Prof. Arthur Holmes, University of Durham, delivered a lecture on Radioactivity and Continental Drift.

The hypsometric curve was interpreted by Wegener to indicate the the existence of two dominant kinds of materials in the earth's crust, sial corresponding to the lighter continental areas, and sima to the denser oceanic floors. This view has been confirmed by Hiller's study of surface seismic waves. The properties of the sima of the Pacific floor correspond to those of gabbro. The effect of compression on gabbro would be to transform the material into eclogite. Such change of density and the simultaneous action of isostacy would lead to subsidence of the compressed belt and therefore to the formation of oceanic deeps. Applying the principle of isostasy, it is easily shown that the average thickness of the sial should be about 30 km. This conclusion is confirmed by the recent work of Jeffreys on near earthquakes, which reveals the existence of an upper layer 10 km. thick (identified with granitic rocks); an intermediate layer 20 km. thick (supposed by Jeffreys to be tachylite, but identified by Holmes with diorite and quartz-diorite on petrological and thermal grounds), and a lower layer which may be eclogite or peridotite or both. The continents are thus thin slabs of sial, ranging in composition from granite to diorite, averaging 30 km. thick by about 3000 km. across, and embedded in material which on any interpretation is much more dense than sial.

Thus for physical reasons it becomes as impossible to "sink" a continent as to sink an iceberg. Considerable areas of the Atlantic and Indian Oceans were formerly occupied by continental masses, and since these ancient lands are no longer there we are driven to believe that their material has been moved away sideways. Evidence of lateral movement is also forthcoming from tear faults; overthrust structures of the Alpine type; the geological history of geosynclines; the echelon structures of the Asiatic Island festoons; and by the opening of the Urals geosyncline at the same geological moment as the compression of the Caledonian Mountains of Britain and Scandinavia. Moving the continental regions back in the directions indicated by the evidence leads to a Permo-Carboniferous reconstruction similar to that of Wegener's diagrams, a reconstruction that is independently called for on palaeo-

climatic grounds. Wegener's deduction that the equator of the time ran through the coalfield belt from N. America to China is supported by the distribution of Permo- Carboniferous laterites and bauxites. It is concluded that there is now evidence pointing to the former occurrence of continental drift on a scale of the same order as that advocated by Wegener.

The dominant forces avaliable to move the continental slabs in the required directions (outwards from Africa towards the Pacific) tend to set up a westerly drift (tidal action) and a drift from the poles towards the equator (due to the departure of the a polar section through the earth from a circle). Since our actual geography is totally different from the picture thus visualised, we have an indication that some other agency must have been at work to move the continents into the positions they now occupy. There seems no escape from the deduction that slow but overwhelmingly powerful currents must have been generated in the underworld at various times in the earth's history. These, as suggested by A.J.Bull, are probably convection currents set up in the lower layer as a result of differential heating by radioactivity. In place of the mobile basaltic magma of Joly, one imagines a highly viscous sima heated unequally to very great depths. A sheet-like upward current would develope beneath the region of greatest heat output. In turning over at or near the base of the sial it would excercise a powerful drag on the undersurface in two opposed directions, leading to the formation of a geosyncline. The return downward current would be looked for just beyond the continental edges. A continental mass would move forward by stoping of the heavy ocean floor just in front. When this ceased mountain building would set in , and ultimately the direction of the currents would be reversed. Convection currents which themselves move their boundaries and the sources of much of the heat responsible for their existence can clearly lead to the periodic alternations of heating and cooling in any one region.

Prof. J.W.Gregory said that some of the facts used in support of the theory of continental drift required to be established. For instance, with regard to the interpretation of the Matterhorn as a denuded remnant of the hinterland of Africa resting on Jurassic schists; were these schist really Jurassic? Many isolated facts of geology were difficult to explain on Wegener's theory. For instance, the Squantum Tillite (Boston) is situated on the line of Wegener's equator. The theory of convection currents in the sima was not open to many of the objections to Joly's theory.

Dr. G.W.Tyrrell said that Prof. Holmes' theory corresponded better with the facts of igneous geology than those of Joly and Jeffreys. Any movement of the continents would be reflected in the rhythm of igneous activity. Joly's theory demanded alternate world-wide fusion and solidification of the substratum, but there was no corresponding world-wide rhythm of igneous events. Prof. Holmes' theory, on the contrary, does not demand that fusion should be world-wide, and is therefore consistent with the local limitation of igneous episodes. What determined the inception and localisation of the convection currents?

Mr. J.V.Harrison also spoke.

Prof. Holmes, in reply, said that the late Mr. Lamplugh had worked out a theory of continental drift to explain the distribution of the Permo-Carboniferous glaciations. Like Prof. Gregory, he (Prof. Holmes) had been unable to find any evidence for the Jurassic age of the schists below the Matterhorn, but their precise age was not a matter of great importance. The Squantum Tillite was a difficulty on any hypothesis. There occurred close together in that area alleged laterites, tropical coal-seams and glacial deposits. The difficulty lay in the interpretation of the facts themselves, and was possibly due to wrong stratal correlation. With regard to the localisation of convection currents, there would be four systems corresponding to the four divisions of Wegener's continent. Mr. Harrison's suggestion that sial might be present in the Pacific was not supported by the evidence of L earthquake waves and petrology.

Prof. Holmes was accorded a vote of thanks for his lecture, to which he briefly replied.

A. Macgregor

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