ON THE INHERITANCE OF THE MENTAL AND MORAL CHARACTERS IN MAN, AND ITS COMPARISON WITH THE INHERITANCE OF THE PHYSICAL CHARACTERS.

The Huxley Lecture for 1903.

By Professor Karl Pearson, F.R.S.

[Presented October 16th, 1903.]

Introductory.—The Material and its Collection.

(1) There are probably few persons who would now deny the immense importance of ancestry in the case of any domestic animal. The stud-books, which exist for horses, cattle, dogs, cats- and even canaries, demonstrate the weight practically given to ancestry when the breeding of animals has developed so far that certain physical characters possess commercial value. A majority of the community would probably also admit to-day that the physical characters of man are inherited with practically the same intensity as the like characters in cattle and horses. But few, however, of the majority who accept this inheritance of physique in man, apply the results which flow from such acceptance to their own conduct in life— still less do they appreciate the all important bearing of these results upon national life and social habits. Nor is the reason for this—or better, one out of several reasons for this—hard to find. The majority of mankind are more or less conscious that man has not gained his pre-eminence by physique alone. They justly attribute much of his dominance in the animal kingdom to those mental and moral characters, which have rendered him capable of combining with his neighbours to form stable societies with highly differentiated tasks and circumscribed duties for their individual members.

Within such communities we see the moral characters developing apparently under family influences; the mental characters developing not only under home training, but under the guidance of private and public teachers, the whole contributing to form a complex system of national education. To use technical terms, we expect correlation between home influence and moral qualities, and between education and mental power, and the bulk of men too rashly, perhaps, conclude that the home and the school are the chief sources of those qualities on which social stability so largely depends. We are too apt to overlook the possibility that the home standard is itself a product of parental stock, and that the relative gain from education depends to a surprising degree on the raw

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material presented to the educator. We are agreed that good homes and good schools are essential to national prosperity. But does not the good home depend upon the percentage of innately wise parents, and the good school depend quite as much on the children's capacity, as on its staff and equipment?

It is quite possible to accept these views and yet believe that the moral and mental characters are inherited in either a quantitatively or a qualitatively different manner from the physical characters. Both may be influenced by environment, but the one in a far more marked way than the other. Since the publication of Francis Galton's epoch-making books, *Hereditary Genius* and *English Men of Science*, it is impossible to deny *in toto* the inheritance of mental characters. But we require to go a stage further and ask for an exact quantitative measure of the inheritance of such characters and a comparison of such measure with its value for the physical characters.

Accordingly some six or seven years ago I set myself the following problem: What is the quantitative measure of the inheritance of the moral and mental characters in man, and how is it related to the corresponding measure of the inheritance of the physical characters?

The problem really resolved itself into three separate investigations:—

> (*a*) A sufficiently wide inquiry into the actual values of inheritance of the physical characters in man.
>
> > This investigation was carried out by the measurement of upwards of 1000 families. We thus obtained ample means of determining both for parental and fraternal relationships the quantitative measure of resemblance.
>
> (*b*) A comparison of the inheritance of the physical characters in man with that of the physical characters in other forms of life.
>
> > This has been made for a considerable number of characters in diverse species, with the general result that there appears to be no substantial difference, as far as we have been able to discover, between the inheritance of physique in man, and its inheritance in other forms of life.
>
> (*c*) An inquiry into the inheritance of the moral and mental characters in man.
>
> > This is the part of my work with which we are at present chiefly concerned, and I want to indicate the general lines along which my argument runs.

In the first place it seemed to me absolutely impossible to get a quantitative measure of the resemblance in moral and mental characters between parent and offspring. You must not compare the moral character of a child with those of its adult parents. You can only estimate the resemblance between the child and what its parents were as *children*. Here the grandparent is the only available source of information; but not only does age affect clearness of memory and judgment, the partiality of the relative is a factor which can hardly be corrected and allowed for.

If we take, on the other hand, parents and offspring as adults, it is difficult to appeal to anything but the *vox populi* for an estimate of their relative moral merits, and this *vox* is generally silent unless both are men of marked public importance. For these and other reasons I gave up any hope of measuring parental resemblance in moral character. I confined my attention entirely to *fraternal* resemblance. My argument was of this kind. Regarding one species only, then if fraternal resemblance for the moral and mental characters be less than, equal to, or greater than fraternal resemblance for the physical characters, we may surely argue that parental inheritance for the former set of characters is less than, equal to, or greater than that for the latter set of characters.

In the next place it seemed impossible to obtain moderately impartial estimates of the moral and mental characters of *adults*. Who but relatives and close friends know them well enough to form such an estimate, and which of us will put upon paper, for the use of strangers, a true account of the temper, probity and popularity of our nearest? Even if relatives and friends could be trusted to be impartial, the discovery of the preparation of schedules by the subjects of observation might have ruptured the peace of households and broken down life-long friendships. Thousands of schedules could not be filled up in this manner. The inquiry, therefore, resolved itself into an investigation of the moral and mental characters of *children*. Here we could replace the partial parent or relative by the fairly impartial school teacher. A man or woman who deals yearly with forty to a hundred new children, rapidly forms moderately accurate classifications, and it was to this source of information that I determined to appeal.

I would refer at once to an objection, which I think is not real, but which I know will arise in the minds of some. It will be said that the temper, vivacity and probity of children is not a measure of the like qualities in the adult. The shy boy at school is not necessarily a shy man on the floor of the House of Commons or confronting a native race on the north-west frontier. Granted absolutely. But what we are comparing is what that boy was at school, with what his brother and sister may have been. We can legitimately compare for purposes of heredity a character of the larval stage of two insects, although that character disappears entirely when both are fully developed as *imago*.

It is possible that some allowance ought to be made for changes during the school period in the mental and moral characters, but I have not found that those characters change very substantially in their percentages with the age of the school children, the bulk of whom lie between 10 and 14. Accordingly, while the physical characters change during the school period, it did not to a first approximation seem needful to allow for age changes in the mental and moral characters.[1] Such changes may exist, but they do not appear to be so marked as to substantially influence our results.

In order to carry out this investigation I sought and received aid from the

[1] An additional memoir on the change of mental and physical characters with growth is in course of preparation.

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Government Grant Committee of the Royal Society. I have further to acknowledge the assistance I have received, in the task of reduction and computation, from a grant made to my department at University College, by the Worshipful Company of Drapers.

I had deemed it desirable to measure not only the mental and moral characters, but a wide range of physical characters also. These would act as a check on the whole work, for we knew perfectly well what the inheritance of these physical characters might be expected to be. They were further needed as part of a more general investigation into the relationship between the mental and physical characters in man. In order to confine the cost of the inquiry within reasonable bounds, a special headspanner was devised with the assistance of Mr. Horace Darwin of the Cambridge Scientific Instrument Company. This instrument has not the exactness, of course, of the metal callipers of the craniologists, but it affords, carefully handled, a quite adequate means of obtaining the maximum length, maximum breadth and auricular height of the living head. It had further the great advantage that, made in numbers, it cost comparatively little and could be distributed widely among teachers.

Schedules were then, after much consideration and some experimenting, prepared, in which teachers could briefly note the chief characteristics of the children under their charge. These schedules were white for a pair of brothers, pink for a pair of sisters, and blue for a brother and sister. Additional brothers were given on attached white, and additional sisters on attached pink sheets. With the schedules were distributed (a) printed directions for the use of the head spanner; (b) general directions as to the estimation of both the physical and mental characters; and (c) two additional series of lithographed instructions, which were suggested by special inquiries of the teachers who first began the observations. Copies of the schedule and the general directions are printed in Appendix I.

The material took upwards of five years to collect. Appeal was made through the columns of the educational journals to teachers of all kinds, and our observations were made not only in the great boys' public schools, in the girls' high schools and the grammar schools of the country, but in modern mixed schools, in national and elementary schools of all kinds, in board schools and private schools throughout the kingdom. Some 6000 schedules were distributed and between 3000 and 4000 returned with more or less ample data. I have most heartily to thank the masters and mistresses of nearly 200 schools in which observations have been made for me. In the midst of arduous professional claims on their time and energy, they have, in many cases at considerable personal inconvenience, recorded and measured the children in their charge, for a purpose only dimly foreshadowed to them. In no case could they realize on the basis of their own 10 or 20 schedules the value of the scientific inquiry to which they were contributing, for its success depended entirely on the combination of tens and twenties into hundreds and thousands, a possibility which even some of my keenest assistants despaired of during the years in which the investigation was in progress. We were, indeed, more than once confronted by an

apparent drying up of all conceivable sources of new material. The number of schools is of course immense, but the means of reaching and interesting their masters and mistresses extremely limited.[1] It is only right and proper to place on record the names of my chief co-operators in this investigation. See Appendix II.

The list in Appendix II will not only show the class range of the schools dealt with, but also the great variety of localities which contributed. As far as the United Kingdom contains local races, we have fairly sampled them. Of course one would much prefer to have dealt entirely with a single district with little immigration, and thus have worked wholly within one local race, but a little consideration showed how impossible it was to get material enough for any safe conclusions from such a limited area. It is not one per cent. of teachers who can spare the time, or, being able to spare the time, have the imagination which will induce them to aid in co-operative inquiry of this kind. With the assistance of Mr. E. W. Adair an attempt at a limited area was made in the case of Guernsey. But we only succeeded in getting 150 to 200 schedules filled in. These were sufficient to show that a perceptible differentiation in the physical characters existed between Channel Island and English children. No differentiation in the psychical characters could be observed. Accordingly the Guernsey children were not pooled with the others for physical characters, but the material was far too insignificant in amount to justify a separate investigation of the statistical constants.[2] The influence of local race would undoubtedly make itself felt on our statistics, but taken broadly our constants represent the condition of things in the nation at large, and if any portion of the relationship between brothers and sisters is really due to local race, then we must inquire whether local race is or is not equally influential on the moral and mental characters. My belief that local race is not largely influential in this enquiry is based fundamentally on the following facts:—

(a) The constants of parental heredity deduced from my Family Records, made like the School Observations on members of many English local races, are closely like results found for such selected breeds as race-horses and greyhounds.

(b) The Family Records and the School Observations are for the fraternal relationships in excellent agreement.

Hence, while I admit the "local race" problem to be of first-class importance for many anthropological investigations, I do not think that to a *first* approximation, it has had sensible bearing on our present results.

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[1] I must not omit to acknowledge the courtesy of the editors of the *Journal of Education*, *The School World*, *The Schoolmaster* and other educational journals in publishing my appeals.

[2] While showing a certain differentiation, the general accord between the Guernsey correlations and those of the United Kingdom was remarkable, and extremely satisfactory when we want confirmation of the fact that, within broad lines, we are dealing with general "human" characters and relations, and not with something peculiar to "local race." As an instance I cite the "correlation ratio," η, a constant determining association,—for the case of head growth with age in girls. Guernsey Girls: $\eta = \cdot 44$; English Girls: $\eta = \cdot 46$. Considering that this Guernsey result is based on 110 cases only, the agreement is remarkable. We are clearly dealing with a constant of human growth in general.

So much may be said here about the nature and manner of collecting our material. The absolute classification and tabling has been a work of great labour. I have to thank in this matter my group of co-workers at University College, more especially Miss Alice Lee, D.Sc.; Miss Marie Lewenz, M.A., Miss E. Perrin, Miss Mary Beeton and Miss Margaret Notcutt have likewise aided me. More recently in the pressure of preparation for this lecture Mrs. W. F. R. Weldon and Miss F. E. Cave have come strenuously to my assistance. The chief labour of computing has fallen upon Dr. Alice Lee, but a considerable number of the tables have been re-done or revised by myself. Miss F. E. Cave has either computed, or reworked and computed, a considerable number of the head measurements and growth with age tables (not here published) necessary for the reduction of head measurements to a uniform age. To Miss M. Lewenz I owe aid in the computation of the health, ability and athletics data. In short, although *I* may be giving the Huxley Lecture, the work is essentially the result of a co-operative investigation extending over a number of years, and depending upon a body of collaborators, without whom it would have been quite impossible to deal with, much less to collect, the extensive data on which my results entirely depend.

(ii.) *Nature of the Theory Applied.*

Much of what I have to say upon this point would not be new to those who have examined recent biometric work, and some of it would not be intelligible except to the trained mathematician. Still we must strive in broad lines to see how the work has been done, and above all, to justify our treatment of the psychical characters.

To illustrate the method I will examine a little at length the degree of resemblance of brothers in a physical character. I choose cephalic index and this for two reasons :—

> (*a*) Because from the first few years of life onwards the cephalic index scarcely changes with growth.
>
> I have not yet investigated my own school data from this standpoint, but I have every confidence in the care taken by the late Dr. W. Pfitzner in his elaborate system of measurements, and the above is the conclusion he reaches.[1]
>
> (*b*) Several great authorities have recently stated that they do not " believe " in the cephalic index, *i.e.*, consider it of small value for anthropometric purposes.

In Table E (i), Appendix III, we have the cephalic index given for 1982 pairs of brothers. This table is, I hope, perfectly intelligible. Taking the boys, for

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[1] *Zeitschrift für Morphologie u. Anthropologie*, vol. i, 1899, p. 372. My schoolboys from all districts give 78·9 ; 3000 criminals of adult age from all districts give 78·5—there is not much room for sensible growth change in these juvenile and adult results. Observations of my own on actually the same growing children, show very small, if any change.

example, with cephalic indices between 74 and 75, these boys had 78 brothers who were distributed according to the arrangement in the column headed 74 to 75. Brothers are not alike in cephalic index, but distributed with a considerable range of variation.   We now take in the usual way the arithmetic mean of this array of brothers, and find it to be 77·45.   The average brother of a boy with cephalic index = 74·5 has an index of 77·45.   This is the phenomenon of regression towards the general population mean (78·9) as discovered by Francis Galton.   Now turning to Diagram I we plot to 74·5, the mean brother 77·45, and doing this for all arrays we get the series of points there exhibited.   You will see at once that they lie almost exactly on a straight line.   This is the well-known regression line.   If that line had a slope of 1 in 1, the brother of 74·5 would have a mean brother of 74·5 cephalic index.   If it had no slope at all the brother of 74·5 would have a brother
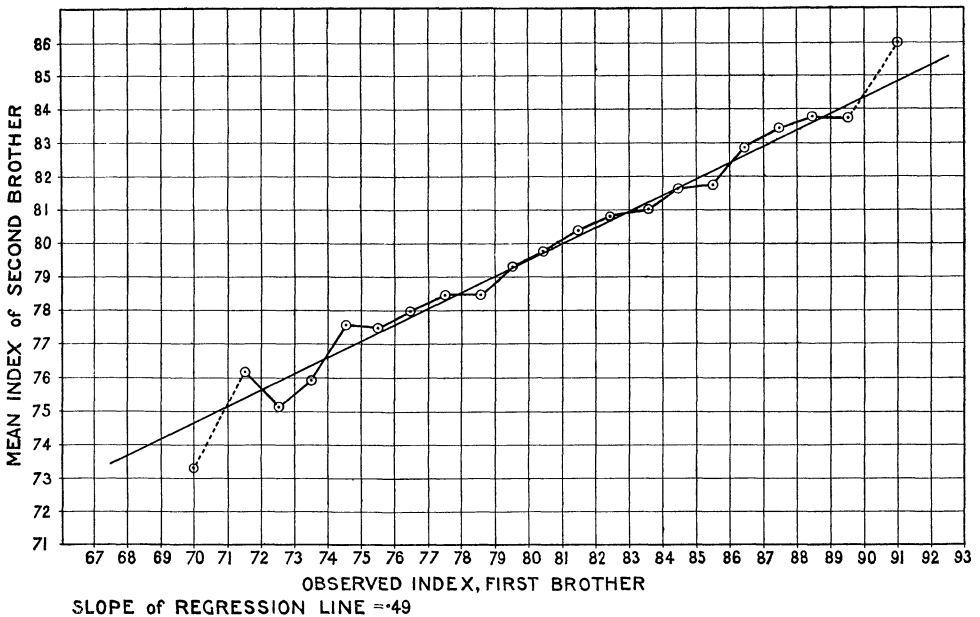
DIAGRAM I.—RESEMBLANCE OF BROTHERS IN CEPHALIC INDEX.

like the mean of the general population.   In the one case we have absolute resemblance, in the other case no resemblance at all.   The actual degree of resemblance, our brothers being equally variable, is measured by the steepness of this regression line.   In our case that steepness is ·49, almost ·5 or 1 in 2.   That is the measure of fraternal resemblance in brothers for cephalic index—the correlation between brothers as we term it.

Now we have learnt two great features of inheritance in man.   First, that the points in Diagram I, within the limits of observation are on a line, and secondly, that the slope of this line is about ·5.   Are these results true for characters other than the cephalic index?   Undoubtedly for all the physical characters yet worked out in man.   Here are additional illustrations: see Diagrams
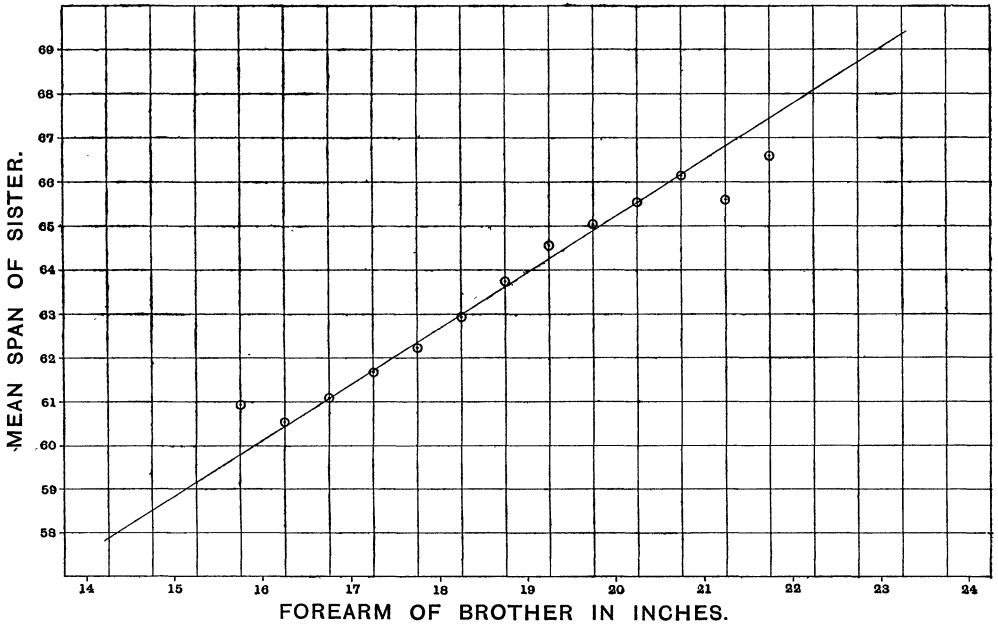
DIAGRAM II.—RESEMBLANCE OF SISTER'S SPAN TO BROTHER'S FOREARM.
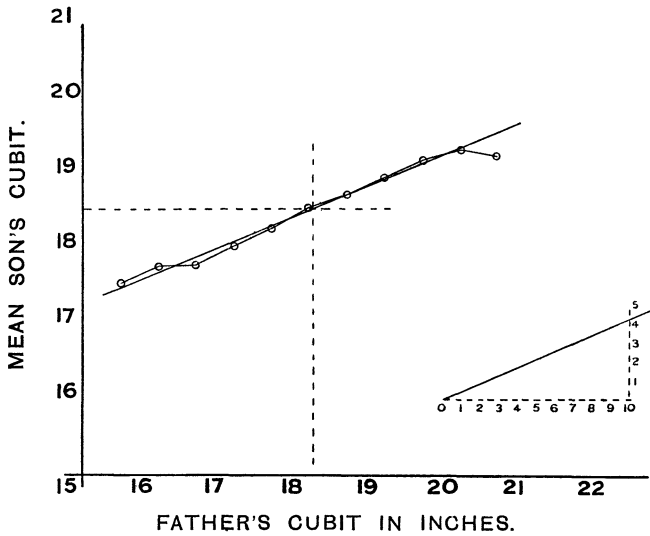
DIAGRAM III.—RESEMBLANCE OF FATHER AND SON IN CUBIT.

II–IV.[1]   We cannot hesitate about the regression line being essentially linear. Has it for brethren usually a slope of about ·5 ?

MOTHER'S SPAN IN INCHES.
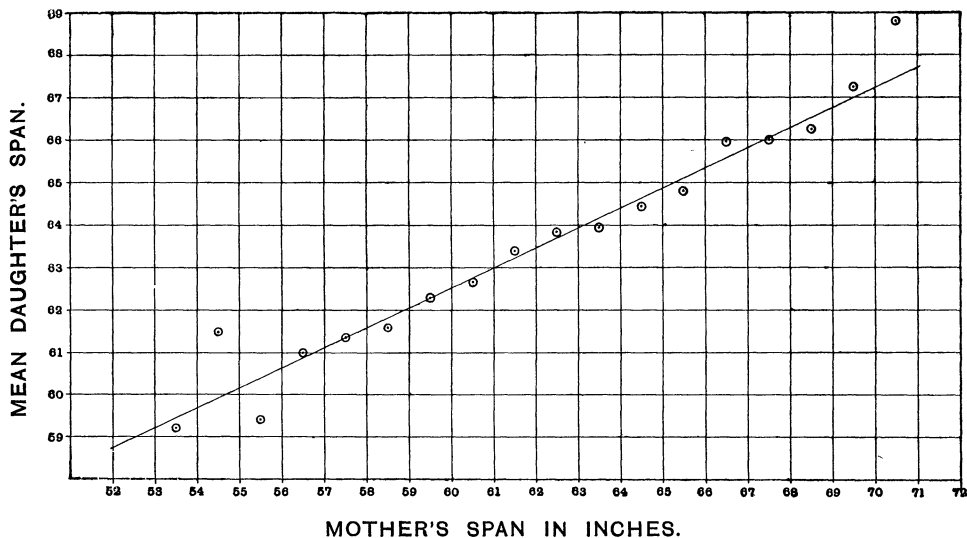
DIAGRAM IV.—RESEMBLANCE OF MOTHER AND DAUGHTER IN SPAN.

In Table I are given my observations on some 1000 families for adult brothers and sisters. You will see that the steepness of the regression line is essentially about ·5.

TABLE I.

Inheritance of the Physical Characters.

Records of Adults.

Character.	Correlation.		
	Brothers.	Sisters.	Brothers and Sisters.
Stature...	·51	·54	·55
Span	·55	·56	·53
Cubit	·49	·51	·44
Eye Colour	·52	·45	·46
Mean	·52	·51	·49

[1] Diagrams II and IV are reproduced from a memoir by the author on "Inheritance of the Physical Characters in Man," *Biometrika*, vol. ii, pp. 362–3, and Diagram III from an article in the same *Journal*, vol. ii, p. 216, on the "Law of Ancestral Heredity."

In Table II are given my observations on the head measurements of school children. We note at once precisely the same convenient number ·5.

I think we, therefore, may safely conclude that for the measurable physical characters in man, we have a quite definite regression line, and that it ascends 1 in 2.

TABLE II.
Head Measurements on School Children.

Pair →	Brother-Brother.			Sister-Sister.			Brother-Sister.				
Characters.	Mean.	S.D.	Correlation.	Mean.	S.D.	Correlation.	Mean.		S.D.		Correlation.
							B.	S.	B.	S.	
Cephalic Index..	78·92	3·314	·4861	78·29	3·988	·5360	78·72	78·96	3·237	3·382	·4265
Head Length (12 years)	184·52	6·154	·5041	180·22	6·346	·4251	183·82	179·20	6·563	6·510	·4575
Head Breadth (12 years)	145·23	5·739	·5925	140·21	6·547	·6208	144·24	140·59	5·975	5·708	·5419
Head Height (12 years)	127·19	6·479	·5537	124·07	6·868	·5237	127·36	124·80	7·031	6·226	·4897
Mean.	—	—	·5341	—	—	·5264	—	—	—	—	·4789

S.D. = Standard deviation, the measure of the variability of the observed character.

It is proper before I go further, to explain how the results for resemblance between brothers and sisters of different ages in head measurements have been made. In the first place a growth curve for each sex and for every measurement was drawn; this growth curve simply consists in plotting the average size of head of a child of given age to that age. Diagram V, represents the growth of auricular height of head of the mean girl from 4 to 19 years of age. The observation points are then smoothed and we obtain the mean growth curve. I cannot stay to discuss these mean growth curves now, but it must be clear that they give us a method of ascertaining the mean head growth of a child from any one year of its life to any other. Now all children do not grow in the same manner, but as we are dealing with average results we shall obtain a reasonable measure of growth by using the growth curve of the mean child. By means of six growth curves like that shown, the length, breadth, and height of every child's head was reduced to the dimensions it would most probably have at the age of 12 years. Thus we were able to compare the likeness in head measurements of brothers at the *same* standard age. This is the method by which the inheritance of head length, breadth, and height, given in Table II was deduced.[1]

[1] By a much more elaborate investigation in multiple correlation I found for resemblance between brothers in head length ·54 (see *R.S. Proc.*, vol. 71, p. 294). The growth correlation not being absolutely linear, I am not sure that that value is better than the ·5 of the present simpler method.
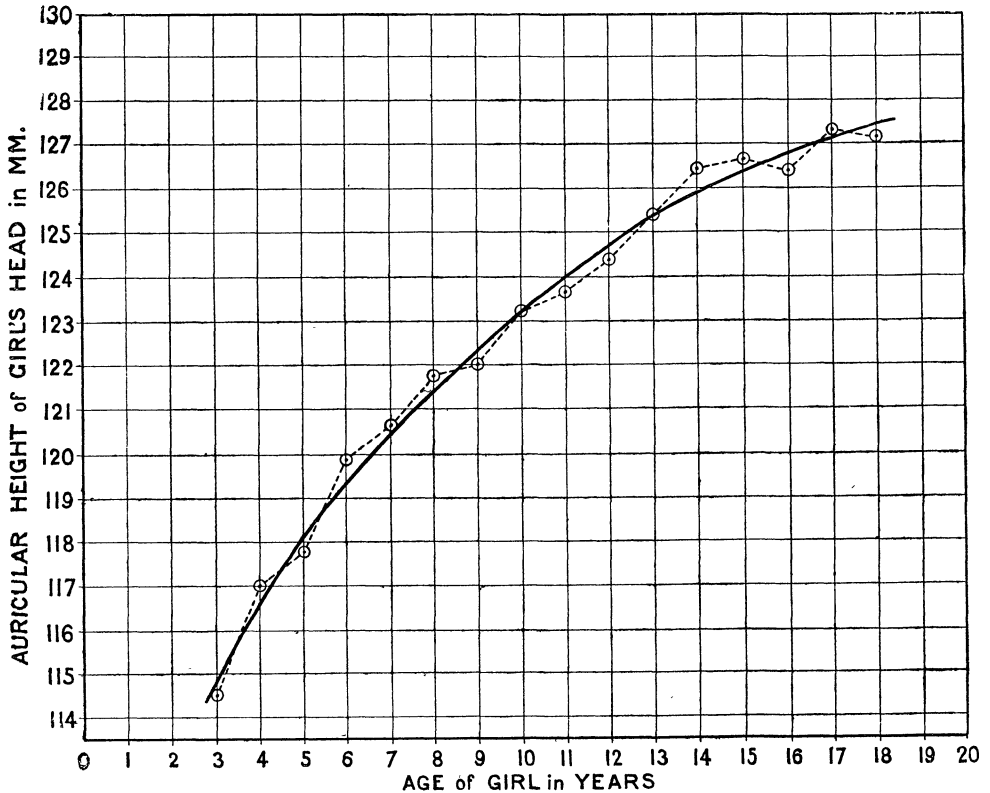
DIAGRAM V.—GROWTH OF AURICULAR HEIGHT IN GIRL'S HEAD.

Now what are we to understand by "believing" or "not believing" in the value for anthropological purposes of any character? Surely the main point for such purposes is the question of whether or no it be inherited and have small variability within the group? I don't think if we look at Table II we shall find the cephalic index worse than other head measurement, especially if we stick to one sex. It has an inheritance coefficient of about ·5, just what for practical purposes we have found for other physical characters.

So far we have seen surprising uniformity in the inheritance of the measurable physical characters. How are we to extend our results to physical characters not capable of accurate measurement, and to psychical characters? Clearly the whole problem turns on this: Can we find the steepness or slope of this regression line without all the paraphernalia of the correlation table and the means of arrays? The answer is: Yes; providing we assume a certain distribution of frequency for the character in human populations. This distribution of frequency is given by the Gauss-Laplacian normal curve of deviations from the mean. Grant this distribution, and by very simple classifications indeed we can determine the steepness of the regression line. Now the problem before us is the following one:—Is this assumption legitimate? It is certainly not true for organs and characters in *all* types of life. But it really does describe in a remarkable manner

the distribution of most characters in mankind. We have shown that within the limits of random sampling, it is very true for a great variety of characters in the human skull.[1] Dr. Macdonell has demonstrated it also for measurements on criminals, and you can be fairly convinced of its suitability by looking at one or two diagrams. Diagram VI gives the distribution of nearly 2000 boys in cephalic
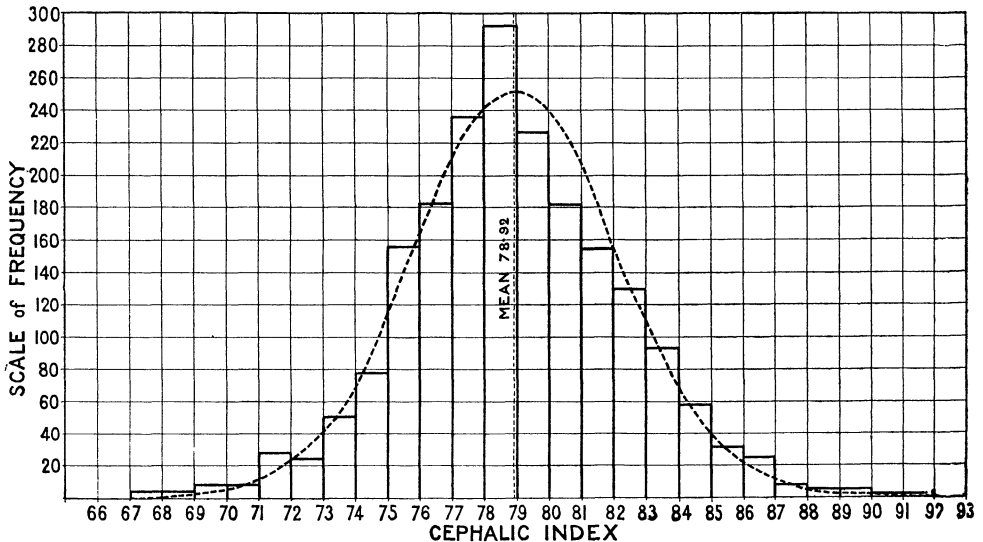
DIAGRAM VI.—DISTRIBUTION OF CEPHALIC INDEX IN 1982 BOYS.

index; Diagram VII the distribution of stature in 1000 women; Diagram VIII the distribution of head breadth in 3000 criminals.[2] I should be the last to assert that no human characters can be found that do not diverge sensibly from this Gaussian distribution. But I believe they are few, and that for practical purposes we may with nearly absolute safety assume it as a first approximation to the actual state of affairs. This being once granted we can obtain the slope of our regression line by an exceedingly simple process. We can make a mere classification of the following kind, say, into boys with breadths of head below 145 mm., and boys with breadth of head above 145 mm. For example, here is a simple classification of 2022 pairs of brothers by this process :—

[1] *Biometrika*, vol. i, p. 443.
[2] Diagram VII is from a paper on the "Inheritance of the Physical Characters in Man," *Biometrika*, vol. ii, p. 364, and Diagram VIII from Dr. Macdonell's memoir in the same *Journal*, vol. i, p. 184. I have gratefully to acknowledge the kindness of the proprietors of that *Journal* for allowing me to illustrate the present memoir by using Diagrams II, III, IV, VII and VIII.

STATURE OF WOMEN IN INCHES.
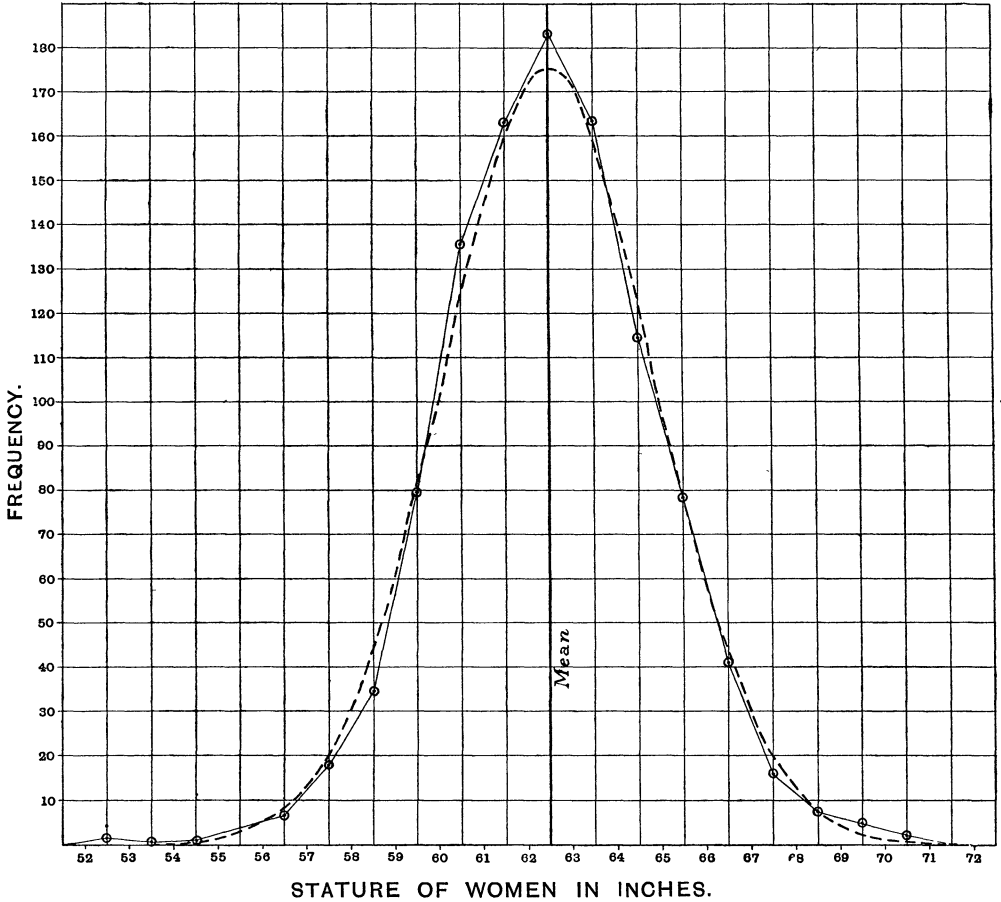
DIAGRAM VII.—DISTRIBUTION OF STATURE IN WOMEN.

Breadth of Head.
First Brother.

		Below 145.	Above 145.	Totals.
Below 145	...	635·5	307	942·5
Above 145	...	307	772·5	1079·5
Totals	...	942·5	1079·5	2022

The result is precisely the same as dividing this ring model (*exhibited at the lecture*) by a pair of rectangular planes and counting up the number of rings in each of the four spaces.
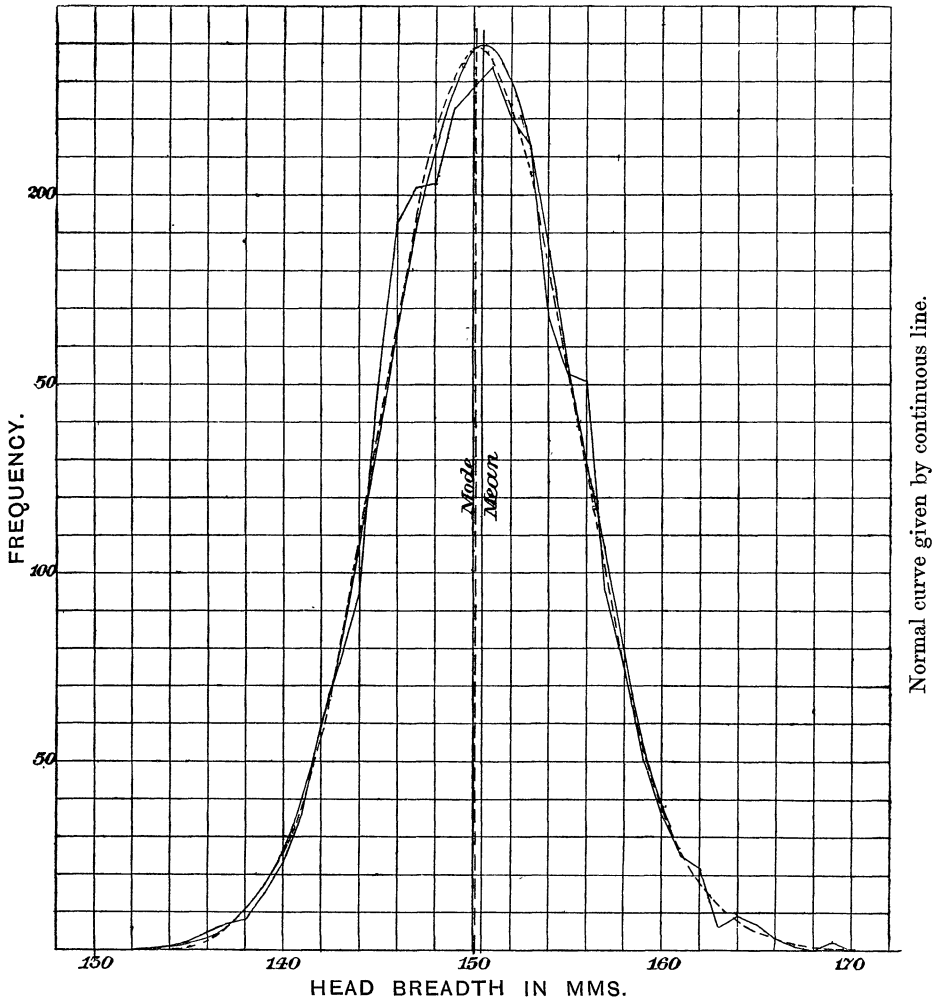
DIAGRAM VIII.—DISTRIBUTION OF HEAD BREADTHS IN 3000 CRIMINALS.

Now from such a division the mathematician can deduce[1] the slope of the regression line on the assumption of normal distribution. Here, to give us confidence, are the results for head breadth and height in boys, which were worked out both ways:—

Resemblance of Brothers.

	Long table.	Fourfold division.
Head Breadth ...　　...　　...	·59	·58
Auricular Height　　...　　...	·55	·56

For practical purposes these results are identical.

[1] Mathematical Contributions to the Theory of Evolution. VII. "On the Correlation of Characters not Quantitatively Measurable," *Phil. Trans.*, vol. 195 A, pp. 1–47.

Accordingly let us assume this fourfold division will work, and investigate by means of it a non-quantitatively measurable physical character in man. I choose *Health* as an example. In Table A (i), Appendix III, we have the distribution of health in a population of 1918 school boys, and in Diagram IX, we have the arrangement of the same material, supposing it to follow a normal curve. My five classes were (i) *Very Strong*; (ii) *Strong*, being here used not in the sense of physically strong, but of *Robust*; (iii) *Normally Healthy*; (iv) *Rather Delicate*; and (v) *Very Delicate*. You will see that the "modal" boy is somewhat on the normally healthy side of robust, but that the *Very Robusts* are more numerous than the *Very Delicates* and the *Robusts* than the *Delicates*. I think the scale is not without suggestiveness even as a general health distribution for the population at large. It gives us for the first time an exact measure of the ranges of delicacy and robustness in terms of normal health.

Now I applied this scale to the relation between brothers in health character. I plotted up at the mean of robust boys, a length on this scale equal to the mean on the same scale of the array of brothers of these robust boys; there was naturally a regression towards normal health. I did this for all the possible five arrays,[1] and I thus obtained the five points given in Diagram X. You will see at once that our five points lie quite nicely distributed about the regression line as found by the fourfold division method discussed above. In other words, there can be little doubt that the general health of boys is a character which closely follows the normal law of distribution, and has a true line of regression. The slope of that line is ·52, or we may safely say that general health in the community is inherited in precisely the same manner as head-measurements or body-lengths.

I now come to the fundamental idea of my comparison of the psychical and physical resemblance of brothers. Suppose we assume that moral and mental qualities in man, like the physical, follow a normal law of distribution, and that the regression is linear. What results shall we obtain by thus assuming perfect continuity between the physical and the psychical? No doubt the drums will begin to beat the tattoo, we shall hear talk of the hopeless materialism of some men of science. But to use Huxley's appropriate words: "One does not battle with drummers." I cannot free myself from the conception that underlying every psychical state there is a physical state, and from that conception follows at once the conclusion that there must be a close association between the succession or the recurrence of certain psychical states, which is what we judge mental and moral characteristics by, and an underlying physical confirmation be it of brain or liver. Hence I put to myself the problem as follows :—Assume the fundamental laws of distribution which we know to hold for the physical characters in man, and see whither they lead us when applied to the psychical characteristics. They must : (*a*) Give us totally discordant results. If so, we shall conclude that these laws have

[1] For the benefit of the mathematical statistician, I may say that I used the modal group of each sub-array to determine its mean and standard deviation in terms of those of the scale for the whole population.
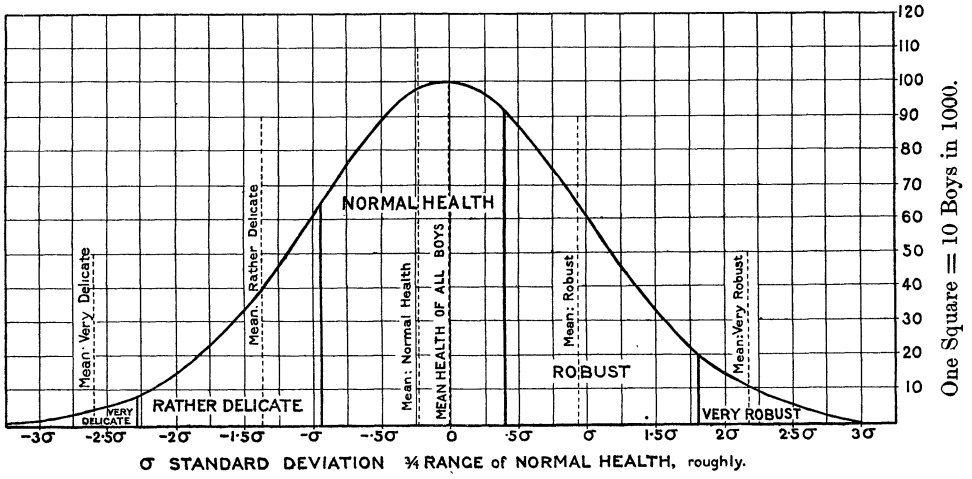
DIAGRAM IX.—DISTRIBUTION OF HEALTH IN 1918 SCHOOL BOYS.
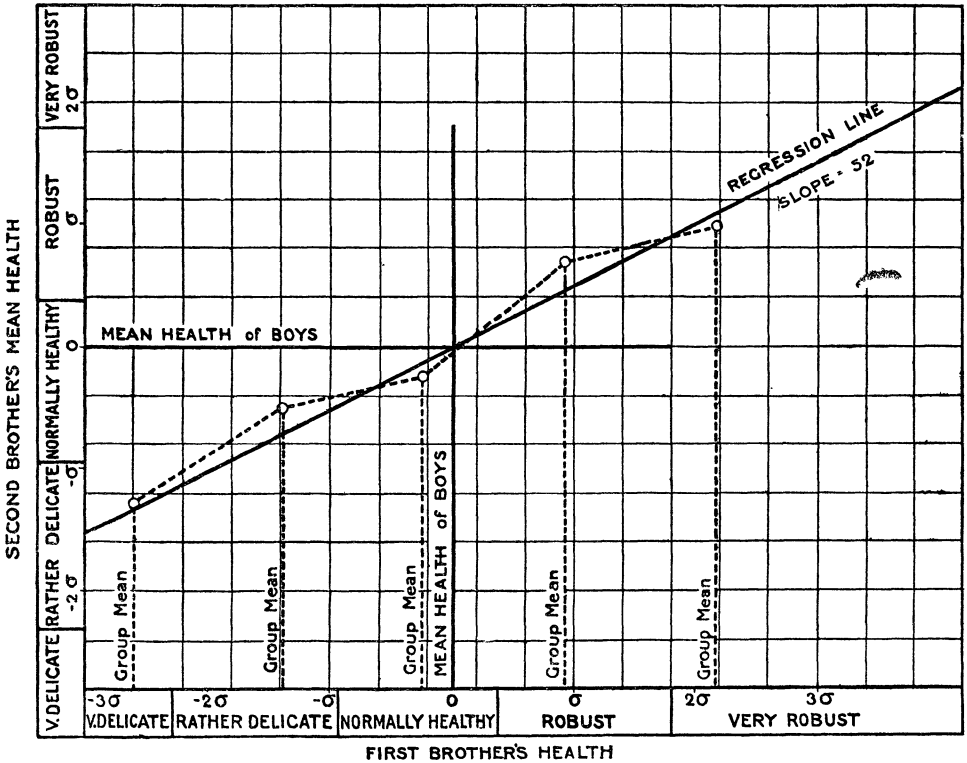
DIAGRAM X.—RESEMBLANCE IN GENERAL HEALTH OF 1918 PAIRS OF BROTHERS.

SCALE of ABILITY
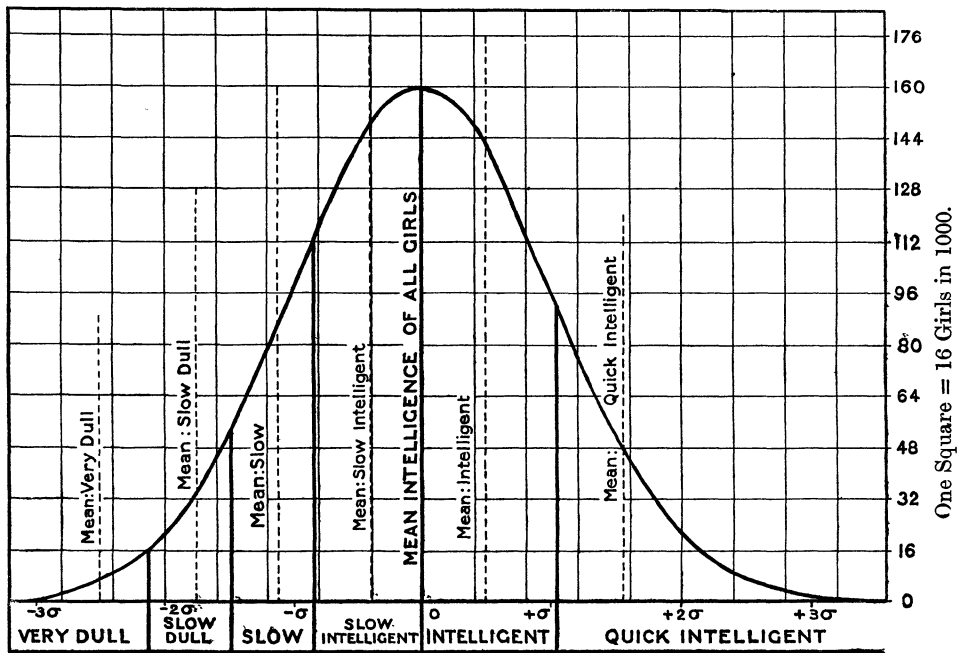
σ = STANDARD DEVIATION = ·97 RANGE of "INTELLIGENT"

DIAGRAM XI.—DISTRIBUTION OF INTELLIGENCE IN 2014 GIRLS.

FIRST SISTER'S ABILITY
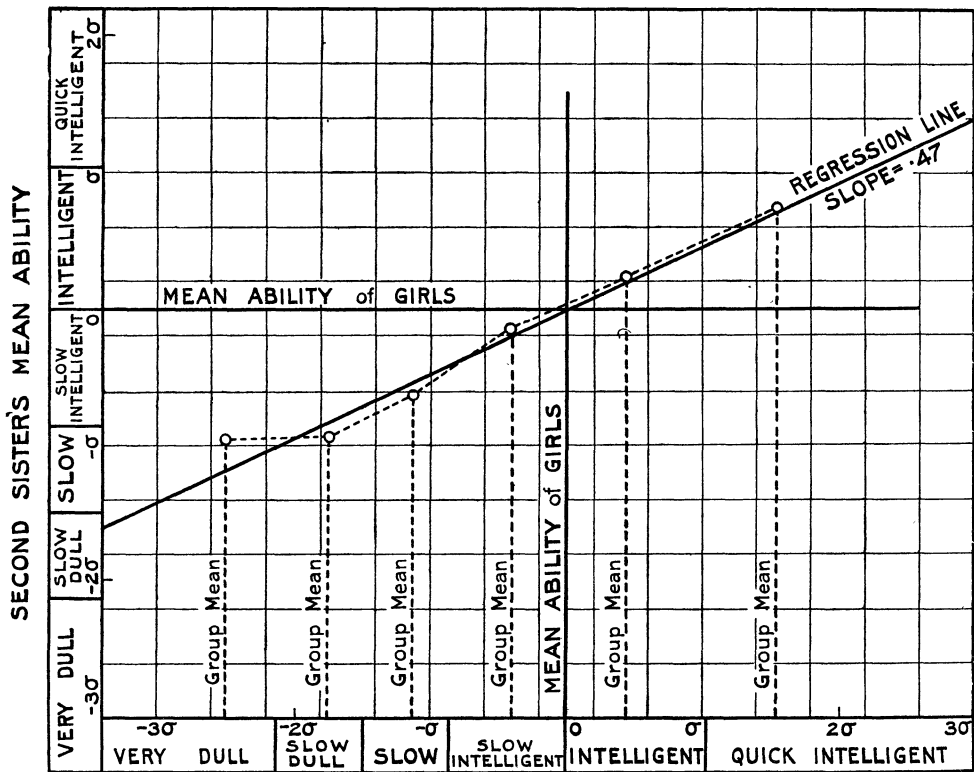
DIAGRAM XII.—RESEMBLANCE OF SISTERS IN ABILITY.

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no application to the mental and moral attributes. Or, (*b*) Give us accordant results. If so, we may go a stage further, and ask how these results compare with those for the inheritance of the physical characters : are they more or less or equally subject to the influence of environment ? Here are the questions before us. Let us examine how they are to be answered. As an illustration I take *Ability in Girls*. I measured intelligence by the following seven classes. (i) *Quick Intelligent*; (ii) *Intelligent*; (iii) *Slow Intelligent*; (iv) *Slow*; (v) *Slow Dull*; (vi) *Very Dull*, and a quite distinct category; (vii) *Inaccurate-Erratic*. Some explanation of these terms is given in Appendix IA, which contains the general instructions for observation, and the terms themselves were practically formulated by a schoolmaster of considerable pedagogic and psychological experience.

My next stage was to ask two or three different teachers in several schools to apply the classification to 30 to 50 pupils known to each of them. The classifications were made quite independently, often by teachers of quite different subjects, and a comparison of the results showed that 80 to 85 per cent. of the children were put into the same classes by the different teachers, while about 10 per cent. more only differed by one class. This gave one very great confidence not only in the value of this scale, but of other psychical classifications when used by observant teachers. The next stage was to obtain exactly, as in the case of *Health*, a general scale of intelligence.[1]

Diagram XI gives the normal distribution of intelligence in a population of 2014 girls. It is a curious, if a common result of experience, to find that the modal ability is on the borderland between the *Intelligent* and *Slow Intelligent*. We have here for the first time a quantitative scale of intelligence, and we can at once apply it to the problem of the degree of resemblance between sisters as regards ability. Just as in the case of *Health*, all the girls of a given class are taken, say the *Slow Intelligents*, and at the average value of this class, is plotted upon this scale of intelligence, the average value of the intelligence of the sisters of these girls on the same scale. We thus obtain the six points of Diagram XII, all well within the limits of random sampling, lying on the straight line found from the fourfold division of the data. The slope of this line is ·47 or 47, close to 50, in the 100. There can, I think, be small doubt that *Intelligence* or *Ability* follows precisely the same laws of inheritance as *General Health*, and both the same laws as *Cephalic Index*, or any other physical character.

In precisely the manner indicated here all the other physical and psychical characters recorded may be dealt with. But before we sum up our results for the slopes of all the lines thus investigated, it is most essential to make, especially to an anthropological audience, some remarks on the manner in which the individual physical and mental characters have been treated.

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[1] I should say at once that the *Inaccurate-Erratics* turned out a surprisingly small class, a fractional per cent. of the community, and that they were not further dealt with.

(iii.) *Remarks on Individual Characters dealt with.*

Physical Characters.

(A) *Health.*—We have already seen how this was recorded. In order to deduce the correlation two fourfold tables were made. In the one the division was made between *Delicate* and *Normally Healthy*, in the other between *Normally Healthy* and *Strong*. Theoretically the fourfold divisions ought to be made everywhere where possible, and the weighted mean taken of the results to smooth out irregularities, but the labour is too great for practical purposes, and we must content ourselves with a few simple divisions.

(B) *Eye Colour.*—Our division was into light, medium, dark. The eyes corresponding to these classes are stated in the general instructions. See Appendix IA. For practical purposes the scale is one of the intensity of yellow pigmentation.[1] In this case, remembering that " medium " is rather a vague class, the fourfold division was taken at each of the four corners of the medium-medium category and the mean correlation of the four resulting tables taken to represent the actual correlation in eye colour.

(C) *Hair Colour.*—This is a character concerning which we sadly need a combined investigation on the part of a physiologist, a chemist, and an anthropologist. In saying this, I am not forgetting the pioneer work of Mr. H. C. Sorby published in the *Journal* of this Institute.[2] I do not feel perfectly convinced that we have really got to the number of pigments involved. Even if we have, and there be just two, it by no means follows that our nomenclature enables us effectually to separate hair possessing these pigments in various degrees, still less to place in their right position in any scale the cases of blended pigments. Assume by way of illustration *only*, that there existed two pigments, black and red. We might by placing red at one end of the scale and black at the other, obtain a single scale which would really be a double one, *i.e.*, a scale of diminishing amounts of black pigment from one end, and of red from the other. In the one case the fairs are classed with red as marking an absence of black pigment and in the other case with the darks as marking an absence of red. Fourfold divisions of this table would then give the correlation between brethren either in the amount of red pigment or in the amount of black pigment. Unfortunately the observer comes across—besides a very deep red type of hair which seems to be pure red, and which shades, if enough individuals are taken, continuously away from " fair reds "—another red, a " dark red," which I found frequently described as " brown red " or " dark brown red," and which seems to be a blend of the red and dark pigments. The existence of these brown reds seems to me the difficulty of the single scale arrangement. It is on this account that some hair scale makers have placed the reds alongside the browns, but this appears to misplace the " fair reds " and " pure reds." I am at present working on the problem of a practical hair scale, and I am not at all certain that something corresponding to the

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[1] Blue is to be considered as an absence of pigmentation.

[2] *Journ. Anthr. Inst.*, vol. viii, 1878, pp. 1–14.

artist's conception of " value " is not what we want, if we are to use hair colour as a character for investigations about inheritance.   I merely refer to this method because I consider these hair colour results somewhat unsatisfactory and subject to revision and reclassification.   There is another point also to which I must refer.   I have found a distinct growth in children's hair colour with age.   This, of course, has been recognized in a general way, but our data supply, as soon as we have settled our scale, the quantitative measure of it.   Hence, exactly as in the case of head measurements, we ought really to allow for the growth change in hair before measuring the resemblance of brothers.   Allowance for this growth, to judge from the effect of growth in other cases, might easily change the value of the correlation by 10 to 15 per cent.   I hope to return to the problems of scale and growth in hair colour ; meanwhile I would describe what I have done.   The hair correlation tables have been worked out in four different ways, namely, by forming fourfold tables at each corner of the " brown-brown " category.   By doing this I have endeavoured to allow for the position of the red-browns, which were classified under reds, *i.e.*, whenever a division comes for the fourfold table between brown and dark, it is immaterial whether the reds are placed beyond the fairs, between fairs and browns, or between browns and darks.   The results given for hair are the means of the four correlations found by working out the tables in four different ways.   I believe on any system of " value "[1] my result will be approximately correct, but it would still need correction for growth, *i.e.*, a sensible darkening in the fifteen years of life covered by our observations.   On the whole, I publish the hair colour results with reservations.

(D) *Curliness of Hair.*—Our three categories were smooth, wavy, curly.   The results are the means of two computations, first with the division between smooth and wavy, and then with the division between wavy and curly.

(E) *Cephalic Index.*

(F) *Head Length.*

(G) *Head Breadth.*

(H) *Auricular Height.*

The method of investigating the degree of resemblance in these characters has been already referred to.   We may note that, in all cases, the order of intensity in resemblance is head breadth, auricular height and head length.   I confess to believing that some of this is due to greater difficulty in getting a true head length, than a true breadth or height, but I do not believe that this is the sole source of the divergence.   I shall touch on this subject on another occasion when I come to deal with growth of head in children, meanwhile I would say that it appears to me that a pause arises in the growth of head length which is not perceptible, or at least not so perceptible, in the case of the growth of breadth or height.   I should not be surprised to find that the on-coming of puberty affects the growth of head length differently from the growth of head breadth or height, and that a comparison for this character of brothers or sisters, one of whom has and the

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[1]   I hope shortly to be able to publish photographic measures of ." value " in hair-colour.

other of whom has not reached the age of puberty, may to some extent affect our results. This influence would not be fully allowed for by growth curves, as the age of puberty, especially in girls, seems to vary largely, even in members of the same family.

(I) *Athletic Power.*—While I have worked with only eight physical and eight mental characters, I have an additional character which it is needful to refer to here, and which it is difficult to class as purely physical. I mean athletic capacity. We may define the athletic individual as one not only keen on sports and games, but as capable in them. This denotes a training and a *mental control* of hand and eye, and approaches psychical efficiency.[1] It might therefore be a problem to determine in which class of characters the athletic should be placed. The results, however, of dealing with athletics are from the standpoint of inheritance abnormally high. An examination of the schedules led me at once to the conclusion that much of this resemblance was wholly spurious. Certain schools, boys' public schools and the larger girls' schools, pride themselves on an athletic reputation; hence two brothers or two sisters at such schools are usually returned as an athletic pair. On the other hand, schools without an athletic reputation are too liable to return the two members of a pair as non-athletic, the teachers having little or no knowledge of the game capacity of their pupils. Hence arises the high value of resemblance in athletic power between the members of a pair of brothers or a pair of sisters. This resemblance is largely, perhaps 40 to 50 per cent., a result of a differentiation between the class of schools in which athleticism is a cult and the class in which it is not—the town or board school with little play-ground and no game training.

To complete the demonstration of this conclusion we need only turn to the mixed schools, whence our brother-sister pairs are drawn. These schools do not exhibit the athletic cult on the same scale, and we get quite a fair and reasonable value for the resemblance of brothers and sisters in athletic power. To obtain the correlation the fourfold division was taken between the athletic and non-athletic.

Psychical Characters.

(J) *Vivacity.*

(K) *Assertiveness.*

(L) *Introspection.*

(M) *Popularity.*

(N) *Conscientiousness.*

In all these five psychical characters, our schedule admitted of only three possibilities, *i.e.*, the cross must be placed in the space allotted to either contrasted character, or on the dividing line between, marking a "betwixt and between" state of affairs. Our tables were prepared with a ninefold system of categories including a "betwixt" column and row. The "betwixts" were not, however, very

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[1] This is confirmed by the high correlations I have found to exist between athletic capacity and many psychical characters.

numerous, and they were then halved or quartered as the case might be into the adjacent groups to save the great labour of working with four fourfold tables and averaging the four results.

(O)   *Temper.*— Our categories were : *Quick-tempered, Good-natured,* and *Sullen,* with the usual system of " betwixts." In a very few instances sullen children were recorded who had occasional outbursts of quick-temper. In this classification accordingly, some of the like difficulties arise that we have noted in the case of hair-colour. To surmount these, first a division was made between quick temper and good temper, and the correlation found from the fourfold table thus reached. Secondly, the sullen were thrown in with the quick, and the whole classed as *Bad tempered* in contrast to *Good tempered.* In the first case we are measuring a certain phlegmatic character, in the second rather the extent of self-control. But the two divisions led to very sensibly the same results. Thus for girls we have the correlations :—

Division between Quick and Good temper : ·49.
Division into Good and Bad (Quick and Sullen) tempers : ·50.

The mean of the two results was then taken as a measure of correlation in the matter of temper.

(P)   *Ability.*—We have already (p. 196) discussed this character at some length. All that seems necessary to add is that the division for the fourfold table was taken between *Intelligent* and *Slow Intelligent.*

(Q)   *Handwriting.* Some persons may be inclined to question whether this character is properly placed in the psychical class. Is it really a largely muscular characteristic ? Personally I do not think it desirable to draw very rigid lines between the physical and psychical, and the present inquiry has much strengthened that opinion. But we have gone far further with handwriting than is obvious on the face of this paper, which is confined to inheritance ; and, without anticipating results yet to be published, I would say that, quite contrary to my expectation, very sensible correlations exist between the psychical characters and the handwriting, which on the other hand has only very moderate or zero correlations with the physical characters. In school children at any rate, temper, probity and assertiveness are all correlated with the character of the handwriting, and I have little hesitation myself therefore in including it with the psychical rather than the physical group.

These remarks on the individual characters dealt with may enable the reader to understand something of the method adopted in analysing our material. They will at any rate suggest that many points have been considered and investigated which cannot be even touched upon here, but which have aided us in our classifications and general treatment.[1]

[1] For example upwards of 120 correlations between physical characters, between psychical characters and between physical and psychical characters have been worked out, tending to throw right on the interrelationships of these supposed widely differentiated sides of the human character.

(iv.)   *Comparison of the Values found for the Inheritance of the Physical and Psychical Characters in Man.*

Thus far my whole object has been to describe the sources of my material, and to throw some light, perchance, on the new methods we have adopted in classification and computation. I have spent a considerable time over this latter topic, because to the anthropologist of the older school, the biometrician too often appears as a juggler in figures. It is impossible, perhaps, to help this at present, when the biometrician is introducing a new calculus, which cannot be learnt without hard work, and which cannot be handled without training. We are not endeavouring to discredit anthropology, but to furnish such branches of it as anthropometry and craniology with new tools—a little sharp-edged to the uninitiated who handle them incautiously—but which will raise anthropometry and craniology in the future into the category of the more exact sciences. Such must be my excuse for describing so fully, and yet, I fear, so ineffectually, the processes we have adopted. It is another point to ask you to admit that I came to this inquiry without prejudice. I expected *a priori* to find the home environment largely affecting the resemblance in moral qualities of brothers and sisters. I expected to find a spurious emphasis of the inheritance of the moral qualities owing to this environment. Putting any thought of prejudice on one side, accept for a moment

TABLE III.
Inheritance of the Physical Characters.
School Observations on Children.

Character.	Correlation.		
	Brothers.	Sisters.	Brother and Sister.
Health	·52	·51	·57
Eye Colour	·54	·52	·53
Hair „	·62	·57	·55
Hair Curliness	·50	·52	·52
Cephalic Index	·49	·54	·43
Head Length ..	·50	·43	·46
Head Breadth...	·59	·62	·54
Head Height ...	·55	·52	·49
Mean ...	·54	·53	·51
Athletic Power	·72	·75	·49

the methods adopted, and listen—regardless of the drummers—to the broad results of the inquiry.   You have in Table I (see p. 187) the mean of the resemblance in physical characters of brothers and sisters from my records of family measurements. You have in Table III the mean of the physical measurements of our school records—16 series in the first, 24 series in the latter.   I venture to say that remembering the possible slips in measurement and in classification, there is not the slightest doubt that those two series absolutely confirm each other, and give a mean degree of resemblance of nearly ·5 between children of the same parents for physical characters.   How much of that physical resemblance is due to home environment ?   You might at once assert that size of head and size of body are influenced by nurture, food, and exercise.   It is quite true ; even curliness may be subject to home influences.   But what is the broad effect of such environment on our coefficients of heredity ?   Can any possible home influence be brought to bear on cephalic index, on hair colour, or eye colour ?   I fancy not, and yet these characters are within broad lines inherited exactly like the quantities directly capable of being influenced by nurture and exercise.   I am compelled to conclude that the environmental influence on physical characters, however great in some cases, is not to the first approximation a great disturbing factor when we consider coefficients of fraternal resemblance in man.   I do not believe it to be at all comparable with the irregularities that arise from random sampling and occasional carelessness in measurement or in appreciation of character.

TABLE IV.

Inheritance of the Mental Characteristics.

School Observations on Children.

Character.	Correlation.		
	Brothers.	Sisters.	Brother and Sister.
Vivacity	·47	·43	·49
Assertiveness	·53	·44	·52
Introspection	·59	·47	·63
Popularity	·50	·57	·49
Conscientiousness	·59	·64	·63
Temper	·51	·49	·51
Ability	·46	·47	·44
Handwriting	·53	·56	·48
Mean	·52	·51	·52

Now turn to Table IV of the degree of resemblance in the mental and moral characters.. What we do find ? Perhaps slightly more irregularity in the values than in the case of the physical characters. The judgment required is much finer; and the classification is much rougher. Let me frankly admit the difficulties of the task, both for observers and computers. I will lay no weight whatever, if you like, on the second place of decimals. But what is the obvious conclusion ? Why, that the values of the co-efficient again cluster round ·5. If anything the average degree of resemblance for the psychical is rather less than for the physical, it certainly is not greater. Personally I would lay not a grain's weight on the difference.
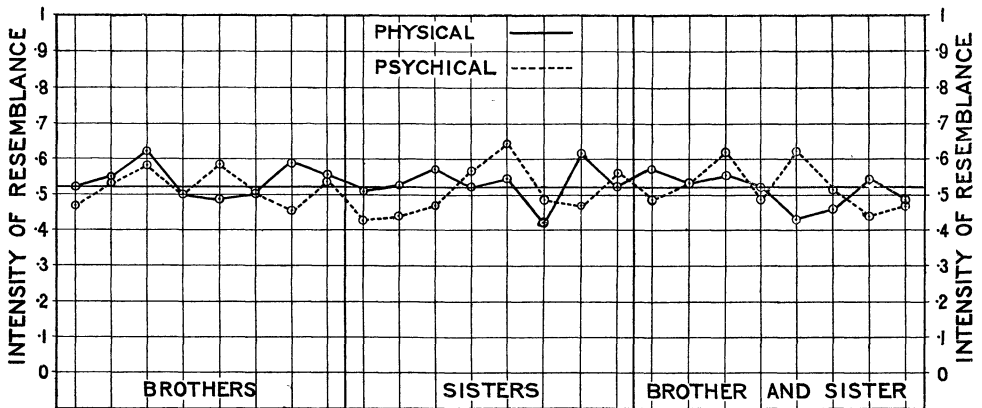
DIAGRAM XIII.—COMPARISON OF RESEMBLANCE FOR PHYSICAL AND PSYCHICAL CHARACTERS.

I have illustrated the whole result in Diagram XIII. The two lines representing physical and psychical qualities go bobbing up and down, and cutting and re-cutting one another. No wise man, however, would venture to assert that one or other is sensibly uppermost, or that any of those rises or falls have real significance. We are forced absolutely to the conclusion that the degree of resemblance of the physical and mental characters in children is one and the same.

It has been suggested that this resemblance in the psychical characters is compounded of two factors, inheritance on the one hand and training or environment on the other. If so, you must admit that inheritance and environment make up the resemblance in the physical characters. Now these two sorts of resemblance being of the same intensity, either the environmental influence.is the same in both cases, or it is not. If it is the same, we are forced to the conclusion that it is insensible, for it cannot influence eye colour. If it is not the same, then it would be a most marvellous thing, that with varying degrees of inheritance, some mysterious force always modifies the extent of home influence, until the resemblance of brothers or sisters is brought sensibly up to the same intensity ! Occam's razor will enable us at once to cut off such a theory.

We are forced, I think literally forced, to the general conclusion that the physical and psychical characters in man are inherited within broad lines in the same manner, and with the same intensity. The average home environment, the average parental influence is in itself part of the heritage of the stock and not an extraneous and additional factor emphasising the resemblance between children from the same home.

But we are not yet at the end of our conclusions. By assuming our normal distribution for the psychical characters we have found, not only self-consistent results—linear regression, for example, as in the case of the inheritance of intelligence, but we have found the *same* degree of resemblance between physical and psychical characters. That *sameness* surely involves something additional. *It involves a like heritage from parents.* The degree of resemblance between children and parents for the physical characters in man may be applied to the degree of resemblance between children and parents for psychical characters. We inherit our parents' tempers, our parents' conscientiousness, shyness and ability, even as we inherit their stature, forearm and span.

At what rate is that? I show you a table (*see* Table V), which represents our present knowledge of parental inheritance in man,[1] and in other species. I venture to say that—within broad lines—the physical characters are inherited at the same rate in man and in the lower forms of life. The resemblance of parent and offspring is again roughly ·5.

What conclusion flows upon us irresistibly from the inspection of such a table? Why, that the physical characters are not features, which differentiate man from

TABLE V.
Parental Inheritance in Different Species.

Species.	Character.	Mean value.	No. of pairs used.	Source.	Remarks.
Man	Stature	·506	4886	*Biometrika*, vol. ii, p. 358.	—
,, ...	Span	·459	4873	ditto.	—
,, ...	Forearm	·418	4866	ditto.	—
,, ...	Eye colour	·495	4000	*Phil. Trans.*, vol. 195, p. 106.	—
Horse	Coat colour	·522	4350	*Phil. Trans.*, vol. 195, p. 93.	—
Basset Hound ..	Coat colour	·524	823	*R. S. Proc.* vol. 66, p. 154.	Dams only used.
Greyhound	Coat colour	·507	9279	Unpublished data for two characters.	Dams and sires both used.
Aphis (*Hyalopterus Trirhodus*) ..	Right antenna / Frontal breadth	·439	368	*Biometrika*, vol. i, 139.	Ratios only taken to free from growth factor.
Daphnia *Magna* ..	Protopodite / Body length	·466	96	*R. S. Proc.*, vol. 65, 1899.	

[1] Taken from a memoir: "On the Laws of Inheritance in Man. I. Inheritance of the Physical Characters." *Biometrika*, vol. ii, p. 379.

the lower types of life.   If they are inherited like man's physical characters, if they are inherited even as the protopodite of the water flea, what reason is there for demanding a special evolution for man's mental and moral side ?   We look upon the universe and wonder.   The man of science probes a little deeper into nature than the ordinary mortal, but the deeper he probes, the greater his wonder, for the more complex and mysterious the universe appears.   Do you wish to draw the line of mystery at living forms ?   Look at the sky on a clear night, and realise that while astronomers have *described* the motions of a tiny corner of the universe, they have not the least explanation of how and why those motions are taking place.

Nay, take the least, apparently most inert particle of metal, and remember that if modern physical views are correct, millions, probably billions of small corpuscles are in relative motion within it, with a complexity and yet probably with an underlying order as great as in the starry universe, even if on a totally different scale.   Remember that we have scarcely touched the fringe of a description of those motions, and that their *why* is as inexplicable to us as the motions of the celestial bodies themselves.   Note all this, and ask yourselves if there be less mystery in the motions of non-living than of living things.   You may call a man who would link up the motion of living to non-living things a materialist.   But the materialist in no way lessens the endless mystery of the universe.   He knows not what matter is, why it moves, or how he comes to be conscious of its motion.   He is but fulfilling the task of science, the linking of mystery to mystery, by bringing them under one common wider conception of the ultimately inexplicable.   So it is when we pass from the lower living forms to man.   If we see that his physical development is closely allied to brute development, we link mystery to mystery in a common description—a law if you like—but it removes no grain of the ultimate mystery of why life is there, and why it develops.   Lastly, turning to the psychical character of man, to some the greatest of all mysteries, we link it up to the physical.   We see the man, not only physically, but morally and mentally, the product of a long line of ancestry.   We realise that evolution and selection play no greater, and play no less a part in the production of the psychical character than in the production of the physique of man.   Once fully realise that the psychic is inherited in the same way as the physical, and there is no room left to differentiate one from the other in the evolution of man.   Realise all this, and two mysteries have been linked into one mystery, but the total mystery is no less in magnitude, and no more explicable than it was before.   We know not why living forms vary, nor why either physical or psychical characters are inherited, nor wherefore the existence at all of living forms, and their subjection to the great principle of selective evolution.   We have learnt only a law common to the physical and the psychical ; we have not raised the one or debased the other, because in a world where the ultimate source of change is utterly inexplicable, whether you strive to perceive it through matter like a physicist, through the lower living forms like the biologist, or through man like the anthropologist, all terminology like

higher and lower is futile. Where the mystery is absolute in all cases, there can be no question of grade.

But I would not leave you with a mere general declaration that all is mystery, that scientific ignorance of the ultimate is profound. Rather I would emphasize what I have endeavoured to show you to-night, that the mission of science is not to explain but to bring all things, as far as we are able, under a common law. Science gives no real explanation, but provides comprehensive description. In the narrower field it has to study how its general conceptions bear on the comfort and happiness of man. Herein, I think, lies especially the coming function of anthropology. Anthropology has in the first place to study man, to discover the sequence of his evolution from his present comparative stages and from his past history. But it cannot halt here; it must suggest how those laws can be applied to render our own human society both more stable and more efficient. In this function it becomes at least the handmaiden of statecraft, if indeed it were not truer to call it the preceptor of statesmen.

If the conclusion we have reached to-night be substantially a true one, and for my part I cannot for a moment doubt that it is so, then what is its lesson for us as a community ? Why simply that geniality and probity and ability may be fostered indeed by home environment and by provision of good schools and well equipped institutions for research, but that their origin, like health and muscle, is deeper down than these things. They are bred and not created. That good stock breeds good stock is a commonplace of every farmer; that the strong man and woman have healthy children is widely recognized too. But we have left the moral and mental faculties as qualities for which we can provide amply by home environment and sound education.

It is the stock itself which makes its home environment, the education is of small service, unless it be applied to an intelligent race of men.

Our traders declare that we are no match for Germans and Americans. Our men of science run about two continents and proclaim the glory of foreign universities and the crying need for technical instruction. Our politicians catch the general apprehension and rush to heroic remedies. Looking round impassionately from the calm atmosphere of anthropology, I fear there really does exist a lack of leaders of the highest intelligence, in science, in the arts, in trade, even in politics. I do seem to see a want of intelligence in the British merchant, in the British professional man and in the British workman. But I do not think the remedy lies solely in adopting foreign methods of instruction or in the spread of technical education. I believe we have a paucity, just now, of the better intelligences to guide us, and of the moderate intelligences to be successfully guided. The only account we can give of this on the basis of the result we have reached to-night is that we are ceasing as a nation to breed intelligence as we did fifty to a hundred years ago. The mentally better stock in the nation is not reproducing itself at the same rate as it did of old ; the less able, and the less energetic, are more fertile than the better stocks. No scheme of wider or more

thorough education will bring up in the scale of intelligence hereditary weakness to the level of hereditary strength. The only remedy, if one be possible at all, is to alter the relative fertility of the good and the bad stocks in the community. Let us have a census of the effective size of families among the intellectual classes now and a comparison with the effective size of families in the like classes in the first half of last century. You will, I feel certain, find, as in the case of recent like censuses in America, that the intellectual classes are now scarcely reproducing their own numbers, and are very far from keeping pace with the total growth of the nation. Compare in another such census the fertility of the more intelligent working man with that of the uneducated hand labourer. You will, I again feel certain, find that grave changes have taken place in relative fertility during the last forty years. We stand, I venture to think, at the commencement of an epoch, which will be marked by a great dearth of ability. If the views I have put before you to-night be even approximately correct, the remedy lies beyond the reach of revised educational systems ; we have failed to realize that the psychical characters, which are, in the modern struggle of nations, the backbone of a state, are not manufactured by home and school and college ; they are bred in the bone ; and for the last forty years the intellectual classes of the nation, enervated by wealth or by love of pleasure, or following an erroneous standard of life, have ceased to give us in due proportion the men we want to carry on the ever-growing work of our empire, to battle in the fore-rank of the ever intensified struggle of nations.

Do not let me close with too gloomy a note. I do not merely state our lack. I have striven by a study of the inheritance of the mental and moral characters in man to see how it arises, and to know the real source of an evil is half-way to finding a remedy. That remedy lies first in getting the intellectual section of our nation to realize that intelligence can be aided and be trained, but no training or education can *create* it. You must breed it, that is the broad result for state-craft which flows from the equality in inheritance of the psychical and the physical characters in man.

APPENDIX 1A.

GENERAL DIRECTIONS FOR FILLING UP DATA PAPERS OF COLLATERAL HEREDITY.[1]

1.   The object of this investigation is two-fold :
    (i)   To ascertain the degree of resemblance, mental and physical, between children of the same parents.
    (ii)   To discover, if possible, whether there is any relationship between the external shape of the head and a teacher's estimate of the general grade of ability of the pupil.

Co-operators are warned *ab initio* that no inferences whatever can be drawn from individual instances or from a small series of measurements.   The numerical quantities to be determined are small, and it is only when large masses of observations have been collected from many quarters and have been reduced that reliable inferences can be drawn.

2.   The measurements and estimates are to be made on :
    (i) Pairs of brothers (white data paper).
    (ii) Pairs of sisters (pink data paper).
    (iii) Pairs of brothers and sisters (blue data paper).

Care must be taken that the right coloured data paper is selected.

The names of the measured are only required in case there should be need for the verification of any entry, and they will be treated as strictly confidential.   Initials, in fact, may be used where it seems desirable, if the observer keeps a key to them for the purpose of reference should reference be required.

The observer should have known *well* both members of the pair measured for at least six months, and, if possible, for a much longer period.   The classification is purposely made rather wide and indefinite in order that there may be less hesitation in classifying.   What is needed is the general impression of a teacher who has carefully observed his or her pupils.

For both physique and ability it is very desirable that the observer should consult, where it is possible, one or more colleagues before filling up the data paper.

To give some confidence in the scales adopted, I may remark that in response to my appeal in the *Journal of Education*, I received details of some 150 boys and girls tested for ability by three observers independently (language, science, and mathematical teachers) and belonging to half-a-dozen different schools.   The agreement in classification was complete in more than 80 per cent. of cases, and only differed by as much as two classes in about five per cent. of cases.[2]   This degree of accordance is sufficient for the present statistical purposes.

3. I.   *Physique.*   In making the record, attention should be paid not only to appearance, energy, and athletic qualities, but to irregularity of attendances owing to ill-health, frequency of visits to school-infirmary, etc.

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[1] The quantitative laws of heredity, such as we have reached at present, do not apply to individual cases, but only to the averages of large numbers.   It is important to insist on this, because more than one of my helpers on hearing the results of a particular research has seemed disappointed, remarking that the law does not hold for the family X or the brothers Y.

[2] Even this amount of divergence would probably have disappeared after a consultation with regard to the individuals classified.

II.   *Ability.* (a)   Some account of this scale will be found in the *Journal of Education* for September, 1898, which it might be well for the observer to examine. The following may help to show the significance of the terms :

Very Dull. Capable of holding in their minds only the simplest facts, and incapable of perceiving or reasoning about the relationship between facts.

Slow Dull. Capable of perceiving relationship between facts in some few fields with long and continuous effort ; but not generally, or without much external assistance.

Slow. Very slow progress generally, but with time and continual care progress will be made.

Slow Intelligent. Slow generally, although possibly more rapid in certain fields. Quite sure of knowledge when once acquired.

Intelligent. Ready to grasp and capable of perceiving facts in most fields ; capable of good progress without much effort.

Quick Intelligent. Very bright and quick both in perception and in acquirement, and this not only of customary, but of novel, facts. Ready to reason rightly about things on purely self-initiative.

Inaccurate-Erratic. Capable of perceiving facts, but quick to form erroneous conclusions about them, illogical and erratic in reasoning.

(b)   *Handwriting.* If possible, in addition to this classification, get the pair under investigation to write the last lines of Lord Macaulay's *Lay of Horatius*, with their own signatures on the back of the data paper.

(c)   *Work.* If the individual be good at several subjects, put a cross against all these in the first row ; as well as the strongest subject in the next row ; if the individual be good at none, make no entry in the first row, but only in the second row, where *best at* must be interpreted in this case as *least bad at*. The individual should be asked his favourite subject and favourite game. Mathematics covers Arithmetic and Geometry ; Descriptive Science includes Botany, Experimental Physics, Physiography, etc.

III.   *Head Measurements.* These are to be made with the head-spanner, full directions for the use of which are given in its case.

IV.   *Hair.* Comment seems unnecessary.

V.   *Eyes.* Light covers blue of all shades, light grey, very light green ; medium covers dark grey, green, light chestnut, orange and grey combined ; dark covers dark chestnut, light and dark brown, black.

VI.   *Relative Characters.* This entry is needful for the numerical reduction of the statistics in those cases in which both brothers have been given the *same* class, otherwise no use should be made of it.

If the characteristic be equally strong in both, write equal, instead of putting a cross.

VII.   If the alternative characteristics are neither possessed in a marked degree, place the cross on the dividing line.

VIII.   *General Remarks.* Under this heading it may be useful *occasionally* to note any marked physical or mental characteristic of the pair. Care should, however, be taken not to lay greater stress on points of resemblance than on points of diversity.

4.   It is most desirable that the head-spanners should not be kept longer than four to six weeks, in order that they may be sent on as rapidly as possible to other schools. They should be returned with the stamped and addressed labels. Any school anthropometrical laboratory desiring to procure a head-spanner of the present pattern, can do so at a cost of 19s. 6d., from the Cambridge Scientific Instrument Company, Carlyle Road, Cambridge.

The spanners need to be carefully handled. Should any part be broken or lost the box with the spanner should be returned at once, in order that it may be repaired without delay and again sent out for use.

Any special inquiries should be addressed to me, at University College, London.

<div align="right">KARL PEARSON.</div>

Appendix Ib.

Data Paper for Collateral Heredity Investigations.

B.   SISTER-SISTER SERIES.
(Whole, not half sisters.)

No. in whole series.
(Not to be filled in.)

Please return this Paper to Professor KARL PEARSON, F.R.S., University College, London.

School :

Observer :

Date :

No. in School Series

Place a cross against the class of each sister under as many headings as possible, except under III and VIII.   Please read first the General Directions.

	ELDER SISTER.	YOUNGER SISTER.
Name		
Age		
District of Home		

I.   Physique :

	Very Strong.	Strong.	Normally Healthy.	Rather Delicate.	Very Delicate.	Athletic.	Non-Athletic.
Elder Sister ...							
Younger Sister ...							

II.   Ability : (a) *General Scale.*

	Quick Intelligent.	Intelligent.	Slow Intelligent.	Slow.	Slow Dull.	Very Dull.	Inaccurate-Erratic.
Elder Sister ...							
Younger Sister ...							

(b) Handwriting : (See Back.)

	Very Good.	Good.	Moderate.	Poor.	Bad.	Very Bad.
Elder Sister ...						
Younger Sister ...						

(c) Work :

		Classics.	Modern Languages.	History.	Mathematics.	Descriptive Science.	Drawing.	Singing, Music.
Elder Sister ...	Good at ...							
	Best at ...							
	Likes best							
Younger Sister	Good at ...							
	Best at ...							
	Likes best							

(d) Games or Pastimes :

	ELDER SISTER.	YOUNGER SISTER.
Likes ...		
Good at ...		

III.   Head Measurements.:

	Length.	Breadth.	Height.	a.	b.	c.	(a), (b), (c), Indices (not to be filled in).
Elder Sister ...							
Younger Sister ...							

IV.   Hair :

	Red.	Fair.	Brown.	Dark.	Jet Black.	Smooth.	Wavy.	Curly.
Elder Sister ...								
Younger Sister ...								

V.   Eyes :

	Light.	Medium.	Dark.
Elder Sister ...			
Younger Sister ...			

VI.   Relative Capabilities :   This is *only* to be filled in in those cases wherein the two sisters fall into the *same* class.

	Physique, stronger in	More Athletic.	Ability, greater in	Handwriting, better in	Hair, darker in	Eyes, darker in
Elder Sister ...						
Younger Sister ...						

VII.   Character, etc. :

	Noisy.	Quiet.	Self-conscious.	Unself-conscious.	Self-assertive.	Shy.	Conscientiousness. Keen.	Dull.	Popular.	Unpopular.	Temper. Quick.	Good-natured.	Sullen.
Elder Sister ...													
Younger Sister ...													

VIII.   General Remarks.   Add here any striking features of resemblance or dissimilarity in the sisters.

Elder Sister ...

Younger Sister ...

[On the back of the Schedule spaces were arranged for samples of the handwriting.]

Appendix II.

Observers and Schools contributing to the Data upon which this Memoir is based.

Aberdeen, A. N. Meldrum ; Ferry Hill Public School, J. D. Anderson. *Aberuthven* School, J. M. S. Math. *Acocks Green,* Wellesbourne House School, O. Sunderland. *Aldenham* School, F. B. Stead. *Alresford,* Swanaton School, W. L. W. Eyre. *Barnard Castle,* County School, F. Hodson. *Bakewell,* Lady Manner's School, H. Martin. *Berwick,* Berwickshire High School, H. S. Mabbatt. *Birmingham,* King Edward's School, F. M. McCarthy ; King Edward's School, C. J. Wood ; King Edward's School for Girls, M. J. Nimmo and A. L. Parmenter. *Bradford-on-Avon,* Winsley and Turley National School, Alice E. Griffiths. *Bridgend,* County School, W. A. Whittan. *Bridgewater,* St. John's School, E. M. Lucas. *Brighton,* Brighton and Hove High School for Girls, R. Mayhew. *Bristol,* Two-Mile Hill Board School, A. F. Bateman. *Buckhurst Hill,* Oakfield School, E. Linder. *Burghead* Public School, M. Brenner. *Burnley,* Higher Grade and Science School, F. H. Hibber. *Cardenden,* Craigderran School, David Rorie. *Cardiff,* Eleanor Street Boys' School, A. C. Badcoe ; Intermediate School for Boys, A. Abbatt. *Carlisle,* High School for Girls, A. Beavor and G. Whiting. *Caterham,* Congregational School, F. W. G. Foat. *Cheltenham,* Ladies' College, Catherine E. Berridge. *Chesterfield,* Hipper Street School, S. Steel. *Clacton-on-Sea,* Clacton College, H. Picton. *Clapham,* High School for Girls, M. Cave and Mrs. Woodhouse. *Congleton,* St. James' School, W. F. Warburton. *Cork,* High School for Girls, H. A. Martin. *Darlington,* Bowes School, D. L. Smith. *Dereham,* Swanton Morley National School, J. Lewton Brain. *Dewsbury* Grammar School, G. Rowland. *Dulwich,* Alleyn's School, J. V. H. Coates ; Dulwich College, H. Brereton Baker ; Dulwich Village Evening Continuation School, C. T. Hunt. *Dollar* Public School, J. Begg. *Dundee,* Monikie School, P. Grant. *Durham* School, J. T. Johnson. *Duffus* Public School, J. W. Garrigall. *Epsom,* The College, S. R. Browne. *Ferry Hill,* Bishopton School, T. G. Frankton. *Edinburgh,* Fettes College, C. J. N. Fleming and W. I. Sargent. *Fochaber,* Speymouth Public School, A. Geddie. *Folkestone,* Sidney Street Board School, J. A. Hugill. *Glossop,* Arundel School, R. H. Dickinson. *Grangemouth,* Grange Higher Grade Science School, F. W. Maryon. *Grantham,* North Raunceby Church School, A. W. M. Drew and W. H. Baily. *Great Ayton,* Friends' School, F. R. Arundel. *Guernsey,* Island of (many schools), E. W. Adair and S. Butler. *Halifax* Higher Board School, W. Dycke. *Harrogate,* Western Board School, J. W. Hammond. *Haslemere,* Fernhurst Board School, H. Watts. *Hassocks,* Clayton School, L. H. Beecher-Shand. *Handsworth,* Grammar School, S. R. Hart. *Haywards Heath,* National Schools, A. J. Mouncher. *Hinckley,* Elementary School, O. C. Hirst. *Hornsey,* Board School, J. C. Hudson. *Huntley,* Corse Public School, A. C. Rathway. *Ilkeley,* Grammar School, F. T. Cramphorn. *Isle of Wight,* Chorley School, G. E. Jeans. *Keighley,* Kiedwich School, T. Appleby. *Keswick,* Keswick School, S. Horton Barnard. *Landewednack,* Board School, J. Carwardine. *Leek,* High School, T. L. Warrington. *Leighton Buzzard,* Linslade School, G. F. Andrill. *Lerwick,* Widows' Asylum, J. Allen. *Leyton,* Elementary School, F. J. Chittenden ; Technical Institute, H. Hills. *Lisburn,* Ulster Provincial School, W. D. Braithwaite. *Llandebie* School, T. Mathews. *Liverpool,* High School for Girls, E. Canning ; Liverpool Institute, W. S. Saul. *Londonderry,* Fahan School, W. A. Dickson. *Lyme Regis,* National School, J. Radford. *London,* University College School, J. L. Paton and Staff ; Whitechapel Road Foundation School, F. Dixon ; Priory Grove Board School, W. R. Suddeley ; Fernhead Road School, J. C. Bedwell ; Goswell Road, St. Thomas', Charterhouse, W. W. Woodward ; New Southgate, High School, J. Fairquire ; Chelsea, Cook's Ground Board School, D. H. Hodge ; Walworth, Michael Faraday School, T. M. Upfield ; Titchborne Street, St. John's Girls' School, A. McGilhvray ; Radnor Street Wesleyan School, J. W. Parkinson ; Fernham Street Girls' Board School, S. Carter ; Dulwich, High School for Girls, M. Barwell ; Highbury, High School for Girls, M. Minasi ; Notting Hill, High School for Girls, T. F. Grünbaum ;

Camden Town, North London Collegiate School for Girls, S. Bryant; Limehouse, St. Anne's Schools, C. J. Carter; Hampstead, Soldiers' Daughters' Home, C. D. Fawcett; Morley College, J. Denton; Notting Hill School, M. M. Adamson; Limehouse, Higher Grade Board Schools, Thomas Street, J. Crabtree; Old Charton Girls' School, A. Baker; Hampstead, King Alfred's School, J. Russell; Christ's Hospital, C. E. Browne.   *Manchester*, Hulme Grammar School, C. H. Crombie; High School for Girls, C. Coignou; Withington, Lady Barn House School, C. Herford. *Mansfield*, Brunt's Technical School, C. E. Stacey.   *Margate*, New Cross Street Board School, E. Parker.   *Markinch*, Star Public School, Wm. McLachlan.   *Marston Green*, Cottage Homes, W. J. Rees.   *Merthyr Tydfil* School, M. J. Swift.   *Milford Haven* County School, L. Jones.   *Morpeth*, Netherwitton Board School, J. Anderson.   *Newark*, Beacon Hill School, W. A. Greames.   *Newbury* School, C. Cecil Fry; Donnington School, Mrs. Bell.   *Newcastle-on-Tyne*, Central High School for Girls and other schools, E. W. N. Williams.   *Newton Stewart*, Ewart High School, C. S. Dougall.   *Norwich*, Angel Road Board School, B. H. Barber.   *Nottingham*, Berridge Road Girls' Board School, A. N. Stone; Morley House, B. Smith; Waverley School, H. T. Facon.   *Oxford*, High School for Girls, E. Macdonald; Abbey Road School, Miss Sheppard.   *Pembroke Dock*, County School, G. W. West.   *Pemberton*, St. John's Schools, J. T. Milward.   *Peterborough*, Fitzwilliam School, G. E. Holmes.   *Peterhead* Academy, J. Don. *Petersfield*, Bedales School, T. J. Garstang.   *Pinner*, Woodridings School, Z. Haes.   *Polperro* School, F. H. Perry-Coste.   *Pontefract*, Ackworth School, G. E. Bell.   *Pontypridd*, Wesleyan School, W. H. Rees.   Mill Street Higher School, J. Farr.   *Portsmouth*, High School for Girls, M. M. Adamson.   *Pwlheli*, County School, J. W. Evans.   *Reigate*, Church High School, E. E. Ardington.   *Richmond* (Surrey), County School, A. E. Buckhurst; Richmond Hill School, H. D. Greig.   *Royston*, Littlington School, W. C. Whitehead.   *Saffron Walden*, Friends' School, E. W. Sawdon.   *St. Leonards-on-Sea*, Silverhill Girls' School, E. H. Woodd.   *Sheffield*, West-bourne School, Miss Sims.   *Shrewsbury*, Criggian School, R. Brack; Murivane High School for Girls, G. M. Wise.   *South Shields* School, R. Sanderson.   *Southwold*, St. Felix School, C. M. Sant.   *Spennymore* School, H. Askew.   *Spilsby*, Spendleby School, A. Teare.   *Stranraer*, Ardwell School, D. Thomson.   *Swansea* Grammar School, E. H. Tripp.   *Sydenham* School, R. Lulham. *Taunton*, King's College, E. B. Vincent.   *Tavistock*, Kelly College, P. L. Andrews.   *Tottenham* High School, L. F. Ushendoor.   *Upholland* Grammar School, D. L. Rennard.   *Warrington*, Penketh School, W. E. Brown.   *Wellington* College, G. E. Blundell and H. P. Fitzgerald. *West Ham*, Castor House Board School, R. Symes.   *Whitehaven*, Girls' School, W. Blackmore. *Winchester* College, W. B. Croft.   *Wimbledon*, High School for Girls, Miss Knight.   *Windlesham* Board School, J. Simms.   *Winscombe*, Sicot School, B. Lean.   *Woodford*, Wanstead College, J. B. Martin.   *Wragby* School, T. Dixon-Spain.   *York*, High School for Girls, M. Leader. *Yeovil*, Kington School, E. H. Davison.   *Yiewsley*, St. Mathew's Schools, J. J. Wade. *Ystalyfera*, County School, A. B. Gully; and other schools.

APPENDIX III.—DETAILED TABLES.

I. PHYSICAL CHARACTERS.

HEALTH.

A (i).   *Brother-Brother.*

First Brother.

	Very strong.	Strong.	Normally healthy.	Rather delicate.	Very delicate.	Totals.
Very strong	24	31	11·5	4	—	70·5
Strong	31	342	163·75	65·75	3	605·5
Normally healthy	11·5	163·75	588·5	137·25	6	907
Rather delicate	4	65·75	137·25	95	11	313
Very delicate	—	3	6	11	2	22
Totals	70·5	605·5	907	313	22	1918

(Second Brother.)

A (ii).   *Sister-Sister.*

First Sister.

	Very strong.	Strong.	Normally healthy.	Rather delicate.	Very delicate.	Totals.
Very strong....	44·5	38·5	17·5	8·5	—	109
Strong	38·5	306·5	154·5	74	5	578·5
Normally healthy	17·5	154·5	411	201·5	19	803·5
Rather delicate	8·5	74	201·5	166	28·5	478·5
Very delicate	—	5	19	28·5	15	67·5
Totals	109	578·5	803·5	478·5	67·5	2037

(Second Sister.)

A (iii).   *Brother-Sister.*

Brother.

	Very strong.	Strong.	Normally healthy.	Rather delicate.	Very delicate.	Totals.
Very strong	46	15	7	4	--	72
Strong	35	174·5	64	22·5	1	297
Normally healthy	17	85·25	191·75	50·5	3	347·5
Rather delicate	9	34·25	69·75	48	3	164
Very delicate	1	2	1	2·5	6	12·5
Totals	108	311	333·5	127·5	13	893

(Sister.)

Q 2

EYE COLOUR.

B (i).   *Brother-Brother.*

First Brother.

Second Brother.		Light.	Medium.	Dark.	Totals.
Light		558	190	81·5	829·5
Medium		190	426·5	122	738·5
Dark		81·5	122	228·5	432
Totals....		829·5	738·5	432	2000

B (ii).   *Sister-Sister.*

First Sister.

Second Sister.		Light.	Medium.	Dark.	Totals.
Light		438·5	196·5	71·5	706·5
Medium		196·5	598	136	930·5
Dark		71·5	136	257·5	465
Totals....		706·5	930·5	465	2102

B (iii.)   *Brother-Sister.*

Brother.

Sister.		Light.	Medium.	Dark.	Totals.
Light		206·5	66·5	33	306
Medium		86	208·25	46·25	340·5
Dark		28	53·25	104·25	185·5
Totals....		320·5	328	183·5	832

HAIR COLOUR.

C (i).   *Brother-Brother.*

First Brother.

	Red.	Fair.	Brown.	Dark.	Jet black.	Totals.
Red	30·5	23	16	12	—	81·5
Fair	23	416	158	67·75	·25	665
Brown	16	158	394	98·25	8·25	674·5
Dark....	12	67·75	98·25	328·5	19	525·5
Jet black	—	·25	8·25	19	10	37·5
Totals	81·5	665	674·5	525·5	37·5	1984

(left side: **Second Brother.**)

C (ii).   *Sister-Sister.*

First Sister.

	Red.	Fair.	Brown.	Dark.	Jet black.	Totals.
Red	31	22	19	14	1	87
Fair	22	474	195·5	47·5	—	739
Brown	19	195·5	474	162·5	4·5	855·5
Dark....	14	47·5	162·5	206	6·5	436·5
Jet black	1	—	4·5	6·5	4	16
Totals	87	739	855·5	436·5	16	2134

(left side: **Second Sister.**)

C (iii).   *Brother-Sister.*

Brother.

	Red.	Fair.	Brown.	Dark.	Jet black.	Totals.
Red	12	9·5	12·5	5	—	39
Fair	10·5	198·5	73	29·5	—	311·5
Brown	4	72	138·5	57	3	274·5
Dark....	5	32·5	52·5	91	10	191
Jet black	—	1	3	4	5	13
Totals	31·5	313·5	279·5	186·5	18	829

(left side: **Sister.**)

CURLINESS OF HAIR.

D (i).   *Brother-Brother.*

First Brother.

	Smooth.	Wavy.	Curly.	Totals.
Smooth	1556·5	111·5	34·5	1702·5
Wavy	111·5	134·5	20	266
Curly	34·5	20	11	65·5
Totals....	1702·5	266	65·5	2034

(Row label: Second Brother.)

D (ii).   *Sister-Sister.*

First Sister.

	Smooth.	Wavy.	Curly.	Totals.
Smooth	937·5	190·5	98	1226
Wavy	190·5	213·5	52	456
Curly	98	52	76	226
Totals....	1,226	456	226	1908

(Row label: Second Sister.)

D (iii).   *Brother-Sister.*

Brother.

	Smooth.	Wavy.	Curly.	Totals.
Smooth	395·5	24	12	431·5
Wavy	106·5	33	11	150·5
Curly	49	11	17	77
Totals....	551	68	40	659

(Row label: Sister.)

E (i). Cephalic Index. Brother-Brother.

First Brother / Second Brother.

First Brother \ Second Brother	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	81—82	82—83	83—84	84—85	85—86	86—87	87—88	88—89	89—90	90—91	91—92	Totals
67—68	1	1	1																							3
68—69		1	1																							2
69—70	2	1	1	2	1	1																				8
70—71		1	1	2	2	1	1																			8
71—72	1	2	2	2	2	5	2	4	2	1	1	1	1													26
72—73	1	2	2	2	3	1	3	2	2	1	3	1														23
73—74	1	2	3	6	5	7	10	7	3	2	1	1	1													49
74—75	1	2	1	5	6	11	8	11	13	7	6	1	3	1	1	1										78
75—76		2	1	5	3	7	11	16	18	24·5	34	15	5	4	8	2	1									156·5
76—77			2	2	10	8	18	20	24	40·5	23	17	6	6	1	2	2									181·5
77—78				4	2	7	11	24·5	24	38	39	27·5	19·5	13	10	10	3	3	1							236·5
78—79					2	1	3	13	34	40·5	39	50	36·5	25·5	20	12	6	6	2	2	1					293·5
79—80							3	2	7	15	23	27·5	36·5	34	23	21	14·5	12	1	3	3	1	1			227·5
80—81					1	1	1	6	5	17	19·5	25·5	23	26	24	8·5	15	4	4	1						181·5
81—82					1	1	1	1	4	6	13	20	21	24	26	17	8	9	2	1	1					156
82—83							1	1	3	8	6	10	12	14·5	8·5	17	10	15	15	5	2	1	1			130
83—84										1	1	2	1	10	6	12	15	8	15	8·5	6·5	3	4			93
84—85										1	1	2	3	6	1	4	9	15	6·5	4·5	3	1	1			58
85—86													1	3	2	3	4	2	5	3	3	2	1	1	1	31
86—87																2	2	3	1	2	4	1	1	4	3	23
87—88																			1	1	1	1	3			7
88—89																				1	1	1	1			4
89—90																					1	1	1	1		4
90—91														1												1
91—92																						1				1
Totals	3	2	8	8	26	23	49	78	156·5	181·5	236·5	293·5	227·5	181·5	156	130	93	58	31	23	7	4	4	1	1	1982

E (ii).

Cephalic Index.   Sister-Sister.

First Sister.

This is a bivariate correlation table. The column headings (First Sister cephalic index, read along the bottom) and the row headings (Second Sister cephalic index) are paired with marginal totals.

Second Sister (index range)	Total
91·5—92·5	3·5
90·5—91·5	1·5
89·5—90·5	1
88·5—89·5	2
87·5—88·5	5
86·5—87·5	6·5
85·5—86·5	22
84·5—85·5	41·5
83·5—84·5	52
82·5—83·5	87
81·5—82·5	159
80·5—81·5	166
79·5—80·5	205
78·5—79·5	231
77·5—78·5	226
76·5—77·5	190·5
75·5—76·5	161·5
74·5—75·5	96·5
73·5—74·5	68·5
72·5—73·5	59·5
71·5—72·5	50
70·5—71·5	21
69·5—70·5	28·5
68·5—69·5	12
67·5—68·5	5
66·5—67·5	9
65·5—66·5	6
64·5—65·5	4
63·5—64·5	8
62·5—63·5	7

First Sister (index range) marginal totals, read along bottom:

First Sister (index range)	Total
62·5—63·5	7
63·5—64·5	8
64·5—65·5	4
65·5—66·5	6
66·5—67·5	9
67·5—68·5	5
68·5—69·5	12
69·5—70·5	28·5
70·5—71·5	21
71·5—72·5	50
72·5—73·5	59·5
73·5—74·5	68·5
74·5—75·5	96·5
75·5—76·5	161·5
76·5—77·5	190·5
77·5—78·5	226
78·5—79·5	231
79·5—80·5	205
80·5—81·5	166
81·5—82·5	159
82·5—83·5	87
83·5—84·5	52
84·5—85·5	41·5
85·5—86·5	22
86·5—87·5	6·5
87·5—88·5	5
88·5—89·5	2
89·5—90·5	1
90·5—91·5	1·5
91·5—92·5	3·5

Totals ... 1936

Second Sister.

E (iii).

Cephalic Index.   Brother-Sister.

Brother.

Sister.	Totals.	90—91	89—90	88—89	87—88	86—87	85—86	84—85	83—84	82—83	81—82	80—81	79—80	78—79	77—78	76—77	75—76	74—75	73—74	72—73	71—72	70—71
68—69	1																·5	·5				
69—70	2															1						
70—71	3·5													2	·5		1					
71—72	11·5													·5	1	3		2	1	1	1	
72—73	13										2	1		1·5	1·5	3	3		1	2		1
73—74	14									2			4		2	·5	1	3	4	·5	1·5	
74—75	36							·5	1	1·5	1·5	2	6·25	4	3	7	2	4	4·5	·5	2·5	
75—76	51						1	·5		1	3	5	10	8·25	4	7	4	3	4·5	4·5	1	·5
76—77	70						1		1·5	3·5	3·25	9	3·25	8·75	9	11·25	6·5	5	2·5	1·5	1	·5
77—78	74·5				1	1	1		3	4·5	5·5	6·75	4·25	14·5	14·5	12	7·75	6·5	4	2·5		1
78—79	106·5				1	1	2	1	6	5·5	7	12·25	10	14	16·5	10·5	13·5	1·5	2			1
79—80	84							2	2·5	4·5	10·5	9	13·25	18·5	10	5·5	7·5	1·5	3·5	1		
80—81	81·5				1	1	1	3	3·5	6	3·5	12·25	6·75	14		2·5	5	1	1			
81—82	54					1	·5	3	3·5	2	6	9·25	1·75	8	9·5	3·5	2	1·5	3			
82—83	42						·5	3	2		7·5	4·5	4·75	7·25	6·5	3·5	2	2	1·5			
83—84	36	1				1		2		·5	3·5	2	4·5	2·75	1·5	3·5	3	1·5	1·5			
84—85	22				1					3	2	2	1	1·5	4	·5	2·5					
85—86	11						·5				4	4			1		1					
86—87	9·5		·5	1				·5	1	·5						1						
87—88	3		·5	1								1				1						
88—89	2															1						
89—90	4			1					1	1			1		1							
Totals ...	732	1	1	3	4	5	8·5	18·5	27·5	37·5	61·5	76·5	81	105·5	83	73	61	30·5	31	11	7	5

Sister.

F (i).

Head Length reduced to 12 years. Brother-Brother.

Second Brother ＼ First Brother	205·5	203·5	201·5	199·5	197·5	195·5	193·5	191·5	189·5	187·5	185·5	183·5	181·5	179·5	177·9	175·5	173·5	171·5	169·5	167·5	165·5	163·5	Totals
163·5															1	·5		1·5	1	·5	·5	1	2
165·5															1	3	4	4	2	1	1	1	2·5
167·5													1		·5	4·5	5·5	5·5	1·5	1	1		4
169·5											·5	2	5	1	4	5·5	2	4·5	4	·5			24
171·5											1·5	2	6	1	9·5	7	5·5	9·5	3	·5			44
173·5									1	2	3	6·5	18·5	2	15·5	5	15·5	2	4	·5			53·5
175·5								1	3·75	3	3	16·5	21	12	5	12	2·5	5	1				90·5
177·5						1	2·5	1	4·25	1·5	7·5	20·5	25	24	17	18·5	6	3	1				150
179·5			1			1·5	1	4·5	4·5	4·25	10·75	29	24	32	24	16·5	6·5	3	2				186
181·5					1	·5	4·5	5·5	12·25	8	28·5	42·5	42·5	25	21	7·5	3	1	1·5				230
183·5			1·5		1	2	5·5	17·75	19·75	15	24·75	53·5	24·75	29	20·5	4·25	1·5	1	2				295·5
185·5			1·5		1	2	7·25	16·75	23·25	24·75	35	35	24·75	28·5	10·75	3·75	1·5	1					238·5
187·5			·5		2·5	4·5	13	24	23·75	35·5	28·5	35·5	12·25	15	8	1		1					217·5
189·5		1		2·5	2	4·5	15·5	17·75	33	31	31	19·75	17·75	4·5	4·25	·5							189·5
191·5				1·5	2	6·5	9·75	26·75	26·75	28	23·25	16·75	4·5	5·5	4·5	1							166
193·5	1			·5	7	9·75	16	23	15·5	23·75	24	5·5	2	1	2·5								89
195·5	1		1	4	4	10·75	4·5	9·75	9·75	17·75	7·25	4·5	1	2	1								61·5
197·5	1	1	1	2	6	4·5	6	10·75	7	13	4·5	2·5	1	1									38
199·5			1	3·5	5·5	5	3·5	4	4	6·5	2	2·5											18·5
201·5			1	2·5	3	5·5		2	1	2	1·5	1											8·5
203·5				·5	·5	2·5				·5	1												2
205·5					1·5	1	1	1		1	1												3
Totals	3	2	8·5	18·5	38	61·5	89	166	189·5	217·5	238·5	295·5	230	186	150	90·5	53·5	44	24	4	2·5	2	2114

F (ii).

Head Length reduced to 12 years.   Sister-Sister.

First Sister.

Second Sister \ First Sister	159·5	161·5	163·5	165·5	167·5	169·5	171·5	173·5	175·5	177·5	179·5	181·5	183·5	185·5	187·5	189·5	191·5	193·5	195·5	197·5	199·5	201·5	203·5	Totals
159·5										1														3
161·5					1					4														2
163·5					2·5	3	2	4		10														3
165·5	1			5	2	3·5	2	10·25	4	3	3			1										27·5
167·5				2·5	3·5	5	4	9·25	7·5	13·5	2		1	·5										40·5
169·5	2	1		3	4	8·25	8·25	11	3	22·5	5·5	1	2·5	1										53·5
171·5				2	7·5	10·25	21·5	17	8·5	34	10·5	1	5	·5						1				102
173·5				4	10	3	9·25	22·5	17	25	19	3	7·5	5	1									128
175·5				4	2	3	8·5	19	38	33·5	24·5	5·5	11	5·5	3·5	1				1				179
177·5				3	1	5·5	13·5	10·5	34	38·5	33·5	10·5	6·5	5·5	1	1·5			1					244·5
179·5				1	1	3	10·5	11	24·5	28	41	18	28	15	4·5	6			5					255
181·5				2·5	1	5	5·5	5·5	18	15	36·5	38·5	31	20	4·5	4·5	1	1	2·5					239·5
183·5				·5	1	·5	7·5	4·5	6·5	7	31	36·5	32·5	18·5	7	6·5	1·5	1	6					223·5
185·5		1	1			3·5	5	1·5	5·5	4·5	20	33	26	28·5	19	3·5	·5	·5	3·5					174
187·5							1	·5	4·5	3	19	32·5	28·5	23	24	10·5	3	2		3				150
189·5		1	1				1·5	·5	6	1	6·5	18·5	23·5	19	23·5	16	1	1			1			86
191·5							1	1	2		1	24	10·5	16	19	12·25	6	3			2			37
193·5			1				1				1	3·5	5	4·5	15	15·5	5	2·5	1			1		22
195·5											1	6	2·5	2·5	12·25	5·25	4·5	2·5	1				·5	21
197·5												3	2·5	6	5·25	2·5	5·25	2				·5		6
199·5												5		1	3·5	1	5·25	2·5						3
201·5														1	3		2	2						1·5
203·5															2		2	·5						·5
Totals	3	2	3	27·5	40·5	53·5	102	128	179	244·5	255	239·5	223·5	174	150	86	37	22	21	6	3	1·5	·5	2002

Second Sister.

F (iii).

Head Length reduced to 12 years.   Brother-Sister.

Brother.

Sister \ Brother	159·5	161·5	163·5	165·5	167·5	169·5	171·5	173·5	175·5	177·5	179·5	181·5	183·5	185·5	187·5	189·5	191·5	193·5	195·5	197·5	Totals
163·5					1																1
165·5	1	·5	·5	1	1	2	2														8
167·5		·5	·5	1		1															3
169·5			1·75	·25	2	·5	1	·5	1												7
171·5			1·75	2·25	4	3·5	2	2·5	1	2	1	1	1								22
173·5	1	1	2	3	3·5	5	1	5	4	1·5	2										31
175·5	1	1		2	4·5	4·5	6·5	3	5	·5	1	1	1	1							32
177·5	1	1	1		4·5	4·75	5·75	7·5	10	3·5	5	5	1	1							52
179·5		1	1	1·5	2·5	1·75	7·75	12·5	16	9·25	5·75	6·5	4·5	1	1	1					73
181·5		1		3·5	4	1·5	9	16	11	18·25	8·25	7·75	1·75	1	2	1	1				86
183·5			1	4	2	4·5	8	15·5	13	15·5	16·25	9·5	2·75	2·75	2·75	1		1	1		100·5
185·5				3	4	5	9·25	10·75	22	14·75	14·25	12·5	3·75	4·25	1	1	1	1			110·5
187·5				2	4·5	4	6·75	11·75	9	10·5	9·5	11	5·5	2	2						79·5
189·5			3	1	2·5	6	12	9	11	14·5	9	10	1·5	3	1	2					85·5
191·5	1	2·5	5	2	2·5	1·5	5	3·5	6	4	1	1	·5								35·5
193·5		·5	2·5	4·5	4	1·25	5·25	4	3	4	2·5	·5									32
195·5			3	·25	2·75	3	1·5	1	2·5	1											15
197·5			·5	1	·5	1·5	1·5	1	4	·5	1										11·5
199·5				1		1	1·5	1	1·5	·5	·5										7
201·5																					0
203·5							1											1			2
205·5										1											1
Totals	3·5	4	2·5	13·5	22·5	28	36	59·5	92·5	101	109	80	86	58·5	37·5	25	19·5	5·5	7	4	795

Sister.

G (i)

Head Breadth reduced to 12 years. Brother-Brother.

First Brother (rows) × Second Brother (columns).

First \ Second	122·5	124·5	126·5	128·5	130·5	132·5	134·5	136·5	138·5	140·5	142·5	144·5	146·5	148·5	150·5	152·5	154·5	156·5	158·5	160·5	Totals
122·5						1															1
124·5																					0
126·5									1												1
128·5				2		2	1	1		2											8
130·5			1		10		1	6		2		1	1								22
132·5				2		4	3	9	2	4		1	1								26
134·5	1		1	1	3	6	5	9	7	4	3	2	2	1	2						47
136·5			1	6	9	5	4	17	11	10	9	9	2	2	1						86
138·5				2	9	17	14	23	23	18	6	5	4	4	1	1					127
140·5				2	2	4	7	11	23	46	35	36·5	27·5	22	10	1	1				228
142·5						4	10	23	35	36	45	35·5	32	15	8	2	2				247·5
144·5					1	1	3	9	18	36·5	45	50	39·5	33	23·25	13·25	4·5	·5		1	279
146·5					1	1	2	9	6	27·5	35·5	39·5	44	43	29·75	28·25	7·5				274
148·5							2	2	5	22	32	33	43	66	37·5	21·5	20	5		1	290
150·5							1	2	4	10	15	23·25	29·75	37·5	36	23·5	8·5	10·5	5	1	207
152·5							2	1	4	1	8	13·25	28·25	21·5	23·5	14	11·5	6·5	2	1	137·5
154·5									1	1	2	4·5	7·5	20	8·5	11·5	8	3		4	71
156·5									1		2		·5		5	10·5	6·5	3	2	5	35·5
158·5												·5			5	2		5	4	3	19·5
160·5												1		1	1	1	4		3	2	13
Totals	1	0	1	8	22	26	47	86	127	228	247·5	279	274	290	207	137·5	71	35·5	19·5	13	2120

G (ii).

Head Breadth reduced to 12 years. Sister-Sister.

First Sister.

Second Sister	113·5	115·5	117·5	119·5	121·5	123·5	125·5	127·5	129·5	131·5	133·5	135·5	137·5	139·5	141·5	143·5	145·5	147·5	149·5	151·5	153·5	155·5	157·5	159·5	161·5	Totals.
113·5				1																						1·5
115·5				1					·5																	3·5
117·5			1	1						1	1															4·5
119·5			1		1		1			·5	2·5	·5														15
121·5		1	1	1	1	1	·5		1	4·5	1·5	·75														12·5
123·5		1		1	4	1	4	2·5	1	1	1·5	3·25	2	2												12
125·5				1	1	1	3·5	3·5	5	2	2·5	3·5	·25	1												18·5
127·5	1	1	·5		1	·5	1	1	6	4	7·5	8·75	2·25	4·5	2											20
129·5	·5	1	1	1	2	2·5	2	4	7·5	6	11·5	9·75	4	9	5·5											47
131·5		·5	1	2	2·5	2·5	1·5	2·5	3·5	16	9·75	13·5	7·75	9·75	11·75	5·5	1									88·5
133·5		1		1		1·5	·75	3·25	4	12	15·25	21·5	15·25	21·75	9·75	8	2·5									99
135·5				1			·25	2·25	4·5	8·75	9·75	21·75	21·5	36·5	27·5	15·5	3·5	1·5								117·5
137·5			·5			2	2	1	2	7·75	11·75	9·75	61	34	41	23·75	1	1·5	1							217
139·5						2	1		2·5	9	8	15·5	36·5	41	41·5	38·5	5	3	2	·5						239
141·5								2	1·5	5·5	1	5	27·75	38·5	41·75	41·75	8·5	4	·5	·5						250·5
143·5									1	5·5	2	3	23·75	17·5	28·5	50	17·5	19	1·5	1	2	1				268
145·5										3·5	·5	·5	8·5	19	25	28	28·5	25	2·5	1	15·75	6·25	2·25	1·25	1	174
147·5										1·5		·5	4	2·5	10·5	31·5	28	31·5	10·5	2	11	6	1·25	·25		152
149·5													1·5	1	2	16·25	23	29	16·25	4·25	11	6	4·5	6	·5	81
151·5													1	1	·5	4·25	29	18	15·75	6·25	6	4·5	1	3	·5	30·5
153·5																2	15·75	11	11	6	6	3	1	·5	1	19
155·5																1	6·25	6	6	4·5	1·25	·5	·5	·5		3·5
157·5																	2·25	1·25	4·5	1	1	2				3
159·5																	1·25	·25	6	3	1	1				2
161·5																	1		·5	·5	1					1
Totals	1·5	3·5	4·5	15	12·5	12	18·5	20	47	88·5	99	117·5	217	239	250·5	268	174	152	81	30·5	19	3·5	3	2	1	1880

Second Sister.

G (iii).
Head Breadth reduced to 12 years.   Brother-Sister.

Sister \ Brother	122·5	124·5	126·5	128·5	130·5	132·5	134·5	136·5	138·5	140·5	142·5	144·5	146·5	148·5	150·5	152·5	154·5	156·5	158·5	160·5	Totals
121·5								1													1
123·5																					0
125·5	1			3		1		1	2												9
127·5	1			1	1	1	1	1													6·5
129·5				1				3		2·5			1					1			18·5
131·5				·5		1	5·5	2·5	·5	7·5	1	2·5	2	·5							29·5
133·5				1	·5	3	1·5	6·5	1·5	6	·5	4	1	2·5		1	1				43
135·5					1	1	9	11	5	7·5	7·5	1·5	3	3					1		61
137·5					·5		4	2·5	9	15·5	8·5	9·5	8·5	2		1		1			93
139·5				1			4·5	5·5	9·5	15·5	15	12	8	11·5	2	2	1·5	1			105·5
141·5				·5	1·5		2·5	3·5	8·5	12·5	23	19·5	17	4·5	6·25	4·25	·5		1	1	111·5
143·5								·5	7·5	7·5	21	22	13·5	10	11·25	4·25	2·5	3	4		89
145·5					1·5				8	2	10·5	5	9	18	10·5	5	4	2			76·5
147·5						1	2		5	·5	8	6	14	11	11·5	7·5	4·5	2	·5	1	60·5
149·5									1		3·5	4	6·5	14·5	13	5	5		1·5		28
151·5									3	1	1	2	4	7·25	4·25	2·5	1				15
153·5												2·5	2	1·25	3·25	·5	2			1	7
155·5										1		·5	1		1·5	2	1				2·5
157·5												1			·5	·5					·5
159·5										1						·5					1·5
Totals …	2	0	0	8	6	8	30	40	61·5	91·5	99·5	92	90·5	86	64	36	23	10	8	3	759

H (i).

Head Height reduced to 12 years.   Brother–Brother.

First Brother.

Second Brother	146·5	144·5	142·5	140·5	138·5	136·5	134·5	132·5	130·5	128·5	126·5	124·5	122·5	120·5	118·5	116·5	114·5	112·5	110·5	108·5	106·5	104·5	Totals
104·5															1			·5	1	·5	·5		·5
106·5													·5	·5	·5	1		2	·5	·5	1		2·5
108·5													·5	3·5	1·5	2		2	·5	1	1	·5	4
110·5											1	1	4·25	3·5	1	2	·5	1	2	·5			11·5
112·5									1		1	4·25	8	3	4·25	8·75	2	3·5	1·5	·5			11·5
114·5								1	·5	1	1	8	16·25	10·5	14·25	8·5	8·75	·5	3·5	1			31
116·5					·5		1	1·5	4	1	5	17·25	20·75	17	17	14·25	4·25	1	·5				82·5
118·5					·5		·5	3	8	6	15	20·75	20·5	11	17	10·5	3	1	1				125·5
120·5					1	1	1·5	6·5	9·25	7	18·5	26	26	20·75	16·25	8	4·25		1				144·5
122·5					·5	1·25	4·25	8·5	13·25	13·75	28·5	33	28·5	20·75	17·25	5	4·25						181·5
124·5				3·5	·5	6	3·5	13	20·25	20	39·5	39·5	20	18·5	15	6	1						233
126·5				1·5	1·5	3·75	10·25	26·75	37	31	40	31	13·25	13·75	7	4	·5						274
128·5			1	2	2·5	3	14·75	26·75	31·25	37·5	37·5	20·25	8·5	9·25	8	1·5	1						236·5
130·5			1	2·5	3·5	14	12·75	30·75	48	27	37	13	3·5	6·5	3	·5	1						253·5
132·5			2	5·5	11·5	13	16·75	23	30·75	31·25	26·75	10·25	6	4·25	1·5	1	·5						185·5
134·5	1		1·5	7·5	7·25	11·75	14·75	14·75	16·75	26·75	14·75	3·75	·5	1·25	1	·5							119
136·5		2	1·5	5·5	8·25	12·25	10·5	11·75	13	12·75	3	1·5	3·5	·5									89·5
138·5		1	1·5	6·5	5·5	9	12·25	7·25	11·57	14	2·5	1·5	1										58
140·5	1	2	·5	3·5	7	5·5	8·25	7·5	5·5	3·5	2	2											43
142·5		1·25	1·25	3	3·5	6·5	5·5	1·5	1·5	2·5	1												15·5
144·5		1·25	3·25	1	3·25	1·25	·5	1		1·5													8·5
146·5	1	1	2	1	1·25	1·25	2	1	2														3
Totals	3	8·5	15·5	43	58	89·5	119	185·5	253·5	236·5	274	233	181·5	144·5	125·5	82·5	31	11·5	11·5	4	2·5	·5	2114

Second Brother.

H (ii).

Head Height reduced to 12 years.   Sister-Sister.

First Sister.

First Sister ↓ / Second Sister →	104·5	106·5	108·5	110·5	112·5	114·5	116·5	118·5	120·5	122·5	124·5	126·5	128·5	130·5	132·5	134·5	136·5	138·5	140·5	142·5	144·5	146·5	Totals.
146·5													1										1
144·5											1			1			1	2		1			6
142·5									2		1	1	1	1	1	1	2		1				11
140·5									2	1	1	2	2	4	3		3		2	2			22
138·5							1	1			4	4		1	1	3		2	3	1			21
136·5							2	3	3	5	2	3	3	2	3	6		1	1	1			34
134·5						2	1	3	7	2	5	9	7	11	5	12	3	3	3	1			74
132·5						2	3	1	2	7	8·5	14	11	11	10	5	2	1	4	1		1	83·5
130·5			1				1	6	14	11	13·5	12·5	19	12	11	11	3	1	2	1	1		120
128·5		1					2	10	11	21	22·5	21·5	38	19	11	7	3		1				168
126·5		1	1	1	1	3	3	14	23	23	29·5	28	21·5	12·5	14	9	2	4	2				191·5
124·5		1		1	5	7	13·5	17·5	20·5	37·5	35	29·5	22·5	13·5	8·5	5	5	4	1				227
122·5				3	4·5	11	9	27	41·5	31	37·5	23	21	11	7	2	3		1	2	1		235·5
120·5	1	2	3	3·5	4·5	8·5	11·5	19	32	41·5	20·5	23	11	14	2	7	3		2				209
118·5	1		3	4·5	4	12	9·5	9	19	27	17·5	14	10	6	1	3	2	1					143·5
116·5		5	6·5	3	16	20	9·5	11·5	9	13·5	3	3	2	1	3	1		1					105
114·5	3	2	8	8	10	16	12	8·5	11	7	3		2	2									92·5
112·5		2		2	8	3	4	4·5	4·5	5	1												34
110·5			6		8	6·5	4·5	3·5	3	1	1												33·5
108·5	1	6		2	2	5	3	3		1		1											24
106·5		1			3		2		1		1												8
104·5								1	1														2
Totals																							**1846**

Second Sister.

H (iii).

Head Height reduced to 12 years.   Brother-Sister.

Brother. / Sister.

Brother \ Sister	106·5	108·5	110·5	112·5	114·5	116·5	118·5	120·5	122·5	124·5	126·5	128·5	130·5	132·5	134·5	136·5	138·5	140·5	142·5	144·5	Totals
152·5						1															1
150·5																					0
148·5												1									1
146·5													·5								·5
144·5											·5		·5	1	2·5						4·5
142·5										1	1·5	2	1	·5	2·5	2	1	1	2		14·5
140·5									1	1	3	2·5	1	7	2·5	1·5	1	2			22·5
138·5											2·5	·5	2	·5	1	2	1	4·5	3		19
136·5										1	4	6	3	6	5·5	3	1	·5			30
134·5									1	1	4	7·5	2	5	3	5	2	1·5	1		33
132·5								1	5	2·5	4	5	12	12·5	7·5	7	6	1	1	1	65·5
130·5								3	4	11·5	10·5	14	16	15·5	9	6·5	5	1	1	1	98
128·5					1	·5	5	6	8	11	10	12	12	10	4·5	6	1	1			88
126·5					3·5	4·5	3	5·5	12	16	21	10·5	6	3·5	3	2·5					91
124·5	1	1	2	2·25	3·75	5	11·5	13	11	13·5	4·5	3	3·5	4	1·5	1					81·5
122·5			1	2	6·75	2·25	6	8	13·5	11·5	6·5	1	2	1							61·5
120·5			4·5	5	6	5	9·5	13·5	8	4·5	2	1	1	1							61
118·5		1	·5	1·5	2	4	3	5·5	8	3·5	3										32
116·5		2	·5	3	4·5	3·5	3	2	2	1	1										22·5
114·5		1	3·5	4	1	2	2·5	1	1												16
112·5	1	1	1	1·5		·5	1	2	1						1						10
110·5		1		2	1		·5	·5													5
108·5	1		1		1																3
106·5		1		1	1																3
Totals	2	4	9	15	27·5	33·5	50	69·5	103·5	106	101	85	52	42	34	10	12	2	4	2	764

ATHLETIC CAPACITY.

I (i).   *Brother-Brother.*

First Brother.

Second Brother.		Athletic.	Betwixt.	Non-athletic.	Totals.
Athletic	....	906	20	140	1066
Betwixt	....	20	76	9	105
Non-athletic	....	140	9	370	519
Totals	....	1066	105	519	1690

I (ii).   *Sister-Sister.*

First Sister.

Second Sister.		Athletic.	Betwixt.	Non-athletic.	Totals.
Athletic	....	638	15	153	806
Betwixt	....	15	16	11	42
Non-athletic	....	153	11	452	616
Totals	....	806	42	616	1464

I (iii).   *Brother-Sister.*

Brother.

Sister.		Athletic.	Betwixt.	Non-athletic.	Totals.
Athletic	....	195	5	43	243
Betwixt	....	5	2	2	9
Non-athletic	....	91	5	86	182
Totals	....	291	12	131	434

R 2

II. PSYCHICAL CHARACTERS. DETAILED TABLES.

VIVACITY.

J (i).   *Brother-Brother.*

First Brother.

	Quiet.	Noisy.	Totals.
Quiet	917	292·5	1209 5
Noisy	292·5	350	6J2·5
Totals	1209·5	642·5	1852

Second Brother.

J (ii).   *Sister-Sister.*

First Sister.

	Quiet.	Noisy.	Totals.
Quiet	1013	349	1362
Noisy	349	393	742
Totals	1362	742	·2104

Second Sister.

J (iii).   *Brother-Sister.*

Brother.

	Quiet.	Noisy.	Totals.
Quiet	360·25	164·25	524·5
Noisy	79·25	148·25	227·5
Totals	439·5	312·5	752

Sister.

ASSERTIVENESS.

K (i). *Brother-Brother.*

First Brother.

Second Brother.		Shy.	Self-assertive.	Totals.
	Shy	679	247	926
	Self-assertive	247	399	646
	Totals	926	646	1572

K (ii). *Sister-Sister.*

First Sister.

Second Sister.		Shy.	Self-assertive.	Totals.
	Shy	672	296	968
	Self-assertive	296	436	732
	Totals	968	732	1700

K (iii). *Brother-Sister.*

Brother.

Sister.		Shy.	Self-assertive.	Totals.
	Shy	241	114	355
	Self-assertive	70·5	147·5	218
	Totals	311·5	261·5	573

L (i).   INTROSPECTION.

Brother-Brother.

First Brother.

	Self-conscious.	Unself-conscious.	Totals.
Self-conscious	600	245	845
Unself-conscious ...	245	550	795
Totals	845	795	1640

Second Brother.

L (ii).   *Sister-Sister.*

First Sister.

	Self-conscious.	Unself-conscious.	Totals.
Self-conscious	561	302·5	863·5
Unself-conscious ...	302·5	588	890·5
Totals	863·5	890·5	1754

Second Sister.

L (iii).   *Brother-Sister.*

Brother.

	Self-conscious.	Unself-conscious.	Totals.
Self-conscious	126·25	210·25	336·5
Unself-conscious ...	253·75	66·75	320·5
Totals	380	277	657

Sister.

POPULARITY.

M (i). *Brother-Brother.*

First Brother.

Second Brother		Popular.	Unpopular.	Totals.
	Popular...	1107·5	185·5	1293
	Unpopular	185·5	147·5	333
	Totals	1293	333	1626

M (ii). *Sister-Sister.*

First Sister.

Second Sister		Popular.	Unpopular.	Totals.
	Popular...	1133·5	182·5	1316
	Unpopular	182·5	175·5	358
	Totals	1316	358	1674

M (iii). *Brother-Sister.*

Brother.

Sister		Popular.	Unpopular.	Totals.
	Popular...	432·75	54·25	487
	Unpopular	40·75	26·25	67
	Totals	473·5	80·5	554

Conscientiousness.

N (i).   *Brother-Brother.*

First Brother.

		Keen.	Dull.	Totals.
Keen		970	216·5	1186·5
Dull		216·5	287	503·5
Totals		1186·5	503·5	1690

Second Brother. (row label)

N (iii).   *Sister-Sister.*

First Sister.

		Keen.	Dull.	Totals.
Keen		1071·5	201	1272·5
Dull		201	278·5	479·5
Totals		1272·5	479·5	1752

Second Sister. (row label)

N (iii).   *Brother-Sister.*

Brother.

		Keen.	Dull.	Totals.
Keen		366·75	122·75	489·5
Dull		59·75	136·75	196·5
Totals		426·5	259·5	686

Sister. (row label)

TEMPER.

O (i).   *Brother-Brother.*

First Brother.

	Quick.	Good-natured.	Sullen.	Totals.
Quick	138·5	152·25	39·75	330·5
Good-natured ...	152·25	1026·5	106·25	1285
Sullen	39·75	106·25	84·5	230·5
Totals	330·5	1285	230·5	1846

Second Brother.

O (ii).   *Sister-Sister.*

First Sister.

	Quick.	Good-natured.	Sullen.	Totals.
Quick	198	177	77	452
Good-natured ...	177	996	165	1338
Sullen	77	165	120	362
Totals	452	1338	362	2152

Second Sister.

O (iii).   *Brother-Sister.*

Brother.

	Quick.	Good-natured.	Sullen.	Totals.
Quick	60	45·5	10	115·5
Good-natured ...	68·75	388	43·75	500·5
Sullen	13·25	56·5	18·25	88
Totals	142	490	72	704

Sister.

ABILITY.

P (i).   *Brother-Brother.*

First Brother.

	Quick-intelligent.	Intelligent.	Slow-intelligent.	Slow.	Slow-dull.	Very dull.	Totals.
Quick-intelligent	88	62·25	42·25	11	2	2	207·5
Intelligent	62·25	313·5	183·75	72·5	9·5	1	642·5
Slow-intelligent	42·25	183·75	255·5	73	22·5	8	585
Slow	11	72·5	73	97·5	39	4	297
Slow-dull....	2	9·5	22·5	39	28	7	108
Very dull.... ...	2	1	8	4	7	6	28
Totals	207·5	642·5	585	297	108	28	1868

Second Brother.

P (ii).   *Sister-Sister*

First Sister.

	Quick-intelligent.	Intelligent.	Slow-intelligent.	Slow.	Slow-dull.	Very dull.	Totals.
Quick-intelligent	118	111	49·5	14	7	1	300·5
Intelligent	111	326	213	47	10	5	712
Slow-intelligent ...	49·5	213	204	99·5	30	9	605
Slow	14	47	99·5	64	29	7	260·5
Slow-dull.... ..	7	10	30	29	22	5	103
Very dull....	1	5	9	7	5	6	33
Totals....	300·5	712	605	260·5	103	33	2014

Second Sister.

P (iii).   *Brother-Sister.*

Brother.

	Quick-intelligent.	Intelligent.	Slow-intelligent.	Slow.	Slow-dull.	Very dull.	Totals.
Quick-intelligent	53	39	23	8	5·25	·25	128·5
Intelligent	51	118·5	90	25	11·75	5·75	302
Slow-intelligent ..	17	77·5	119	39	15	5	272·5
Slow	7	28	38	29	7	1	110
Slow-dull....	2	5	5	5	9	5	31
Very dull....	1	3	5	—	1	6	16
Totals....	131	271	280	106	49	23	860

Sister.

HANDWRITING.

Q (i). *Brother-Brother.*

First Brother.

	Very good.	Good.	Moderate.	Poor.	Bad.	Very bad.	Totals.
Very good	52	51	27·5	3	1	---	134·5
Good	51	335	224·5	32	4	1	647·5
Moderate	27·5	224·5	406	101·5	15·5	2	777
Poor	3	32	101·5	96	15	2	249 5
Bad	1	4	15·5	15	7	1	43·5
Very bad	—	1	2	2	1	4	10
Totals	134·5	647·5	777	249·5	43·5	10	1862

(Second Brother down the left margin)

Q (ii). *Sister-Sister.*

First Sister.

	Very good.	Good.	Moderate.	Poor.	Bad.	Very bad.	Totals.
Very good ...	50	29	23	5	—	---	107
Good	29	334	170	36·5	6	—	575·5
Moderate	23	170	300	90·5	17	5	605·5
Poor	5	36·5	90·5	68	14	—	214
Bad	—	6	17	14	10	4	51
Very bad	---	—	5	—	4	4	13
Totals	107	575·5	605·5	214	51	13	1566

(Second Sister down the left margin)

Q (iii) *Brother and Sister.*

Brother.

	Very good.	Good.	Moderate.	Poor.	Bad.	Very bad.	Totals.
Very good	15	13	7	3	—	—	38
Good	27	146·5	106·75	31·75	1	—	313
Moderate	9	74	140·25	42·75	—	1	274
Poor	-—	13	40	31	4	2	90
Bad	—	2	5	2	2	—	11
Very bad	---	—	1	—	1	—	2
Totals	51	248·5	300	110·5	15	3	728

(Sister down the left margin)