

LETTERS TO THE EDITORS

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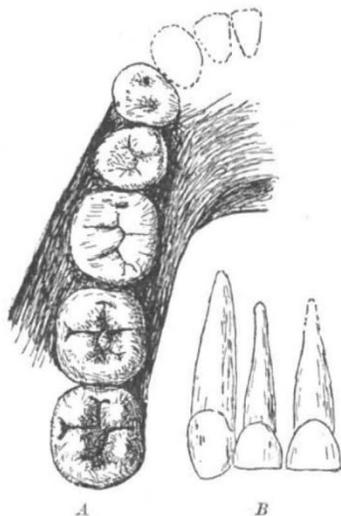
Another New Type of Fossil Ape-man

SOME years ago, I pointed out that in my opinion the cave deposits in the dolomite of the Transvaal when fully worked will give us the remains of most stages of early man and pre-man that have inhabited South Africa from probably Middle Pliocene to Recent. In the Sterkfontein area alone there are apparently in about ten square miles more than a hundred different cave deposits, and many of these are of quite different ages judging by the faunas. Almost all the animals at Kromdraai main deposit are quite different species from those at the main quarry at Sterkfontein. The jackals, the sabre-toothed tigers, the baboons, the dassies and the ape-men are quite different species.

At the beginning of November we started work at a new spot in association with the California University Expedition. Though the deposit is on the farm Swartkrans and only a mile from the main Sterkfontein quarry, the fauna so far as we have gone proves to be very different—whether older or younger we cannot yet say. Luckily we found teeth of a new type of ape-man within ten days, and a week later discovered much of a mandible with the complete lower premolars and molars.

The new mandible is not closely allied to that of the Sterkfontein ape-man *Plesianthropus*; the teeth are allied to those of the Kromdraai ape-man *Paranthropus*; but they are much larger and differ in a number of respects.

We have found two beautiful upper incisors and a perfect upper canine. These teeth are almost typically human, though a little larger than most human teeth. The canine has no deep infolding of the enamel on the lingual side as we have in the canines of *Plesianthropus*. It is also interesting to note that the canine and the 2nd incisor have been in contact, as each has been abraded by the other.



Teeth of *Paranthropus crassidens* Broom. $\frac{1}{2}$ Natural size. A. Left mandibular ramus. The 1st premolar is a little displaced in the specimen and has been restored to its natural position. The 3rd molar is drawn from the 3rd right molar reversed. B. Right upper incisors and canine

The mandible was found in the same deposit but at a spot about 10 ft. from the isolated upper teeth, and it cannot belong to the same individual though it is clearly of the same species.

The mandible is very massive. The horizontal ramus is preserved from the 2nd premolar to the 2nd molar; the 1st premolar is also preserved but a little displaced. Most of the inner side of the symphysis resembles more closely that of the Heidelberg jaw than any other specimen of man or ape-man I know.

But the teeth are relatively huge. The drawing is of the occlusal view with the 1st premolar in position, and the left 3rd molar drawn from the right tooth reversed.

This new type of ape-man is not closely allied to either *Australopithecus* or *Plesianthropus*, but is allied to *Paranthropus*. When a skull is discovered it may prove to belong to a new genus; but provisionally we may call it *Paranthropus crassidens*.

As further evidence of the richness of our deposits, attention may be directed to the wonderful finds being made in the northern Transvaal at the Makapan caves. For about a couple of years the Bernard Price Institute has been working there, and Prof. R. A. Dart has recently announced the discovery of a remarkable ape-man occiput, and a few weeks later of a very fine mandible. These he has referred to a species of *Australopithecus*, and has called the animal *A. prometheus*. Though I am not convinced that he made fire, I am of opinion that the being belongs not only to a new species but also to a new genus. Prof. Dart has some other most important remains which he is describing. But I feel at liberty only to refer to what has been already announced.

R. BROOM

Transvaal Museum,
Pretoria. Dec. 7.

Exchange Integral with 3d Wave-Functions

PRECISE calculations have been carried out of the exchange integral occurring in a first-order perturbation calculation of molecular energies on the basis of the Heitler-London treatment. The wave-functions used for the two separate atoms were of the 3d hydrogenic type, but having spherical symmetry,

$$\psi = Nr^2 \exp(-ar), \quad (1)$$

N being a normalizing factor appropriate to a charge distribution which is an average over the five degenerate m_l states. Calculations have been made for effectively the whole range of internuclear distances, and it is found that the exchange integral is negative over nearly all the range for which the first-order perturbation calculation gives a reliable approximation. Additional calculations of the Coulomb integral show that the energy of the $^1\Sigma$ state is always lower than that of the $^3\Sigma$ state, that is, that the total spin in the ground-state of the molecule is zero.

The importance of these calculations lies in their relevance to ferromagnetism, which is in general to be ascribed to a positive interaction between 3d electrons¹. Previous qualitative discussions by Heisenberg², Slater³ and Sommerfeld and Bethe⁴ have suggested that, with a fairly large internuclear separation, a strong overlap of wave-functions in the internuclear regions and a weak overlap near the nuclei should lead to a positive exchange integral, and that the conditions for a positive sign are likely to become more favourable as the orbital quantum