

CONCEALED COALFIELDS OF THE MIDLANDS

SINGULARLY appropriate to the presidential theme of "Man's Use of Energy", and also to the Birmingham setting of the British Association meeting, was the discussion held by Section C on the subject of "The Concealed Coalfields of the Midlands". This discussion followed naturally the accounts of the work of Charles Lapworth which had been delivered on the previous day.

Prof. L. J. Wills, in opening his address, paid tribute to Lapworth's report on the Midlands, made to the Coal Commission of 1905; but explained that since that time so much new information has been acquired that it is necessary to analyse afresh the geological factors determining the distribution of Coal Measures throughout the area. Nearly all the valuable coals, Prof. Wills pointed out, are contained in the productive coal measures below the Aegir (Mansfield) Marine Band, and zoning has shown that this coal-belt thins towards the south due to non-deposition of sediments. Shortly after these coals were laid down, there followed, in the early stages of the Upper Coal Measures, the first Malvernian folding and erosion, which removed the coals from a large area in Shropshire. Prof. Wills also believes that it was at this time, and not later, that much of the erosion took place in the Pennine anticline and in Charnwood. Afterwards, the second Malvernian folding, at the end of the Keele-Enville period, produced sharp anticlines and reversed faults in certain narrow belts. In Enville times, sedimentation was confined to the down-warps, but little erosion took place from the up-warps except in a region south of Birmingham, where the 'Mercian Uplands' had begun to rise. The period that followed was one of vertical block-movements with the establishment of well-defined horsts and graben. During the Clent Breccia and Bridgnorth Dune Sandstone stages the horsts were being denuded at the same time as sedimentation took place in the graben. Later, the area of deposition extended during the Bunter Pebble Beds and Keuper and a great levelling-up took place. Further vertical displacements of the fault blocks were brought about by post-Triassic movements, and subsequent denudation of the resultant horsts has exposed the five Midland coalfields. In the intervening areas the cover of New Red rocks is extremely variable, both in nature and thickness.

Prof. Wills illustrated his thesis by a comprehensive series of maps in which each stage in the development processes was demonstrated. The results of his analysis were summarized in a final map showing his conclusions regarding the extent of the present hidden coalfields and the probable depths of cover.

Dr. G. M. Lees then presented an account of geological deductions from geophysical work by the Anglo-Iranian Oil Co., Ltd., bearing on the prospect of Coal Measures in the South Midlands area. In his opening remarks, he explained that his interest in the extent of Coal Measures was incidental to the search for oil, and arose because the conditions under which oil had been found in carboniferous rocks of the East Midlands monocline had encouraged a search for further areas in which similar structures might retain a considerable cover of Coal Measures. An analysis of the main structural trends which had affected southern England, particularly when considered in

relation to the structure of northern France and the lowlands of Europe, led him to believe possible a wide extent of concealed Coal Measures. Dr. Lees pointed out that over much of southern England the average density of boreholes which have proved Palaeozoic rocks is only one in approximately 600 square miles, and the Anglo-Iranian Oil Co. had therefore set out to gain further information from geophysical work. Lantern slides were shown giving contour maps of Bouguer gravity anomaly summarizing the results of the gravimeter surveys. These surveys revealed, in a number of areas, gravity lows, which persisted as areas of low gravity after allowance was made for the effects of known and estimated thicknesses of Mesozoic cover. Extensions of the gravimetric observations revealed gravity lows in close association with the coal basins of the Kent and Bristol coalfields, and on the basis of these associations the gravity lows in a belt south of Worcester and in areas near Oxford, near Redhill, and in the Thames estuary were regarded as indicating the presence of further Coal Measure basins.

In certain areas the gravimetric surveys had been followed up by seismic work, and a high-velocity medium, interpreted as the Carboniferous Limestone, had been followed at depths of the order of 6,000 ft. Though the methods employed could not differentiate between Upper Carboniferous and Triassic rocks, nevertheless, since in these areas a great thickness of Trias was unlikely, the seismic results therefore appeared to support the conclusions reached from interpretation of the gravimetric measurements. Some geophysical work is still in progress and it is desirable that the survey should be supported by suitable boreholes. In conclusion, Dr. Lees expressed the view that investigations of this nature could play a part in the exploration for further coal resources.

Mr. T. Eastwood, who followed, said that for some years his attention had been turned to the possibility of potential coal resources in the area between the South Staffordshire and Warwickshire coalfields. Basically, he had approached the problem by asking three questions: first, has any coal ever been there?; then, if so, how much was there originally?; and finally, how much now remains? Similarities in the coal sequences of Warwickshire and south Staffordshire suggest that they were deposited in a single Coal Measure basin, and that similar deposition must have taken place in the area between the two coalfields. The present arrangement of Keele and Etruria outcrops in the Warwickshire coalfield shows that the dominant structure is a syncline pitching southwards. In the South Staffordshire coalfield, although the most northerly beds show a westerly dip, the main structure is also a syncline pitching south, and consideration of conditions at the margins of the exposed coalfields suggests that this structure is again repeated in the area between the two coalfields. A complicating factor, however, is the presence of the Hints Fault, which might have a considerable downthrow to the south-east. Outcrops of lower beds of the Trias near Lichfield appear to reflect an anticline crossing the inter-coalfield syncline, and in 1949 a Geological Survey boring was drilled on this anticline north-west of the

Hints Fault. In this boring were proved 30 ft. of workable coals at depths of less than 3,000 ft. The succession encountered can be correlated closely with that of the Cannock area, thus suggesting the existence of a considerable concealed coalfield extending from the north-eastern margin of the South Staffordshire coalfield into the Lichfield area.

Prof. W. G. Fearnside next gave some details of explorations carried out in the West Midlands by the National Coal Board during the past few years. He dealt first with the area to the north-east of Cannock Chase where, about two years ago, a boring programme was started in the hope of reinforcing the dwindling resources of Breton Colliery, south-east of Rugeley. Almost at the same time as the Survey boring at Whittington, the first boring outside the eastern boundary fault was drilled at Redhill. This entered the Coal Measures at considerably less than 1,000 ft., afterwards proving the full Cannock succession of coals. Further borings to the north and north-east all proved the workable coals, which appear to lie in a shelf at least two miles wide and thrown down about 1,000 ft. from those of the exposed coalfield. In this area the quality of the coals is good, and seam gradients, indicated by the boreholes, extremely low. Prof. Fearnside went on to describe the explorations by which new resources have also been proved east of the Coalbrookdale coalfield in areas north-east of Lilleshall and in the Madeley syncline. Further explorations are being made in several areas west and east of the South Staffordshire coalfield and south of the Warwickshire coalfield. Up to the present, from twenty deep borings in the West Midlands, considerable new resources have been proved.

The final speaker, Dr. G. H. Mitchell, dealt with the area east of the Warwickshire coalfield, and summarized information which has recently been made available from operations in that area by the National Coal Board and the Directorate of Opencast Coal Production. Recently, the limits of the South Derbyshire-Leicestershire coalfield have been proved to run from Desford, through Nailstone, Heather and Snarestone, to Netherseal. North-east of Netherseal the coals lie in a roughly basin-like structure, interrupted by many local contortions and faults. The basin is broken on the west by large faults beyond which the Coal Measures have not yet been proved. On the east side of the coalfield the Thringstone Fault is now known to be a large reversed fault. Between the South Derbyshire-Leicester coalfield and the Warwickshire coalfield, borings at Market Bosworth have proved Cambrian strata. The eastern extension of the Warwickshire coalfield is still unproved.

In the open discussion which followed, Mr. W. Bullerwell displayed maps showing some results of a gravimetric survey made by the Geological Survey over an area connecting the Coalbrookdale coalfield and the northern parts of the South Staffordshire and Warwickshire coalfields.

Dr. C. J. Stubblefield stated that the southern coalfields of the Midlands appear to be faunally connected with a province south of the Brabant Massif, and that certain differences between their marine faunal assemblages and those of the South Derbyshire coalfield suggest that in Coal Measure times a barrier may have existed between the coalfields of Warwickshire and South Derbyshire. Supplementing Mr. Eastwood's remarks on the Whittington boring, Dr. Stubblefield added that the lower section has proved fossiliferous Millstone Grit, Carboniferous

Limestone of northern facies, and—a rarity in the Midlands—fossiliferous Upper Old Red Sandstone.

Dr. P. E. Kent said that from the investigations east of Charnwood by the Anglo-Iranian Oil Co., it appears possible that a deep syncline containing Coal Measures exists near Grantham. Coal Measures may also be present in the Melton Mowbray area in troughs adjacent to the boring at Sproxtton which, drilled on an anticline, has proved Millstone Grit.

Prof. L. R. Moore outlined similarities between beds which were deposited about the time of Malvernoid movements in the South Wales-Bristol district and corresponding sections in the Midlands which had been described by Prof. Wills.

The large and representative audience was a clear indication that the meeting had aroused wide interest. From the particular point of view of a geophysicist, the proceedings demonstrated forcibly the absolute indispensability of the classical methods of pure deductive geology in the search for new coal resources, and also afforded a clear statement of the many questions which geophysical techniques must be able to answer before they can be considered to have graduated in coal measure problems. While present geophysical methods may assist greatly in the reconnaissance for new coalfields, the geologist and mining engineer require extremely detailed information before seam correlation, gradients and quality can be established firmly enough to support constructive planning. Only in exceptional circumstances can current geophysical methods give sufficiently accurate information at this stage, and there is therefore a need for further application and refinement. In view of this, it seems appropriate to conclude by expressing good wishes to the Department of Geophysics newly established under the Department of Geology at the University of Birmingham. In the light of the discussion, this new Department is not likely to be short of problems close at hand.

EXPERIMENTAL WORK WITH ATOMIC PILES

AT the Birmingham meeting of the British Association, four papers were presented in a discussion arranged by Section A (Mathematics and Physics) on "The Application of Atomic Piles to Experiments in Nuclear Physics". The experiments related to the properties of the neutron itself, the properties of atomic nuclei and the application of the atomic pile to the study of solids.

Dr. R. E. Bell, of the Chalk River Laboratory, Canada, described an outstanding piece of experimentation in which Robson has measured the energy spectrum of the beta-rays emitted by the natural radioactive decay of a strong beam of neutrons, and has identified the protons produced. He has verified in detail the predictions about the radioactive properties of the neutron. Bell and Elliott have redetermined the binding energy of the deuteron by studying the capture gamma-rays from hydrogen. The new value obtained for the binding energy is considerably larger than the previously accepted value, so that the accepted mass of the neutron has to be raised by about forty parts in a million.

The energy-levels of nuclei have been studied by Kinsey, Bartholomew and Walker, who measured the spectra of capture gamma-rays emitted by a large