A New Cave Man from Rnodesia, South Africa.

By DR. ARTHUR SMITH WOODWARD, F.R.S.

DURING recent years the British Museum has received from the Rhodesia Broken Hill Development Co. numerous bones from a cave discovered in their mine in North-west Rhodesia about 150 miles north of the Kafue river. All except the smaller of these bones are merely broken fragments, and they evidently represent the food of men and flesh-eating mammals who have at different times occupied the cave. As described by Mr. Franklin White (Proc. Rhodesia Sci. Assoc., **vol. 7, p. 13, 1908**) and Mr. F. P. Mennell (*Geological Magazine* [5], vol. 4, p. 443, 1907), rude stone and bone implements are abundant among the remains, and there can be no doubt that the cave was a human habitation for a long period. Very few of the bones can be exactly named, but, so far as they have been identified by Dr. C. W. Andrews and Mr. E. C. Chubb, they belong to species still living in Rhodesia or to others only slightly different from these. The occupation of the cave, therefore, seems to have been at no distant date—it may not even have been so remote as the Pleistocene period.

Until lately no remains of the cave man himself have been noticed at Broken Hill, but at the end of last summer Mr. W. E. Barren was so fortunate as to discover and dig out of the earth in a remote part of the cave a nearly complete human skull, a fragment of the upper jaw of another, a sacrum, a tibia, and the two ends of a femur. These specimens have just been brought to England by Mr. Ross Macartney, the managing director of the company, and they are to be added to the many generous gifts of the company to the British Museum.

The skull is in a remarkably fresh state of preservation, the bone having merely lost its animal matter and not having been in the least mineralised. As shown in the accompanying photograph, it is strangely similar to the skull of the Neanderthal or Mousterian race found in the caves of Belgium, France, and Gibraltar. Its brain-case is typically human, with a wall no thicker than that of the average European, and its capacity, though still not determined, is obviously well above the lower human limit. Its large and heavy face is even more simian in appearance than that of Neanderthal man, the great inflated brow-ridges being especially prominent and prolonged to a greater extent at the lateral angles.

The roof of the skull at first sight appears remarkably similar to that of Pithecanthropus from Java, having the same slight median longitudinal ridge along the frontals and rising to its greatest height just about the coronal suture. It is, however, very much larger, and the resemblance may not imply any close affinity. The length of the skull from the middle of the glabella to the inion is about 210 mm., while its maximum width at the parietal bosses is 145 mm. The skull is therefore dolichocephalic, with a cephalic index of 69. Its greatest height (measured from the basion to the bregma) is 131 mm. In general shape the brain-case is much more ordinarily human than that of the La Chapelle Neanderthal skull, which differs in the expansion and bun-shaped depression of its hinder region. The mastoid process, though human, is comparatively small. The supramastoid ridge is very prominent and broad. The tympanic meatus is short and broad, as always in man. The foramen magnum occupies its usual forward position, so that the skull would be perfectly poised on an erect trunk.

The facial bones much resemble those of the La Chapelle skull, the great flat maxillaries, without canine fossæ, being especially similar. The nasal bones, however, are more gently sloping; the sharp lateral edge of the narial opening runs down on the face (as in the gorilla), allowing the

premaxillary surface to pass uninterruptedly into the floor of the narial cavity; and the infranasal region is unusually deep. The typically human anterior nasal spine is conspicuous.

The palate is of enormous size, as large as that inferred by Boule from the fragments preserved in the La Chapelle skull. It is, however, in all respects human, being deeply arched and bounded by the horse-shoe-shaped row of teeth, which are unusually large, but also entirely human. The teeth are much worn, and those of the front of the jaw met their lower opposing teeth in the primitive way, edge to edge. The canines are not enlarged. The second molar is square, 13·5 mm. in diameter. The third molar is much reduced, measuring 12·5 mm. in width by 9·5 mm. in length. The total length of the molar series is about 33 mm. The outside measurement of the dentition across the second molars is 78 mm. The width between the sockets of the third molars

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is 51 mm. The length from the socket of the median incisor to a line drawn across the back of the third molars is also 51 mm. The whole dentition is much affected with caries, and the disease has spread to the tooth-sockets, which are pierced in some places.

The lower jaw is unfortunately absent, but the size of the palate and the extent of the temporal fossæ show that it must have been massive. Even the Heidelberg jaw is slightly narrower and shorter than this must have been.

Although the new skull from the Rhodesian cave so much resembles that of Neanderthal man, the shape of the brain-case and the position of the foramen magnum are so different that we may hesitate to refer the two skulls to the same race. This hesitation seems to be justified when the associated limb-bones are considered, for the tibia is long and slender, of the typically modern type, and the extremities of the femur do not differ in any essential respect from the corresponding parts of a tall and robust modern man. They are thus very different from the tibia and femur of Neanderthal man found in the caves of Belgium and France. As the skull appears to postulate an erect attitude, the congruous limb-bones may well be referred to it. We therefore recognise in the Rhodesian cave man a new form which may be regarded as specifically distinct from *Homo neanderthalensis*, and may be appropriately named *Homo rhodesiensis*.

The precise systematic position of this new species of primitive man can be determined only by further discoveries. It has, however, been pointed out by Prof. Elliot Smith that the refinement of the face was probably the last step in the evolution of the human frame. The newly discovered Rhodesian man may therefore revive the idea that Neanderthal man is truly an ancestor of *Homo sapiens*; for *Homo rhodesiensis* retains an almost Neanderthal face in association with a more modern brain-case and an up-to-date skeleton. He may prove to be the next grade after Neanderthal in the ascending series.

Problems of Physics.[1]

By PROF. O. W. RICHARDSON, D.Sc., F.R.S.

RELATIVITY is the revolutionary movement in physics which has caught the public eye, perhaps because it deals with familiar conceptions in a manner which for the most part is found pleasantly incomprehensible. But it is only one of a number of revolutionary changes of comparable magnitude. Among these we have to place the advent of the quantum. The various consequences of the electronic structure of matter are still unfolding themselves to us, and are increasing our insight into the most varied phenomena at a rate which must have appeared incredible only a few decades ago.

The enormous and far-reaching importance of the discoveries being made at Cambridge by Sir Ernest Rutherford cannot be over-emphasised. These epoch-making discoveries relate to the structure and properties of the nuclei of atoms. At the present time we have, I think, to accept it as a fact that the atoms consist of a positively charged nucleus of minute size, surrounded at a fairly respectful distance by the number of electrons requisite to maintain the structure electrically neutral. The nucleus contains all but about one-two-thousandth part of the mass of the atom, and its electric charge is numerically equal to that of the negative electron multiplied by what is called the atomic number of the atom, the atomic number being the number which is obtained when the chemical elements are enumerated in the order of the atomic weights; thus hydrogen = 1, helium = 2, lithium = 3, and so on. Consequently the number of external electrons in the atom is also equal to the atomic number. The evidence, derived from many distinct and dissimilar lines of inquiry, which makes it necessary to accept the foregoing statements as facts, will be familiar to members of this Section of the British Association, which has continually been in the forefront of contemporary advances in physical science.

The diameters of the nuclei of the atoms are comparable with one-millionth of one-millionth part of a centimetre, and the problem of finding what lies within the interior of such a structure seems at first sight almost hopeless. It is to this problem which Rutherford has addressed himself by the direct method of bombarding the nuclei of the different atoms with the equally minute high-velocity helium nuclei (alpha-particles) given off by radioactive substances, and examining the tracks of any other particles which may be generated as a result of the impact. A careful and critical examination of the results shows that hydrogen nuclei are thus expelled from the nuclei of a number of atoms such as nitrogen and phosphorus. On the other hand, oxygen and carbon do not eject hydrogen under these circumstances, although there is evidence in the case of oxygen and nitrogen of the expulsion of other sub-nuclei whose precise structure is a matter for further inquiry.

The artificial transmutation of the chemical elements is thus an established fact. The natural transmutation has, of course, been familiar for some years to students of radio-activity. The philosopher's stone, one of the alleged chimeras of the mediæval alchemists, is thus within our reach. But this is only part of the story. It appears that in some cases the kinetic energy of the ejected fragments is greater than that of the bombarding particles. This means that these bombardments are able to release the energy which is stored in the nuclei of atoms. Now, we

[1] Abridged from the presidential address delivered to Section A (Mathematics and Physics) of the British Association at Edinburgh on September 9.

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