The Peking Skull.*

By Prof. G. ELLIOT SMITH, F.R.S.

WITH characteristic promptitude, Prof. Davidson Black has now provided us with a full report upon the features of the Peking skull, giving a detailed description of its external form, illustrated by 16 photographic plates (each photograph provided with a transparent explanatory drawing) and 37 text-figures. The drawings represent exact orthogonal projections not only of the type skull but also of the second skull of *Sinanthropus*, the finding of which was discussed in NATURE of Aug. 9, 1930 (p. 210), and of a series of other fossil human skulls. The purpose of this comparison is to define the distinctive characters of *Sinanthropus* and to emphasise the contrasts in size and proportions that differentiate it from *Pithecanthropus* and the series of Neanderthal skulls. An elaborate series of measurements is provided together with a statistical analysis of the significance of the figures, in comparison with those of other fossil human types, as well as of representatives of modern races of men. Hence complete data are now available to enable the anthropologist to realise the distinctive features of the Peking skull and the reasons which induced Prof. Davidson Black to differentiate it from all other known human types and assign it a distinctive generic rank.

The history of the finding of the skull by Mr. W. C. Pei on Dec. 2, 1929, has already been told in NATURE (Mar. 22, 1930, p. 448). It was not until four months later that Dr. Black completed the process of removing from the surface of the skull the hard mass of travertine in which it was embedded. He then began to make casts and photographs of the specimen and to prepare the preliminary reports. After this was accomplished, he set to work to expose the interior of the skull, and in this he was inspired by the motive of preserving if possible the natural endocranial cast. Fortunately, this was possible because the braincase was fractured, enabling the bones to be removed piecemeal. Moreover, the skull is that of a young adolescent, whose age, in Dr. Black's opinion, corresponds to that of a modern child between the time of eruption of the second permanent molar teeth and the attainment of adolescence, say 15 ± 2 years. Thus it was possible easily to disarticulate the constituent bones. This work lasted until well into the summer of 1930, when Dr. Black succeeded in removing the cranial bones from the surface of the endocranial cast and then reconstituted each individual bone, and eventually rearticulated the skull with more precision than it had at the time

when it was found. Before doing so, however, he made photographs and models of each separate bone, and took X-ray photographs to display the sinuses and other details in the texture of the bones, such, for example, as the labyrinth in the temporal bone. Then the skull was rearticulated and an artificial cast made of the cranial cavity.

The present monograph describes the external surface of the skull and each individual bone. The description of the endocranial cavity and cast which Prof. Davidson Black has obtained of it will be discussed in a second monograph that is now in course of preparation.

In July 1930 a large part of a second braincase

FIG. 1.—Median longitudinal projections of the Peking skulls. $\times \frac{1}{2}$.

was obtained from certain blocks of limestone which had been brought into the laboratory in October 1930. In his monograph Dr. Black gives full details of the comparison of the two skulls and the evidence upon which he relied to interpret the sexual characters and ages of the two individuals. The skull obtained in December 1929 he now regards (for reasons set forth in full in this report) as that of a youth in a stage of development between puberty and adolescence, and the second skull that of a woman. Partial obliteration of the left side of the coronal suture suggests that the latter was an adult, possibly more than ten years older than her companion. In the accompanying diagram (Fig. 1) Prof. Davidson Black's drawings of median longitudinal projections of the young skull (shaded) and of the adult (female) skull have been superimposed. The female skull is slightly thinner than that of the youth and is also larger, being somewhat higher and longer than the male skull (Fig. 1) and presenting other differences which are probably expressions of the difference in sex.

In view of the claims put forward by certain writers that the Peking skull should be included in the genus *Pithecanthropus* or, alternately, in the species *H. neanderthalensis*, Prof. Black has devoted a large amount of attention to the comparison of

* Davidson Black, "On an Adolescent Skull of *Sinanthropus Pekinensis* in Comparison with an Adult Skull of the same Species and with other Hominid Skulls, Recent and Fossil", *Palaeontologia Sinica*, Series D, vol. 7, Fascicle 2. (Peiping: Geological Survey of China, Peiping, April 28, 1931.)

the projections of the skulls of *Pithecanthropus* and the various representatives of the Neanderthal species. By means of statistical comparisons he has made out a conclusive case in justification of the necessity of making a new genus and species for the reception of the Peking skulls.

While it is evident that the crania of *Sinanthropus* and *Pithecanthropus* resemble one another (Fig. 2)

FIG. 2.—Mid-sagittal skull contours of *Sinanthropus* and *Pithecanthropus*; left norma lateralis view. $\times \frac{1}{2}$.

much more closely than they do any other human type, it is no less certain that they differ from one another in point of size, proportions, and detail to a degree amply sufficient to proclaim their generic distinction. It is a remarkable fact, Prof. Black adds, that in all its cranial parts *Pithecanthropus* shows "evidence of an archaic specialisation in marked contrast to the evidences of archaic generalisation so abundantly preserved in the crania and teeth of *Sinanthropus*". In other words, the apparent primitiveness of the Java fossil is in part probably due to degenerative changes responsible for the uncouth shape of the skull, which presents so striking a contrast to the elegant and undistorted braincase of the Peking man. Apart from its massive supraorbital torus and reduced third molar tooth, the Peking skull presents no highly specialised features. On the contrary, its general proportions, the morphology of the teeth, and the features of the tympanic and other individual elements of the skull, all provide evidence that *Sinanthropus* was a generalised and progressive type.

Prof. Black does not devote much attention to the comparison with the Piltdown skull. The purpose of the present work is to provide anthropologists with a detailed description of his specimen and an exact comparison with other specimens of unquestioned and generally recognised authenticity. For this reason, as well as to avoid partiality, he uses the data collected by Dr. H. Weinert in the case of *Pithecanthropus*, based upon the study of the actual fossil, with information provided by Prof. Dubois in amplification. Similarly, for the Neanderthal skulls Dr. Black relies on the data and figures provided by Dr. G. M. Morant. As, unfortunately, there is still considerable doubt in the minds of many anthropologists concerning the Piltdown skull and the mode of its reconstruction, Dr. Black does

not make much use of it for comparison. He does, however, emphasise the fact that the peculiarly developed postero-inferior parietal boss in the Peking skull resembles in certain important features the similar, if less obtrusive, development of the Piltdown parietal. He also directs attention to the similar thickness of the skull in the genera *Sinanthropus* and *Eoanthropus*, but points out that the range of unevenness in thickness of the Peking skull presents a marked contrast to the more uniform Piltdown fragments.

Although Dr. Black himself has refrained from instituting detailed comparisons with the Piltdown skull, it is interesting to compare (Fig. 3) the transverse section he provides of the skull of *Sinanthropus* (the thick lines) with a section made in the corresponding plane (auditory meatus) of the reconstruction of the Piltdown skull (the larger shaded area) made by the late Prof. John Hunter. This section, like the view of the two skulls from the posterior aspect, brings out the essential identity of their architectural plan in a most striking way, and reveals a similarity of form and proportions which is unexpectedly close. Apart from the difference in thickness, the adult skull of *Sinanthropus* approaches even nearer to the Piltdown skull in some respects. Thus (see Fig. 1) it is loftier than the type skull and its height is identical with that of *Eoanthropus*, but the latter is considerably wider and correspondingly more capacious.

FIG. 3.—Transverse sections of Peking and Piltdown skulls. $\times \frac{1}{2}$.

The general form and proportions of the Peking skull, as well as the details of many of its constituent parts, are surprisingly modern in character. The man of China was clearly a very primitive and generalised member of the human family close to the main line of descent of *Homo sapiens*.

Prof. Black devotes particular attention to the unique character of the temporal bone, which presents a marked contrast to that of all other known men and apes. Of special interest are the distinctive features of the tympanic and mastoid portions,

showing, not only in the case of the mastoid but also in the form of the auditory meatus and middle ear, characters which in modern man occur only in newborn infants and very young children—a widely open meatus terminating at an ear drum the inclination of which closely approaches the horizontal. This state of affairs is lost in *Homo sapiens* long before the age of puberty is attained. As Dr. Black remarks, the features of the tympanic region of *Sinanthropus* are admirably suited to serve as a starting-point for phylogenetic speculation. "With this generalised type before us it is not difficult to imagine developmental stages through which such an element in a stem-form may well have passed, leading to the modifications such as are characteristic of the Piltdown, Neanderthal, and modern men". On the other hand, since all the essentials of the tympanic morphology of the great anthropoid apes may be recognised in these elements of *Sinanthropus*, a comparison of the latter may serve to indicate in some measure the degree of their divergence from a common type. In spite of this provocative comment, Prof. Davidson Black refrains from discussing the intriguing problems he

mentions. He does not depart from the admirable restraint that characterises all he has written upon this subject, which makes his monograph a reliable guide to those who want the data and prefer to form their own opinions as to their meaning.

The great importance of the discoveries in China lies in the fact, not only that the material is more abundant than the remains found at Trinil and Piltdown, and their geological age is unquestionable, but also that, while *Sinanthropus* is differentiated from the genera *Pithecanthropus* and *Eoanthropus*, it is much more generalised than either, yet definitely linked to both. While it is the most primitive type of human being so far discovered, its structural affinities with both the Javanese and the British genera link together all the known types of Pleistocene men and give cohesion to our knowledge.

It is fortunate that the information concerning this unique material has been so fully and so promptly supplied to anthropologists in a monograph which is distinguished by admirable clearness and impartiality. Once more Prof. Davidson Black deserves our congratulations on a great achievement.

The Spicer-Dufay Process of Natural Colour Kinematography.

By T. THORNE BAKER.

ALL modern attempts to reproduce by photography the natural colours of a subject depend upon some method of three-colour analysis. The theory that by the admixture, in various proportions, of blue-violet, green, and orange, any colour in Nature can be imitated, has been adequately borne out by practical experiment. So-called 'two-colour' processes must at the best be regarded as crude attempts to saddle each of two of the primaries with one-half of the third.

Methods of photography in which a glass support is coated with a mosaic or matrix of tiny coloured areas of the three primary colours, and then with a photographic emulsion, are well-known. Such material is exposed through the coloured mosaic, so that the light rays are microscopically analysed before reaching the sensitive emulsion. It is then developed, and after the black developed image has been dissolved away, the previously unexposed silver salts are exposed to light and themselves developed and blackened in turn. This procedure gives a positive transparency image, and if it be viewed by transmitted light—that is, through the coloured matrix on which it lies—the original picture will be seen in its original colours. To A. and L. Lumière belongs the credit of having first issued such a material (1907); it is still known as the Autochrome plate, and is still largely used.

Motion picture photography based on the same fundamental idea has proved vastly more complicated. The coloured mosaic necessarily absorbs a very high proportion of the incident light, and corresponding increase in exposure is required. With the advent of 'talking pictures', the old speed of sixteen pictures per second in kinematography

has been raised to twenty-four, and with the best shutter mechanism this means that no more than 1/40 second can be allowed for each individual exposure. Hence quite apart from the immense improvement in large aperture lenses which has come about in recent years, it has been necessary to produce panchromatic emulsions of extremely high sensitivity.

The films exhibited on May 20 at the convergence of the Royal Society at Burlington House were procured on a new film which has been developed during the past four years in the research factory of Messrs. Spicers, Ltd., at Sawston, Cambridgeshire. The film base itself, which is made at Sawston, is of the acetate type, and is non-inflammable in the strictest sense. By a combination of new plasticisers with a novel method of maturation, a film has been produced which retains its suppleness and whiteness indefinitely. So rapid is the maturing that the base can be used for photographic purposes a few hours after it has been cast.

The base is coated with a very thin layer of collodion containing a green dye of the necessary concentration to act as a primary green filter. It is then passed through a rotary printing-press of special design which impresses upon it 375 parallel ink lines to the inch, with the same number of intervening clear spaces. It is next passed over rollers through a bleaching bath, which decolorises the green dye where it is unprotected by the greasy lines of printing-ink. It then passes through an orange dye, when the bleached spaces become dyed the primary orange. Finally, passage through a series of benzole tanks against revolving brushes removes the printing-ink, and a material is left