Dimensions in millimetres:

	Length.	Breadth.	Thickness.
Holotype . . .	2·7	2·5	1·2
Paratypes . . .	2·8	2·0	1·5
	2·6	2·1	1·2

Type Locality.—Everett's limestone quarry, Kakanui, New Zealand.
Horizon.—Oamaruian (probably Miocene).
Material.—Holotype and four paratypes; one of the latter consists of a dorsal valve only.
Remarks.—The Kakanui limestone consists largely of hollow or partially filled shells of Brachiopods, a peculiarity of fossilization being that the pores of the shells are obscured, so that in many undoubtedly punctate shells, such as *Terebratula oamarutica*, Boehm, the punctation cannot be distinguished even under a microscope. The specimens of *Thecidellina hedleyi* are of a dull white colour and show no sign of punctation, but it does not necessarily follow that it is absent. No trace of deltidium can be seen, and this is in agreement with *T. maxilla*, Hedley. In external form *T. hedleyi* has more resemblance to *T. Barretti* than to *T. maxilla*, but is more nearly trigonal than either of these species.

NOTICES OF MEMOIRS.

I.—British Association for the Advancement of Science, Eighty-fifth Annual Meeting, held at Manchester, September 7–11, 1915. List of Authors and Titles of Papers read in Section C (Geology).

Presidential Address by *Professor Grenville A. J. Cole, F.G.S.*
Dr. G. Hickling.— Address on the Geology of Manchester and District.
Professor E. J. Garwood, F.R.S.—On the discovery of *Solenopora* and *Sphærocodium* in Silurian Rocks of Britain.
Hon. Professor W. Boyd Dawkins, F.R.S.—The Classification of the Tertiary Strata by means of the Eutherian Mammals.
Hon. Professor W. Boyd Dawkins, F.R.S.—The Geological Evidence of the Antiquity of Man in Britain.
Joint Discussion with Section E on the Classification of Land Forms. Opened by *Dr. J. D. Falconer.*
Canon T. G. Bonney, F.R.S.—Notes on the North-West Region of Charnwood Forest.
Professor W. W. Watts, F.R.S.—Note on Granite Surfaces of Mount Sorrel.
Dr. A. H. Cox & Mr. A. K. Wells.—The Ordovician Sequence in the Cader Idris District (Merioneth).
Professor W. G. Fearnsides.—A Contour Map of the Barnsley Seam of Coal in Yorkshire.
Mr. E. S. Cobbold.—Sixth Report on Excavations among the Cambrian Rocks of Comley, Shropshire.
Professor W. J. Sollas, F.R.S.—On the Restoration of certain Fossils by Serial Sections.

Dr. D. M. S. Watson.—Vertebrate Life Zones in the Permo-Trias.
Professor R. C. Wallace.—The Corrosive Action of Brines in Manitoba.
Dr. A. Wilmore.—Carboniferous Limestone Zones of North-East Lancashire.
Mr. H. Day.—A brief Criticism of the Fauna of the Limestone Beds at Freak Cliff and Peakshill, Castleton.
Dr. Arthur Vaughan.—On the Shift of the Western Shore-line in England and Wales during the Avonian Period.
Dr. Albert Jowett.—A Preliminary Note on the Glacial Geology of the Western Slopes of the Southern Pennines.
Reports of Research Committees.
Discussion on Radio-active Problems in Geology. Opened by *Professor Sir E. Rutherford.*
Professor C. A. Edwards.—Twinning in Metallic Crystals.
Dr. J. W. Evans.—The Isolation of the Directions Image of a Mineral in a Rock-slice.
Dr. G. Hickling.—On the Micro-structure of Coal.
Mr. Thomas Crook.—On the Economic Mineral Products of Damaraland, South-West Africa.
Mr. W. Lower Carter—Committee to consider the preparation of a List of Characteristic Fossils.
Professor E. W. Skeats.—Committee to consider the Nomenclature of the Carboniferous, Permo-Carboniferous, and Permian Rocks of the Southern Hemisphere.
Dr. F. A. Bather.—Committee to consider the preparation of a List of Stratigraphical Names used in the British Isles, in connexion with the Lexicon of Stratigraphical Names in course of preparation by the International Geological Congress.
Professor W. G. Fearnsides.—Committee to excavate Critical Sections in Lower Palæozoic Rocks of England and Wales.
Professor Grenville A. J. Cole.—Committee to investigate the Old Red Sandstone Rocks of Kiltorcan, Ireland.

SECTION E.—GEOGRAPHY.

Presidential Address by *Major H. G. Lyons, F.R.S.*
Professor J. W. Gregory, F.R.S.—Relations of the Central Lakes of Westralia.

II.—*Papers read before Section C (Geology), British Association, Manchester, September, 1915.*

(1) ON THE UNDERGROUND CONTOURS OF THE BARNSLEY SEAM OF COAL IN THE YORKSHIRE COALFIELD. By W. G. FEARNSIDES, M.A., F.G.S., Sorby Professor of Geology, University of Sheffield.

IN this paper the author presents a preliminary account of the results of his statistical analysis of about a hundred records of borings and sinkings which have proved the depth of the Barnsley Bed or its equivalents (the Gawthorpe, the Warren House Coals of Yorkshire, and the Top Hard Coal of Derbyshire) in Yorkshire. The majority of the records of borings and sinkings discussed have been collected by a committee of the Midland Institute of Mining, Civil, and Mechanical Engineers, and were published by that institution in volume form in 1914, the sites at which the information was obtained being plotted on a half-inch map. The depths to the coal have been corrected for the height of the surface location above sea-level, and, after the manner of Dr. Gibson's map (plate i) in the Geological Survey Memoir on the Concealed Coalfield (1913), contour-lines have been drawn among the spot-levels so obtained. Other contour-lines similarly obtained from the records of borings which have passed through Permian strata show the character of the surface of the Coal-measures where they underlie the Permian strata.

In drawing the contour-lines no attempt has been made to distinguish between those changes of level in the seam between neighbouring pits which are due to faulting, and those due to the folding of the strata. Since, however, over most of the coalfield the faults tend to nullify the change of level which the dip has accomplished, it is maintained by the author that to plot contours which show the average rate of change of level is a statistical method which yields a useful presentation of the truth.

1. From an analysis of the results as plotted it appears that the underground contours of the Barnsley Bed (strike lines) in Yorkshire in detail generally range either N.E.–S.W. or N.W.–S.E., and that within the area under which the Barnsley Bed has actually been proved by working it is difficult to find either a N.–S. or an E.–W. strike constant over more than a very few miles of country. This circumstance, if general over the coalfield, would seem to demand some revision of current views respecting the origin and structure of the Pennine Chain.[1]

2. The greatest structural division of the coalfield 'basin' is by the equivalent of a N.E.–S.W. anticline of which the southern limb is along the line of the Don faults from Sheffield by Rotherham and Conisborough to Doncaster. North of this line there is some evidence for the existence of a completed syncline, with its axis central near Frickley. In ground from which the Permian rocks have been denuded, the Barnsley coal attains a depth exceeding 1,800 feet below sea-level. The general line of this northern trough follows a N.W.–S.E. trend from Wakefield to South Kirkby, whence, displaced perhaps by the Don anticline, it bends somewhat eastward through Bulcroft. South of the Don a wider trough, also trending N.W.–S.E. through Yorkshire Main Colliery (Edlington) and Bawtry, carries the Barnsley Bed (at Rossington) below 2,600 feet.

3. The inclination of the Barnsley Bed is at its steepest near the outcrop, and after the manner of gentle folds the measures flatten

[1] These views were admirably expressed by Professor E. Hull, who in advocating them in 1868 succinctly remarked (Q.J.G.S., 1869, p. 331): "Immediately upon the close of the Carboniferous period the northern limits of the Yorkshire and Lancashire Coalfields were determined by the upheaval and denudation of the beds along east and west lines, while the coalfields themselves remained in their original continuity across the region now formed of the Pennine hills from Skipton southwards, and that at the close of the Permian period these coalfields were dissevered by the uprising of the area now formed of the Pennine range by lines of upheaval ranging from north to south."

out when the centre line of the syncline is approached. There is no evidence to suggest any general eastward rise of the Barnsley Seam within the area plotted on the map. (The eastern boundary of the map is through Thorne and Retford.)

4. By the plotting of the contour-lines on Bartholomew's layer-coloured half-inch contour map, the interdependence of underground structure and topographical relief in the area of the exposed coalfield has been well brought out. Over the whole coalfield most of the ridges are of escarpment form and are elongate along the line of strike, but from the map it becomes evident that wherever the strike of the Barnsley Bed shows a change of direction, there the escarpment ridges are found upstanding above their average height, and this whether they form the arches or lie in the troughs of the folds.

From his experience of the application of the contour method to the study of the tectonics of the Barnsley Bed, the author suggests that the method is of peculiar usefulness in coalfield work. He offers this preliminary account of the results of his work in Yorkshire in the hope that workers on the western side of the Pennines may take up the method and use it in the further investigation of the many and difficult problems of geological structure presented by the 'Backbone of England'.

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(2) A Brief Criticism of the Fauna of the Limestone Beds at Treak Cliff and Peakshill, Castleton, Derbyshire. By Henry Day, M.Sc.

THE author put forward some observations on a collection of some three hundred species of Carboniferous Limestone fossils from the localities Treak Cliff and Peakshill, Castleton, and embracing about one hundred species of Brachiopods and Corals. The beds at both places may be referred to the 'Brachiopod beds' of Sibly (Q.J.G.S. 1908), which are allocated by him to sub-zone D_2—the Lonsdalia sub-zone The present list of species presents some features of considerable interest bearing on the value of certain types as zonal indices. Reference is made to Vaughan's paper on the Bristol area, where it is indicated that amongst the Brachiopod groups confined to the Tournaisian in that area are the following: *Productus* cf. *Martini*, *Leptena analoga*, *Schizophoria resupinata*, *Rhipidomella* aff. *Michelini*, *Spiriferina octoplicata*, *Syringothyris cuspidata*. Two of these, it is noted, *Spiriferina octoplicata* and *Schizophoria resupinata*, are sub-zonal indices, and each with its maximum in its sub-zone. The list of Castleton forms from well up in D, now presented, includes all the above-mentioned Brachiopod groups. *Syringothyris cuspidata* and *Spiriferina octoplicata* are fairly abundant at both Treak Cliff and Peakshill, *Schizophoria resupinata* is extremely abundant at both places, *Leptena analoga* is abundant, whilst *Productus* cf. *Martini* and *Rhipidomella Michelini* are rare.

Passing to the coral fauna, the genus *Zaphrentis* appears in the Castleton list, i.e. one of the two genera of Corals confined to the Tournaisian in the Bristol area and not extending into the Viséan. The genus, though not very abundant, is represented by several species. In addition, the genera *Michelinia* and *Amplexus*, characteristic of the Upper Tournaisian of Bristol, but possibly extending into the base of the Viséan, are cited in the Castleton list, *Michelinia glomerata* being fairly abundant at Peakshill, and *Amplexus coralloides* is found at Treak Cliff, but is extremely rare.

These facts lead to a consideration as to how far the types mentioned are of value in zonal determinations. If any one of them, as recorded from Castleton, be regarded as representing exactly the same form as that recorded from the Bristol area, then its value as one of a number of index fossils of a zone becomes negligible. Examples are cited in the cases of *Spiriferina octoplicata* and *Schizophoria resupinata*. If the Castleton forms of D_2 horizon agree in identity with the Bristol types of K_2 and Z_2 respectively, then these two types become worthless as sub-zonal indices. It was pointed out that, even allowing of the rather unlikely possibility that in all the cases cited the Castleton specimens represented mutational forms of the Bristol species, the real difficulty as to their zonal value is not overcome, since the line of demarcation between mutations is more or less arbitrary, and there is still a considerable field of discussion as to what constitutes a 'mutation'.

It appears probable that any system of zonal indices can be of local value only, as for example in the application of the Bristol zonal indices within the Bristol area, and cannot be of any general application.

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(3) A Preliminary Note on the Glacial Geology of the Western Slopes of the Southern Pennines. By Albert Jowett, D.Sc., F.G.S.

THE area dealt with extends from Blackstone Edge southwards to the southern extremity of the Pennines.

No striated surfaces of solid rock have been discovered at high levels, and the two that have been recorded at Salford and Fallowfield serve only to indicate a general movement from N.W. to S.E. For more detailed information as to the movements of the ice-sheet, the only evidence is that afforded by the distribution of the drift at high levels and by the systems of drainage along the edge of the ice. From this it may be inferred that the main directions of ice movement about the time of the maximum extension of the ice-sheet were roughly towards the north-east in the Tame Valley, the east in the Etherow Valley, and the south-east and south-south-east in the Goyt Valley and further south. These directions were much modified locally by the complicated configuration of the sub-glacial surface.

The first barrier of hills met with on approaching the Pennines from the South Lancashire and Cheshire plain was almost everywhere overridden by ice, which left definite deposits of drift with foreign rocks at altitudes up to 1,360 feet, and scattered erratic boulders up to 1,400 feet. As this foreign drift penetrates further into the hills its maximum altitude falls steadily. It has only been traced across the main Pennine divide at the broad col (1,100 feet above O.D.) south-east of Chapel-en-le-Frith.

Thick deposits of drift and big erratics are comparatively rarely met with at the extreme limit of the foreign drift, towards which

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the erratics generally diminish in number and in size. Boulders of local rocks, often obviously transported and uplifted beyond their parent outcrops, become relatively more abundant towards the limit of the foreign drift, and generally form a spread of drift extending beyond it and passing insensibly into the driftless area.

Great lakes were held up by the ice barrier some time after it commenced to retreat from the western slopes of the Pennines. During early stages in this retreat the drainage from the lakes in and north of the Etherow Valley escaped northwards, and ultimately passed through the Walsden Gap into the Calder. When the ice barrier east of Manchester fell below 600 feet above O.D., this drainage followed the course of that south of the Etherow Valley and escaped southwards.

The action of the ice-sheet with its associated streams of water, together with the marginal water derived from melting ice and draining from the region beyond the ice-sheet, assisted by the action of post-glacial streams, in depositing the original drift, in cutting new channels through rock and drift, and in resorting and redepositing the debris, seems quite sufficient to account for the complicated superficial deposits in this area.

No evidence has been found of more than one period of glaciation nor of any local glacier system. There are, however, curious corrie- or cirque-like features, e.g. on Shelf Moor, Glossop. Moreover, although the Pennines are on the whole much lower north of the Etherow Basin than further south, the overflow channels of glacier lakes can be found at higher altitudes in the former than in the latter region. This is the reverse of what might be expected if the higher ground were ice-free. It may be, therefore, that at and near the time when the ice-sheet attained its maximum development the snow-line actually descended below the altitude of the higher Pennine hills, and, without bringing about a definite local glaciation, temporarily filled the higher hollows with snow up to the general level of the ridge. Thus, instead of the margin of the ice-sheet at that stage melting away rapidly, melting might be considerably reduced and even temporarily suspended, and the ice-sheet reinforced by the local snowfall. Such conditions would tend to depress the limit of distribution of erratics immediately west of the highest ground, but where an ice-stream carrying erratics actually crossed the watershed they might lead to the distribution of those erratics further and more widely than otherwise might have been possible.

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(4) The Old Red Sandstone Rocks of Kiltorcan, Ireland. Report of the Committee, consisting of Professor Grenville Cole (Chairman), Professor T. Johnson (Secretary), Dr. J. W. Evans, Dr. R. Kidston, and Dr. A. Smith Woodward.

THE Committee has spent the sum of £5 from the unexpended balance of the grant made in 1913, and has returned the remaining balance to the General Treasurer. The grant of £10 made in 1914 was not called on, since the work for which it was specially intended, excavation at Tallow Bridge, proved impracticable, owing to local difficulties. The regular working of the Kiltorcan quarry, however, makes it desirable to secure good specimens as they are turned out, since the owner is the local contractor for roads, and the stone and plant-remains become alike used in making the Kilkenny highways. Short of actual purchase and preservation of the historic site, the alternative is to pay the owner to watch the work as it goes on and to set aside the more interesting material. He has shown a ready appreciation of the requirements of the Committee.

Hence the Committee asks for its continuance and a grant of £10 for the excavation work at Kiltorcan, and for specimens obtainable in 1915–16.

The Committee would be glad to be allowed to send, carriage forward, duplicate material of *Archæopteris*, *Bothrodendron*, *Archanodon*, etc., to the botanical and geological sections of universities, colleges, and museums in the British Empire, where it is found that such specimens would be welcome. Such gifts would, of course, be accompanied by a statement as to the auspices under which the material was obtained.

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(5) The Geological Evidence in Britain as to the Antiquity of Man. By Hon. Professor W. Boyd Dawkins, M.A., D.Sc., F.R.S.

PROFESSOR BOULE, in his masterly essay published in *Anthropologie*, xxvi, Jan.-Avril, 1915, freely criticized the evidence on which the antiquity of man in Britain has been stated to go back beyond the early Pliocene age, and concludes that it is not of a nature to throw light on so important a problem. The antiquity of man—or, in other words, his place in the geological record—is a geological question to be decided, like all others, on the lines of a rigid induction. In each case it is necessary to prove, not only that the objects are of human origin, but further that they are of the same age as the strata in which they occur, without the possibility of their having been introduced at a later time. In this communication I propose to apply these tests to the evidence.

The Pliocene age of man in East Anglia is founded entirely on the roughly chipped flints in the basal Pliocene strata—on eoliths, mainly of the rostro-carinate or eagle's-beak type of Moir and Lankester. It has been amply proved in this country by Warren, Haward, and Sollas, and in France by Boule, Breuil, and Cartailhac, that these can be made without the intervention of man by the pressure and movement of the surface deposits, by the action of ice, by the torrents and rivers, and by the dash of the waves on the shore. The type-specimens taken to be of human work have been selected out of a large series of broken flints that graduate into forms obviously made by natural fractures. They are, as Boule aptly says, "hypersélectionnées," and can only be rightly interpreted by their relation to the other flints on the Pliocene shore-line.

As might be expected, if they are due to natural causes, the 'rostro-carinates' are widely distributed through the basal beds of the Crag

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in Norfolk and Suffolk. They occur also in the Upper Miocenes of Puy-Courny (Auvergne), in the Pleistocene gravels of London, and the present shore-line of Selsey, where they are now probably being made by the breakers. For these reasons I agree with M. Boule that they have not been proved to have been made by man, and that therefore they throw no light on his place in the geological record.

The presence of man in East Anglia during the Glacial period is founded on even worse evidence than this. The Ipswich skeleton on which Moir and Keith base their speculations was obtained from a shallow pit sunk through the surface soil of decalcified boulder-clay—not of boulder-clay in situ, as stated—into the Glacial sand that crops out on the valley slope. It is, in my opinion, a case of interment that may be of any age from the neolithic to modern times. The skeleton also is of modern type, and belongs, as Duckworth shows, to the graveyard series of burials.

We come now to the consideration of the evidence of the famous discovery on Piltdown of *Eoanthropus Dawsoni*—the missing link between primitive man and the higher apes. After the examination of the whole group of remains, and a study of the section, I fully accept Dr. Smith Woodward's opinion that the find belongs to the early Pleistocene period. The associated implements are of the same Chellean or Acheulean type as those so abundant in the mid-Pleistocene Brick-earths of the Thames Valley between Crayford and Gravesend. They may imply that *Eoanthropus* belongs to that horizon, in which the stag is present and the reindeer absent. It must not, however, be forgotten that the classificatory value of these implements is lessened by their wide range in Britain and the Continent through the later Pleistocene River deposits. The stag, the beaver, and the horse of Piltdown—leaving out of account the Pliocene fossil mammals more or less worn into pebbles—are common both to the pre-Glacial Forest-bed and the Lower Brick-earths of the Thames Valley and the later Pleistocene River-deposits. It must also be noted that the intermediate characters of the Piltdown skull and lower jaw point rather to the Pliocene than the Pleistocene stage of evolution. We must, in my opinion, wait for further evidence before the exact horizon can be ascertained. On the Continent there is no such difficulty.

The earliest traces of man are there represented at Mauer by a mandible associated with the peculiar fauna of the Forest-bed, showing that *Homo Heidelbergensis*, a chinless man, was living in the Rhine Valley during the earliest stage of the Pleistocene. The Neanderthal man, thick-skulled and large-brained, with small chin and stooping gait, belongs to the Mousterian stage, that, in my opinion, is not clearly defined from the Chellean and Acheulian gravels of the late Pleistocene. He ranged from the Rhine through France southwards as far as Gibraltar, and was probably the maker of the Palæolithic implements of those strata throughout this region. It is also probable that he visited Britain, then part of the Continent, in following the migration of the mammalia northward and westwards across the valley of the English Channel. While primitive men of these types inhabited Europe there was no place in the Pleistocene

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fauna for the thin-skulled men taken by Dr. Keith[1] and others to prove that modern types of men lived in Britain in the Pleistocene age.

Man appears in Britain and the Continent at the period when he might be expected to appear, from the study of the evolution of the Tertiary Mammalia—at the beginning of the Pleistocene age when the existing Eutherian mammalian species were abundant. He may be looked for in the Pliocene when the existing species were few. In the older strata—Miocene, Oligocene, Eocene—he can only be represented by an ancestry of intermediate forms.

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(6) THE CLASSIFICATION OF LAND FORMS. By Dr. J. D. FALCONER, M.A.

THE investigation of processes is the common ground of geology and geography. The geographical processes, however, are less numerous than the geological and are studied by geologists and geographers with a different purpose. The geologist studies these processes in order to elucidate the past history of the earth, the geographer in order to systematize the present topographical features of the surface. Geological interest in the geographical processes thus ceases as soon as the so-called land forms have been referred to their respective processes or combinations of processes. Since most textbooks of physical geography have been written from the geological point of view, it follows naturally that the treatment of land forms in these textbooks is entirely subsidiary to the discussion of processes and offers no clue to the scientific definition and classification of individual forms. It is believed, however, that these submit themselves to systematic classification with almost as much ease as the subject-matter of other natural sciences, and that it falls clearly within the scope of geography as the science of the earth's surface to establish such a classification. The first attempt in this direction was made by Professor Passarge, of Hamburg, in 1912.[2] The classification outlined below is based upon similar principles and has already appeared in the *Scottish Geographical Magazine*.[3]

It is proposed to set up two classes of land forms, each containing two orders—

Class A. Endogenetic Forms.
  Order I. Negative Forms.
  Order II. Positive Forms.
Class B. Exogenetic Forms.
  Order I. Degradation Forms.
  Order II. Aggradation Forms.

The two orders of endogenetic forms are then subdivided into four families—

Family 1. Forms due to superficial volcanic activity.
2. ,, ,, sub-crustal volcanic activity.
3. ,, ,, radial movements.
4. ,, ,, tangential movements.

[1] The skeletons of Galley Hill, in Kent, and probably that of Cheddar cave in Somerset, have, in my opinion been buried, and do not belong to the Pleistocene age. They are either prehistoric or even historic.

[2] Mitt. der Geog. Gesell. in Hamburg, xxvi, p. 133, 1912.

[3] xxxi, p. 57, 1915.

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Similarly, the two orders of exogenetic forms are each subdivided into nine families—

Family 1.	Forms due to the action of the	run-off.
2.	,, ,, ,,	percolating water.
3.	,, ,, ,,	streams and rivers.
4.	,, ,, ,,	life.
5.	,, ,, ,,	lightning.
6.	,, ,, ,,	sun heat.
7.	,, ,, ,,	the atmosphere.
8.	,, ,, ,,	frozen water.
9.	,, ,, ,,	the sea.

Each family is then subdivided into genera and species or specific forms. It is suggested that a land form be defined as any surface or slope which may be referred in origin to the operation of a single process or force. Monodynamic surfaces of this kind being rare, however, the commoner polydynamic surfaces may be classified according to the predominant force amongst those responsible for the production of the surface. This definition may be extended to include such surface features as cones or domes enclosed by one continuous surface, or such features as ridges or mounts enclosed by surfaces meeting in edges, provided that all these surfaces may be classified as examples of the same specific form.

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(7) The Isolation of the Directions Image of a Mineral in a Rock-slice. By J. W. Evans, D.Sc., LL.B.

THE author discussed the different methods by which the interference figures of a small mineral in a rock-slice may be kept distinct from those of adjoining minerals. He recommended two. In one, which he believes to be new, a diaphragm with a small aperture is placed below the condenser, which is lowered till the image of the aperture appears in focus on the rock-slice. In some microscopes the iris diaphragm provided for the Becke method of determining the refractive index may be employed. In others it is too near the condenser. The aperture should be sufficiently large to illuminate the maximum area of the mineral under investigation, but no portion of the others. The directions image may then be observed in any of the usual ways. Unless the condenser and diaphragm revolve with the stage the aperture must be very carefully centred with the axis of rotation.

The other method was proposed by Becke in 1895, but is very little known. The diaphragm is placed in the focus of the eye-piece so as to shut out all except the mineral selected. The Becke lens, or system of lenses resembling an eye-piece, is placed above the eye-piece, when the directions image of the mineral will be seen without any admixture of light from its neighbours. This method has the advantage that the diaphragm is less highly magnified at the time of adjustment. When a rotating stage is employed, a very accurate centreing of the nose-piece of the microscope is required, so that the coincidence of the object with the aperture may be maintained.

The common practice of placing a diaphragm for this purpose immediately below the Bertrand lens rests on no scientific basis, and is not effective in shutting out the light of minerals other than that which is being studied.