ON SEVERAL ANATOMICAL CHARACTERS OF THE HUMAN BRAIN, SAID TO VARY ACCORDING TO RACE AND SEX, WITH ESPECIAL REFERENCE TO THE WEIGHT OF THE FRONTAL LOBE.

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A survey of the literature on the peculiarities of the brain in men of genius, in women and in the lower races indicates that some anatomists have thought they could determine, almost at a glance, whether or not a given specimen came from a great man, a woman or from a negro. I refer especially to the older works of Huschke and of Parker and to the more recent ones of Spitzka and of Bean.

Huschke[1] cut the frontal lobe from the rest of the brain at the line of the coronal suture, that is he removed that portion of the cerebrum which is covered by the frontal bone and compared it with the rest of the brain. The result showed a *decidedly* greater amount of frontal lobe, fully one per cent (!) in the male than in the female. The fresh brains that were studied by Huschke were simply cut with a knife along the line mentioned above. He further states that the central sulcus is straighter, more perpendicular and nearer the front end in the female brain, the difference in position being about 12½ per cent of the brain length.[2] The latter figures were obtained from wax casts of brains.

Huschke also expresses himself regarding the negro brain as follows: "Aus allem diesen geht hervor, dass das Negerhirn,

[1]Huschke. Schädel, Hirn und Seele. Jena, 1854.

[2]The misprint in Huschke, p. 153, has been copied by Eberstaller, p. 41. The number given is 86.1 per cent, it should be 56.1 per cent.

sowohl das grosse wie das kleine, ja auch das Rückenmark, den Typus des kindlichen und weiblichen Hirns eines Europäers besitzt und ausserdem sich dem Typus des Hirns der höheren Affen nähert," etc.

It is admitted by Huschke that it is extremely difficult to recognize a difference in the convolutions due to sex, but, "es ist aber keine Frage, dass sie existiren." He further generalizes, as has often been quoted, that in the male there is more frontal lobe: "Das Weib ist ein *homo parietalis* und *interparietalis,* der Mann ein *homo frontalis,* und das Weib hat deshalb auch ein runderes Gehirn, als der Mann." According to his measurements it was found that in seven women the frontal lobe, *i. e.* the portion of the brain covered by the frontal bone, contains 23.9 per cent of the brain weight. In fifteen men it contains 24.4 per cent. So it was actually determined by weighing the parts of the brain that the frontal lobe in men is one per cent heavier than in women. This difference he believes corresponds with the differences of the areas of the surface of the brain as well as with that of its volume. It may be noted that the individual frontal lobes given in his tables range from 21.8 per cent to 26.1 per cent, the values being often recorded to the second decimal place (*e. g.*, 24.49 per cent).

Meynert[3] examined 157 brains from insane individuals by separating the mantle from the brain stem which included the basal ganglia and some of the gray substance of the island. He then cut the mantle through the central sulcus with a scissors which gave him the frontal lobe composed of the brain tissue in front of the fissure of Rolando minus the basal ganglia. This portion was then compared with the rest of the brain mantle. He concludes that in men as contrasted with women there is relatively more brain substance in front of the central sulcus than behind it—a conclusion which, it seems to me, is not justified by his own figures. They are as follows. (Note especially the summary in the third table.)

According to Donaldson,[4] Broca divides the cerebrum into three lobes, one of which is the frontal, limited behind by the central

[3]Meynert. Das Gesammtgewicht und die Theilgewichte des Gehirns, etc., Vierteljahrsschrift für Psychiatrie, Bd. 1, 1867.

[4]Donaldson, Growth of Brain, London, 1895.

sulcus and including below its share of basal ganglia. The average weight of Broca's frontal lobe is 43.5 per cent for men and 43.7 per cent for women, thus contradicting what has been asserted by Huschke and by Meynert. When the brain is distorted, due to artificial

MALE.

Age in Years.	Weight of Mantle. Grams.	Weight of Frontal Lobe. Grams.	Per Cent. of Frontal Lobe.	No. of Specimens Examined.
1–19	866	380	43.8	4
20–29	1030	428	41.5	15
30–39	1035	428	41.3	21
40–49	1034	426	41.1	26
50–59	969	402	41.3	23
60–69	1020	424	41.5	12
70–79	948	384	40.5	1
	FEMALE.			
20–29	922	390	42.3	10
30–39	910	374	40.1	16
40–49	916	380	41.4	17
50–59	919	378	41.1	8
60–69	917	366	40.0	2
70–79	846	358	42.3	1
80–89	894	390	43.6	1

WEIGHT OF THE FRONTAL LOBE PER 1000.

	Male.	Female.
During development	416	425
" middle age	414	416
" old age	412	410
" all ages	414	415

deformity of the skull, this percentage remains practically unchanged.[5] I have been unable to consult Broca's original papers, but Professor Donaldson has kindly sent me the necessary data which I append in a foot-note.[6]

[5]Ambialet. La Déformation Artificielle de la Tête, etc. Tonlouse, 1893.

[6]In Broca's collected papers, Memoires Anthropologiques, T. V., page 131, under the title, "Sur le poid relatif des deux hemisphere cerebreux et de leur lobes frontaux," he gives a brief statement to the effect that he

It would seem as if the above statements settled the question of the relative size of the frontal lobe in men and women, but the following remarks are of historical interest. It is noted above that Huschke believed he had shown the central sulcus to be more perpendicular and not as far back in the female as in the male, thus making the frontal lobe smaller in the former.

Rüdinger[7] studied the brains of twin fœtuses and believed that he demonstrated that the development in the male is more advanced than in the female and that the frontal lobe is larger in the male. Recently his question has been thoroughly tested by Waldeyer[8] who found that the development of the brain of the male is more advanced in the majority of specimens of twin fœtuses of opposite sexes, but

weighed (1) the entire encephalon, (2) bulb, (3) cerebellum, (4) pons, and then separated each hemisphere by "deux coupes" into three lobes. In this manner he treated 440 cases.

There is every reason to think that he uses the term "hemisphere" in its technical sense, as he knows the difference between that and the mantle. This would involve the basal ganglia in the lobes as he records them.

Further, in the Bulletin Société d'Anthropologie, T. VI, 1871, page 113, in the article entitled "Sur la deformation toulousaine du crane," he gives numerical statements which lead to the same conclusion. The hardened brain in question weighed

	825 grams
Cerebellum	109 grams
Left hemisphere	339 grams
Right hemisphere	351 grams
Total	799 grams

leaving the difference between that and the weight of the entire encephalon, 26 grams for the pons and medulla. These 26 grams are not too much for the weight of the pons and bulb, and on the other hand are not nearly enough to cover the basal ganglia, see "Growth" etc., page 101. It seems probable therefore that his hemispheres included the basal ganglia.

If we take now his analysis of the right hemisphere, weight 351 grams, he gives the frontal lobe 159 grams, occipital lobe 45 grams, and parieto-temporal lobe 147 grams, total 351 grams. Thus his three lobes equal the weight of his hemisphere, and his hemisphere contains the basal ganglia, and I believe that it is by reasoning similar to this that I arrived at the conclusion expressed on page 181 of my book, to which you refer.

[7]Rüdinger. Verhandl. d. Anatom. Gesell., 1894.

[8]Waldeyer. Sitzungsber, d. K. P. Akad., 1907.

that in individual specimens this was not always the case, "so dass wir noch keinesweges in der Lage sind, von einem 'gesetzmässigen Verhalten' wie es Rüdinger tut, sprechen zu können." My own experience confirms Waldeyer's, for while the male of twin pregnancies is often markedly larger than the female it is by no means always so. Of course, this does not mean that the frontal lobe is relatively larger in the male.

More extensive measurements were made by Passet[9] who studied with great care the brains of 17 adult males and 12 females. He found the position of the central sulcus much the same in both sexes, if anything a little further back in the male than in the female. He shows by a diagram (Fig. 6) that there is a great deal of variation of the position of this sulcus in different brains, its angle with the sagittal plane ranging from 46° to 79°. The average is 62° for the male and 64° for the female. He states that the central fissure is shorter and straighter in the female and lies farther forward. Although his work was done with the greatest of care his methods are too crude, the number of specimens studied too small, and the degree of variation so great, that nothing is proved regarding the relative size of the frontal lobe in the two sexes.

Eberstaller[10] in the discussion of the above question in his excellent monograph on the frontal lobe concludes that there are no differences due to sex in the angle that the central sulcus of the brain makes with its sagittal median plane. His measurements included 300 hemispheres and he found that the above mentioned angle varies constantly between 70° and 75°. He further found that the central sulcus when extended intersected the sagittal border of the mantle at 65.4 per cent of the distance from the olfactory trigonum to the occipital pole in men and at 66 per cent in women. If this means anything it indicates that the frontal lobe in the brain of women is relatively larger than it is in men. The objections to the conclusions of Huschke and Passet regarding the percentages of brain in front and behind the central sulcus are fully discussed by Eberstaller, who points out the weaknesses of their observations as well as the objections to their conclusions.

[9]Passet. Arch. f. Anthropologie, XIV, 1883.
[10]Eberstaller. Das Stirnhirn. Wien, 1890.

Cunningham[11] confirms fully the conclusions of Eberstaller in the examination of 86 brains of various ages. "At no period in its growth does the fissure of Rolando exhibit in its position what we might safely regard to be sexual differences." Mingazzini[12] seem to be of different opinion. Regarding his statement, Waldeyer sounds a warning as follows: "Des weiteren möchte ich herzu noch bemerken, dass es mir sehr misslich erscheint, Schlüsse aus Untersuchungen zu ziehen, die auf wenige beobachtete Fälle sich erstrecken." He further remarks that his own experience agrees with the results of Eberstaller and of Cunningham.

It seems to me that it is quite apparent that with the methods used by the above named investigators it cannot be definitely concluded that there is a marked difference between men and women in the relative amount of brain in front of the central sulcus. The variations in various brains are so great that an approximately correct percentage can only be obtained from a very large number of specimens and those have been supplied only by Eberstaller and by Cunningham. Furthermore, the personal equation of the investigator plays a very important rôle in studying a question of this kind, and even if Eberstaller and Cunningham have proved that there is no difference in the position of the central sulcus due to sex, they have not proved that the weight of the frontal lobe does not show such a difference. In fact the methods employed to determine the relative weight of the frontal lobe are so crude that unless the differences found are constant and marked we must challenge the statements of those who assert that differences due to sex exist. I would like to ask them to separate a collection of 100 brains (50 of men and 50 of women) each of the same weight and see how well they can do it. Until their "guesses" prove to be correct in over 50 per cent of the specimens examined we must conclude that the "differences," like those of Huschke, are largely due to the personal equation of the investigator.

While these various attempts, which we consider unsuccessful, have been made to show that there is an unlike distribution of the

[11]Cunningham. Jour. Anat. and Physiol., Vol. 25, 1891.

[12]Mingazzini. Lezione di Anat. clinica dei centri nervosi. Torino, 1905.

brain substance in women and in men, attempts have been made to show that in the brains of negroes as well as in those of men of genius similar distinctions can be found. In general the differences in weight between each of these three classes of brains is fully 100 grams, and if it were shown that the proportion of their parts is different in each class it would be a discovery of great importance. The smaller frontal lobe in women and in negroes, and the larger in men of genius would prove, it is believed, that this portion of the brain is the chief seat of a good mind. It appears, however, that no such unequal distribution of brain substance exists.

A few years ago the startling announcement was made by Spitzka[13] that the area of the cross section of the corpus callosum was larger in eminent than in ordinary men, that of Leidy being 10.6 sq. cm. Since the corpus callosum is associated mainly with the frontal lobe the observation, if correct, would be of great significance. The question was immediately tested[14] by comparing in over 150 white and negro brains the area of the cross section of the corpus callosum with the brain weight and it was found that these characters varied with each other (see Bean, Chart V).[15] Since the average weight of the brain of eminent men is about 100 grams heavier than the average brain weight of ordinary men, and since the average negro's brain is 100 grams lighter, the error of Spitzka is easily explained, for in making his comparison he did not take brain weight into consideration. According to Spitzka the brains of "notable men possessing large capacity for doing and thinking much more than their fellows," "compared with ordinary men, individually and collectively, have larger callosa. The callosum of Joseph Leidy exceeds in cross-section that of any other in this series or recorded in literature. Here again, then, we have an index in somatic terms of how we may distinguish the brain of the genius or talented man from that of

[13]Spitzka. Connecticut Magazine, 1905, and Proc. Amer. Assoc. Anat., Amer. Jour. Anat., 1905.

[14]Bean. Amer. Jour. Anat., Vol. 5, 1906.

[15]Spitzka has not mentioned Bean's observation in his last monograph in the Trans. of the American. Philosoph. Soc., XXI, 1907. Bean compares area of the corpus callosum with the volume of the brain, which is statistically objectionable, but the point made is strong enough to question seriously Spitzka's statement.

persons of only ordinary abilities" (p. 303). What he says regarding the callosum of Leidy is true, but regarding the rest he is in error. All the rest of the callosa of notable men given by Spitzka are not above the average for brains of the same weight, and the callosa given in his group of ordinary men (which are from electrocuted criminals) are very much below the average (compare Spitzka's Tables A and B with Bean's Chart V and with the data given in my table). In fact many negroes of lighter brain weight have larger callosa than most of Spitzka's eminent men. Cope's callosum as measured by Spitzka is far below the average of brains weighing over 1500 grams. Comparing Spitzka's records with Bean's and mine it would be more correct to state that criminals have callosa much smaller than the average.

Furthermore, Bean believed that he had shown that the genu is relatively larger and the splenium is relatively smaller in the negro, an assertion which is even more striking than Spitzka's. From this as well as from other data Bean deduced that the frontal lobe is smaller in negro brains than in white. This is in apparent contradiction to the results he obtained by comparing the position of the central sulcus, which in 126 hemispheres holds about the same position in the two classes of brains. If anything, it lies more posterior in the female negro (Table IV*a*, p. 381) which would indicate that her frontal lobe is relatively the largest of all.

All of Bean's measurements are made from a brain axis which passes in the sagittal plane between the two hemispheres immediately above the anterior commissure and just below the splenium. As a rule this line (the axis) passes parallel with the longest axis of the corpus callosum and just below it. From this line he erected two perpendiculars, one just in front of the genu and one just behind the splenium. The distance between the two perpendiculars was then divided into ten parts, the first three, including the genu, he calls the genu, the second three the body, the next two the isthmus and the last two, including the large rounded splenium, the splenium. He then compared the area of the genu with that of the splenium, using the former as ordinates and the latter as abscissæ in the construction of his Chart VII. It was found by this treatment that

the negro brains separated almost completely from the white brains, in Bean's Chart VII, and this line of separation I have inserted at the proper place in my chart, Fig 1.

I have tabulated as Bean did the area of the genu with that of the splenium in 106 brains and do not find that the symbols for the brains of the two races separate. Most of the negro brains in my chart are intermixed with the white brains above the line which separates them in Bean's chart. My measurements were all made by tracing the outline of the corpus callosum with the very accurate projecting apparatus made by Hermann of Zurich, while Bean's were made with a less precise instrument borrowed from the Smithsonian Institution. The areas of both Bean's and my own were made with a Conradi planimeter whose minimum registration is 10 sq. mm. and its probable error was found to be 10 sq. mm. In order to exclude my own personal equation, which is an item of considerable importance in a study like this, all of the tracings as well as the measurements of all of the areas were made without my knowing the race or sex of any of the individuals from which the brains were taken. The brains were identified from the laboratory records just before the results were tabulated.

Tabulation of the brain weight with the area of the cross section of the corpus callosum confirms what Bean found, that is, the area increases with the brain weight. The same is true when the area of the corpus callosum minus that of the splenium is tabulated with the weight of the frontal lobe. However, there are great individual variations, but they seem to be of like extent in both the white and the negro brains. The female records separate somewhat from the male, but this is due no doubt to the lighter weight of the former.

My figures do not confirm Bean's result that the genu is relatively larger and the splenium relatively smaller in the white than in the negro brain. The specimens I examined include 18 brains which Bean studied, and I find that the measurements I made of the areas of the genu and splenium in them do not agree altogether with his. Ten of the specimens are white and eight negro brains. In making the comparison a deviation of 10 sq. mm. is overlooked, for this error is to be expected from the planimeter we employed. The genu

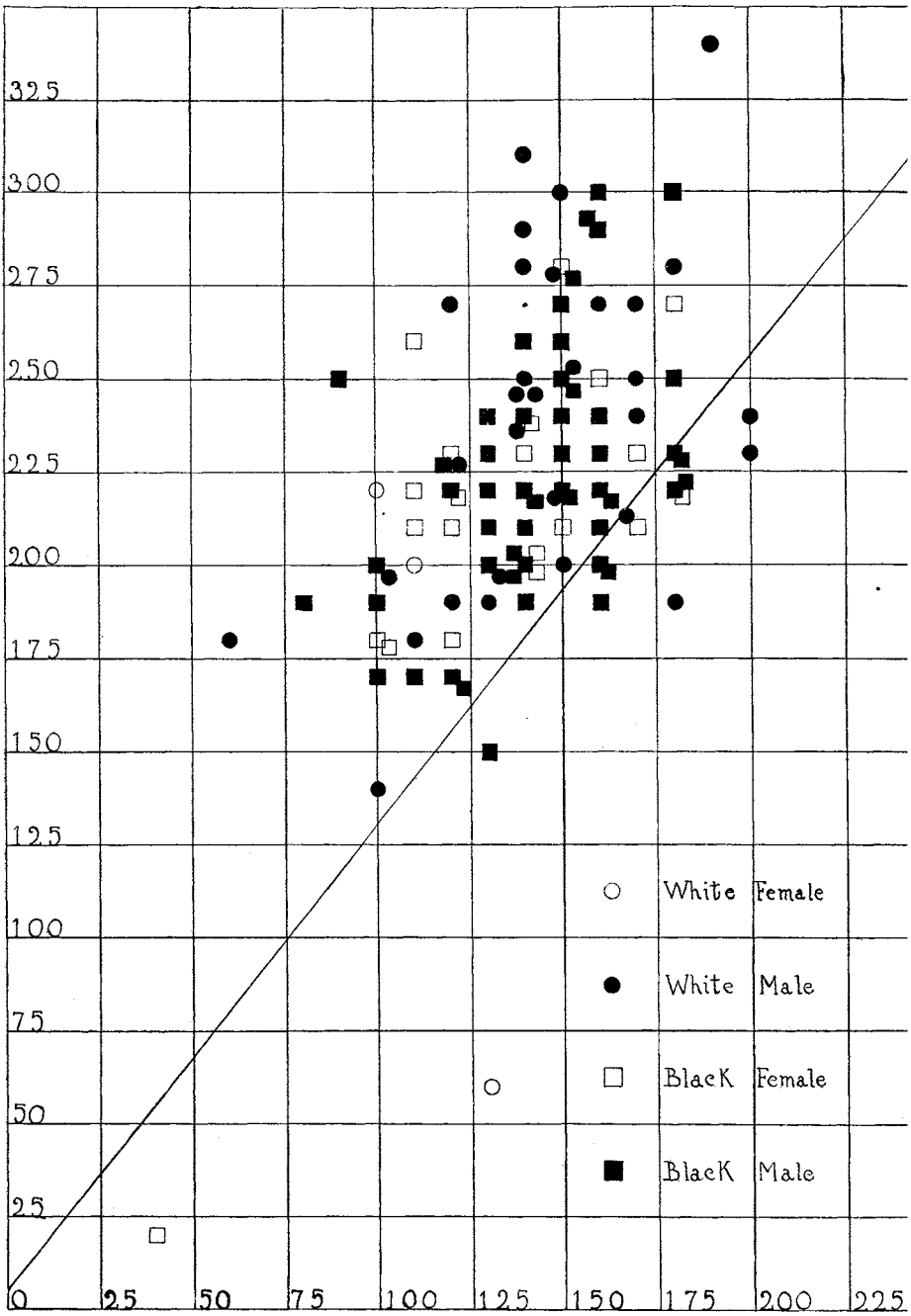

FIG. 1. Showing the relation of the area of the cross section of the genu (ordinates) to that of the splenium (abscissæ). The figures represent square millimeters. The diagonal line is in the position which separated the whites from the negroes in Bean's Chart VII.

is larger in Bean's tables than in mine in 7 white brains and one black brain and smaller in 4 black and 2 white. The splenium is larger in 7 black and 4 white and is not smaller than mine in a single instance in Bean's tables. This discrepancy between our figures is sufficient to account for the racial differences in the corpus callosum found in Bean's tables but not in mine, although the individual deviations in both our charts are very great. I think my chart (Fig. 1) shows conclusively, as far as possible with the method I employed, that there is no variation in either genu or splenium of the corpus callosum due to either race or sex.

In order to determine the relative weight of the frontal lobe in white and in negro brains I made numerous tests in separating this lobe from the rest of the cerebrum to develop first an accurate method. It was found that it is quite easy to break the cerebrum after it has been hardened in formalin through the central sulcus along the motor tract down through the basal ganglia with considerable precision. The real test of the accuracy was made by comparing the results obtained on the right side with those on the left. If the half brains are of equal weight the frontal lobes should be also of equal weight if the method is a reliable one. It was found in over two-thirds of the brains that the two frontal lobes weighed practically alike, *i. e.*, within 5 grams of each other, a variation which could be accounted for by a slight difference in the amount of drainage and evaporation of water from the specimens. In the remaining one-third of the brains the difference between the two sides averaged 10 grams, which in rough equals the weight of half of the precentral gyrus. Expressed differently the probable observational error in the weight of the frontal lobe compared with the whole hemisphere is less than one per cent of its weight, so a deviation in the weight of the frontal lobe due to race or sex would have to be fully two per cent in order to be detected.

Another source of error might be due to the fact that only hardened brains were broken, or could be broken, with precision through the central sulcus. It is well known that formalin causes the brain to swell, and it has been shown by Hrdlicka[16] that there is an unequal

[16]Hrdlicka. Brains and Brain Preservatives. U. S. Nat. Mus., XXX, Washington, 1906.

expansion of the brain, due to both its age and its size. So it is possible for the frontal lobe at first to expand more rapidly than the rest of the brain, and later to shrink more quickly. This, of course, would affect the percentage of the frontal lobe and is a source of error to be reckoned with. The presence of a second preservative like common salt, alum or carbolic acid, which was used in a number of my specimens, is also to be taken into account, for they influence very much the change of volume of the brain.

In order to test this question I weighed the pieces of 5 brains a number of times during a period of nearly a year and found that there was much fluctuation in the brain weight, but the percentage value of the frontal lobe remained very constant, usually within one-half of one per cent.

The figures are as follows. The first weighing was made as soon as the brain was fairly hardened at the end of about a week, so the weights of the parts when fresh were not obtained. Those marked with a star (*) are the weights recorded in the Table and in the Figures.

No.	1907.				1908.	
	March 19.	May 1.	June 4.	Nov. 8.	Jan. 25.	
2861	1110	1190	1120*	1035	1040	gm. of cerebrum.
	44	44	44—	44—	43.5	% value of frontal lobe.
2864	1250	1215*	1190	1150	1150	gm.
	44+	44—	44	44—	44	%
2865	1300	1325	1460*	1210	1235	gm.
	44.5	45	45	44.5	44.5	%
2867	830	870	875*	765	780	gm.
	42	43.5	43—	43	43	%
2878	1170	1240	1205*	1080	1090	gm.
	43—	43.5	43.	43.5	43.	%

No special care was taken to keep the strength of the formalin constant, in fact it was often changed, and this accounts for the fluctuations in the weight of the whole brain. In all cases the parts of each brain were kept together in a single jar in order to subject them to the same strength of formalin from weighing to weighing.

I also weighed the parts of a number of well hardened brains a second time after they had been in formalin for another year. In these the fluctuations of the weight are less marked and the deviation of the percentage value of the frontal lobe is, if anything, less than in the first set. The data are as follows. The figures given in the first column are the ones entered in the charts.

As said above, my personal equation was excluded entirely because all of the breaks and weighings were made without my knowing the race or sex of the individual from which the specimen came.

No.	Jan., 1907.	Jan., 1908.	
1521	1035	1045	weight of cerebrum.
	44.5	45	% value of frontal lobe.
1697	780	775	weight
	45—	45+	%
1720	1030	1025	weight
	43+	43.5	%
1836	950	895	weight.
	45—	45—	%
1840	1140	1130	weight
	44.5+	44.5—	%
2621	1015	1025	weight
	45—	45—	%
2660	960	1020	weight
	42	43	%
2665	830	825	weight
	41—	41+	%
2667	895	885	weight
	44	43.5	%
4x	930	950	weight
	41	42	%

In general I used Broca's method to divide the frontal lobe from the rest of the cerebrum and found as he did that the mean weight of the frontal lobe in both men and women is between 43 and 44 per cent. The same is true for both the negro and the white. This bears out what I have found by measuring the area of the genu and splenium and leads to the conclusion that it is incorrect to state that the frontal lobe of the negro brain is relatively lighter than that of the white.

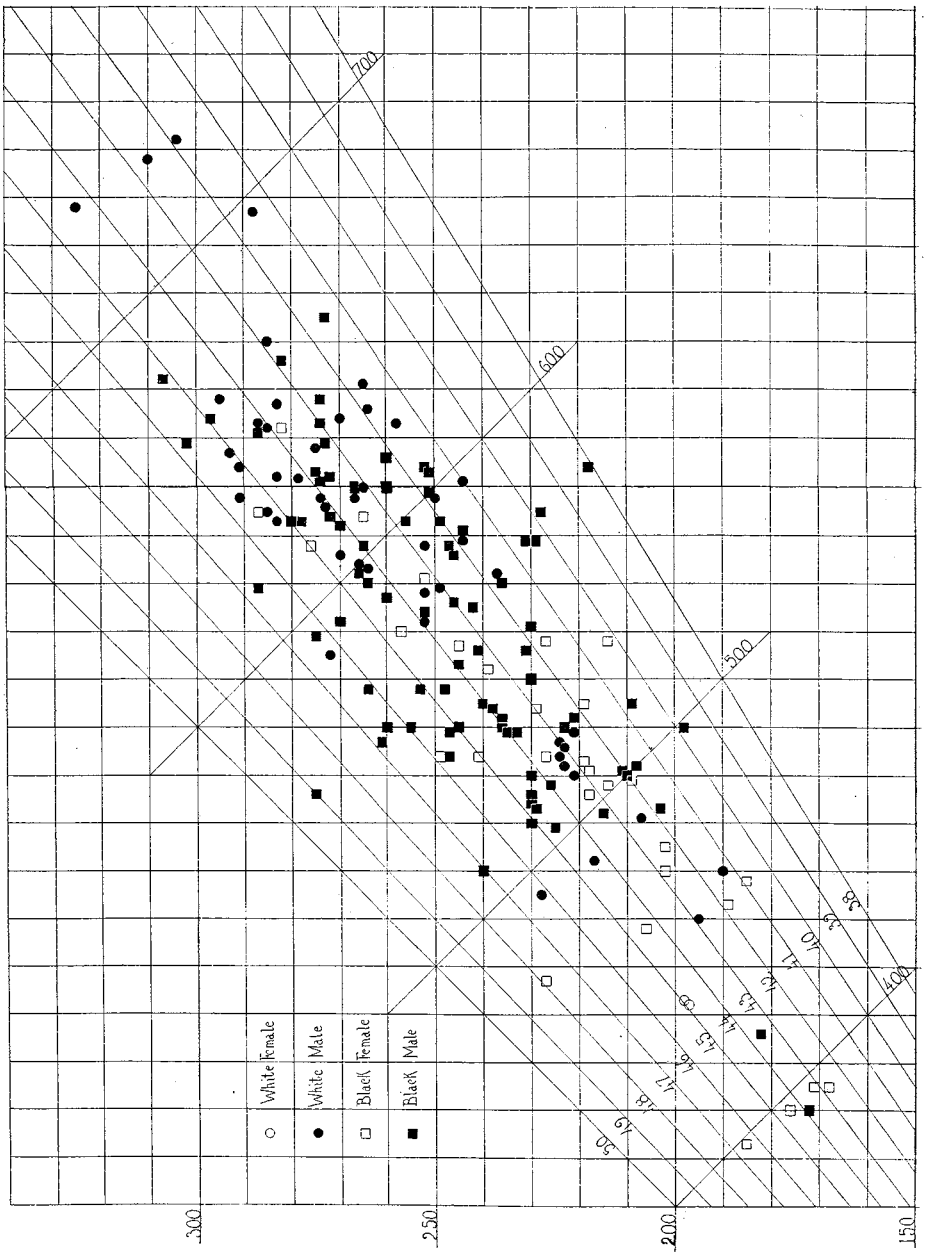

FIG. 2. Showing the relation of the brain substance lying in front (ordinates) of the sulcus centralis to that lying behind it (abscissæ). Each symbol represents a half brain.

The figures are in grams. The long diagonal lines, 38-50, indicate the percentage of the precentral brain weight. The lines marked 400-700 indicate the weights of the hemicerebra. The weights given are reduced to those of the fresh brain.

All of my figures are given in the table at the end of this article and their bearing upon the percentage of the frontal lobe is given in the two charts. In the first chart, Fig. 2, the weight of each hemisphere is treated by itself and the weights are all reduced to their weight in the fresh state. Of course, only those brains in which the weight when fresh is known could be included in this chart. In making the chart the weights of the frontal lobe are given in ordinates and those of the rest of the hemisphere in abscissæ. Thus each symbol gives an individual half brain. The diagonal lines give the percentage of the frontal lobes and the diagonal lines at right angles to them the weight of the hemi-cerebra. The symbols in the first block and to the left represent hemi-cerebra, between 400 and 500 grams, the next block between 500 and 600 grams, etc.

It is noticed that the weights of the hemicerebra range from less than 400 to over 700 grams and that the percentage of the frontal lobes fluctuates from 38 per cent to 49 per cent. The mean is about 43.5 per cent. If in each block the black and the white, and the male and the female are compared it is seen that the distribution is quite even and that on an average the percentage of the frontal lobe is the same in both races and sexes.

In order to give the question another and possibly a better test, I tabulated all the brains in which both halves were weighed, but did not reduce the figures to those of the fresh weight, for in a number of specimens this is not given. Then the combined weight of both sides was divided by two, thus giving the average weight of the frontal lobe of each brain and that of each hemicerebrum behind the central sulcus. In this chart, Fig. 3, each symbol represents a whole cerebrum divided by two, and in it more of the symbols are shifted to the left, for in general there is more shrinkage of the brains due to the long action of formalin and carbolic acid. The individual deviations are not as great as they are in Fig. 2 (39 per cent to 48 per cent) but the mean is about the same (43.5 per cent). Again there is no separation of the brains due to race or sex.

I must therefore conclude that with the methods at our disposal it is impossible to detect a relative difference in the weight or size of the frontal lobe due to either race or sex, and that probably none

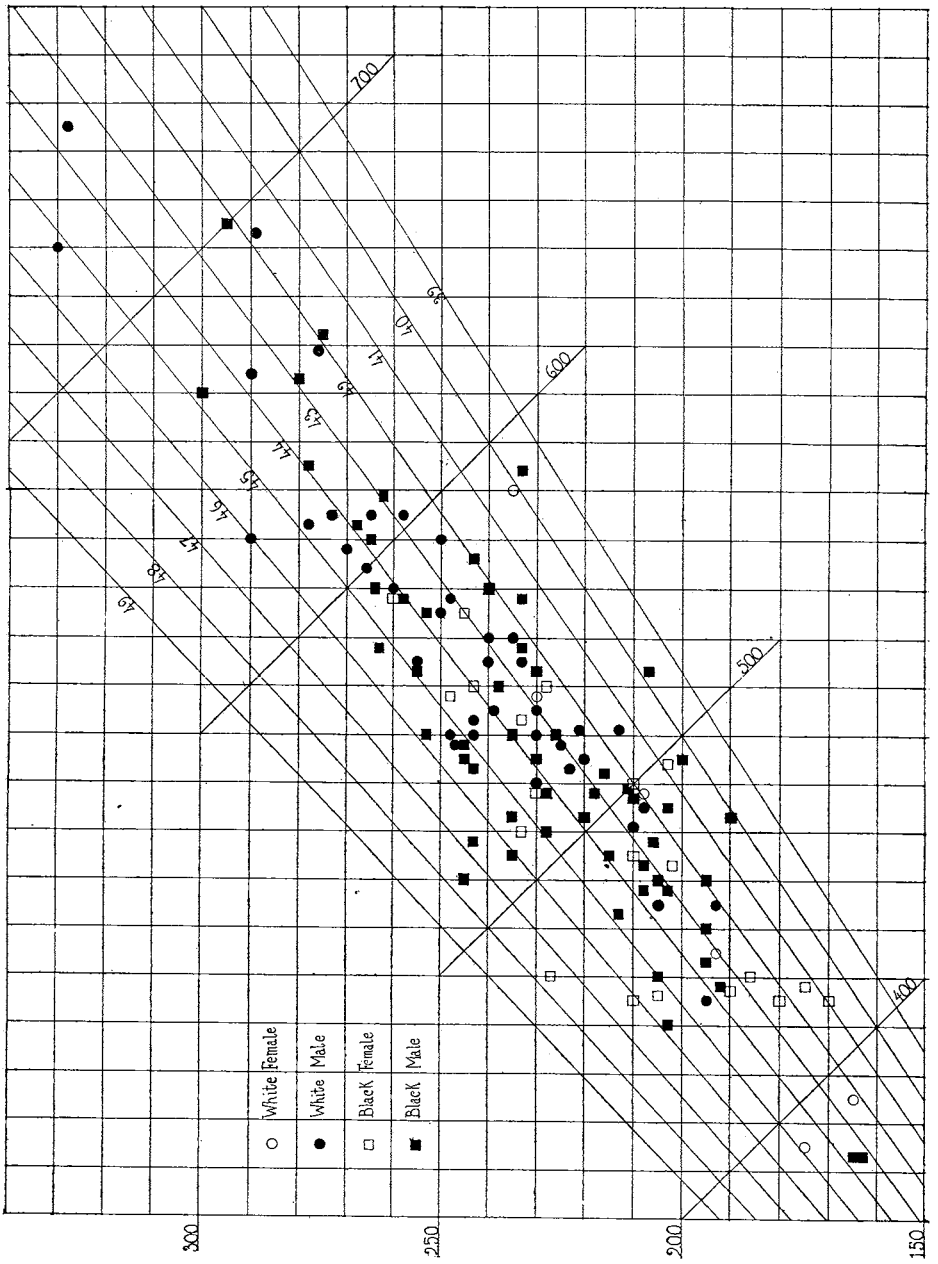

FIG. 3. The same as Fig. 2 with the exception that each symbol represents the average of the two sides of the brain. Each, therefore, represents a whole brain. The weights given are those of hardened brains.

exists. My weighings of the frontal lobe were made in three series and each time I did not know the race or sex of the individual whose brain was being tested until it had been broken and weighed. There were 6 white and 6 negro brains in the first series and the racial difference found in it was very marked,—41 per cent of frontal lobe in negro brains and 44 per cent in white brains. In the next series of the brains, the white and the negro brains came closer together and in the third series of about 10 brains this difference was lost altogether. It is evident, as Schwalbe and Pfitzner[17] have pointed out, that a percentage to be of any significance must not change as the records increase in number.

As it is generally believed that the brains of men of genius are of complex configuration, so it is also believed that the brains of lowly races are of a simple and embryonic type. Thus Parker[18] says that the Sylvian fissure in the negro is 5/8 inches (16 mm.) shorter than in the white and the central sulcus is simpler, straighter and less undulated. He also found a negro brain in which there was a complete connection between the fissures of Sylvius and Rolando. He states that the occipital fissures are ape-like with a well marked perpendicular fissure. The negro brain as it presents itself in this country, he says, bears an unmistakably nearer relation to the ape type than does the white, being also more fœtal in character.

To anyone who is familiar with the negro brain the statements of Parker appear to be careless and superficial. His observations upon the length and form of the fissures of Sylvius and Rolando can not be taken seriously in the light of recent studies of these fissures, and they strike one rather as an opinion supported by a strong personal prejudice, as are so many of the observations upon the gyri of sulci. Furthermore, other students of the negro brain found no such difference and state that they are practically like the white (see Tiedemann, Luschke and Marshall.) Schwalbe,[19] who reviews the work of Parker, states expressly that racial differences in the negro

[17]Schwalbe and Pfitzner. Morph. Arbeiten, Vol. 3.

[18]Parker, A. J. Cerebral convolutions of the negro. Proc. Acad. Nat. Sci., Phila., 1878.

[19]Schwalbe. Neurologie, 1881, p. 575.

brain are in all probability due to similar racial peculiarities of the skull. The same statement is also made by Hrdlicka and has been fully tested by Bean. However, such differences are but slight, for a variation in the shape of the skull influences only the main outlines of the brain and not its gyri. The flattening over the anterior association area, as first observed by Hrdlicka, was fully confirmed by Bean and can be seen in most full-blood negro brains, certainly in more than one-half. One precaution must always be taken in these cases and that is to compare whites and negroes of the same type of form of the skull. The majority of negroes are dolichocephalic and these should be compared only with dolichocephalic whites.

In order to make a preliminary test of this question I attempted to assort a collection of negro and white brains, calling those with the peculiar narrowing and flattening of the upper surface of the frontal lobe, negro, and those in which it was more convex, white brains. The brains tested were a mixed lot which happened to be on one shelf in the brain room. After they had been assorted according to the character above mentioned I found that there were 60 negro and 30 white brains and that their assortment was correct in exactly 75 per cent of the cases. Had all of the brains been dolichocephalic I think the test would have fallen out better, and Dr. Hrdlicka informs me that this is also his opinion.

I then mixed the brains again, added to their number, and assorted them a second time according to the richness of the gyri and sulci, using as a standard the two illustrations given on Plate 54 in Retzius' *Menschenhirn*. In case the configuration was complex, of the Gauss type, it was called stenogyrencephalic, and in case it was simple, of fœtal type, it was called eurygyrencephalic. Doubtful specimens, and there were many of them, were at first set aside and in case it was impossible to render a decision regarding them by a second effort they were excluded altogether.

The results of this test, based upon brains of unknown origin at the time it was made, are given on the opposite page.

The percentage of eurygyrencephaly and stenogyrencephaly is therefore about the same in both races.

In order to make a further comparison the brains pictured in

Retzius' *Menschenhirn* were arranged into two classes to correspond with his types given on Plate 54. This is, of course, more difficult to do and a large number of doubtful ones were necessarily excluded. The classification of the pictures into two groups was made independently by Dr. Mellus, Dr. Sabin and myself, none of us know-

Negro.			
Male.		Female.	
Eurygyrencephaly.	Stenogyrencephaly.	Eurygyrencephaly.	Stenogyrencephaly.
32 brains 68%	15 brains 32 %	12 brains 64 %	7 brains 36%
White.			
19 brains 66%	10 brains 34 %	1 brain 50 %	1 brain 50 %

ing at the time whether the illustrations in question were of the brains of men or of women. Our results are given in the following table:

	Male.		Female.	
	Eurygyrencephaly.	Stenogyrencephaly	Eurygyrencephaly.	Stenogyrencephaly
Dr. Mall.....	29 brains (53 %)	26 brains (47 %)	12 brains (60 %)	8 brains (40 %)
Dr. Sabin.....	29 brains (58 %)	23 brains (42 %)	10 brains (62 %)	6 brains (38 %)
Dr. Mellus....	23 brains (64 %)	14 brains (36 %)	7 brains (54 %)	6 brains (46 %)

Although our results vary considerably they are substantially similar. In general stenogyrencephaly is a little more common in the Swedish brains pictured by Retzius than in the 97 negro and white brains of Baltimore used in constructing the first table. Unless

one attempts to separate brains into complex and fœtal types he does not realize the difficulties in doing it and I think the deviation in a second attempt might be fully ± 10 per cent of the first determination. If the personal equation were added the deviation might be much greater.

The above tables are given to show how unreliable the statements regarding the complexity of the gyri and sulci may be, and that with the present crude methods the statement that the negro brain approaches the fœtal or the simian brain more than does the white is entirely unwarranted.

In this connection the recent statement of Elliott Smith regarding racial peculiarities in the brain should also be considered. It relates to the so-called Affenspalte. Smith[20] says: "It often happens (especially in the brains of lowly human races, such as negroes and aboriginal Australians, and in the anthropoid apes) that the sulcus occipitalis anterior, together with the sulcus occipitalis inferior form a large arc (parallel to the sulcus lunatus) forming the anterior limit of a great tongue of cortex, the tip of which often reaches the upper end of the sulcus temporalis superior in those cases in which there is no temporo-parietalis. The presence of this great arcuate sulcus explains much of the misleading literature relating to the search for an 'Affenspalte' in the human brain."

The "Affenspalte" first described by Rüdinger has caused anatomists much trouble and its presence in all human brains was often questioned. A few years ago Elliott Smith[21] demonstrated that a marked occipital operculum which is identical with that of the gorilla's brain is often present in the brain of the Egyptian fellah. However, the operculum is not always well marked, but it is bounding sulcus, which Smith calls the sulcus lunatus, can be seen in every human brain. Smith's studies are directed rather towards the homology of the Affenspalte which he has fully demonstrated with the aid of the structure of the cortex, *i. e.*, the extent of the stripe of Gennari.[22] At first he showed that the Affenspalte (sulcus lunatus)

[20]E. Smith. Jour. Anat. and Physiol., Vol. 41, 1907.
[21]Smith. Anat. Anz., 24, 1904, p. 74.
[22]Smith. Anat. Anz., XXIV, p. 437.

is present in all Egyptians brains[23] and later he found it present in negro, Syrian, Turkish and Greek brains and with a study of literature he concluded that it is a normal feature of the adult human brain. It would have been easy for Smith to draw a wrong conclusion regarding this sulcus, for he began his study of it with the Egyptian brain; however, he did not end there.

It may also be noted that Parker states that he found a negro brain with a gyrus cunei on the surface as is the case in the simian brain. Since Parker gives no illustrations it is difficult to ascertain whether or not he saw only an annectent gyrus partly on the surface, as described and pictured in Quain's Anatomy.[24] This latter condition I have also observed in both negro and white brains. Until it is thoroughly investigated in a large number of specimens its meaning still remains an open question. Probably it will fall, as do other anatomical peculiarities of the negro when they are fully investigated.

I wish to add a remark regarding the anatomy of the negro. One is often led to believe[25] that there are more anatomical anomalies in the negro than in the European body. I have now had considerable experience in the dissection of the negro and have yet to observe that variations are more common in the negro than in the white. In fact it seems as if excessive development of facial muscles and other variations is more common in the white, but until a large number of statistics are collected no definite statement can be made. However, we have made many thousands of records of nerve variations and find in them no racial peculiarities.[26] The misleading statements are based upon a few dissections of negroes in which the variations found are given as peculiarities of the race. An equal

[23]Smith. Anat. Anz., XXIV, p. 216.

[24]Quain's Anatomy, Tenth Edition, Vol. 3, p. 144 and Fig. 102.

[25]For example, Duckworth. Morphology and Anthropology, 1904.

[26]In tabulating these nerves Bardeen and Elting (Anat. Anz., XIX, 1901, p. 132) say that race seems to play no very marked part as a cause in the number or kind of variations (see also Anat. Anz., XIX, p. 217). In his later and more extensive publication Bardeen does not consider race in the tabulation of nerve variations, presumably because it did not seem to influence them (Amer. Jour. Anat., VI, 1907.)

number of variations will be found in any corresponding series of white cadavers.

The hope has often been expressed that through the study of the brains of men of genius anatomical conditions would be found which may account for their eminence. In fact one of the first studies included the brain of Gauss[27] and showed that this particular brain was unusually rich in gyri and sulci. Since then the brain of Gauss has often been used as a type representing the highest development. But Wagner says that higher intelligence may exist in individuals with brains either rich or poor in gyri, but the normal brain must be of a certain weight, a certain richness of gyri and sulci as well as certain thickness of cortex. Since Wagner's time quite a large number of brains of distinguished persons have been studied and in general the conclusion has gradually been reached that with the methods at our disposal we are unable to detect in their anatomy conditions to account for great mental ability. The recent studies of Retzius[28] all point in this direction, for he was unable to detect anything remarkable in the brains of distinguished individuals, and no one is more competent than this investigator to deal with this subject.

Within a year the report on the brains of Mommsen, Bunsen and Menzel has been published by Hansemann[29] who has also given an account of the anatomical findings in the brain of Helmholtz. Hansemann also concludes his study with a healthy scepticism, for he says that within physiological limitations we cannot tell the brain of a distinguished person from that of an ordinary one. He then falls back on the analogy that muscular men are not necessarily athletic, but under proper conditions could easily become so. Furthermore, he predicts that individuals with unusual qualities in one direction, but who are otherwise quite inferior, like mathematical prodigies or remarkable chess players, may possess brains with portions unusually well developed. The recent study by Stieda[30] of the brain of a man

[27]Wagner. Vorstudien zu einer Wissenschaft. Morphol. d. Menschl. Gehirns, etc., 1862.

[28]Retzius. Biol. Unt., VIII, 1898, IX, 1900.

[29]Hansemann. Ueber die Gehirne von Mommsen, Bunsen und Menzel, Stuttgart, 1907.

[30]Stieda. Zeit. f. Morph. u. Anthropol., XI, 1907.

who spoke fifty languages gave a negative result, for nothing peculiar was found in it. However, Hansemann states that we should expect to find a morphological basis to account for geniuses of the first rank, for they possess qualities peculiar to themselves. In fact the configurations of the brains of Helmholtz and Menzel showed some peculiarities which may support this theory.

The one ray of hope in the study of the peculiarities of the configuration of the gyri and sulci comes from the comparison of brains of members of the same family which often show many similarities. This important discovery was made by Spitzka,[31] who observed that there were hereditary resemblances in the brains of three brothers. This was fully confirmed by Karplus[32] in studying the brains of 21 groups of relations in each of which he found a marked similarity of the gyri and sulci. The configuration of the right side has a tendency to repeat itself on the right side, and the left on the left, but peculiarities on the right side are not found on the left in near relatives. There is an hereditary tendency in the fissuration of the brain as there is in the other features.

Nevertheless, even if we should find that the brains of two eminent men of the same family were much alike we have by no means shown that the genius has an anatomical basis. Furthermore, it seems to have been established that anatomical variations often show different percentage in different communities. Schwalbe and Pfitzer[33] have shown, for instance, that the absence of the psoas minor is as follows.

	Men			Women		
	No. of Cases.	No. of times absent.	Per Cent.	No. of Cases.	No. of times absent.	Per Cent.
St. Petersburg.....	900	405	45.	600	326	54.3
Strassburg.....	386	219	56.7	175	99	56.6
Boston	400	223	55.8	208	145	69.7
England.....	210	125	59.5	130	93	71.5

[31]Spitzka. American Anthropologist, VI, 1904.
[32]Karplus. Obersteiner's Arbeiten aus d. Neurol. Inst., XII. Wien, 1905.
[33]Schwalbe and Pfitzer, Morph. Arbeiten, Bd. 3.

In each group the percentage had reached a constant value, that is with an increase of the number of cases the percentage in a given locality did not change. The same condition may exist in brain configuration, and Merkel[34] states that the brains from cadavers used for dissection in Göttingen, and which come from Brunswick, of which Gauss was a native, were often very rich in gyri and sulci. On the other hand, in Mecklenburg, where Merkel also had had a large experience, brains of the Gauss type were never seen in the dissecting room, but instead a very simple type prevailed.

It certainly would be important if it could be shown that the complexity of the gyri and sulci of the brain varied with the intelligence of the individual, that of genius being the most complex, but the facts do not bear this out, and such statements are only misleading. I may be permitted to add that brains rich in gyri and sulci, of the Gauss type, are by no means rare in the American negro.[35]

While there seems to be no evidence to show that the configuration of the brain of genius is different from that of other brains, there is some evidence in favor of the statement that there are slight differences due to sex. It is often said that the brains of women are of a simple type, but if their weight is not considered it is questionable whether a collection of brains could be assorted according to sex with any degree of certainty. Furthermore, even the more pronounced differences of eurygyrencephaly and stenogyrencephaly are not easily recognizable because they are not easily measured. Of course, when gyri of the simple type are twice as broad as those of the complex type, as pictured on Plate 54 in Retzius' *Menschenhirn,* it is not difficult, but there are many intermediate stages and the observer can only express an opinion, for there is nothing that can be weighed or measured. Waldeyer states that to determine whether a brain

[34]Merkel. Top. Anat., I, Braunschweig, 1885-1890.

[35]Spitzka, Amer. Phil. Soc., Vol. 21, has arranged a number of figures in plates showing the evolution of the complexity of the gyri. For example, in his Fig. 8 the gorilla with a simple brain is below, the brain of a Bushwoman is in the middle and that of Gauss, the most complex, is above. In another plate, Fig. 10, the brain of Gambetta holds the lower position, Altmann the middle and Skobeleff the upper. Comparing Figs. 8 and 10 it appears that Gambetta's brain resembles the gorilla's more than it does that of Gauss.

came from a man or woman is much like identifying the sex of the individual from which a given skull came. I am not so optimistic and would rather take my chances with the skull.

In the article by Schwalbe and Pfitzer mentioned above many anatomical variations are tabulated and there do not seem to be more variations in the male than in the female, but the percentage of variations is by no means always alike in the two sexes. If there is a percentage difference according to sex in a special variation it tends to remain constant in various sets of statistics and does not become the same as the records are increased in number. Moreover, "bei den weiblichen Fällen werden in der Regel die Werthe viel rascher constant als bei den männlichen." In other words, a smaller number of records are required in the female than in the male to obtain the true percentage of variations. How much this indicates is by no means clear, but this conclusion should be that there is not a simpler type, but less variations in the female, which appears to be the opinion of Retzius regarding the female brain.

We have tested this difference by grouping the illustrations of brains in the great *Atlas* of Retzius under simple and more complex types, without knowing whether the picture of a brain in question was from a man or from a woman and obtained the result given on page 19. In the first line in the table my estimates are found with the percentages below them. In the second line another estimation by Dr. Sabin is given, and in the third line one by Dr. Mellus. In general the opinion expressed in these estimations does not bear out the notion that the configuration of the brains of women is of a simpler type than in those of men.

This, however, is only our opinion regarding the complexity of the gyri and sulci of pictures of brains. But Retzius has tabulated in an excellent way a number of concrete data of 100 brains which can easily be tested in other specimens. These include a number of variations, such as the central sulcus communicating with the fissure of Sylvius, regarding which there can be little difference of opinion. There are in all 73 such records, 19 being of the norm and 56 of variations. Each of these records can be entered a second time by subtracting its frequency in percentage from 100. Thus, if the central

sulcus communicates with the fissure of Sylvius in 3 per cent of the cases it is called a variation in 3 per cent of the cases, while in the remaining 97 per cent it is normal. In this way I obtained a column of 73 records, representing the norm as well as the variations for each hemisphere both of the male and the female. The average of these figures is as follows.

Men.				Women.			
Right Side.		Left Side.		Right Side.		Left Side.	
Norm.	Variations.	Norm.	Variations.	Norm.	Variations.	Norm.	Variations.
78%	22%	75%	25%	81%	19%	81%	19%

This table indicates that the brain of woman is not nearer the norm but varies less than does that of man. Could all the variations found be grouped together in single brains, leaving the rest as perfectly normal, then 76 brains of men and 81 of women out of our 100 would be exactly normal in the arrangement of the gyri and sulci.

Retzius has done us a great service in pointing out the way by which this problem can be attacked by the statistical methods. A few remarks regarding his conclusion may be made, but before they can be criticised properly it will be necessary to tabulate many other brains, as he has done, of both men and women.

In the first column of figures in Retzius' table regarding the fissure of Sylvius both the norm and the variation is given, but the missing figures can easily be obtained by subtracting the given percentage from 100. In case the average of a given record is more than 50 in both male and female, it is called normal, while when it is less it is called a variation. Thus the central sulcus anastomoses with the sulcus precentralis superior in 18 per cent of the cases and therefore these do not anastomose in 72 per cent. It may be remarked that the number of brains of men studied by Retzius is somewhat small, while that of women is decidedly too small, for in the latter each single record equals 8 per cent when reduced to the scale of 100.

The data given by Retzius regarding differences in the gyri and sulci due to sex may be criticized from two standpoints. Those in

which there is a marked difference between the brains of men and women may be tested by other records. For instance, according to Retzius the anterior branch of the fissure of Sylvius is divided and forms an operculum frontale intermedium in 82 per cent of the brains of men and in 100 per cent in those of women. At this point woman's brain forms a perfect norm, being richer in all cases in gyri and sulci. However, only four specimens of brains of women without an intermediary operculum would have made the results for the two sexes exactly alike. No doubt a larger number of records would have shown, even in Stockholm, that the operculum frontale intermedium is not always present in the female brain. I notice that Karplus, in the article mentioned above, figures four brains of women without the operculum frontale intermedium, and states expressly that it is missing in those four specimens which were found in a relatively small number of brains. His record will bring the chief difference, given by Retzius, pretty close to the male average of 82 per cent. The second criticism can only be made by collecting many more statistics along the lines laid down by Retzius in his great monograph.

At any rate what has been written by Karplus is to the point: "Auf die von den Autoren angegebenen einzelnen Geschlechtsmerkmale der Gehirne, die ja von vielen bestritten werden, will ich hier nicht näher eingehen. Auch hier muss zunächst viel mehr Material gesammelt werden, bisher bin ich nicht davon überzeugt, dass sich aus dem Furchenbild eine Inferiorität des weiblichen Gehirns ableiten liesse."

The question of the type of the female brain, a subject which has been discussed so much, is therefore still far from being solved in a satisfactory manner.

Furthermore, it is by no means established that there are male and female types of the brain due to the form and arrangement of the gyri and sulci, as has been so frequently asserted. Each claim for specific differences fails when carefully tested, and the general claim that the brain of woman type is fœtal or of simian type is largely an opinion without any scientific foundation. Until anatomists can point out specific differences which can be weighed or measured, or until they can assort a mixed collection of brains, their assertions

TABLE OF BRAINS STUDIED.

No.	Length of body.	Color.	Sex.	Weight of Brain.	Weight of Parts of the Brain. (Hardened)				Cerebellum.	Per cent to be added to or subtracted from hardened brain to make it equal fresh.	Area of Section of Corpus Callosum.		
					Right side.		Left side.				Whole.	Genu.	Splenium.
					Anterior.	Posterior.	Anterior.	Posterior.					
	cm.			gm.	gm.	gm.	gm.	gm.	gm.		sq. cm.	sq. cm.	sq. cm.
1405	170	W.	M.	....	290	340	...	...	180		...	...	...
1451	153	B.	M.	....	265	335	265	345	170		6.3	3.0	1.6
1452	153	B.	F.	....	250	330	240	320	160		5.5	2.4	1.4
1453	162	B.	M.	....	212	319	201	304	166		5.9	2.1	1.3
1454	160	B.	M.	....	205	265	200	270	160		5.9	2.3	1.6
1457	173	W.	M.	....	230	300	220[1]	295[1]	160		...	...	...
1458	173	W.	M.	....	270	345	270	330	170		...	...	...
1478	178	B.	M.	....	220	295	215[2]	280[2]	170		5.8	2.3	1.8
1485	162	W.	F.	....	170	230	160	220	130		2.7	.6	1.3
1489	191	W.	M.	....	240	305	245	295	145		6.9	2.8	1.4
1493	158	B.	F.	....	205	250	205	250	160		5.4	2.3	1.2
1510	170	W.	F.	....	205	290	210	285	155		...	...	...
1519[3]	130	B.	M.	....	190	250	194	245	150		4.3	1.7	1.0
1521	158	B.	F.	....	225	295	235[4]	280[4]	135		6.6	2.5	1.6
1527	158	W.	F.	....	185	255	200	225	120		...	...	...
1591	165	W.	M.	....	220	290	220	300	180		6.4	2.1	1.7
1682	165	W.	M.	....	245	305	240	300	165		6.9	2.7	1.5
1683	173	W.	M.	1410	210	295	205[5]	275[5]	160	+23	6.6	2.5	1.5
1686	165	B.	F	....	185	252	195	242	128	..	6.4	2.3	1.7
1690	168	W.	M.	....	262	335	270	332	182	..	7.0	2.4	2.0
1696	178	W.	M.	1440	250	350	250	330	180	+ 6	...	...	...
1697	158	W.	F.	1000	175	215	175	215	110	+12½	4.9	2.2	1.0
1699	163	B.	M.	1230	235	315	240	305	155	— 2	6.1	2.5	1.5
1707	160	W.	M.	1300	190[6]	230[6]	200	260	150	+26	4.2	1.4	1.0
1716	168	W.	M	1320	235	310	230	320	150	+ 6	5.6	2.5	1.4
1720	186	W.	M.	1430	225	280[7]	220	305[7]	170	+20	7.1	2.3	2.0
1728	163	B.	M.	1393	230	315	230	310	150	+13	5.9	2.5	1.5
1787	...	B.	M.	1200	205	290	200	280	210	+ 1	6.1	2.0	1.4
1788	175	B.	M.	1470	...	...	...	...	190	..	...	...	...
1789	170	B.	M.	1210	205	275	210	260	175	+ 9	5.3	1.9	1.4

1790	163	B.	M.	1280	235[8]	300	250	285[8]	155	+ 4½	5.9	2.3	1.3
1811	168	B.	F.	1195	210	280	210	275	170	+ 4	6.2	2.1	1.5
1835	175	W.	M.	1420	260	330	260	330	170	+ 5	5.8	2.5	1.4
1836	165	B.	M.	1190	215	265	210	260	160	+ 7	6.3	2.2	1.2
1837	186	W.	M.	....	280	375	272	382	196		5.4	2.3	1.8
1840	158	W.	M.	1370	253	315	255	315	175	+ 4	5.7	2.4	1.4
1847	163	B.	F.	1195	180	240	180	250	130	+22	4.3	1.8	1.0
1867	180	B.	M.	1250	235	285	235	280	160	+ 5	5.5	2.0	1.4
1868	175	W.	M.	1620	280[9]	395[9]	295	410	195	+ 3	8.8	3.4	1.9
1869	163	B.	M.	1150	230	280	240	270	120	0	6.7	2.3	1.8
1874	178	W.	M.	1200	205	265	205	265	140	+11	5.0	2.0	1.5
1877	165	B.	M.	1340	250	300	255	300	180	+ 4	...	...	...
1895	175	W.	M.	1480	247	295	247	300	165	+18	..-	...	...
1896	186	B.	M.	1310	215	300	225	295	185	+ 7	5.9	2.2	1.5
1906	186	B.	M.	1450	260	320	255	335	180	+ 7	5.8	2.2	1.6
1907	158	B.	M.	1205	205	270	205	270	170	+ 8	6.0	2.1	1.6
1908	163	B.	M.	1240	213	285	218	298	155	+ 6	5.7	2.2	1.3
1909	158	B.	F.	1120	210	242	200	250	150	+ 7½	...	...	...
1950	178	B.	M.	1350	230	320	235	315	140	+ 9	7.1	2.7	1.5
1962	147	B.	F.	1220	235	280	230	280	140	+ 4	5.6	2.2	1.8
1963	165	B.	M.	1250	225	275	220	280	150	+ 9	4.0	1.5	1.3
1971	175	B.	M.	1330	240	330	240	330	160	+ 2	...	...	...
1972	158	W.	M.	1360	250	280[10]	245	320[10]	152	+ 9	6.4	2.7	1.6
1976	158	B.	F.	1050	173	250	177	245	140	+ 7	5.6	2.1	1.7
2004	168	W.	M.	1390	215	300	210	302	170	+16	...	...	...
2005	158	B.	F.	1110	200	250[11]	220[11]	240	160	+ 3	6.3	2.8	1.5
2021	163	B.	F.	1400	265	325	255	330	170	+ 4	7.0	2.7	1.8
2022	165	W.	M.	1450	260	340	270	350	165	+ 5	...	...	...
2027	165	B.	F.	1300	235	305	230	300	175	+ 4	5.7	2.3	1.4
2028	175	B.	M.	1200	230	290	230	285	165	0	5.3	2.2	1.2
2469	...	B.	M.	....	205	295	215[12]	280[12]	155		5.1	1.9	1.6
2536	170	B.	M.	....	190	265	200	255	170		5.9	2.3	1.5
2612	169	B.	M.	1350	250	290	240	300	150	+10	5.1	2.2	1.5
2614[13]	173	W.	M.	1500	230	290	230	290	160	+25	7.3	2.8	1.7
2620	175	B.	M.	1450	220	280	220	285	165	+24	5.7	2.0	1.6
2621	160	B.	M.	1350	225	280	230	280	170	+10	5.7	2.4	1.5

No.	Length of body.	Color.	Sex.	Weight of Brain.	Weight of Parts of the Brain. (Hardened.)				Cerebellum.		Area of Section of Corpus Callosum.		
					Right side.		Left side.				Whole.	Genu.	Splenium.
					Anterior.	Posterior.	Anterior.	Posterior.					
	cm.			gm.	gm.	gm.	gm.	gm.	gm.		sq. cm.	sq. cm.	sq. cm.
2622	172	B.	M.	1450	200	245	205	235	155	+40	6.6	2.9	1.6
2629	172	B.	M.	1400	210	295	210	295	160	+20	7.5	2.6	1.5
2632	176	B.	M.	1450	215	275	215	275	150	+28	4.4	1.7	1.2
2639	165	B.	M.	1320	200	295	200	295	155	+15	...	...	...
2647	157	B.	M.	1350	205	275	210	270	170	+20	5.3	2.1	1.4
2649	174	B.	M.	1300	250	260	264	280	160	+10	4.8	1.7	1.2
2660	163	B.	M.	1270	205	275	200	280	120	+18	5.4	2.5	.9
2665	163	B.	F.	1270	165	245	175	245	150	+30	5.4	2.6	1.1
2666	170	W.	M.	1050	190	270	195	260	135	0	...	...	...
2667	166	B.	M.	1170	190	250	200	255	140	+13	5.3	2.0	1.4
2672	170	W.	M.	1450	245	330	250	325	160	+10	7.1	3.0	1.5
2683	170	B.	M.	1450	250	315	260	310	155	+ 4	5.9	2.2	1.4
2689[14]	167	B.	F.	1320	220	285	222	295	155	+ 3	5.4	2.1	1.2
2697	155	B.	F.	1150	225	310	230	309	160	— 7	4.3	1.8	1.0
2703	167	B.	M.	1350	240	335	245	337	170	+ 2	7.4	2.9	1.6
2719	...	B.	M.	....	230	355	235	353	182		6.1	2.2	1.6
2722		B.	F.		207	286	198[15]	302[15]	159		5.0	2.2	1.1
2731		W.	M.		225	297	217	305	157		7.2	2.7	1.7
3732	...	B.	M.	....	225	298	227	302	165		4.5	2.0	1.3
2743	...	W.	F.	....	227	360	242	340	152		...	...	...
2746	...	W.	M.	....	240	295[16]	237	315	170		4.9	1.9	1.2
2748	...	W.	M.	....	280	345	275	340	290 (?)		5.1	2.0	1.3
2751	...	B.	F.	....	230	250	225	250	155		5.0	2.2	1.2
2752	...	W.	M.	....	210	277	210	285	130		4.6	2.0	1.0
2753	...	B.	F.	....	202	275	202	270	135		...	...	...
2759	...	B.	M.	....	262	345	262	352	165		5.4	2.3	1.2
2762	...	B.	M.	....	230	335	235	320	165		5.8	2.4	1.4
2789	...	B.	M.	....	255	320	250	330	185		5.4	2.0	1.6
2796	...	W.	M.	1500	295	368	285	380	170		5.3	2.7	1.2
2801	164	B.	F.	1500	245	317	250	300	195		5.2	2.1	1.1

2807	167	B.	M.	1250	235	300	235	300	170		4.6	1.9	1.0
2810	150	B.	F.	1200	245	305	240	315	160		4.6	1.8	1.2
2826	162	B.	M.	1450	280	370	280	375	170	— 2	6.2	2.4	1.3
2828	155	B.	M.	1500	310	375	290	365	180	— 1	7.3	3.0	1.8
2829	180	W.	M.	1650	335	420	320	430	195	— 3	7.5	3.1	1.4
2833	161	B.	M.	1400	275	360	280	355	170	— 3	6.6	2.8	1.5
2834	170	B.	M.	1500	290	410	300	400	195		5.9	2.2	1.8
2837	180	B.	M.	1370	270	385	280	375	170		5.5	2.2	1.4
2842	167	B.	M.	1320	265	335	260	325	160		6.7	2.5	1.8
2861	...	B.	M.	1250	270	345	265	340	205		5.6	2.4	1.6
2864	185	W.	M.	1440	270	340	265	340	160		6.6	2.4	1.7
2865	167	W.	M.	1440	330	400	330	400	220		6.9	2.5	1.7
2867	167	B.	F.	970	185	250	190	250	155		5.3	2.0	1.4
2878	169	W.	M.	1330	250	350	265	340	195		5.5	2.5	1.4
105	Infant	B.		....	170	206	157[16]	219[16]	137		3.8	1.9	.8
108	Infant	B.	F.	....	90	120	90	120	55		1.3	.2	.4
169		W	M.(?)	1110	195	250	210	270	150		3.4	1.8	.6
193	175	B.	M.	950	160	205	170	220	130		4.2	1.7	1.1
196	...	W.	M.	....	250	325	250	325	170		6.4	2.9	1.4
3x	...	B.	M.	....	230	300	230	290	195		...	...	...
4x	...	B.	M.	....	190	280[17]	200	260[17]	...		4.6	2.0	1.0
	..	B.	F.	....	210	273	209	276	155		...	...	...
	163	W.	M.	1200	230	305	230	305	160		...	...	...
	...	W.	M.	1130	235	295	225	305	165		...	...	..
	...	W.	M.	1200	240	325	240	315	180		...	...	..
	...[18]	W.	M.	1200	240	315	240	315	169		...	...	...
	175	B.	M.	1520	260	320	265	315	170		...	...	...
	...	W.	F.		230	310	230	305	180		...	...	...
	168	W.	M.	....	240	320	230	320	140		...	...	...
....	...	W.	M.	....	...	...	...	...	...		5.0	1.9	1.3
....	...	B.	F.	....	...	...	...	...	...		4.8	2.0	1.4
1538	...	W.	M.	....	...	...	...	...	...		5.8	2.2	1.5
1839	...	B.	M.	....	...	...	...	...	...		7.0	2.6	1.4
1969	...	W.	M.	....	...	...	...	...	...		4.7	1.8	1.1
2668	...	W.	F.	....	...	...	...	...	...		4.2	2.0	1.1
2670	...	W.	M.	....	...	..	...	...	...		5.8	1.9	1.8

regarding male and female types are of no scientific value. It may turn out, however, that variations in the gyri and sulci will not be of the same percentage in both men and women and that the constant value in the latter will be found more readily, as is the case with other anatomical variations (Schwalbe).

In this study of several anatomical characters said to vary according to race and sex, the evidence advanced has been tested and found wanting. It is found, however, that portions of the brain vary greatly in different brains and that a very large number of records must be obtained before the norm will be found. For the present the crudeness of our method will not permit us to determine anatomical characters due to race, sex or genius and which if they exist are completely masked by the large number of marked individual variations. The study has been still further complicated by the personal equation of the investigator. Arguments for difference due to race, sex and genius will henceforward need to be based upon new data, really scientifically treated and not on the older statements.

Note to the Preceding Table.

The data given in the preceding table have been aranged in a great variety of ways, but only three of these bear upon the subject under discussion. They are given in Figs. 1 to 3. The individiual records are appended to enable those who are interested in the subject to make further comparisons with those given by Bean and by Spitzka, as well as for further use to those who may collect new data.

The genu and splenium were outlined by Bean's method, given on page 8.

FOOTNOTE TO THE TABLE.

[1]Pia on left side. [2]Pia off on left side. [3]Boy. [4]Break not even on left side. [5]Pia off on left side. [6]Ventricle on right side greatly dilated. [7]Break unsatisfactory. [8]Sulci on both sides very irregular. [9]Pia off on right side. [10]The posterior left is decidedly larger than the posterior right. [11]Left operculum is very large and right parietal convolutions are very atrophic. [12]Curious interlacing of fiber bundles below central fissure on the left side. [13]Boy. [14]Central fissure seems to be double on both sides. [15]Break unsatisfactory. [16]Large cavity in right brain; break also unsatisfactory; break on left side is not accurate. [17]Breaks unsatisfactory. [18]Insane murderer.