of the leading engineering institutions in the United Kingdom in setting up a special committee which should consider and report to the council on the broad principles of engineering education and training likely to yield the best results. Sir William White, who was then president of the institution, was appointed chairman of the committee; its membership embraced a considerable number of men occupying eminent positions in the practice of all branches of engineering. The inquiries of the committee included general preparatory education, as well as the scientific and practical training of those who were proposing to enter the engineering profession. The work to be done, therefore, was very extensive in its range, and occupied the committee more than two years. The report was unanimous, and was approved by the council of the Institution of Civil Engineers and by the councils of the other engineering institutions which had been represented on the committee. That report has exercised great influence since its appearance, and as the council of the institution arranged for its publication at a low price (by Messrs. Clowes and Sons) it has obtained a wide circulation, both at home and abroad. One of the most valuable features in this report was an appendix containing the analysis of replies made by a large number of eminent practising civil engineers to a series of questions framed and circulated by the committee. From this analysis it became evident that the suggestions made in the report not merely represented the views of the members of the committee, but that the recommendations of the committee were endorsed by the great majority of engineers consulted. In the main the report undoubtedly represented, and still represents, the views of the leading men in the civil engineering profession. Five years have passed since the report was issued, and the council of the institution this year reached the conclusion that many questions of detail and of method which were involved in the realisation of the principles laid down in the report might with advantage receive further consideration. It was mainly for the purpose of affording an opportunity of discussing important questions of that kind that the recent conference was held.

The broad conclusions of the members of the conference in regard to preparatory education of boys who may be intended to become engineers were confirmatory of opinions expressed in the education committee's report of 1906: a good general education, including modern languages, was considered to be essential, and early specialisation was deprecated. The advantages obtained by engineering students who are attached to a university were generally admitted, but one most interesting feature of the discussions was an outspoken declaration by professors of engineering in favour of the practical workshop training being chiefly obtained in manufacturing establishments rather than in college workshops. As to practical training, anyone who has studied the subject cannot fail to have been impressed with the enormous importance attaching to friendly relations between engineering employers and college students.

The question of the period at which practical training should be undertaken by those who intended to receive a college training has been much discussed. The report of the education committee of 1906 recommended that boys after leaving a secondary school (say, at the age of seventeen or eighteen) should serve for about a year in mechanical engineering workshops, so as to gain some knowledge of practical conditions and work. It was also recommended that at the age of about nineteen they should proceed to college and complete their scientific training, taking courses of three or four years, and availing themselves of any opportunities for practical training during the vacations. After graduation, their practical training in such branches of engineering as they might desire to follow would be completed. This clear statement of the committee's report was not grasped by some of the speakers at the recent conference, some of whom argued that the whole of the practical training should be taken between the secondary school and the college, while others maintained that all the practical training should be taken after the college course was completed, in order that there should be no break between the secondary school and the college. The balance of opinion, however, was much in favour of the committee's suggestion, and that also represents the established practice in Germany. Formerly all practical training in that country was put after the technical university or high-school education; but experience led the Germans to adopt the system which the education committee recommended. After twelve years' trial of the new arrangement, the German authorities are more than ever in favour of its beneficial effects.

No doubt whatever was expressed as to the absolute necessity of thorough scientific training for all engineers. There was equally universal acceptance of the view that no man can be considered fit to take part in the design, as well as in the control and direction, of engineering works, unless there is added to a competent scientific knowledge a thorough practical training under actual engineering conditions.

In announcing their decision to summon the conference, the council expressed the hope that it would be widely supported by those interested in solving the difficulties and uncertainties which are experienced by aspirants to membership of the engineering profession. The result of the conference has shown that this hope was well founded. No one who took part in the conference will entertain the least doubt as to the value and interest of its proceedings or of the certain and considerable benefits which will result therefrom to the engineering profession. W. H. W.

THE PROBLEM OF PITHECANTHROPUS.[1]

NEARLY twenty years have gone since Eugene Dubois, then a young surgeon attached to the Dutch forces in Java, and now professor of geology in the University of Amsterdam, discovered that remarkable individual to which he gave the name of *Pithecanthropus erectus*. The actual discovery, it will be remembered, consisted of the roof of a skull, a thigh bone, and two teeth; they were found in a fossil-bearing stratum on the left bank of the Solo or Bengawan, a stream which, after flowing through the province of Mediun—"the hell of Java"—in the centre of the island, turns in a north-easterly direction to reach the sea. Experts agree that the bones found were parts of the same individual or at least of individuals of the same race or species. As to the nature of the individual, there has been a wide divergence of opinion; the discoverer regarded it as more anthropoid than human, hence the name, while others, looking on it as altogether human, simply name it the "fossil man of Java."

The position of Pithecanthropus amongst the higher primates is still debated; while one school of experts places it in the direct line of human evolution, another regards it as part of a side stem which ended in extinction. The age of the formation in which it was found is also still under discussion; Dubois assigned the fossil-bearing layer to late in the Pliocene period;

[1] "Die Pithecanthropus-Schichten auf Java." Geologische und Paläontologische Ergebnisse der Trinil Expedition (1907-1908). Herausgegeben von M. Lenore Selenka und Prof. Max Blanckenhorn. Pp. xiii+268+32 (Leipzig: W. Engelmann, 1911.) Price 50 marks.

the evidence and expert opinion to be found in the well-illustrated and excellent scientific memoir now under review indicate a more recent age for Pithecanthropus. It belongs, not to the Pliocene, but at the utmost to an early Pleistocene formation.

The late Prof. Emil Selenka, who did more than any man of his time to advance our knowledge of the higher primates, saw very clearly that the right way to solve the Pithecanthropoid problems was not discussion, but exploration. After his death in 1902, his widow took up the aim he had in view, and the manner in which she has carried it out commands our unstinted praise. Only those who have organised a scientific expedition know the care, labour, and expense entailed. Financial assistance was obtained from learned institutions in Berlin and Munich, but the major part of the expenditure had to be met from Fräu Selenka's private purse. Scientific investigators and overseers had to be selected and sent out; coolies had to be engaged—as many as seventy-five were employed at one time—and barracks built for them; Fräu Selenka accompanied the expedition into this remote and unhealthy part of Java. Extensive mining and digging operations were necessary for the fossil-bearing layer lies under 35 feet of a sedimentary deposit of volcanic origin. In the seasons 1907-8 10,000 cubic metres of material were removed, and forty-three large boxes filled with the fossil remains found. The contents of these boxes were sent to Europe and distributed amongst seventeen specialists. Their reports, with an introduction by Fräu Selenka and a summary of results by Prof. Max Blanckenhorn, make up the present memoir.

So far as Pithecanthropus itself is concerned, the expedition was a failure; the stone which Dubois erected to mark the spot of his discovery was found, but no further trace was seen of the much-discussed fossil primate. In the dry bed of a tributary of the Bengawan—about two miles from the scene of Dubois's discovery—the crown of a human tooth was picked up; it is a human lower molar of rather remarkable dimensions, but otherwise showing no special feature beyond its state of preservation. Dr. Walkhoff found that the dentine within the enamel cap was replaced by a fossilised organic matrix. From its condition he infers that it may be older in point of time than the remains found of Pithecanthropus, and is inclined to regard it as the earliest known trace of man.

Dr. E. Carthaus has prepared even a greater surprise for the readers of this memoir. In the same stratum as contained Pithecanthropus he has found traces of man's existence. These traces are:—(1) Certain splinters of bones and tusks; (2) hearth foundations and wood charcoal. He is quite aware of the fact that jungle fires by ignition from volcanic outbursts still occur in Java, but believes the appearances he has seen cannot be explained by any accidental conflagration.

On the slender evidence thus brought forward by Drs. Walkhoff and Carthaus, Fräu Selenka supports the theory that man was a contemporary of Pithecanthropus, and that therefore the latter is an aberrant form, taking no place in the line of human evolution. The evidence, in our opinion, is rather of the nature of suspicion than of fact; the Selenka expedition leaves the problem of Pithecanthropus—so far as concerns its structure and position, unchanged, but it may be otherwise as concerns its geological age. Dr. E. Carthaus regards the Pithecanthropus stratum as belonging to a comparatively recent Pleistocene formation; Fräu H. Martin-Icke finds that 87 per cent. of the gasteropods found in it are modern forms, and concludes that the formation must be well within the Pleistocene period; the evidence and opinion of the botanist, Dr. J. Schuster, tend to the same conclusion.

The problems relating to the estimation of the age of a fauna of a tropical and distant country are many and difficult; most palæontologists will follow the example of Dubois and look to the mammalian fauna as the means of fixing, if not the age, at least the degree of evolutionary change undergone by higher vertebrates in this part of the earth since the period of Pithecanthropus. It is the mammalian fauna which is best known; Dubois found remains of nineteen genera and twenty-seven species; Dr. H. Stremme and Dr. W. Janensch, who describe the mammalian remains of the Selenka expedition, found fourteen genera and seventeen species, many of which are new. The whole of the mammalian fauna contemporaneous with Pithecanthropus has been extinguished or modified, and hence those authorities lean towards Dubois's estimate that Pithecanthropus belongs to the Pliocene period which is at least not on a point of geological age that Pithecanthropus can be excluded from the genealogy of modern human races.

Prof. Blanckenhorn's general summary of the results of the expedition constitutes one of the best chapters of this memoir. He recognises the difficulty of drawing a line between Pliocene and Pleistocene in the formations of Europe and the even greater complexity in correlating the geological data of Europe and Java. As a tentative hypothesis he places the age of Pithecanthropus in the first interglacial period, corresponding to the formation of the Norfolk beds; the Heidelberg man—whose lower jaw only is known from the Mauer strata—he places in the second interglacial period, while the Neanderthal race he assigns to the third period. From an anatomist's point of view this provisional dating will answer very well, for these three forms are certainly progressive steps towards the modern human type. A. KEITH.

DR. G. JOHNSTONE STONEY, F.R.S.

DR. JOHNSTONE STONEY has passed away, one of the last of those who, during the latter half of the nineteenth century, contributed to the development of the modern ideas of the constitution of the atoms, which have borne such a rich harvest during the last two decades.

It is often difficult to get back to the point of view from which to estimate correctly the pioneer work of those who took the first steps; often the new ideas introduced by them have become the commonplace, so to speak, of science, but it is just these first steps breaking away from the older positions which mark the far-seeing intellect.

So early as 1871 we find Stoney endeavouring to formulate a relation for spectral lines depending upon possible simple harmonic modes of vibration in the atom, and he succeeded in finding a numerical relationship of a simple character in the case of the hydrogen spectrum, which has proved to be the forerunner of much subsequent work. Twenty years later he returned to the subject in a paper in which he considered the question more systematically, viewing the internal movements of the atom as those of a planetary system. Much work had been done by others in the meantime in following up the clue which Stoney had found in the numerical relationships of the spectral lines of hydrogen, and he was able himself to show further that double and triple lines would be produced by perturbations of elliptic orbits described under controlling forces in the atom, double lines being attributed to apsidal motions, triple lines to precessional motions. These conceptions of the constitution of the atom afterwards found satisfactory