Dr. Jeffreys takes this ***suggestion*** to be a ***fact***, and would have us believe that the thickness of this radio-active layer has been fairly accurately measured and that consequently it is possible to calculate the depth of the level of no strain.

The discovery of radio-active elements in the rocks of the earth has ***not*** rendered the compression theory any more probable. In its naked simplicity it appears to show that the earth is getting hotter and increasing in diameter at an "appalling rate". I am inclined to agree with Holmes that the radio-active elements are mainly concentrated near the earth's surface; but think that the exact amount of concentration is uncertain. An expanding earth would account for the formation of "rift valleys", normal faults and lines of volcanic activity or crustal weakness.

The theory I have supported to the effect that the folding and contortion of the rocks of the earth's crust have been largely due to vertical flow resulting from denudation and horizontal flow by the spreading of elevated areas, would account for the peculiarities our rocks present *even if the earth were slowly expanding*.

Dr. Jeffreys states that "substances possessing any elasticity are called solids". "If it is absent . . . the substance is a fluid." Contrast this statement with the following from Maxwell's *Theory of Heat*, edited by Lord Rayleigh, p. 302: "Gases and liquids, and perhaps most solids, are perfectly elastic, as regards stress uniform in all directions, but no substance which has yet been tried is perfectly elastic as regards shearing stress, except perhaps for exceeding small values of the stress." Dr. Jeffreys will find that the difference between a solid and a liquid is clearly stated on p. 303 of the above quoted work. Both solids and liquids are brittle and elastic. This can, in the case of a liquid, be clearly seen as regards pitch, but not in the case of water; but all liquids are elastic even under tangential stress.

In my article on "Mountain Building" which Dr. Jeffreys criticizes, I did not venture to introduce any new theories concerning the properties of matter, and I think that my critic should have pointed out that his views are not those of our textbooks. To my mind his theories concerning the solid and liquid states are quite inadmissible.

NOTICES OF MEMOIRS.

A Triassic Isopod Crustacean from Australia.

A Fossil Isopod belonging to the Freshwater genus *Phreatoicus*. By Chas. Chilton. Journ. Proc. Roy. Soc. N.S. Wales, li, pp. 365–88, 13 text-figs., 1918.

Of the six (or perhaps seven) sub-orders composing the order Isopoda, only the Flabellifera and Valvifera have been definitely recognized in a fossil state. The Flabellifera are represented by several genera as early as the Jurassic, while the Valvifera are known only by a single species from the Oligocene. Professor C. Chilton now announces the discovery, in the supposed Rhætic rocks of New

South Wales, of a representative of the remarkable little sub-order, the Phreatoicidea. To make clear the importance of this discovery it is necessary to give a brief account of the existing members of the group.

The genus *Phreatoicus* was established thirty-five years ago, by Professor Chilton himself, for a blind species which he found inhabiting subterranean waters in New Zealand. Other species, some of them blind and some with functional eyes, were subsequently discovered in streams and lakes of New Zealand, New South Wales, Victoria, and Tasmania, and two species of terrestrial habitat were also found. Three of the species were referred to as many genera distinct from *Phreatoicus* and forming with it the family Phreatoicidæ, for which Mr. Stebbing in 1893 established the Tribe (now ranked as a sub-order) Phreatoicidea. In 1914 Mr. K. H. Barnard greatly extended the known range of the group by discovering a species of *Phreatoicus* living in streams on Table Mountain at Cape Town.

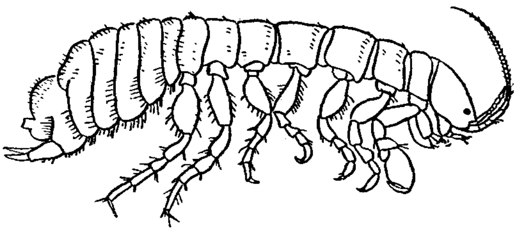

FIG. 1.—*Phreatoicus australis*, Chilton. Recent. Mt. Kosciusko, New South Wales. × 4. (After Chilton.)

The Phreatoicidea are distinguished from all other Isopods by having the body more or less compressed from side to side, and resembling in general appearance that of an Amphipod. This resemblance, however, is no more than superficial, and the structure of the animals shows that they are in no way closely related to the Amphipoda.

As in nearly all Isopods, seven somites are distinct in the thoracic region, and the telson is not separated from the last abdominal somite. In the Phreatoicidea, however, the first five abdominal somites are not only distinct and movable but they are of considerable size. This is of some importance as a primitive character, since the abbreviation of the abdominal region is one of the most characteristic features distinguishing the Isopoda from the other orders of Malacostraca. Even when, as in many Flabellifera, the abdominal somites are distinct from one another, they are crowded together, and the greater part of the length of the abdomen is formed by the enlarged terminal segment. The great development of the side-plates (pleura) of these abdominal somites in the Phreatoicidea, and the fact that they are directed downwards instead of laterally, are characters of less morphological significance, but they contribute to the Amphipod-like aspect. Another character

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that may be regarded as primitive is found in the first or coxal segments of the thoracic legs. These are all of small size and, on the last six segments at any rate, are movably articulated with the body. In this character the Asellota resemble the Phreatoicidea, but in other Isopods these segments are expanded into broad "coxal plates" and more or less completely fused with the somites that carry them. Finally, the last pair of abdominal appendages (uropods) project from near the end of the body as bifurcate styles, like the uropods of certain Asellota, and still more like those of Amphipods.

In nearly all other respects—in the structure of antennules, antennæ, mouth-parts, thoracic legs, branchial abdominal limbs, and even sexual appendages—the Phreatoicidea are commonplace Isopoda, not differing essentially from many representatives of the central and typical sub-order, the Flabellifera. That they retain certain features which we believe to be primitive, or which point the way to groups outside the order itself, has already been stated, but this is true also of the Asellota and of the Flabellifera, and it is perhaps impossible to rank any one of these three sub-orders as, on the whole, more primitive than the others.

FIG. 2.—*Phreatoicus wianamattensis*, Chilton. Rhætic (?). St. Peter's Brickworks, Sydney. × 3½. (After Chilton.)

The habitat and the geographical distribution of the Phreatoicidea are also noteworthy. Isopods of truly freshwater habitat are few, and in no other case are they conspicuously different in structure from marine representatives of the group. With the possible exception of the single family Asellidæ, they are scattered, and no doubt recent, immigrants from the sea. The Phreatoicidea, on the other hand, are not known to have any near relatives among the marine Isopoda, and it is this that gives special significance to their remarkable distribution in New Zealand, South-Eastern Australia, Tasmania, and South Africa.

In describing the first known species of *Phreatoicus*, Professor Chilton stated that the group "must be of very considerable antiquity". This prediction he has now had the good fortune to verify in a striking manner. The specimens which he describes were detected by Mr. R. J. Tillyard while investigating the fossil insect fauna of Queensland and New South Wales, and were found in the Wianamatta Shale of St. Peter's Brickworks, Newtown, Sydney. The strata in which they occur were at first referred to the Trias-Jura, and Professor Chilton quotes Mr. Tillyard's opinion that "evidence is accumulating that will probably place them in the Upper Trias, probably as the nearest Australian equivalent of the Rhætic". Dr. Smith Woodward, who has reported on the fossil fishes from the same beds, agrees that the fish fauna, if it had been found in the Northern Hemisphere, could not possibly have been regarded as of later than Rhætic age.

The largest specimen obtained must have measured about 30 mm. in length when complete. After examining a long series of specimens, Professor Chilton shows that, in the general form and segmentation of the body, the large size of the abdominal somites with their downwardly directed side-plates, the size and shape of the terminal segment and the uropods, the short antennæ (or antennules), and the form and proportions of the chief segments of the legs, the fossils closely resemble the living Phreatoicidea. There is indeed nothing to forbid their inclusion in the type-genus, to which he assigns them under the name *Phreatoicus wianamattensis.*

It seems probable from the presence of insects, of such Mollusca as *Unio*, and of numerous plant remains, that the beds in which the fossils are found are of freshwater or estuarine origin, so that even as early as the Triassic period the Phreatoicidea had adopted, or were on the way to adopt, the freshwater habitat to which they are at the present day confined.

While *Phreatoicus* is thus one of the oldest, if not the very oldest, of fossil Isopods yet discovered, and while it undoubtedly presents certain primitive structural characters, it should be noted that it throws no light on the phylogeny of the order. It is, indeed, very far from being an ancestral type, and it only emphasizes the fact that the evolution of the group goes a very long way back in geological times. No doubt among these early Isopods, as among those now living, a vast number of forms were two small and too delicate in structure to be readily preserved as fossils, and, except for some lucky chance, it is likely that we may never be able to trace, with any clearness, the lines of evolution followed by the various sub-orders.

In reporting the discovery of a species of *Phreatoicus* living at the Cape, Mr. K. H. Barnard called attention to its probable bearing on the antiquity of the group and referred to the former extension of "Gondwana land" over the areas where species of the genus now occur. We now learn that they existed, probably as freshwater animals, within the same area at a time when that extension may have been still unbroken. Whether at that remote epoch their geographical range was still wider, we cannot tell. If it was, then it becomes a most extraordinary coincidence that their fossil remains should first be found in a district where the living animals exist to-day.