (*Egerton*)	..	..	..	..	×	..	..	..	..	..
Gyracanthus formosus *Agassiz*	..	..	..	..	..	..	..	..	×	..
Listracanthus spinatus (*Bolton*)	..	..	..	..	..	..	×	..	..	..
Strepsodus sauroides (*Binney*)	..	..	..	..	×	×	..	..	×	..
Rhizodopsis sauroides (*Williamson*)	..	..	..	×	×	×	×	..	×	..
Megalichthys Hibberti, *Agassiz*	..	..	..	×	×	..	..	..	×	..
,, pygmæus (*Traquair*)	..	..	..	..	..	..	..	..	..	..
Cœlacanthus elegans, C. lepturus, *Agassiz*	..	..	..	..	×	×	..	..	..	..
Rhadinichthys monensis (*Egerton*)	..	..	..	..	×	..	..	..	..	..
,, Planti, *Traquair*	..	..	..	..	..	..	..	..	..	..
Elonichthys semistriatus, *Traquair*	..	..	..	..	..	×	..	..	..	..
,, Aitkeni, *Traquair*	..	..	..	..	..	..	×	..	..	..
,, Egertoni (*Agassiz*)	..	..	..	×	×	..	..	..	..	..
Diplodus sp.	..	..	..	..	×	..	..	..	..	..
Coprolites	..	..	..	..	..	×	×	..	..	..
Amphibia.										
Hylonomus Wildi (*A. Smith Woodward*)	..	..	..	..	..	..	×	..	..	..
Microsauria (?)	..	..	..	..	..	..	×	..	..	..

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