been approved. Earlier, Mr. Marples had said that he would have to keep the electrification scheme (which is to cost £175 million) under close review to see how the estimates of cost and the rate of working compared, but that this did not necessarily mean that no other major main-line electrification scheme would be approved.

The White Paper states that the main conclusions reached by the Government are that the activities of the British Transport Commission, as at present constituted, are so large and diverse that it is virtually impossible to run them effectively as a single undertaking. There has been confusion in judging between what is economically right and what is socially desirable, and the commercial capability of the railways is circumscribed by outmoded statutory obligations and restrictions on their trading operations. Mounting deficits (now totalling £500 million), the size of capital debt in relation to the earning capacity of the assets and the increasing burden of interest (already some £75 million alone) as modernization proceeds, present a situation detrimental to the morale of management and workers, to financial control and to hope of recovery. Accordingly, the Government has decided to replace the British Transport Commission and the existing organization by a new structure designed to overcome the main defects and disadvantages of the present organization, to reconstruct the finances of the Commission, and of the railways in particular, and to give the various undertakings the maximum practicable freedom of operation in their commercial affairs.

In the new structure, each of the main activities of the present Transport Commission—railways, London Transport, docks, inland waterways—will be managed by a separate Board holding its own assets and responsible for its own capital debt. The British Railway Board will be responsible for running the railways as an effective national system, but will perform only those central functions which are essential to the running of the railways as a single entity, including policies for safety, training and research, and the determination of the future size and shape of the railway system ; all other functions will be the responsibility of the Regional Railway Boards. Co-ordination of policy between the new Boards for railways, London Transport, docks and inland waterways will be the responsibility of the Minister of Transport, assisted by a new Nationalized Transport Advisory Council. His special duties in respect of safety, training and research will continue. As regards finance, the Government proposes to write off £400 million of the £2,000 million capital liabilities of the British Transport Commission, and when £400 million of the remainder has been transferred to the appropriate new Boards, to place in suspense £800 million of the £1,200 million still remaining against the railways so that it carries neither fixed interest nor fixed repayment obligations. The amount and treatment of this suspense account will be subject to review from time to time in the light of developments. It is expected that the railways will eliminate their present operating loss of £60 million a year. The importance of efficient operation and the most economic use of man-power is also emphasized, and the railways are to be freed from statutory control over their charges except for fares in the London Passenger Transport Area.

THE AGADIR EARTHQUAKE

FOLLOWING a detailed local study of the Agadir earthquake of February 29, 1960, P. Erimesco has published the conclusions in the *Bulletin de L'Institut des Pêches Maritimes du Maroc* (No. 5; September 1960). The author states that earth tremors in Morocco are not infrequent, although they very seldom attain an intensity of more than 5 on the Mercalli scale. In the list given in the text for the period from May 31, 1934, to October 28, 1951, eighteen earthquakes have intensity 4 or greater. Two of these were of intensity 7, and four had maximum intensity 6. The town of Agadir is situated at the intersection of two lines of marked seismicity. One line follows the region between the High Atlas Mountains and the Anti Atlas. The other crosses the High Atlas Range and continues to the coast of the Mediterranean.

During the night of February 29, 1960, after two slight tremors, an earthquake of unusually high intensity for the region (IX–X) devastated the town of Agadir (initial time 23h. 40m. 12s. G.M.T.). According to the map produced by the author, showing isoseismal lines for the shock, the small region of greatest intensity inside isoseismal X lies just on shore. The local estimate of depth of focus lies between 3 and 7 km., and of the magnitude of the shock 5·75 to 6. According to Vít Kárník, of Czechoslovakia, the average formula connecting magnitude (M), intensity (I_0) at epicentre, and depth of focus (h) for European shocks is:

$$M = 0{\cdot}67\, I_0 + 1{\cdot}7 \log h - 1{\cdot}4$$

For $I_0 = 10$ and $h = 5$ km. this gives $M = 6{\cdot}48$, which is somewhat higher than the local estimate.

Whole areas of the town, situated near the port and along the shore, suffered very heavy damage, and in certain places total destruction. A squadron of the French Navy, rushing help to the stricken town, registered on the way two hitherto unknown depths of 15 m. and 10 m. where charts indicated 900 m. and 90 m., respectively. To check these soundings taken visually, two vessels of the Navy made, the next day, a systematic search. At the places in question, no echo at all could be obtained.

At the moment of the earthquake, the trawler *Rolando*, heading south-west, passed approximately the place where later the 10-m. depth was observed. The crew reported that they felt three shocks, as if their boat had hit a solid object. The sea became very choppy for several minutes and a glow appeared in the sea, shifting rapidly towards the town of Agadir. Shortly afterwards they saw the lights in the town going out.

In spite of near-by badly damaged buildings, the quay walls were found practically without serious deformation, with the exception of two short oil wharfs. The slip for the fishing boats had not suffered at all. The tide gauge at the time of the earthquake registered the choppy sea in the harbour usual during that time of the year on account of wind from the south-west, but no exceptional waves. To investigate changes on the sea-floor consequent on the earthquake, P. Erimesco with his assistants examined the effects in the harbour of Agadir and along the shore. In the Bay of Agadir, systematic soundings were made and samples were taken from the bottom at the place where the 10-m. depth was observed. The soundings could not detect any variation from the depths marked on the charts; and the bottom samples at the place where volcanic activity had been suspected contained living annelids in perfect condition.

Thus, contrary to local reports at the time of the earthquake, we have evidence of a most unusual occurrence, namely, an area of intense earthquake destruction practically on the shore line, and virtually no effect at sea—neither the sea bottom nor the sea waves—except perhaps the rising of a shoal of zooplankton and a cloud of mud in the sea.

P. Erimesco seeks to explain this by reference to the local geology. He states that from the geological structure of the region it can be inferred that the almost vertical Cretaceous and Tertiary strata near the coast are dipping steeply underneath the sea bed. The covering Quaternary and Recent layers are sub-horizontal or horizontal and, in their upper part, not yet compacted, and are saturated with water. Earthquake waves in the Cretaceous, or in the underlying folded Palæozoic strata, are thus propagated mainly in the solid rock, and, by total reflexion, literally channelled towards the outcrop of these strata on the coast. In the unconsolidated and water-saturated material at the bottom of the sea, the energy of the shock waves is largely dissipated in the material, and only locally can a fraction of the energy released by the earthquake reach the surface of the sea. The trawler *Rolando* might have been at just such a place.

E. TILLOTSON

SEDIMENTATION IN OROGENIC BELTS

A LITTLE more than twelve years ago, Kuenen and Migliorini set out the evidence which had led them independently to the fruitful idea that certain marine sediments may be re-deposited in deeper water, possibly many hundreds of kilometres distant from their temporary resting places, by the action of turbidity currents. The speakers at the symposium "Some Aspects of Sedimentation in Orogenic Belts", held by the Geological Society at the Royal Institution on February 8, had a wide field over which to range, but it was remarkable how much of the work described stemmed directly or indirectly from this concept.

In opening the symposium the president, Prof. S. E. Hollingworth, reminded the audience how present-day views on re-sedimentation could be traced back to the work of Bailey and O. T. Jones in the 'thirties. The principal speakers in the first session dealt with work in the Alps (Prof. R. Trümpy), the Polish Carpathians (Prof. M. Ksiazkiewicz) and the Himalayas (Prof. W. D. Gill). In the second session Prof. A. Wood spoke on the Lower Palæozoic of Wales, Prof. Scott Simpson on the Upper Palæozoic of south-west England, Prof. R. M. Shackleton on the Dalradians and Prof. Gill on a Carboniferous basin in Ireland. Discussion followed in each session. A summary account will appear in the *Proceedings of the Geological Society*, and rather than duplicate this summary I propose to consider in a more general way some of the topics which came up during the meeting.

Prof. Trümpy, who has recently provided a welcome account of alpine sedimentation[2], opened with a warning note on the use of the term 'flysch'[1,2], which, he said, describes a facies group and not a rock. Flysch, he continued, is marine, thick (> several 100 m.), and essentially composed of sandstones and shales in proportions varying from about 5 : 1 to 1 : 10. Individual beds can be followed for long distances, and flysch is in general monotonous. The shales are silty and the sandstones are often felspathic and generally micaceous. True greywackes are rare. Breccias and conglomerates, though quite subordinate, are typical of many flysch deposits. Prof. Trümpy pointed out that graded calcarenites are not called flysch in the Alps.

The structural setting in which flysch appears was discussed by several speakers. Prof. M. Ksiazkiewicz[3-9] showed how flysch was deposited in various parts of the Carpathian basin at different stages of its evolution. Thus in the outer zone folded in the Lower Miocene the flysch formed from the end of the Jurassic without interruption until the Oligocene. In the middle zone flysch did not appear until the Lower Senonian shortly before the pre-Maestrichtian orogenic stage, while in the inner zone flysch rests on rocks folded at the end of the Cretaceous. In the Alps, Prof. Trümpy suggested, flysch marked a stage when tension gave way to compression. Prof. Scott Simpson made the point that flysch is not confined to fold belts, while Prof. Gill gave a striking account of a comparatively small and shallow epicontinental basin in the Visean of County Dublin, in which slides and turbidity currents had developed in a non-orogenic setting.

The difficult question of the depth of water overlying flysch deposits was approached in several ways. Prof. Trümpy placed the fossils of the Alpine flysch in three ecological groups; an authochthonous fauna of fossils such as fucoids and helminthoids derived from soft-bodied animals indicating deep water beyond the penetration of light; a transported benthonic fauna including the larger foraminifera, calcareous algae and bryozoa, preserved in graded sandstone beds; and thirdly, pelagic microfossils such as globigerinids and radiolaria. Dr. J. F. M. de Raaf reported that foraminifera similar to or identical with recent deeper water species had been found in pelitic rocks above individual turbidites from flysch deposits in Switzerland, France, Spain, Italy and Greece. Profs. Ksiazkiewicz, Scott Simpson and Trümpy gave evidence which indicated that deep-water conditions were established before deposition of flysch began. Where shallow-water sediments were followed by flysch an intervening group of deep-water sediments was often present. In this connexion an interesting parallel emerged