PITHECANTHROPUS ERECTUS.

PROFESSOR MARSH has contributed to the February number of the *American Journal of Science* an account illustrated by plates of the discovery by Dubois described in SCIENCE (January 11) by Professor Brinton. A writer in *Nature* (January 24) under the initials R. L. (Professor Lankaster) holds that the remains are human, the skull being that of a microcephalous idiot. Professor Marsh writes:—

"The brief review here given of the main facts relating to this discovery, together with the figures reproduced from the memoir, will afford the reader some idea of the importance of this latest addition to the known allies of primæval man, if not to his direct ancestry. Whatever light future researches may throw upon the affinities of this new form that left its remains in the volcanic deposits of Java during later Tertiary time, there can be no doubt that the discovery itself is an event equal in interest to that of the Neanderthal skull.

"The man of the Neander valley remained without honor, even in his own country, for more than a quarter of a century, and was still doubted and reviled when his kinsmen, the men of Spy, came to his defense, and a new chapter was added to the early history of the human race. The ape-man of Java comes to light at a more fortunate time, when zeal for exploration is so great that the discovery of additional remains may be expected at no distant day. That still other intermediate forms will eventually be brought to light no one familiar with the subject can doubt. Nearly twenty years ago, the writer of the present review placed on record his belief that such missing links existed, and should be looked for in the caves and later Tertiary of Africa, which he then regarded as the most promising field for exploration in the Old World. The first announcement, however, has come from the East, where large anthropoid apes also survive, and where their ancestors were doubtless entombed under circumstances favorable to early discovery. The tropical regions of both Asia and Africa still offer most inviting fields to ambitious explorers."

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.

THE section of Geology and Mineralogy of the New York Academy of Sciences met on Monday evening, January 21, and listened to a paper by Prof. R. S. Woodward, of Columbia College, on the *Condition of the Interior of the Earth*, of which the following is an abstract. The two envelopes of the earth, the atmosphere and the ocean are important factors in the problem of the interior, and yet we know less of the condition of the outer atmosphere than of the inner earth. The atmosphere's shape we can calculate, with some approximation to the truth, as an oblate spheroid, whose polar radius is 5.4 times the earth's radius, and whose equatorial radius is 7.6 times the latter. This shape is determined by centrifugal force and gravity. Its bulk is 310 times that of the earth, but its mass is only one-millionth that of the latter. If we speak of the latter as 6642×10^{18} tons we can get some conception of the mass of the atmosphere, and of its extreme tenuity in the outer portions.

Our inferences regarding the interior of the earth rest chiefly upon four facts, viz.

1. Its shape and size, which are known with great accuracy.

2. Its surface density, 2.6.

3. Its mean density, 5.58, which is probably accurate within two units in the second decimal place.

4. The precession ratio $\frac{C-A}{C}$, in which C is the moment of inertia of the earth with respect to the polar axis, and A is the moment of inertia with respect to an equatorial axis.

These facts limit the distribution of the earth's mass. The density of the mass must

increase from the surface toward the center. Various laws of its increase have been proposed, of which that of Laplace seems to be on the whole the most plausible.

It is important to appreciate that the strata rest upon one another substantially as if fluid, because the arch of the crust is so flat. The compressive stress on any portion considered as a keystone is 30 times the crushing strength of steel, and 500–1000 times that of granite and limestone, whence it follows that the earth is practically in hydrostatic equilibrium. It also follows that the pressures in the interior are excessive, and that at the center the pressure is about 3,000,000 atmospheres. The earth is 'solid,' as the word is used by Lord Kelvin, that is, it has no cavities below a comparatively shallow depth. The explanations of the changes of latitude lately advanced and based on internal hollows in which loose matter rolls around are absurd. There is perfect continuity of matter, and there is only fluidity when for some local cause the pressure is somewhat relieved. As Major Dutton has shown, the transmission of vibrations from the centrum of the Charleston earthquake indicated a medium nearly as homogeneous as steel.

Geologists have had to account for movements of the crust, such as subsidence, elevation, crumpling, folding, etc. Two elementary forces are necessarily appealed to. The first is *Gravity;* the second that due to the *Earth's Internal Heat.* The idea of the earlier geologists that the earth cooled and contracted and hence caused the disturbances has been mostly relied on as an explanation, but for the last ten or fifteen years it has been felt to be insufficient. The idea of Babbage and Herschel that loaded areas, or areas of sedimentation, sink and crumple up the adjacent areas as mountains, tending thus to renew and perpetuate regions of upheaval, has also had believers. This has had its best formulation in the recent doctrine called *isostasy,* which regards the earth as a body in essentially hydrostatic equilibrium, and as balancing inequalities of pressure by subterranean flow. The speaker regarded this doctrine, however, as insufficient in that it furnishes no start and tends to run rapidly down. We need secular contraction to keep isostasy at work. The earth's internal heat is the great store of energy available for this purpose. How to explain the earth's internal heat is a hard and dark problem. The nebular hypothesis, first outlined in Leibnitz's Protogea has been most widely believed. The critical stage in this method of development came when convection ceased and the sphere was all at the same temperature, the stage usually called *consistentior status.* Then came the formation of a crust and the beginning of geological phenomena as usually discussed. The speaker had reason to question the reliability of the nebular hypothesis and whether the earth had ever been gaseous, etc. An origin for the globe and an explanation of its heat are perhaps as well to be found in the collision of meteoric bodies.

The time that has elapsed since the *consistentior status* has been an interesting subject for computations, and widely varying estimates have been made. Lord Kelvin in 1862, on very questionable data, placed the limits of geological phenomena at 20,000,000–400,000,000 years in the past. On the same line, Tait estimated 10,000,000, but it was doubtless true that in England the weight of Kelvin's authority had fettered geological thought in the last thirty years to too narrow limits of time, for no geologist of eminence had questioned his results. Yet within a month Lord Kelvin has raised his upper limit to a possible 4,000,000,000. All must appreciate that if the data are unreliable, the finest processes of mathematics will lead to no certain result.

The speaker concluded that to secular

cooling must be attributed the principal motive force. The main criticism raised against it is its insufficiency, but George Darwin has shown that as a cause it can be mathematically shown to be able to produce results at least of the same order as those observed. In the speaker's estimation it is probably sufficient, although the heat radiated is a very difficult thing to measure in a reliable way. Our data are all from the continents, and they have not been obtained in sufficient quantity. The oceanic areas are necessarily unobserved.

In discussion Professor Kemp stated that attention had been naturally been drawn to the interior of the earth in the endeavor to explain, first of all, the contrasts of the continental elevations and the oceanic abysses, and secondly, the crumplings, foldings and faults of mountainous regions. Herschel's explanation, while rational and simple on the face of it, is inapplicable because it is the area of sedimentation, subsidence and 'overloading' that later on is upheaved in the mountains, and this apparent contradiction is the great difficulty. He also referred to the measures of rigidity of the crust, to the remarkable localization of the yielding along narrow lines when it did come, and to its great effects and relatively short duration. He asked Professor Woodward also to touch on the slowing up of the revolution of the earth and the consequent readjustment of the spheroid to the loss of centrifugal force, an idea advanced some years ago by W. B. Taylor.

In reply Professor Woodward admitted that the questions were old and very difficult ones, and that for the mountains he had no explanation to advance. He spoke of the mountainous protuberances as measures of the rigidity, and yet this must be qualified by the statement that according to isostasy and to recent pendulum observations they appear to be somewhat lighter under the surface. As to the slowing up of rotation and loss of centrifugal force, the idea was an important and valuable one, but it did not appear to be sufficient to account for the results.

Professor Rees referred to the recent observations on changes in latitude made under his direction, and to certain factors that entered into the calculations which would throw light on the question.

Professor Hallock brought up the recent results of experiments on the gyration of liquids as bearing on the question and proving that a fluid set in rapid rotation continues to gyrate long after the enclosing vessel ceases. The curious results obtained at the Waterville arsenal in the great testing machine were also cited. The attempt was made to burst a cast iron cylinder by forcing into it, through a three-sixteenth of an inch hole, paraffine and tallow. But it was found that both these substances became, under high pressures, more rigid than steel and could not be driven through the hole.

Prof. Britton asked Prof. Woodward if the amount of heat radiated per annum could be quantitatively expressed, and in reply Prof. Woodward said it is computed from very meagre data to be enough to melt a layer of ice 5 to 7 mm. thick over the earth's surface. The chairman, Prof. R. P. Whitfield, in closing the discussion called attention to the fact that the submarine crumpling and upheaval were not well known nor often taken into account, and yet they probably far exceed all that we see on the continents.

The discussion will be continued at the meeting of the Section, February 18.

J. F. KEMP, *Recording Secretary.*

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE, FEB.

Relation of Gravity to Continental Elevation: By T. C. MENDENHALL.