

No. 8. Theophilus, reexamined in 1863. This is the most complete drawing which I *can* make with my 6-inch. I intended to repeat the whole group.

No. 9. The central mountain-group of Theophilus on a large scale. 1863.

No. 10. Posidonius, early morning. 1863. (Unfinished.)

No. 11. Posidonius, nearer to midday. 1863. (Unfinished.)

No. 12. Aristarchus and Herodotus. This is about the sixth drawing, and exhibits in Aristarchus a double crater-wall, the inner one being sharp and interrupted; a deep narrow fissure separates the two walls. The interior surface is more moulded than in any drawings yet published. Herodotus, the dark crater, is merely sketched to give the course of the seeming valley which conducts from it to the seeming delta.

January 23, 1868.

Dr. WILLIAM B. CARPENTER, Vice-President, in the Chair.

The following communications were read:—

- I. "Contributions towards determining the Weight of the Brain in the different Races of Man." By JOSEPH BARNARD DAVIS, M.D. &c. Communicated by Prof. JOHN MARSHALL. Received November 30, 1867.

(Abstract.)

It would naturally be expected that great attention had been directed to the human brain, the organ of mental manifestation. Still little has been done to ascertain its relative magnitude in the different races of mankind. Opportunities for examining exotic brains are rare, and it is only by gauging the internal capacities of human skulls, and deducing the weight of the brain, that data can be obtained.

The inferiority of this method is not so clear as has been assumed, since we are able to fix upon an unchangeable substance of definite specific gravity for the purpose of this gauging, whereby we compensate for the variable condition of the brain, depending upon disease and other causes, and the immediate occasion of death.

The great difficulty hitherto has been to decide upon a definite allowance, or scale of allowance for other matters besides brain which always fill up the cavity of the skull, in different proportions at different ages, &c. In the present investigations it has been considered most advisable to fix upon a definite, and at the same time proportionate, rule for compensating for these fluids and membranes. And, after much inquiry, that rule has been laid down as a general tare of 15 per cent. on the capacity of the skull.

In former inquiries of this kind by Prof. Tiedemann and Prof. Morton, this allowance has been entirely or almost entirely overlooked, by which means their extended observations really refer to the internal capacities of human skulls, and not to the weights of the brain, as they supposed. No

doubt internal capacities themselves become a legitimate means of comparison.

Synostotic and artificially deformed skulls are mostly included, for the reason specified, that their internal capacities are usually not materially interfered with.

Morton also failed to distinguish the sexes, and his Tables give no indication how many of the skulls were those of men and how many those of women. When we recollect the great normal diversity in the size of the brain in the two sexes in any given race, this omission becomes of serious importance. In the series of skulls now examined, this diversity in the weight of the brain in the two sexes extends from less than 10 per cent. to something more than $12\frac{1}{2}$ per cent.; so that Prof. Welcker's datum of 10 per cent. is tolerably correct. In our measurements the sexes are marked, and adult examples only included. All the crania have been carefully and as uniformly as possible filled with dry Calais sand of a definite specific weight, which has been afterwards weighed and then reduced to its equivalent in cerebral matter of 1040 specific gravity, after the deduction of the 15 per cent. The observations on the weight of the brain in all the races have been arranged in seven Tables, corresponding very nearly to the races of the great divisions of the globe. The results show that Prof. Tiedemann was misled when he hastily assumed that, inasmuch as a certain size and mass of brain was an essential condition for the exercise of the faculties of the mind, all human races are furnished therewith in an equal degree.

One important object has always been kept in view—namely, a careful comparison of the calculated observations of the Tables with the actual determinations of those who have weighed the brains of different races, as far as such determinations have extended. This has been done with the view of comparing and correcting our results.

It would be difficult to give any intelligible abstract of the Tables which accompany the memoir. Of the notes to these Tables some short account may be given here.

Dr. Peacock and other excellent and careful observers pretty nearly coincide in the conclusion that the brain of *Englishmen*, on the average, is about 49 oz. av. in weight, or 1389 grammes. Dr. Robert Boyd, in his memoir in the Philosophical Transactions, states as the result of his vast experience, that the adult *male* brain among the *insane* varied from 48·17 oz. to 43·87 oz.; among the *insane women* from 44·55 oz. to 40·55 oz.; whilst in the *sane* adults the averages varied in the *men* from 48·20 oz. to 45·34 oz., and among the *women* from 43·70 oz. to 39·77 oz. It thus appears that Dr. Boyd's investigations bring out an average brain-weight among the English of, speaking roundly, about 5 oz. less than Dr. Peacock's means, and rather more than 3 oz. less than our means. Dr. Thurnam, who examined and weighed the brains of 257 insane men and 213 insane women, agrees in his results with Dr. Boyd, being still rather below the averages

obtained by the latter. The general result of our Table is an average brain-weight for the English of 47·50 oz., or 1346 grms., which agrees tolerably well with the conclusions deduced by all these observers, being a mean term.

The mean derived from the 16 *French* skulls is 45·47 oz., or 1280 grms.—that is, 66 grms. less than the English. The general result of an extended series of measurements by Prof. Broca of 357 French crania, those of men and women undistinguished, when subjected to our rule, gives a mean of 44·58 oz., or 1263 grms.—that is, 17 grms. below our deduced average.

The skulls of *Italians*, of *Lapps*, and of *Swedes* agree in giving a brain-weight closely coinciding with that of the English. Those of the *Frisians* and *Dutch* come into the same category.

In the 15 *German* skulls (it should be observed that 13 are those of men) the average brain-weight exceeds that of the English. It is 50·28 oz., or 1425 grms., an excessive weight. This probably follows from the unusual size of these German skulls, as well as in some degree from the great predominance of men's skulls; for Prof. Huschke, who weighed upwards of 60 brains of Germans, two-thirds being those of men, found the mean weight to be no more than 1384 grms. Prof. Rudolph Wagner also tested by the balance 31 brains of Germans, the larger half being those of men, and obtained a mean of only 1300 grms., itself a sufficiently large weight. In the investigations of Prof. Welcker, who employed 30 adult normal skulls of men and 30 of women, the mean brain-weight of the series rises only to 42·83 oz., or 1214 grms. This seems to be conclusive that our specimens are large skulls, and that the size of the German brain has been somewhat overrated. The result of further investigation will probably be to correct these discrepancies.

In entering upon the decidedly brachycephalic races of Europe, it must be noted that we have for our examination the skulls of men only, and those in small numbers, which will prevent any accurate comparison with the rest of the series. The mean brain-weight of two male *Poles* is 47·14 oz., or 1336 grms. That deduced from Dr. A. Weisbach's gauging of 25 skulls of young Polish men, when subjected to our rule, is 47·21 oz., or 1338 grms., a result almost identical with that from our observations.

The *Gipsies* of Wallachia present a marked diminution of brain-weight when compared with the *Rumangos* and other races of that region. The mean of 6 male Rumango skulls is 45·97 oz., or 1303 grms.; that of two male Gipsies is 43·93 oz., or 1245 grms.

Although it has reference merely to the collection of skulls upon which these observations have been made, the order in which the different European races range themselves, beginning with the heaviest brain-weights and proceeding to the lightest, is given in the memoir. The general mean of the European series is 46·87 oz., or 1328 grms.

In entering upon the ASIATIC RACES, we are at once struck with the small brain-weights of the people at the commencement of the Table, the

Vedaks of Ceylon and the *Hindoos*. The mean obtained from 35 crania of males of Hindoo Tribes is 44·22 oz., or 1253 grms. ; that from those of 31 females 39·99 oz., or 1133 grms.,—which yields a mean of the two sexes of 42·11 oz., or 1193 grms. A reference to Dr. Morton's observations shows that his series, when properly calculated by our rule, give a still lower mean, viz. 41·74 oz., or 1183 grms.

The skulls of *Mussulmen* afford a slightly increased average of brain-weight over those of *Hindoos*. This perhaps might have been anticipated.

The two skulls of male *Khonds*, one of the unquestioned aboriginal races of India, show a brain-weight of 37·87 oz., or 1073 grms.

As we ascend the Himalayan Slope we reach races who have a somewhat increased volume of brain. The *Lepchas*, *Bodos*, and *Bhotias* range about 46 oz.

And when we reach what have been called the Indo-Chinese races, the brain-weight becomes again more considerable. The mean of the *Siamese* is 47·14 oz., or 1336 grms., that of the *Chinese* 47·00 oz., or 1332 grms., and that of the *Burmese* 47·87 oz., or 1357 grms.

Of the races of *Japan* only two crania of true Japanese have been obtained ; but of the aboriginal *Ainos*, of the Island of Yesso, the brain-weight, as deduced from four skulls, is 45·83 oz., or 1299 grms.

The general average of the Asiatic Table shows a diminution, when compared with that of the European. The numbers are, for the latter, 46·87 oz., or 1328 grms., and for the former, 44·62 oz., or 1266 grms., which is a diminution of more than two ounces, or 62 grms.

At the commencement of the AFRICAN RACES we encounter the *Berbers* and the *Guanches*, the former inhabitants of Teneriffe. These are people with rather small brains. The general mean amounts to 43·49 oz., or 1233 grms.

Of the Continental people, the *Negroes of Tribes unknown* give a slightly increased brain-weight of 44·08 oz., or 1249 grms. The *Dahomans* rise to a mean of 46·34 oz., or 1313 grms., and the *Bakeles*, a warlike tribe on the Equator, to an equally high brain-weight. A brain of an adult Negro, weighed by Dr. Peacock, was found to weigh 45·50 oz., or 1289 grms. Another, examined by Dr. Edmond Simon, was found to weigh, with the membranes, 1226 grms.

In passing to the more Southern portions of the African continent we find the races much contrasted in respect of their brain-weights. The *Kafir* skulls, seven-eighths of which are those of men, present a mean of 48·16 oz., or 1365 grms., whilst that of the small *Bushmans* reaches only to 39·70 oz., or 1125 grms.

In Prof. Marshall's valuable and elaborate account of the Brain of a Bushwoman in the Philosophical Transactions, there is a careful calculation of the original weight of the brain, which, by means of experiment upon human brains subjected to the action of spirits of wine, he was able to restore to its original weight ; and he decided this to have been 30·75 oz.,

or 375 grms. Prof. Marshall afterwards gauged the capacity of the skull by filling it with water, which he has given. He found it to be 60·64 cubic inches. With this capacity given, it is easy to determine that the weight of the brain would have been 31·01 oz. according to our rule. Prof. Marshall's calculation very closely approximates to this, viz. 30·75 oz., or only a quarter of an ounce different. This case, in which the brain-weight was restored and the skull was also gauged, seems to be a good instance for testing the accuracy of our method; and the result appears to prove that it may be relied upon with much confidence.

The general mean of our African Races is less than that of European Races,—a result which is not in agreement with Tiedemann's conclusions. It is rather more than two and a half ounces less than our European mean.

In passing to the AMERICAN RACES we have placed first the *Esquimaux* of the whole Arctic Circle. They present the large general mean brain-weight of 46·56 oz., or 1319 grms.

A series of mostly individual skulls belonging to different *American Tribes* affords a general mean of 46·23 oz., or 1310 grms. With these may be compared the 164 skulls of the "Barbarous Tribes" of Morton's American Family. When the mean cubic contents of these are reduced to our terms, with the observance of our rule, they produce a brain-weight of 42·84 oz., or 1214 grms., which is less than our mean by something more than three ozs.

When we arrive at the Caribs, former inhabitants of the Antilles, there is a considerable falling off; they descend to 42·32 oz., or 1199 grms.

Among South American Tribes, the *Amizcas*, or ancient inhabitants of the plain of Bogotá, afford a mean brain-weight of 44·20 oz., or 1253 grms. This is about the average until we reach the warlike *Araucanians*. Of these, six skulls, five of which are those of men, and one of them also a megalcephalic skull, ascend to a mean brain-weight of 48·02 oz., or 1361 grms.

The average of the whole of the American races reaches 44·73 oz., or 1268 grms., which is 2·14 oz., or 60 grms. less than that of the European races. It also comes so near to the general mean of the Asiatic and African races as to produce the impression that the whole must be regarded as pretty nearly equal.

The AUSTRALIAN RACES belong to two families—the *Australians* proper, and the *Tasmanians*; and they are remarkable among human races as possessing the smallest brains. The mean brain-weight among the former is 41·38 oz., or 1173 grms., and among the more robust Tasmanians 42·25 oz., or 1197 grms. The mean of the two families when combined reaches to 41·81 oz., or 1185 grms. This is a brain-weight one-ninth less than that of the general average of Europeans.

The last great section into which we have divided human races is that of OCEANIC RACES. It includes the aboriginal inhabitants of all the Islands, both of the North and the South Pacific Oceans. When we arrive at this section we seem as if we were returning in some measure to the large brain-weights of Europeans.

The eight skulls of *Malays* (six of men and two of women) afford the highest mean of any of the Oceanic Races, viz. 47·07 oz., or 1334 grms. For such a bold and enterprising race, who have pushed their migrations, chiefly for commercial purposes, over almost the whole Ocean, such a rich cerebral endowment might have been in some measure expected.

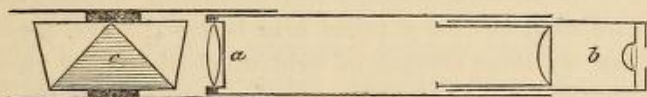
The collection which has afforded the materials for this Memoir is rich in crania from the Dutch dominions in the East-Indian Archipelago. These are distinguished for a tolerably high average of brain-weight. And this is not much diminished when we reach the aboriginal inhabitants of the Polynesian Islands and Western Pacific.

In conclusion, it is believed that this investigation has contributed much more than any former one to define and to discriminate the brain-weights of different human races. Hence it is hoped that it will be accepted as a valid contribution to a most important subject.

II. "Description of a Hand Spectrum-Telescope." By WILLIAM HUGGINS, F.R.S. Received December 19, 1867.

The instrument described in this paper was contrived in the summer of 1866, for the purpose of observing the spectra of meteors and their trains. The special suitability of this apparatus, as a *hand-spectroscope*, for the examination of the spectra of the lights which may be seen about the sun during the total solar eclipse of next year, induces me to offer a description of it to the Royal Society.

The apparatus consists essentially of a direct-vision prism placed in front of a small achromatic telescope.



The achromatic object-glass marked *a* is 1·2 inch in diameter, and has a focal length of about 10 inches. The eyepiece (*b*) consists of two plano-convex lenses. As a large field of view is of great importance, especially for its use as a meteor-spectroscope, the field-lens is made of nearly the same diameter as the object-glass. The imperfect definition at the margin of the field is not of much practical importance, as the spectra can be brought for examination into the centre of the field. The field-lens is fixed in a sliding tube, which permits the distance between the two lenses of the eyepiece to be altered; in this way the magnifying-power of the instrument may be varied within certain limits at pleasure. Before the object-glass is fixed a direct-vision prism (*c*), consisting of one prism of dense flint glass, and two prisms of crown glass.

The field of view of my apparatus embraces an area of sky of about 7° in diameter. The spectrum of a bright star has an apparent length of nearly 3°. The spectrum of the Great Nebula in Orion appears as two