

like rottenness, and the schist, as implied on p. 12, is in good condition close to the very outside. The state of the surface suggests that mechanical forces may have co-operated with chemical, for it is not unlike that produced by blown sand; yet to gouge out some of these, for instance that first described, the winds would have to eddy in a very queer fashion, for the holes occasionally run deep into the rock both sideways and upwards. Nor does the action of dew or of moisture in any form seem a promising explanation, for they occur on both sheltered and exposed sides of the blocks and look to all points of the compass, though more commonly westwards.

This brings me to the difficulty, which, owing to my general knowledge of Corsica and Mr. Tuckett's descriptions, had prevented me from seeking an explanation in Indian or any other desert regions. Its scenery, so far as I know it, is at least as luxuriant as that around the subalpine Italian lakes. There was not a trace of grit or sand about the Ajaccio blocks, and to reduce an island in this part of the Mediterranean to the conditions of a desert or steppe would demand changes of geography or climate which are almost startling, and we must also suppose that since the arid epoch ended the surfaces of the hollows have undergone little or no alteration. Neither atmospheric corrosion nor any form of wind abrasion seems to satisfy all the conditions of the problem, and until I can spend some time in Corsica to study other examples I prefer to restrict myself to this statement, negative though it be.

III.—ON THE HOMOTAXIAL EQUIVALENTS OF THE LOWER CULM OF NORTH DEVONSHIRE.

By WHEELTON HIND, M.D., B.S., F.R.C.S., F.G.S.

IN the paper on the Pendleside group at Pendle Hill, Q.J.G.S., vol. lvii, p. 377, I said, "The further facts of the distribution of *Glyphioceras spirale* and *Posidonomya Becheri* set forth in the foregoing pages open up the wide question of the age of the Culm beds of Devon and Germany." Since then I have had the great advantage of examining suites of fossils from the Lower Culm of Devonshire, collected by Mr. Hamling, of Barnstaple, and Mr. Coomáraswamy, from the Coddon Hill Beds and other localities in North Devon. I was so interested in the fossils that I found it necessary to go down and examine the beds in which they occurred, and Mr. Hamling gave me the inestimable advantage of his guidance. In this way we examined the Lower Culm and the underlying Pilton Beds in detail from West Leigh to Fremington, and the so-called Middle Culm of Bideford and other places. I was able to see the Hall collection of fossils at Barnstaple, and again to renew my acquaintance with Mr. Hamling's collection. This visit to Devonshire, it seems to me, was fortunately planned after a visit last Summer to the Devonian-Carboniferous succession in the south-west of Ireland, and a study of the fauna in the collection of the Geological Survey at Dublin and in the Museum of Queen's College, Cork.

If palæontology is of any value, and the distribution of fossils does indicate homotaxis, then we are particularly fortunate in the Culm, which, though it is not richly fossiliferous, yet contains peculiar and well-marked species, which do indicate well-marked horizons in the Carboniferous series further north.

There are certain stratigraphical facts which are well known, such as the general succession of the Devonian series and its relation to the Culm. It is agreed that the geological structure of Devonshire is a synclinal, and that in the north the rocks are all very highly tilted and dip steadily south at high angles; that the dip is not simple, but that in each member of the series there are many secondary folds, owing to which it is impossible to estimate the thickness of each division. There appears to be no unconformity between the Upper Devonian or Pilton Beds and the Lower Culm.

The Lower Culm consists of two very distinct series of rocks: the Coddon Hill Beds, which are composed of thin-bedded, hard, siliceous, or cherty, light-grey or fawn-coloured rocks, full of radiolarian remains, and containing a small but distinctive fauna, and the Venn or Black limestones, of hard, splintery, black, semi-crystalline limestone and calcareous shales with *Posidonomya Becheri* and *Glyphioceras crenistria*.

The first and important point to settle is the true succession in the Lower Culm, that is to say, what is the relation between the peculiar thin siliceous beds of Coddon Hill and the Black limestones yielding *Posidonomya Becheri* of Venn, Bampton, and West Leigh?

Sedgwick (Trans. Geol. Soc., ser. vi, vol. v, p. 670) thought that the Coddon Hill Beds were below the *Posidonomya* beds. Phillips and many others thought the reverse; but Mr. Ussher ("Culm-measure Types of Great Britain," Trans. Inst. Min. Engineers, vol. xx, 1901, p. 362), in his table of the classification of strata, favours the view that the Coddon Hill cherts are below the *Posidonomya* beds. This Mr. Hamling tells me has been his opinion, and together we examined the ground carefully with a view to ascertain the evidence for this succession.

Mr. Hamling writes me as follows:—"I see at the reading of Hinde & Fox's paper on 'A well-marked horizon of Radiolarian Rocks in the Lower Culm of Devon, etc.,' I expressed agreement with their conclusions, which suggest that Venn beds are below Coddon Hill (Q.J.G.S., vol. li, 1895, p. 609). I have worked these beds very closely since then, and now believe the Coddon beds are below Venn. Perhaps you can explain this change of opinion since 1895."

Standing on Coddon Hill and looking north and east, it is to be noted that the Coddon Hill range runs east to beyond the village of Swimbridge, and that it meets east of that village a ridge which runs into it from the west, forming a Y; i.e., there is a synclinal of Coddon Hill Beds which west of Swimbridge has the beds contained in the syncline gradually pinched out in succession, so that the two limbs of the synclinal come together. The contour of the surface of

the synclinal trough is important. Tracing the rocks from north to south, Coddon Hill beds form an east to west line of elevation, succeeded by a hollow trough. In this hollow the Venn limestones,

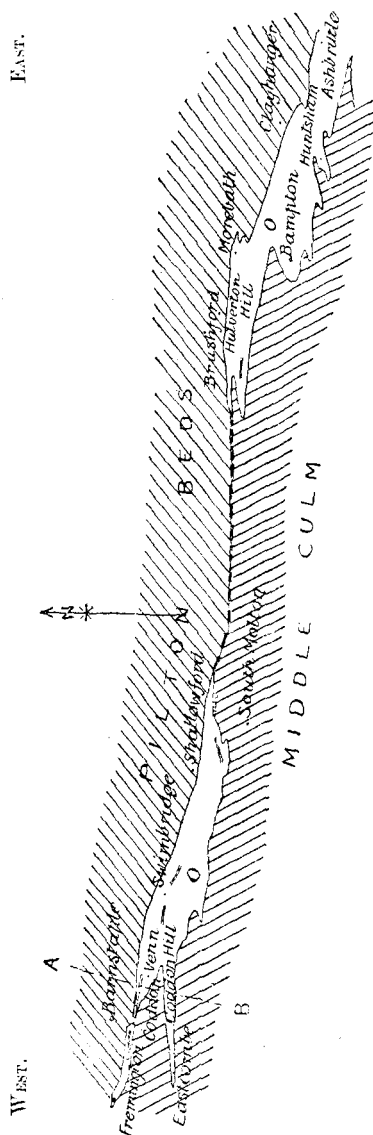


FIG. 1.—Country near Barnstaple, from Fremington and Eastcombe on the West to Clayhanger and Ashbrittle on the East.
O, O = the Coddon Hill Beds, with *Posidonomya* Limestone; A-B, line of section given in Fig. 2.

Scale, 6 miles to an inch.

with *Posidonomya Becheri*, have been worked. In the centre of the synclinal is an east to west line of elevation, sections of which

show grits and rocks of a Middle Culm type. South there is a hollow parallel with the strike between these grits, the main Coddon Hill range, which I think indicates the Black limestone of Venn, and immediately south is the Coddon Hill range. This would make the succession—

Middle Culm grits.
Posidonomya beds.
Coddon Hill beds.

Unfortunately no limestones have been worked in the hollow south of the Middle Culm, although the depression which exists parallel to and between the Coddon Hill Beds and Middle Culm grits seems to indicate calcareous beds.

There is no doubt that the dips taken in various quarries show that the beds on the north are dipping south, and those of the main Coddon Hill range dip north. Also the Venn limestones are dipping south at a very high angle, conformable to the Coddon Hill Beds of Venn Cross quarry on the north side of the synclinal. So that in the valley between Venn Cross, where the beds dip south, and Coddon Hill, where the beds dip north, is situated the Venn limestone with *Posidonomya Becheri* and the Middle Culm grits. Traced east, in the gradually vanishing synclinal, first of all the feature formed by the Middle Culm grits disappears near Hannaford, and in the hollow between this terminating feature and the junction of the two limbs of the Coddon Beds, the *Posidonomya* limestones crop out rich in fossils and occupying a hollow with beds of Coddon Hill type to the north and south of it.

East of Swimbridge, from Filleigh to Marsh, are a line of old workings in the Black limestones, but the Coddon Hill Beds become faulted out, so that apparently in turn, first *Posidonomya* beds and then the Middle Culm beds rest on the Pilton series or Upper Devonian. At Headon, quarries of well-marked Coddon Hill Beds, here associated with much wavellite, are dipping south and are north of the line of the Filleigh limestones, but a little east of North Aller Farm they have disappeared and the limestones are faulted against Pilton Beds. For the next 17 miles eastward Lower Culm beds have been cut off by faults, but near Dulverton Station beds of Coddon Hill type are to be seen having the same strike as at Coddon Hill east and west, dipping almost vertically but with a southerly trend.

Close to Dulverton Station, near Brushford village, is a quarry in Pilton Beds whence Phillips obtained many of the fossils which he described, and south of this village is Kent's Hill quarry with thin siliceous beds of the Coddon Hill type. About half a mile further east is the Hulverton Hill quarry. This hill has the curious contour which seems to be typical of Coddon Hill Beds elsewhere, and the beds themselves are characteristic. Nowhere are beds of *Posidonomya* limestone seen between Pilton and Coddon Hill Beds. Still further east, at Ashbrittle, are Coddon Hill Beds, and these are apparently lying on Pilton Beds.

If the geological map made by Mr. Ussher and published in his paper in the Transactions of the Institute of Mining Engineers (op. supra cit.) be examined, it will be seen that from south to north the Lower Culm beds tend to form a succession of small evanescent synclinals due to folding. Tongues of Middle Culm measures invade the Lower Culm, lying in small troughs which become lost as they pass east. One of these troughs runs up between Hulverton Hill and Westbrook, but in this trough I think I am right in saying no limestones have been found. But at Westbrook Farm and near the road from Brushford to Bampton, beds of Coddon Hill type are to be seen dipping south, to pass beneath the *Posidonomya* limestones so fully exposed in the many Bampton quarries. In the railway cutting north of Bampton Station the beds are distinctly thin and cherty, and approach closely to the Coddon Hill type.

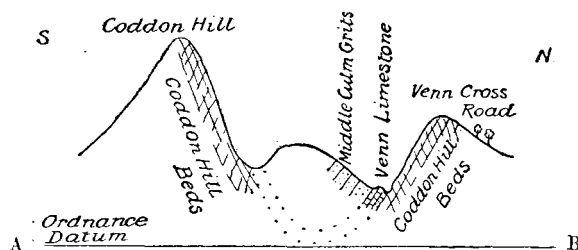


FIG. 2.—Section through Coddon Hill Beds, Barnstaple, on the line A-B in Fig. 1. Scale: horizontal, 4 inches = 3 miles, or 2 inches = $1\frac{1}{2}$ miles; vertical, $\frac{1}{4}$ inch = 150 feet.

At Holcombe-roguis and Westleigh the well-developed limestones all crop out south of the general strike of the Coddon Hill Beds, but the time was too short, in this immediate neighbourhood, to examine the ground in sufficient detail.

West of Barnstaple an examination of the succession at Fremington seems to point to similar conclusions. The river bank at Fremington shows a series of fossiliferous shales with numerous Brachiopods and corals of a Carboniferous type, but containing no fossils which could be used as an index of horizon. These beds evidently are either at the top of the Pilton series or immediately overlie that series, but for our present purpose it is important to note the relation of the strike of these beds to that of the Pilton series, for they afford a base-line for the determination of the beds immediately above them. These are seen at Pen Hill quarry, immediately south of the railway line, where there are thin platy beds with cherts in bands and siliceous beds, but also there is here a development of calcareous beds of some few feet in thickness. The limestones and shales, however, have not been found to contain *Posidonomya Becheri*, and the whole section bears a close lithological resemblance to the Coddon Hill Beds. The beds are dipping south at an angle of 28° . At Fremington Pill, near Gaydon's Cottage, thin-bedded

siliceous rocks of light fawn colour, with numerous chert bands, here decomposed, strongly recall Coddon Hill Beds. These lie above the beds seen in Pen Hill quarry, and in the upper portion of them, 90 yards from the wall of Gaydon's Cottage, occurs *Posidonomya Becheri* in abundance. A short distance further south the Black *Posidonomya* limestones have been worked.

On the foreshore west of Fremington Station are beds dipping 50° S. which have a Coddon Hill character; they are apparently on the top of the limestone band in Pen Hill quarry, which crops out on the shore at low water. This would make the succession at Fremington as follows:—

<i>Posidonomya Becheri</i> Limestones	Venn Limestones.
Dark shales with <i>P. Becheri</i> .	
Lighter-coloured shales with cherts	} Coddon Hill Beds.
Band of limestone	
Shales	
Fossiliferous shales	Passage beds.
Pilton series	Upper Devonian.

Following the beds along the strike westward, no beds of Coddon Hill type are to be seen between the Fremington limestones and the Middle Culm beds at Instow.

The beds at Instow are of great importance; they consist of a series of sandstones, shales, and clays, including calcareous nodules crammed with fossils. I was fortunate enough to find two species which had not previously been recorded from these beds.

<i>Pterinopecten papyraceus</i> , Sow., sp.	<i>Dimorphoceras Gilbertsoni</i> , Phill., sp.
<i>Posidonella levis</i> , Brown, sp.	<i>Cœlacanthus elegans</i> .
<i>Gastrioceras Listeri</i> , Martin, sp.	<i>Elonichthys Aitkeni</i> .
<i>Gastrioceras carbonarium</i> , V. Buch., sp.	

These beds seem to succeed the sandstones and shales at the base of the Middle Culm, and the fauna indicates unmistakably the Lower Coal-measures of the horizon of the Bullion Mine of Lancashire.

Quarries between Instow and Bideford show indurated clays, shales, and grits, which have a very familiar aspect to anyone well acquainted with the Coal-measures of the Midlands.

Roberts' Quarry, east of Bideford, is an important horizon, because here in indurated clay and fawn-coloured shales abundant plant-remains occur, which are identical with ferns and plants found in the Coal-measures of the Midlands. Immediately above the plant-bed is an indurated light-coloured clay, with iron stains in its joints, in which the typical Coal-measure shell *Carbonicola acuta* is not uncommon. Unfortunately, time did not allow further work in the beds above the Lower Culm, but the fauna and flora bear out Sedgwick's view (op. supra cit., p. 682), "The Upper Culm strata of Devon are the geological equivalents of the ordinary Bristol coalfields."

Palæontology.—The fossils of the Lower Culm are, with the exception of some new species of Trilobites described by Dr. Henry Woodward, not confined to Devonshire, but are known to have a fairly definite and constant distribution in other Carboniferous areas.

In that area of England between Cracoe in Craven and Leicestershire where the Pendleside series is developed, it is found that immediately on the top of the massif of Carboniferous Limestone at Warsoe, at the foot of Pendle Hill, in the River Hodder, near Stoneyhurst, and at Astbury limestone quarry at the foot of Congleton Edge, Cheshire, are beds containing *Prolecanites compressus* and Trilobites of various species. Higher up in the series are beds with *Posidonomya Becheri*. Then at Congleton Edge and Pendle Hill some 300 feet below the Millstone Grit beds are marine shales with *Glyphioceras spirale*. Such a succession has been found to occur in many localities, and I take it to be a normal one, and that the fossils mentioned above indicate definite zones in the Pendleside series. Seeing that these fossils occur in the Lower Culm series, it is important to ascertain whether there is any stratigraphical reason for supposing a different succession of these fossil zones; if not, the known relation of the fossil zones in other areas may be used as an argument for a similar succession in the Culm area.

In the Lower Culm series there are two distinct faunas, one contained in the Coddon Hill Beds, the other characterising the Venn limestones.

BEDS OF CODDON HILL TYPE.

In the Coddon Hill Beds the following important fossils have been obtained:—

TRILOBITES.

<i>Phillipsia Leei</i> .	<i>Griffithides acanthiceps</i> .
„ <i>minor</i> .	„ <i>longispinus</i> .
<i>Cliffordi</i> .	<i>Proetus</i> , sp.
? <i>*Phillipsia Polleni</i> .	

CORALS.

<i>*Palæacis humilis</i> , Hinde.	<i>*Pleurodictyum Dechenianum</i> , Kayser.
<i>*Petraia cf. pauciradialis</i> , Phill.	

CEPHALOPODA.

<i>Prolecanites mixolobus</i> , Phill., sp.	<i>*Nomismoceras spirorbis</i> , Phill., sp.
„ <i>compressus</i> , Sow., sp.	<i>*Periclytus</i> , sp.

LANELLIBRANCHS.

<i>*Chænocardiola Footii</i> , Baily, sp.

BRACHIOPODA.

**Chonetes Laquessiana*, and shells either crushed or varieties alluded to by Von Koenen as *C. deflexa* and *C. rectispina*. **Productus plicatus*, Sarres.

**Several RADIOLARIA.*

The species marked * are all found at the base of the Pendleside series in the Bolland district of Yorkshire. The exact locality where Phillips obtained *P. mixolobus* is unknown, as he only gives Bolland, which is a large district in which are beds belonging to the Carboniferous Limestone, Pendleside series, and Millstone Grit.

Palæacis humilis, says Dr. G. J. Hinde, is “fairly common in shale or mudstone, associated with limestones and chert exposed on the banks of the river Hodder, below Stoneyhurst College, Lancashire; according to Mr. R. H. Tiddeman the rocks . . . come in between the Clitheroe limestones and the Pendleside limestones.”

This is so, the beds forming the base of the Pendleside series. It occurs in the Lower Culm only in beds of the Coddon Hill type.

Chænocardiola Footii is a shell always associated with a lower Pendleside fauna in the Midlands and Ireland; its occurrence in the Lower Culm of Hannaford quarry is important. Mr. J. G. Hamling has some fragments in his collection, but I was particularly fortunate to find two valves in the trilobite beds of Hannaford quarry. In my monograph on British Carboniferous Lamellibranchs, vol. i, p. 476, I quoted Coal-measures as the horizon for this species. I think Roscliff, co. Clare, is below that horizon, and should be Pendleside series.

Prolecanites compressus.—Although I feel strongly the value of this species as a zonal form, there is no doubt that it is not absolutely confined to the base of the Pendleside series, for it occurs in the Carboniferous Limestone of Little Island, co. Cork, and in the lower limestones of Scarlett Quarry, Isle of Man. Still, there is a definite and well-defined series of rocks, of no very great thickness, immediately at the base of the Pendleside series, which is characterised by this shell, and it does occur below shales and black limestones with *Posidonomya Becheri*.

Nomismoceras spirorbis.—The type of this species was obtained from the Black limestone of Black Hall, Bolland, Pendleside series; and it is of great interest to note that the strike of the beds and their relation to the Millstone Grits at Black Hall would make these beds below a series quarried at Cold Coates which contain *P. Becheri* in abundance.

Pericyclus, sp.—I have obtained similar examples from the Pendleside series of Yorkshire and the Lower Culm.

Trilobites.—Dr. H. Woodward described two Trilobites from the base of the Pendleside series (R. Hodder, GEOL. MAG., 1894, Dec. IV, Vol. I, pp. 481–489), *Phillipsia Polleni* and *P. Van-der-Grachtii*. Subsequently I found the latter associated with *Prolecanites compressus* at Ashbury quarry, Cheshire, and Dr. H. Woodward recognises *P. Polleni*, though with some hesitation, in the cherty beds of Coddon Hill (GEOL. MAG., 1902, Dec. IV, Vol. IX, p. 482). It is important, however, to note the occurrence of species of Trilobites at the horizon of the base of the Pendleside series and Lower Culm, the majority of which do not occur in the Carboniferous Limestone.

Brachiopoda.—There is no very important evidence afforded by the Brachiopoda found in the Lower Culm and Pendleside series. I have always regarded the varieties of *Chonetes* occurring in the Culm of Germany and described under different names to show no greater difference from each other than is found to obtain amongst a number of individuals collected from the same bed and horizon. Certain species of *Productus* may be peculiar, but unfortunately the specimens are not well enough preserved to say whether the differences are due to dwarfing and crushing or to specific characters. All the other Brachiopods, *Discina nitida*, *Leptaena analoga*, *Orthis crenistria*, *Athyris ambigua*, occur at many horizons in the whole Carboniferous series.

Radiolarian rocks also are found in the Pendleside series. There is, therefore, a very remarkable and close resemblance in the faunas of the Coddon Hill Beds of the Lower Culm and the Pendleside series: so practically identical, indeed, are they, that there can be little or no doubt that they are the homotaxial equivalents of each other.

THE VENN, OR *Posidonomya Becheri* LIMESTONE.

The fauna contained in the black limestones of North Devon is not so rich in species as that of the Coddon Hill Beds, but the following species are abundant:—

<i>Posidonomya Becheri.</i>	<i>Glyphioceras striatum.</i>
<i>Pseudamusium fibrillosum.</i>	„ <i>sphericum.</i>
<i>Glyphioceras spirale.</i>	<i>Orthoceras cylindraceum.</i>
„ <i>crenistrina.</i>	

PLANT REMAINS: *Cordaites*, sp.

Posidonomya Becheri.—I only recognise one species. The examination of a large number of specimens has convinced me that the forms *P. tuberculata* and *P. lateralis* are accidental, due to conditions of preservation and degree of flattening by compression.

I regard *P. Becheri* as an important zonal form, indicating a horizon somewhat above that of *P. compressus*. I have found this zone constant in position from Old Head of Kinsale in the south of Ireland to Clavier and Visé in Belgium. The zone has no great vertical depth, and I am unable to indicate the precise thickness, but in the Midlands, beds characterised by *G. spirale* extend some hundreds of feet above *P. Becheri*.

I have, as in the case of *Prolecanites compressus*, found specimens of *P. Becheri* at a lower horizon. It occurs in the Yoredale series of Wensleydale above the Great Scar Limestone, and I have found it actually in the top beds of the Carboniferous Limestone at Castleton, but in these places it has, with it, a typically Carboniferous Limestone fauna.

At Poolvash, Isle of Man, *P. Becheri* occurs in black limestone and shales, which succeed the shelly white upper beds of the Carboniferous Limestone. With it is the following fauna:—

<i>Solenomya costellata.</i>	<i>Glyphioceras crenistrina</i> , and a crushed
<i>Orthoceras Morrisianum.</i>	Cephalopod which Mr. Crick identifies
„ <i>sulcatum.</i>	as <i>Stroboceras sulcatum.</i>

I have not been able to get at the beds at the base of the series, where I should expect to find *Prolecanites compressus* and Trilobites.

Some curious beds containing *P. Becheri* occur at Budle, Northumberland, the real horizon of which is very doubtful and vague.

IRELAND.

In co. Dublin the Pendleside series succeeds the Carboniferous Limestone near Sherries; at the former horizon *P. Becheri* is found in abundance. At Old Head of Kinsale, south-west of Cork, *P. Becheri* occurs in hard shaly beds in a curious sequence of shales and thin indurated calcareous beds. In South-West Cork, as in Devonshire, the Carboniferous Limestone is absent, and there is

a passage from Devonian rocks into Carboniferous without a stratigraphical break. Curiously enough, beds with a Devonian fauna, *Cucullæa unilateralis* and *Ptychopteria Dammoniensis*, which in Devonshire are recognised as the *Cucullæa* beds and occur below the Pilton Beds, are classed as Carboniferous in Ireland. It appears to me that a similar sequence occurs in both South-West Cork and Kerry and Devonshire. The Coomhola grits with *Cucullæa unilateralis* and *Ptychopteria Dammoniensis*, are the equivalents of the Pickwell Down and Baggy Point Beds, and the beds with *P. Becheri*, the equivalents of the Venn Limestone series of the Lower Culm. It would be well if stratigraphical lines, based on palæontology, were identical in the two countries. The fauna of the Coomhola grits is typically Devonian, and not Carboniferous. The absence of Carboniferous Limestone in North Devonshire and further west along the line of strike, at Old Head of Kinsale and the part of Ireland west of that point, shows that this absence in both localities is due to the same conditions of deposit. The succession in both countries is the same.

DEVONSHIRE.			SOUTH-WEST IRELAND.	
Lower Culm	...	...	<i>Posidonomya</i> beds, Pendleside series,	
Pilton Beds	...	...	Coomhola grits	} Upper Devonian.
Baggy Beds	...	...	<i>Cucullæa</i> zone	

The absence of Carboniferous Limestone in both areas is very definite, and the recognition that the sequence in North Devon and South-West Ireland is identically the same not only broadens the question, but at the same time demonstrates that the Culm of Devonshire is not merely a local condition, and that the absence of Carboniferous Limestone in South-West Cork and in the Carboniferous series of Devonshire is due to the same series of causes.

Pseudamysium fibrillosum.—This species is, as far as I know, never found below the Pendleside series, but it passes up into Coal-measures. This is an important species, because it has been obtained from the Culm of Herborn and Magdeburg. For the synonymy of this species *vide* my monograph on British Carboniferous Lamellibranchs, vol. ii, p. 106.

Glypticeras spirale.—This species is very plentiful, occurring in thousands, in a blackish shale about 500 feet below the third grit at Congleton Edge, Cheshire. I have found it at various other localities in Yorkshire, but I always consider that it denotes a zone higher up in the series than that of *P. Becheri*. The species appears to be more common in South Devonshire than in the north of the country, and I can say nothing definitely about its actual position in the series there, but it is stated that it occurs with *Posidonomya*, Ussher, "British Culm Measures," Somerset Arch. and Nat. Hist. Soc., vol. xxxviii (1892), p. 132; he says, "The *Posidonomya* in these beds are, as a rule, smaller than those occurring in the beds which in the Chudleigh and Bovey Tracey districts carry on the calcareous horizon." In Cheshire *G. spirale* occurs with *Posidoniella lavis*. The other Goniatites found in the *Becheri* beds are not typical of the horizon, for they occur at various horizons in the Carboniferous

Limestone series, but are specially plentiful in the upper shelly limestone of Derbyshire, Staffordshire, and Yorkshire.

Palæontological evidence is therefore decidedly strong in favour of the *Posidonomya Becheri* beds overlying the Coddon Hill Beds, especially when such a sequence of fossil zones is found to obtain over large areas at a distance.

The occurrence of flinty deposits at a definite horizon in the Carboniferous beds may be adduced for what it is worth. In Wensleydale the chert beds come on immediately on the top of the Yoredale series. In Derbyshire and Yorkshire the chert horizon is found at the base of the Pendleside series. At Bishopton, near Gower, a series of white cherty beds, containing Trilobites and Brachiopoda, occur on the top of the upper beds of the Carboniferous Limestone, the Oystermouth Beds. The cherty beds are here overlain by black shales, with *Posidoniella lævis* and *Glyphioceras bilingue*, fossils which occur low down in the Pendleside series. These cherty beds are, I believe, homotaxial with the Coddon Hill Beds. Similar cherty beds, but much less well developed, are to be seen at Clavier, near Dinant, in Belgium, where a typical lower Pendleside fauna, *Prolecanites compressus* and *Chenocardiola Footii*, etc., is obtained. The beds at Clavier rest in hollows in the Carboniferous Limestone, and are therefore on the horizon of the Pendleside series, a fact which cannot be doubted if the collection of fossils made by the Geological Survey of Belgium, and now placed in the Musée Royale at Brussels, is examined. I was enabled by the kindness of Professor Dupont, Director of that Museum, to study all the fossils collected from Clavier, and I identified the following. It was, however, impossible for me to determine in what position they occurred *in situ*, but it is doubtless on record.

<i>Phillipsii</i> , sp., with long cheek spines.	<i>Orthoceras</i> , sp.
<i>Pseudamysium fibrillosum</i> .	<i>Prolecanites compressus</i> .
<i>Posidoniella lævis</i> .	<i>Glyphioceras bilingue</i> .
<i>Posidonomya membranacea</i> .	<i>Glyphioceras spirale</i> .
<i>Pteronites angustatus</i> .	? <i>G. diadema</i> .
<i>Chenocardiola Footii</i> .	<i>Calonautilus sulcatus</i> .
<i>Athyris ambigua</i> .	<i>Lestracanthus Beyrichii</i> .
<i>Chonetes Laguessiana</i> .	Crinoid joints.
<i>Productus scabriculus</i> .	Plant remains.
<i>Productus semireticulatus</i> .	

And from shales at Visé I determined

Posidonomya Becheri.
Pterinopecten papyraceus.
Posidoniella lævis.

Whether or not the Coddon Hill Beds are below the *Posidonomya* limestones, it cannot be denied that the palæontological evidence shows that the Lower Culm is the homotaxial equivalent of the Pendleside series, and that the Instow Beds indicate Lower Coal-measures, and the *Carbonicola acuta* and plant beds near Bideford represent Coal-measures of a higher horizon. The Culm series, then, represents the whole Upper Carboniferous series of the Midlands, and in this case the idea of workable coal being found in Devonshire

is very improbable. It seems to me that the beds of Culm represent the total result of the attempt to form coal, and nothing more is to be hoped for. The views expressed in this paper are the result of a profound belief in the value of certain Carboniferous fossils as zonal indices, based on careful observation in the Midlands. The zones are not quite so well defined as those which obtain in older and newer formations, a result probably due to conditions of deposit, but nevertheless I find these life zones to be of economic importance to the mining engineer.

A paper in the GEOLOGICAL MAGAZINE for June by Dr. J. H. Parkinson, pp. 272-276, on "The Zoning of the Culm in South Germany," is of interest, because from an examination of the fauna of the Culm of Königsberg he arrives at the conclusion that this Culm with a Visé Limestone fauna lies above the *Posidonomya* shales of Herborn.

This is very improbable. The Herborn fauna is identical with that which is found in the Pendleside series of England, which is definitely known to succeed beds with a Visé limestone or a *Productus giganteus* fauna. At Visé also shales with *P. Becheri* succeed the Visé Limestone, and lastly the Tournai Limestone, to which Dr. Parkinson refers the *Posidonomya* beds of Herborn, does not contain the fauna characteristic of the Lower Culm, but has an altogether different assemblage of fossils. Judging from the fauna of Königsberg Culm, I think he is quite correct in referring the beds to the Visé horizon, but beyond that I beg to join issue with his conclusions.

Through the kindness of Dr. H. Woodward I have been favoured with the précis of Mr. Newell Arber's paper on "The Fossil Flora of the Culm Measures of North-West Devon," read before the Royal Society on June 9th. This paper conclusively proves from the evidence of the flora that "the horizon in the Upper Carboniferous represented by that portion of the Upper Culm Measures in which the Coal or Culm occurs in the Bideford district is equivalent to the Middle Coal-measures in other British coalfields." That this is so I have also attempted to demonstrate by the known presence of *Carbonicola acuta* at Bideford, and a Gannister or Lower Coal-measure fauna at Instow.

I greet this work of Mr. Newell Arber with delight, because it tends to prove the subject-matter of this paper from an entirely different point of view.

IV.—NOTE ON THE CORRELATION OF SOME CORNISH BEDS WITH THE GEDINNIAN OF CONTINENTAL EUROPE.

By UPFIELD GREEN, F.G.S.

THE group of beds which I propose to identify and correlate with those known in France, Germany, and Belgium by the name of 'Gedinnien,' forming the lowest member of the Devonian system, extends in its full development from the Lizard peninsula in the west to Gorran and St. Austell on the east, and thence to near Newquay on the north. The upper beds, at least, may be traced