encouraging, and further reports of his enterprising investigations will be awaited with interest.—*The British Medical Journal.*

SCIENTIFIC BOOKS

Geology of the Tertiary and Quaternary Periods in the Northwest Part of Peru. By T. O. BOSWORTH. With an account of the Paleontology by Henry Woods, T. Wayland Vaughan, J. A. Cushman and others. Macmillan & Co., 1922.

This book of 434 pages is devoted to the post-Cretaceous geology of the coastal strip, fifteen to forty miles wide in northern Peru, and extending from Tumbez southward to Payta, a distance of about one hundred and fifty miles. It is made up of five rather distinct and largely uncoordinated parts: (1) Tertiary Geology; (2) Tertiary Paleontology; (3) Quaternary Geology; (4) Desert Geology; (5) Occurrence and Exploitation of Petroleum; all but the second being by the author. The book is a result of several years of professional work in the region and is a most important addition to our knowledge of it.

The geological elements comprise the Andean chain of the Amotape Mountains on the east, consisting of slates, quartzites and granites of Paleozoic and Mesozoic age, and lying west of these mountains the present desert plain made up of Eocene and Miocene, littoral and shallow water formations, and a series of Pleistocene wave cut terraces and beaches or Tablazos. The Oligocene Ovibio formation, the lower Miocene Heath formation, the upper Miocene Talara formation and the Pliocene Payta formation described in this region by Grzybowski and others are shown not to exist.

The Eocene consists of two formations with a total thickness estimated to be more than twelve thousand feet and consisting of clay shales, more or less calcareous sandstones and beach pebbles. The oldest of these, the Negritos formation, is especially rich in gastropods and is divided into an older Turritella series and a younger Clavilithes series. The fauna is shallow water and largely molluscan, but containing a few crustaceans and fish teeth. It shows a marked resemblance to that of the Wilcox and lower Claiborne of our gulf states and is indicative of a seaway between the two regions. Frequent mention is made of the presence of a species of Aturia in the Negritos. The reviewer's collections from that formation contain no Aturia but do contain abundant specimens of a large Hercoglossa.

The Negritos is followed by some five thousand feet of lithologically similar beds constituting the Lobitos formation. The fauna is essentially similar to that of the Negritos but sparser, and contains Foraminifera of several species, notably the genera *Lepidocyclina* and *Orthophragmina,* and is considered to be upper Eocene in age.

The Zorritos formation, which makes up the balance of the Tertiary, is estimated to be about five thousand feet thick and is considered as Miocene in age, although the author seems to be in doubt as to there being any break between it and the Eocene Lobitos formation. The author did little detailed work in the more northern region where the Zorritos is well exposed, consequently but three pelecypods and six gastropods are described from it. In the paleontology of the Zorritos formation published by Spieker[1] before Bosworth's book reached America, there are described forty-four gastropods and fifty-seven pelecypods, and the age was definitely proven to be lower Miocene. Bosworth does not mention the three hundred feet of variegated, partly continental and lignitic Zorritos which is so conspicuous in the Zorritos district.

The Quaternary is represented by a series of four (possibly more) sea-cut terraces, the oldest of which reached inland almost to the Amotape Mountains. These terraces (Tablazos) are named the Mancora, Talara, Lobitos and Salina and record extensive oscillations of level. It seems unfortunate that for the second Bosworth uses a name already used for a supposed Miocene formation in this region, and that for next to the last he uses a name already applied by him to an Eocene formation in the region. These tablazos consist of thin sheets of light colored beds of shell rock, marl, sand, sandstone and conglomerate, very variable laterally, quite fossiliferous, and lying practically horizontally on a plane of marine erosion on the much faulted underlying Tertiary. The pebbles are beach pebbles of volcanic rocks from the western Andes, sub-angular quartz-

[1] Spieker, E. M.: *Johns Hopkins Studies in Geology,* No. 3, 1922.

ites, slates and granites from the Amotape mountains, and those derived from the underlying Tertiary.

The intense block faulting of the Tertiary preceded the Tablazo period, but there has been subsequent differential warping since the surface of the oldest or Mancora tablazo declines from an elevation of eleven hundred feet at Mancora to two hundred feet at Payta. The younger tablazos are progressively less extensive and less elevated, and the latest or Salina plain has been brought above sea level by a recent uplift of from ten to fifteen feet. The contemporaneous breccia fans bordering the mountains, and river terrace and other deposits are also dealt with. The author is impressed with the vast time involved in the oscillations and consequent events of Quaternary time in this region, amounting, if one may take his remarks on page 259 literally, to some five million years.

Part 4 is devoted to desert conditions and processes and is a most valuable description and discussion of land forms and processes under conditions which are little known to the average geologist. Part 5 is a not altogether satisfying account of the petroleum industry in the region. The chapter on the occurrence of oil in fault blocks, often of small size, is as interesting as it is unusual.

In conclusion the work is a most commendable one and indispensable to any one interested in or contemplating working in the region. As an example of book making there are some features that might have been better done. The five parts into which it is somewhat artificially divided are not coordinated and there is considerable repetition. One questions the wisdom of splitting it up into 76 chapters, some of which are only a paragraph in length, and in a book with one hundred and fifty figures besides many plates the readers might dispense with several views of the author at the plane table, which is a well-known instrument even in Peru. With all due appreciation of this as the first comprehensive work on the region it would seem that previous workers have been given but slight consideration, and in particular the main stratigraphic units do not differ greatly from those of the Cuerpo de Ingenieros de Minas of Peru, which is not mentioned.

The author's insistence on a range of pre-Tertiary desert mountains, which he states were higher in earlier times than they are at present, may well be questioned. Obviously the Andean region underwent changes of level both by uplift and erosion throughout its history and some of its rocks were folded in very ancient times, but I am not prepared to accept the author's conclusions, based on the absence of Eocene deposits elsewhere on the west coast of South America to the southward of this region, the enormous estimated thicknesses of the Eocene, and the presence of Andean pebbles, as proof of a high range, particularly as the fossil plants found in the Zorritos formation[2] show no evidence of desert conditions or of high mountains across the path of the easterly humid trade winds, and the topographic form of the mountains themselves precludes such a conclusion, as does also the paleobotanical evidence of Pleistocene elevation derived mostly from Bolivian localities, but recently discovered as near the region treated by Bosworth as Cajamarca in northern Peru.

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SPECIAL ARTICLES

THE LOCATION OF ENERGY

A CALCULATION of the mass of an electron, based upon the modification of electromagnetic theory proposed in a recent paper,[1] has led to the surprising result that the mass inside an electron in uniform motion, when calculated from the momentum, is equal but opposite in sign to the mass outside.

Before the calculation was carried to eight decimal places the sum of the two masses appeared to be a small positive multiple k of e/ac^2, where e is the charge of the electron, a its radius and c the velocity of light. The boundary of the electron is supposed to be a sphere of radius a when the electron is stationary.

It was thought at first that this calculation indicated that a must be much smaller than is generally supposed, of the order 10^{-17} cm., for

[2] Berry, E. W.: *U. S. Natl. Mus. Proc.*, Vol. 55, pp. 279-294, 1919.

[1] *Physical Review*, September, 1922.