The Mount Everest Expedition, 1933—Geological Impressions*

By L. R. Wager

THE route taken on the outward journey by the recent Mount Everest Expedition was the same as that followed by the previous expeditions and covered a region which, in part, had been geologically investigated by Hooker, Mallet, Hayden, Prof. E. J. Garwood, Dr. A. M. Heron and Mr. N. E. Odell. During the return journey some of the party zigzagged along the junction between the metamorphic complex of the main range and the Tibetan sedimentary zone, and the data obtained on the two journeys made it possible to extend the geological mapping in the strip between Mount Everest and Phari.

Over this whole distance (120 miles) a limestone, about 2,000 ft. thick (Heron's ? Permo-Trias), could be traced with but few interruptions. A thick, dominantly pelitic series much injected by granite occurred below this limestone, and above was a quartzite and shale series which underlay typical Jurassic shales. In the Quartzite and Shale series on the Lachi Ridge, four miles north-west of the Donkia La in North Sikkim, a brachiopod fauna was found. A preliminary examination suggested that the fauna is Lower Permian in age. The thick limestone below the fossiliferous horizon, since it forms the summit of Mount Everest, is called the Upper Everest Limestone; it can probably be assigned to the Permo-Carboniferous or Carboniferous system, while the Everest Pelitic series and Odell's Lower Calcareous series must be older.

The structure of the northern border of the eastern Himalaya in eastern Nepal and Sikkim is simple, consisting of Permo-Carboniferous and lower beds dipping gently northwards under the Tibetan Jurassic and Cretaceous rocks (so far the existence of the Trias has not been proved). Outliers of the conspicuous Upper Everest Limestone were found on various peaks in the Everest district, and also, according to Dyrenfurth, on the Jongsong Peak. Granites injecting the Everest Pelitic series, the Upper Everest Limestone, and sometimes the Jurassic beds are probably Tertiary in age. It is believed that in a more southerly zone a distinction can be drawn between Tertiary gneisses and granites and gneisses associated with migmatite and amphibolite which are older and equivalent to similar rocks of Peninsular India.

In the Darjeeling district, Mallet's careful mapping proves large-scale inversion, as the Darjeeling gneiss rests on the chloritic schist of the Daling series which in turn overlies the Damudas and Tertiary beds. The Damudas are roughly contemporaneous with the Quartzite and Shale series or the Upper Everest Limestone, and thus it is probable that the Daling series should be correlated with the Everest Pelitic series. It is interesting to find that to the east of the Darjeeling district the Baxa series, including thick dolomites, occurs between the Damuda and Daling series, the rocks in that area showing, therefore, a close lithological similarity with those of the same age to the north of the main range.

The main Arun gorge and the Yo Ri, the Rongme, and the Jikyop gorges of the Arun River were visited, and Oldham's view, that they are due to uplift of the main Himalayan range subsequent to the establishment of the drainage system, is regarded as the most satisfactory explanation. It is believed that the form of the range after the main compressive movements had occurred can be accurately determined from the present river pattern. The northern part of Sikkim, including Kinchenjunga (28,146 ft.) and the Tista Valley as low as 4,000 ft., is isostatically equivalent to a continuation southwards of the Tibetan plateau at a height of about 16,000 ft. Without wishing to imply anything approaching complete isostatic balance in the region, it is suggested that the grooving by rivers of the edge of the extended Tibetan plateau has resulted in a local upward movement of the crust which has raised the peaks of the eastern Himalaya to their present eminence.

* Substance of lecture delivered before the Geological Society on November 8.

The Neutron

IN his Bakerian lecture delivered before the Royal Society on May 25 and recently published (*Proc. Roy. Soc.*, A, Oct.), Dr. J. Chadwick gave an account of recent work on the neutron. It is now well known that neutrons are produced by bombarding light elements with α-particles, and neutrons have been detected from all the elements up to aluminium, with the exception of helium, nitrogen, carbon, oxygen. These exceptions are to be expected from the general rules of nuclear structure, for in all known nuclei, the atomic mass A is equal to or greater than $2Z$ and this condition would be violated by the new nuclei formed by the disintegration of the elements named with emission of a neutron. Some elements, for example, aluminium and fluorine, may disintegrate, giving either a neutron or a proton, and since these elements are isotopically simple, these are really alternative processes.

The dependence of neutron emission on the velocity of the primary α-particles has been examined and in the cases of boron and beryllium it appears that α-particles of comparatively low velocities penetrate the nucleus by a resonance process, while fast α-particles can enter over the top of the nuclear potential barrier. The energy balance sheet for the disintegration is difficult to construct because the energy of a neutron can only be inferred from the energy transferred to a recoil atom when the neutron strikes a nucleus. In the case of beryllium, it seems probable that the disintegration may result in the formation either of a fast neutron, or of a slower neutron and a γ-ray of about 7 million volts, energy and momentum being conserved.

The energy relations for several neutron-producing disintegrations suggest that the mass of the neutron is about 1·007—slightly less than that of the hydrogen nucleus. The neutron may be an elementary particle of this mass or it may consist of a proton and an electron, and the arguments on this point are conflicting.