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INQUIRIES *into*
HUMAN FACULTY
AND ITS
DEVELOPMENT
by Francis GALTON

F.R.S



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PREFACE TO THE SECOND EDITION

AFTER some years had passed subsequent to the publication of this book in 1883, its publishers, Messrs. Macmillan, informed me that the demand for it just, but only just warranted a revised issue. I shrank from the great trouble of bringing it up to date because it, or rather many of my memoirs out of which it was built up, had become starting-points for elaborate investigations both in England and in America, to which it would be difficult and very laborious to do justice in a brief compass. So the question of a Second Edition was then entirely dropped. Since that time the book has by no means ceased to live, for it continues to be quoted from and sought for, but is obtainable only with difficulty, and at much more than its original cost, at sales of second-hand books. Moreover, it became the starting-point of that recent movement in favour of National Eugenics (see note p. 24 in first edition) which is recognised by the University of London, and has its home in University College.

Having received a proposal to republish the book in its present convenient and inexpensive form, I gladly accepted it, having first sought and received an obliging assurance from Messrs. Macmillan that they would waive all their claims to the contrary in my favour.

The following small changes are made in this edition. The illustrations are for the most part reduced in size to suit the smaller form of the volume, the lettering of the composites is rearranged, and the coloured illustration is reproduced as closely as circumstances permit. Two chapters are omitted, on "Theocratic Intervention" and on the "Objective Efficacy of Prayer." The earlier part of the latter was too much abbreviated from the original memoir in the *Fortnightly Review*, 1872, and gives, as I now perceive, a somewhat inexact impression of its object, which was to investigate certain views then thought orthodox, but which are growing obsolete. I could not reinsert these omissions

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now with advantage, unless considerable additions were made to the references, thus giving more appearance of personal controversy to the memoirs than is desirable. After all, the omission of these two chapters, in which I find nothing to recant, improves, as I am told, the general balance of the book.

FRANCIS GALTON.

LIST OF WORKS.

The Telotype: a printing Electric Telegraph, 1850; The Narrative of an Explorer in Tropical South Africa, 1853, in "Minerva Library of Famous Books," 1889; Notes on Modern Geography (Cambridge Essays, 1855, etc.); Arts of Campaigning: an Inaugural Lecture delivered at Aldershot, 1855; The Art of Travel, or Shifts and Contrivances available in Wild Countries, 1855, 1856, 1860 (1859); fourth edition, recast and enlarged, 1867, 1872; Vacation Tourists and Notes on Travel, 1861, 1862, 1864; Meteorographica, or Methods of Mapping the Weather, 1863; Hereditary Genius: an Enquiry into its Laws and Consequences, 1869; English Men of Science: their Nature and Nurture, 1874; Address to the Anthropological Departments of the British Association (Plymouth, 1877); Generic Images: with Autotype Illustrations (from the Proceedings of the Royal Institution), 1879; Inquiries into Human Faculty and its Development, 1883; Record of Family Faculties, 1884; Natural Inheritance, 1889; Finger-Prints, 1892; Decipherments of Blurred Finger-Prints (supplementary chapters to former work), 1893; Finger-Print Directories, 1895; Introduction to Life of W. Cotton Oswell, 1900; Index to Achievements of Near Kinsfolk of some of the Fellows of the Royal Society, 1904; Eugenics: its Definition, Scope, and Aims (Sociological Society Papers, vols. I. and II.), 1905; Noteworthy Families (Modern Science); And many papers in the Proceedings of the Royal Society, Journals of the Geographical Society and the Anthropological Institute, the Reports of the British Association, the Philosophical Magazine, and Nature.

Galton also edited Hints to Travellers, 1878; Life-History Album (British Medical Association), 1884, second edition, 1902; Biometrika (edited in consultation with F. G. and W. F. R. Weldon), 1901, etc.; and under his direction was designed a Descriptive List of Anthropometric Apparatus, etc., 1887.

LIST OF MEMOIRS.

The following Memoirs by the author have been freely made use of in the following pages:—

1863: The First Steps towards the Domestication of Animals (*Journal of Ethnological Society*); 1871: Gregariousness in Cattle and in Men (*Macmillan's Magazine*); 1872: Statistical Inquiries into the Efficacy of Prayer (*Fortnightly Review*); 1873: Relative Supplies from Town and Country Families to the Population of

Future Generations (*Journal of Statistical Society*); Hereditary Improvement (*Fraser's Magazine*); Africa for the Chinese (*Times*, June 6); 1875: Statistics by Intercomparison (*Philosophical Magazine*); Twins, as a Criterion of the Relative Power of Nature and Nurture (*Fraser's Magazine*, and *Journal of Anthropological Institute*); 1876: Whistles for Determining the Upper Limits of Audible Sound (*S. Kensington Conferences*, in connection with the Loan Exhibition of Scientific Instruments, p. 61); 1877: Presidential Address to the Anthropological Department of the British Association at Plymouth (*Report of British Association*); 1878: Composite Portraits (*Nature*, May 23, and *Journal of Anthropological Institute*); 1879: Psychometric Experiments (*Nineteenth Century*, and *Brain*, part vi.); Generic Images (*Nineteenth Century*; *Proceedings of Royal Institution*, with plates); Geometric Mean in Vital and Social Statistics (*Proceedings of Royal Society*); 1880: Visualised Numerals (*Nature*, Jan. 15 and March 25, and *Journal of Anthropological Institute*); Mental Imagery (*Fortnightly Review*; *Mind*); 1881: Visions of Sane Persons (*Fortnightly Review*, and *Proceedings of Royal Institution*); Composite Portraiture (*Journal of Photographical Society of Great Britain*, June 24); 1882: Physiognomy of Phthisis (*Guy's Hospital Reports*, vol. xxv.); Photographic Chronicles from Childhood to Age (*Fortnightly Review*); The Anthropometric Laboratory (*Fortnightly Review*); 1883: Some Apparatus for Testing the Delicacy of the Muscular and other Senses (*Journal of Anthropological Institute*, 1883, etc.).

Memoirs in Eugenics.

1901: Huxley Lecture, Anthropological Institute (*Nature*, Nov. 1901); Smithsonian Report for 1901 (*Washington*, p. 523); 1904: Eugenics, its Definition, Scope and Aims (Sociological Paper, vol. i., *Sociological Institute*); 1905: Restrictions in Marriage, Studies in National Eugenics, Eugenics as a Factor in Religion (Sociological Papers, vol. ii.); 1907: Herbert Spencer Lecture, University of Oxford, on Probability the Foundation of Eugenics.

The following books by the author have been referred or alluded to in the following pages:—

1853: Narrative of an Explorer in Tropical South-Western Africa (*Murray*); 1854: Art of Travel (several subsequent editions, the last in 1872, *Murray*); 1869: Hereditary Genius, its Laws and Consequences (*Macmillan*); 1874: English Men of Science, their Nature and their Nurture (*Macmillan*).

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INQUIRIES INTO HUMAN FACULTY

INTRODUCTION.

SINCE the publication of my work on *Hereditary Genius* in 1869, I have written numerous memoirs, of which a list is given in an earlier page, and which are scattered in various publications. They may have appeared desultory when read in the order in which they appeared, but as they had an underlying connection it seems worth while to bring their substance together in logical sequence into a single volume. I have revised, condensed, largely re-written, transposed old matter, and interpolated much that is new; but traces of the fragmentary origin of the work still remain, and I do not regret them. They serve to show that the book is intended to be suggestive, and renounces all claim to be encyclopedic. I have indeed, with that object, avoided going into details in not a few cases where I should otherwise have written with fulness, especially in the Anthropometric part. My general object has been to take note of the varied hereditary faculties of different men, and of the great differences in different families and races, to learn how far history may have shown the practicability of supplanting inefficient human stock by better strains, and to consider whether it might not be our duty to do so by such efforts as may be reasonable, thus exerting ourselves to further the ends of evolution more rapidly and with less distress than if events were left to their own course. The subject is, however, so entangled with collateral considerations that a straightforward step-by-step inquiry did not seem to be the most suitable course. I thought it safer to proceed like the surveyor of a new country, and endeavour to fix in the first instance as truly as I could the position of several cardinal points. The general outline of the results to which I finally arrived became more coherent and clear as this process went on; they are briefly summarised in the concluding chapter.

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VARIETY OF HUMAN NATURE.

We must free our minds of a great deal of prejudice before we can rightly judge of the direction in which different races need to be improved. We must be on our guard against taking our own instincts of what is best and most seemly, as a criterion for the rest of mankind. The instincts and faculties of different men and races differ in a variety of ways almost as profoundly as those of animals in different cages of the Zoological Gardens; and however diverse and antagonistic they are, each may be good of its kind. It is obviously so in brutes; the monkey may have a horror at the sight of a snake, and a repugnance to its ways, but a snake is just as perfect an animal as a monkey. The living world does not consist of a repetition of similar elements, but of an endless variety of them, that have grown, body and soul, through selective influences into close adaptation to their contemporaries, and to the physical circumstances of the localities they inhabit. The moral and intellectual wealth of a nation largely consists in the multifarious variety of the gifts of the men who compose it, and it would be the very reverse of improvement to make all its members assimilate to a common type. However, in every race of domesticated animals, and especially in the rapidly-changing race of man, there are elements, some ancestral and others the result of degeneration, that are of little or no value, or are positively harmful. We may, of course, be mistaken about some few of these, and shall find in our fuller knowledge that they subserve the public good in some indirect manner; but, notwithstanding this possibility, we are justified in roundly asserting that the natural characteristics of every human race admit of large improvement in many directions easy to specify.

I do not, however, offer a list of these, but shall confine myself to directing attention to a very few hereditary characteristics of a marked kind, some of which are most desirable and others greatly the reverse; I shall also describe new methods of appraising and defining them. Later on in the book I shall endeavour to define the place and duty of man in the furtherance of the great scheme of evolution, and

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I shall show that he has already not only adapted circumstance to race, but also, in some degree and often unconsciously, race to circumstance; and that his unused powers in the latter direction are more considerable than might have been thought.

It is with the innate moral and intellectual faculties that the book is chiefly concerned, but they are so closely bound up with the physical ones that these must be considered as well. It is, moreover, convenient to take them the first, so I will begin with the features.

FEATURES.

The differences in human features must be reckoned great, inasmuch as they enable us to distinguish a single known face among those of thousands of strangers, though they are mostly too minute for measurement. At the same time, they are exceedingly numerous. The general expression of a face is the sum of a multitude of small details, which are viewed in such rapid succession that we seem to perceive them all at a single glance. If any one of them disagrees with the recollected traits of a known face, the eye is quick at observing it, and it dwells upon the difference. One small discordance overweighs a multitude of similarities and suggests a general unlikeness; just as a single syllable in a sentence pronounced with a foreign accent makes one cease to look upon the speaker as a countryman. If the first rough sketch of a portrait be correct so far as it goes, it may be pronounced an excellent likeness; but a rough sketch does not go far; it contains but few traits for comparison with the original. It is a suggestion, not a likeness; it must be coloured and shaded with many touches before it can really resemble the face, and whilst this is being done the maintenance of the likeness is imperilled at every step. I lately watched an able artist painting a portrait, and endeavoured to estimate the number of strokes with his brush, every one of which was thoughtfully and firmly given. During fifteen sittings of three working hours each—that is to say, during forty-five hours, or two thousand four hundred minutes—he worked at the average rate of ten strokes of the

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brush per minute. There were, therefore, twenty-four thousand separate traits in the completed portrait, and in his opinion some, I do not say equal, but comparably large number of units of resemblance with the original.

The physiognomical difference between different men being so numerous and small, it is impossible to measure and compare them each to each, and to discover by ordinary statistical methods the true physiognomy of a race. The usual way is to select individuals who are judged to be representatives of the prevalent type, and to photograph them; but this method is not trustworthy, because the judgment itself is fallacious. It is swayed by exceptional and grotesque features more than by ordinary ones, and the portraits supposed to be typical are likely to be caricatures. One fine Sunday afternoon I sat with a friend by the walk in Kensington Gardens that leads to the bridge, and which on such occasions is thronged by promenaders. It was agreed between us that whichever first caught sight of a typical John Bull should call the attention of the other. We sat and watched keenly for many minutes, but neither of us found occasion to utter a word.

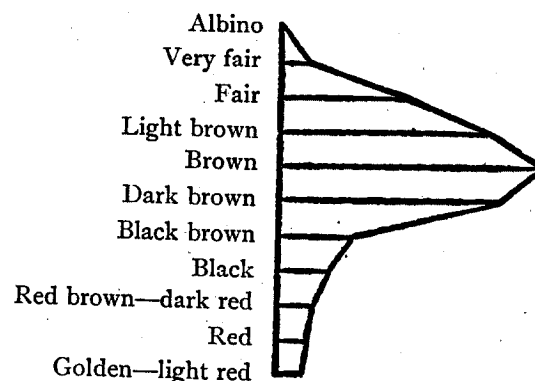
The prevalent type of English face has greatly changed at different periods, for after making large allowance for the fashion in portrait painting of the day, there remains a great difference between the proportion in which certain casts of features are to be met with at different dates. I have spent some time in studying the photographs of the various portraits of English worthies that have been exhibited at successive loan collections, or which are now in the National Portrait Gallery, and have traced what appear to be indisputable signs of one predominant type of face supplanting another. For instance, the features of the men painted by and about the time of Holbein have usually high cheekbones, long upper lips, thin eyebrows, and lank dark hair. It would be impossible, I think, for the majority of modern Englishmen so to dress themselves and clip and arrange their hair, as to look like the majority of these portraits.

Englishmen are now a fair and reddish race, as may be seen from the Diagram, taken from the Report of the Anthropometric Committee to the British Association in 1880 and which gives the proportion in which the

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various colours of hair are found among our professional classes.



I take the professional classes because they correspond with the class of English worthies better than any of the others from which returns have been collected. The Diagram, however, gives a fair representation of other classes of the community. For instance, I have analysed the official records of the very carefully-selected crews of H.M.S. *Alert* and *Discovery* in the Arctic Expedition of 1875-6, and find the proportion of various shades of hair to be the same among them as is shown in the Diagram. Seven-tenths of the crews had complexions described as light, fair, fresh, ruddy or freckled, and the same proportion had blue or gray eyes. They would have contrasted strongly with Cromwell's regiment of Ironsides, who were recruited from the dark-haired men of the fen districts, and who are said to have left the impression on contemporary observers as being men of a peculiar breed. They would also probably have contrasted with any body of thoroughgoing Puritan soldiers taken at haphazard; for there is a prevalence of dark hair among men of atrabilious and sour temperament.

If we may believe caricaturists, the fleshiness and obesity of many English men and women in the earlier years of this century must have been prodigious. It testifies to the grosser conditions of life in those days, and makes it improbable that the types best adapted to prevail then would be the best adapted to prevail now.

COMPOSITE PORTRAITURE.

As a means of getting over the difficulty of procuring really representative faces, I contrived the method of composite portraiture, which has been explained of late on many occasions, and of which a full account will be found in Appendix A. The principle on which the composites are made will best be understood by a description of my earlier and now discarded method; it was this—(1) I collected photographic portraits of different persons, all of whom had been photographed in the same aspect (say full face), and under the same conditions of light and shade (say with the light coming from the right side). (2) I reduced their portraits photographically to the same size, being guided as to scale by the distance between any two convenient points of reference in the features; for example, by the vertical distance between two parallel lines, one of which passed through the middle of the pupils of the eyes and the other between the lips. (3) I superimposed the portraits like the successive leaves of a book, so that the features of each portrait lay as exactly as the case admitted, in front of those of the one behind it, eye in front of eye and mouth in front of mouth. This I did by holding them successively to the light and adjusting them, then by fastening each to the preceding one with a strip of gummed paper along one of the edges. Thus I obtained a book, each page of which contained a separate portrait, and all the portraits lay exactly in front of one another. (4) I fastened the book against the wall in such a way that I could turn over the pages in succession, leaving in turn each portrait flat and fully exposed. (5) I focused my camera on the book, fixed it firmly, and put a sensitive plate inside it. (6) I began photographing, taking one page after the other in succession without moving the camera, but putting on the cap whilst I was turning over the pages, so that an image of each of the portraits in succession was thrown on the same part of the sensitised plate.

Only a fraction of the exposure required to make a good picture was allowed to each portrait. Suppose that period was twenty seconds, and that there were ten portraits, then

an exposure of two seconds would be allowed for each portrait, making twenty seconds in all. This is the principle of the process, the details of that which I now use are different and complex. They are fully explained in the Appendix for the use of those who may care to know about them.

The effect of composite portraiture is to bring into evidence all the traits in which there is agreement, and to leave but a ghost of a trace of individual peculiarities. There are so many traits in common in all faces that the composite picture when made from many components is far from being a blur; it has altogether the look of an ideal composition.

It may be worth mentioning that when I take any small bundle of portraits, selected at hazard, I have generally found it easy to sort them into about five groups, four of which have enough resemblance among themselves to make as many fairly clear composites, while the fifth consists of faces that are too incongruous to be grouped in a single class. In dealing with portraits of brothers and sisters, I can generally throw most of them into a single group, with success.

In the small collection of composites given in the Plate facing p. 8, I have purposely selected many of those that I have previously published, and whose originals, on a larger scale, I have at various times exhibited, together with their components, in order to put the genuineness of the results beyond doubt. Those who see them for the first time can hardly believe but that one dominant face has overpowered the rest, and that they are composites only in name. When, however, the details are examined, this objection disappears. It is true that with careless photography one face may be allowed to dominate, but with the care that ought to be taken, and with the precautions described in the Appendix, that does not occur. I have often been amused when showing composites and their components to friends, to hear a strong expression of opinion that the predominance of one face was evident, and then on asking which face it was, to discover that they disagreed. I have even known a composite in which one portrait seemed unduly to prevail, to be remade without the component in

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question, and the result to be much the same as before, showing that the reason of the resemblance was that the rejected portrait had a close approximation to the ideal average picture of the rest.

These small composites give a better notion of the utmost capacity of the process than the larger ones, from which they are reduced. In the latter, the ghosts of individual peculiarities are more visible, and usually the equal traces left by every member of a moderately-sized group can be made out by careful inspection; but it is hardly possible to do this in the pictures in the Plate, except in a good light and in a very few of the cases. On the other hand, the larger pictures do not contain more detail of value than the smaller ones.

DESCRIPTION OF THE COMPOSITES.

The medallion of Alexander the Great was made by combining the images of six different medals, with a view of obtaining the type of features that the makers of those medals concurred in desiring to ascribe to him. The originals were kindly selected for me by Mr. R. Stuart Poole from the collection in the British Museum. This composite was one of the first I ever made, and is printed together with its six components in the *Journal of the Royal Institution*, in illustration of a lecture I gave there in April 1879. It seems to me that it is possible on this principle to obtain a truer likeness of a man than in any other way. Every artist makes mistakes; but by combining the conscientious works of many artists, their separate mistakes disappear, and what is common to all of their works remains. So as regards different photographs of the same person, those accidental momentary expressions are got rid of, which an ordinary photograph made by a brief exposure cannot help recording. On the other hand, any happy sudden trait of expression is lost. The composite gives the features in repose.

The next pair of composites (full face and profile) on the Plate has not been published before. The interest of the pair lies chiefly in their having been made from only two components, and they show how curiously even two

SPECIMENS OF COMPOSITE PORTRAITURE		
PERSONAL AND FAMILY.		
 <i>Alexander the Great From 6 Different Medals.</i>	 <i>Two Sisters.</i>	 <i>From 6 Members of same Family Male & Female.</i>
HEALTH.	DISEASE.	CRIMINALITY.
 <i>23 Cases. Royal Engineers. 12 Officers. 11 Privates</i>	 <i>6 Cases</i>  <i>9 Cases</i> <i>Tubercular Disease</i>	 <i>8 Cases</i>  <i>4 Cases</i> <i>2 OF the many Criminal Types</i>
CONSUMPTION AND OTHER MALADIES		
 <i>I 20 Cases</i>  <i>II 36 Cases</i>  <i>56 Cases</i> <i>Co-composite of I & II</i> <i>Consumptive Cases.</i>		 <i>100 Cases</i>  <i>50 Cases</i> <i>Not Consumptive.</i>

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faces that have a moderate family likeness will blend into a single one. That neither of these predominated in the present case will be learned from the following letter by the father of the ladies, who is himself a photographer :—

“ I am exceedingly obliged for the very curious and interesting composite portraits of my two children. Knowing the faces so well, it caused me quite a surprise when I opened your letter. I put one of the full faces on the table for the mother to pick up casually. She said, ‘ When did you do this portrait of A? how *like* she is to B! Or *is* it B? I never thought they were so like before.’ It has puzzled several people to say whether the profile was intended for A or B. Then I tried one of them on a friend who has not seen the girls for years. He said, ‘ Well, it is one of the family for certain, but I don’t know which.’ ”

I have made several other family portraits, which to my eye seem great successes, but must candidly own that the persons whose portraits are blended together seldom seem to care much for the result, except as a curiosity. We are all inclined to assert our individuality, and to stand on our own basis, and to object to being mixed up indiscriminately with others. The same feeling finds expression when the resident in a suburban street insists on calling his house a villa with some fantastic name, and refuses, so long as he can, to call it simply Number so and so in the street.

The last picture in the upper row shows the easy way in which young and old, male and female, combine to form an effective picture. The components consist in this case of the father and mother, two sons, and two daughters. I exhibited the original of this, together with the portraits from which it was taken, at the Loan Photographic Exhibition at the Society of Arts in February 1882. I also sent copies of the original of this same composite to several amateur photographers, with a circular letter asking them to get from me family groups for the purpose of experiments, to see how far the process was suitable for family portraiture.

The middle row of portraits illustrates health, disease, and criminality. For health, I have combined the portraits of twelve officers of the Royal Engineers with about an equal number of privates, which were taken for me by

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Lieutenant Darwin, R.E. The individuals from whom this composite was made, which has not come out as clearly as I should have liked, differed considerably in feature, and they came from various parts of England. The points they had in common were the bodily and mental qualifications required for admission into their select corps, and their generally British descent. The result is a composite having an expression of considerable vigour, resolution, intelligence, and frankness. I have exhibited both this and others that were made respectively from the officers, from the whole collection of privates—thirty-six in number—and from that selected portion of them that is utilised in the present instance.

This face and the qualities it connotes probably gives a clue to the direction in which the stock of the English race might most easily be improved. It is the essential notion of a race that there should be some ideal typical form from which the individuals may deviate in all directions, but about which they chiefly cluster, and towards which their descendants will continue to cluster. The easiest direction in which a race can be improved is towards that central type, because nothing new has to be sought out. It is only necessary to encourage as far as practicable the breed of those who conform most nearly to the central type, and to restrain as far as may be the breed of those who deviate widely from it. Now there can hardly be a more appropriate method of discovering the central physiognomical type of any race or group than that of composite portraiture.

As a contrast to the composite of the Royal Engineers, I give those of two of the coarse and low types of face found among the criminal classes. The photographs from which they were made are taken from two large groups. One are those of men undergoing severe sentences for murder and other crimes connected with violence; the other of thieves. They were reprints from those taken by order of the prison authorities for purposes of identification. I was allowed to obtain copies for use in my inquiries by the kind permission of Sir Edmund Du Cane, H.M. Director of Prisons. The originals of these and their components have frequently been exhibited. It is unhappily a fact that fairly distinct types of criminals breeding

Description of the Composites 11

true to their kind have become established, and are one of the saddest disfigurements of modern civilisation. To this subject I shall recur.

I have made numerous composites of various groups of convicts, which are interesting negatively rather than positively. They produce faces of a mean description, with no villainy written on them. The individual faces are villainous enough, but they are villainous in different ways, and when they are combined, the individual peculiarities disappear, and the common humanity of a low type is all that is left.

The remaining portraits are illustrations of the application of the process to the study of the physiognomy of disease. They were published a year ago with many others, together with several of the portraits from which they were derived, in a joint memoir by Dr. Mahomed and myself, in vol. xxv. of the *Guy's Hospital Reports*. The originals and all the components have been exhibited on several occasions.

In the lower division of the Plate will be found three composites, each made from a large number of faces, unselected, except on the ground of the disease under which they were suffering. When only few portraits are used, there must be some moderate resemblance between them, or the result would be blurred; but here, dealing with as many as 56, 100, and 50 cases respectively, the combination of any medley group results in an ideal expression.

It will be observed that the composite of 56 female faces is made by the blending of two other composites, both of which are given. The history was this—I took the 56 portraits and sorted them into two groups; in the first of these were 20 portraits that showed a tendency to thin features, in the other group there were 36 that showed a tendency to thickened features. I made composites of each of them as shown in the Plate. Now it will be remarked that, notwithstanding the attempt to make two contrasted groups, the number of mediocre cases was so great that the composites of the two groups are much alike. If I had divided the 56 into two haphazard groups, the results would have been closely alike, as I know from abundant experience of the kind. The co-composite of the

two will be observed to have an intermediate expression. The test and measure of statistical truth lies in the degree of accordance between results obtained from different batches of instances of the same generic class. It will be gathered from these instances that composite portraiture may attain statistical constancy, within limits not easily distinguished by the eye, after some 30 haphazard portraits of the same class have been combined. This at least has been my experience thus far.

The two faces illustrative of the same type of tubercular disease are very striking; the uppermost is photographically interesting as a case of predominance of one peculiarity, happily of no harm to the effect of the ideal wan face. It is that one of the patients had a sharply-checked black and white scarf, whose pattern has asserted itself unduly in the composite. In such cases I ought to throw the too clearly defined picture a little out of focus. The way in which the varying brightness of different pictures is reduced to a uniform standard of illumination is described in the Appendix.

It must be clearly understood that these portraits do not profess to give the whole story of the physiognomy of phthisis. I have not room to give illustrations of other types—namely, that with coarse and blunted features, or the strumous one, nor any of the intermediates. These have been discussed chiefly by Dr. Mahomed in the memoir alluded to above.

In the large experience I have had of sorting photographs, literally by the thousand, while making experiments with composites, I have been struck by certain general impressions. The consumptive patients consisted of many hundred cases, including a considerable proportion of very ignoble specimens of humanity. Some were scrofulous and misshapen, or suffered from various loathsome forms of inherited disease; most were ill nourished. Nevertheless, in studying their portraits the pathetic interest prevailed, and I returned day after day to my tedious work of classification, with a liking for my materials. It was quite otherwise with the criminals. I did not adequately appreciate the degradation of their expressions for some time; at last the sense of it took firm hold of me, and I cannot now handle the

portraits without overcoming by an effort the aversion they suggest.

I am sure that the method of composite portraiture opens a fertile field of research to ethnologists, but I find it very difficult to do much single-handed, on account of the difficulty of obtaining the necessary materials. As a rule, the individuals must be specially photographed. The portraits made by artists are taken in every conceivable aspect and variety of light and shade, but for the purpose in question the aspect and the shade must be the same throughout. Group portraits would do to work from, were it not for the strong out-of-door light under which they are necessarily taken, which gives an unwonted effect to the expression of the faces. Their scale also is too small to give a sufficiently clear picture when enlarged. I may say that the scale of the portraits need not be uniform, as my apparatus enlarges or reduces as required, at the same time that it superposes the images; but the portraits of the heads should never be less than twice the size of that of the Queen on a halfpenny piece.

I heartily wish that amateur photographers would seriously take up the subject of composite portraiture as applied to different sub-types of the varying races of men. I have already given more time to perfecting the process and experimenting with it than I can well spare.

BODILY QUALITIES.

The differences in the bodily qualities that are the usual subjects of anthropometry are easily dealt with, and are becoming widely registered in many countries. We are unfortunately destitute of trustworthy measurements of Englishmen of past generations to enable us to compare class with class, and to learn how far the several sections of the English nation may be improving or deteriorating. We shall, however, hand useful information concerning our own times to our successors, thanks principally to the exertions of an Anthropometric Committee established five years ago by the British Association, who have collected

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and partly classified and published a large amount of facts, besides having induced several institutions, such as Marlborough College, to undertake a regular system of anthropometric record. I am not, however, concerned here with the labours of this committee, nor with the separate valuable publications of some of its members, otherwise than in one small particular which appears to show that the English population as a whole, or perhaps I should say the urban portion of it, is in some sense deteriorating. It is that the average stature of the older persons measured by or for the committee has not been found to decrease steadily with their age, but sometimes the reverse.¹ This contradicts observations made on the heights of the same men at different periods, whose stature after middle age is invariably reduced by the shrinking of the cartilages. The explanation offered was that the statistical increase of stature with age should be ascribed to the survival of the more stalwart. On reconsideration, I am inclined to doubt the adequacy of the explanation, and partly to account for the fact by a steady, slight deterioration of stature in successive years; in the urban population owing to the conditions of their lives, and in the rural population owing to the continual draining away of the more stalwart of them to the towns.

It cannot be doubted that town life is harmful to the town population. I have myself investigated its effect on fertility (see Appendix B), and found that taking on the one hand a number of rural parishes, and on the other hand the inhabitants of a medium town, the former reared nearly twice as many adult grandchildren as the latter. The vital functions are so closely related that an inferiority in the production of healthy children very probably implies a loss of vigour generally, one sign of which is a diminution of stature.

Though the bulk of the population may deteriorate, there are many signs that the better housed and fed portion of it improves. In the earlier years of this century the so-called manly sports of boxing and other feats of strength ranked high among the national amusements. A man who was

¹ *Trans. Brit. Assoc.*, 1881, Table V., p. 242; and remarks by Mr. Roberts, p. 235.

Bodily Qualities

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successful in these became the hero of a large and demonstrative circle of admirers, and it is to be presumed that the best boxer, the best pedestrian, and so forth, was the best adapted to succeed, through his natural physical gifts. If he was not the most gifted man in those respects in the whole kingdom, he was certainly one of the most gifted of them. It therefore does no injustice to the men of that generation to compare the feats of their foremost athletes with those of ours who occupy themselves in the same way. The comparison would probably err in their favour, because the interest in the particular feats in which our grandfathers and great-grandfathers delighted are not those that chiefly interest the present generation, and notwithstanding our increased population, there are fewer men now who attempt them. In the beginning of this century there were many famous walking matches, and incomparably the best walker was Captain Barclay of Ury. His paramount feat, which was once very familiar to the elderly men of the present time, was that of walking a thousand miles in a thousand hours, but of late years that feat has been frequently equalled and overpassed. I am willing to allow much influence to the modern conditions of walking under shelter and subject to improved methods of training (Captain Barclay himself originated the first method, which has been greatly improved since his time); still the fact remains that in executing this particular feat, the athletes of the present day are more successful than those who lived some eighty years ago.

I may be permitted to give an example bearing on the increased stature of the better housed and fed portion of the nation, in a recollection of my own as to the difference in height between myself and my fellow-collegians at Trinity College, Cambridge, in 1840-4. My height is 5 feet 9½ inches, and I recollect perfectly that among the crowd of undergraduates I stood somewhat taller than the majority. I generally looked a little downward when I met their eyes. In later years, whenever I have visited Cambridge, I have lingered in the ante-chapel and repeated the comparison, and now I find myself decidedly shorter than the average of the students. I have precisely the same kind of recollection and the same present experience of the height of crowds of well-dressed persons. I used always to get a fair view of

what was going on over or between their heads; I rarely can do so now.

The athletic achievements at school and college are much superior to what they used to be. Part is no doubt due to more skilful methods of execution, but not all. I cannot doubt that the more wholesome and abundant food, the moderation in drink, the better cooking, the warmer wearing apparel, the airier sleeping rooms, the greater cleanliness, the more complete change in holidays, and the healthier lives led by the women in their girlhood, who become mothers afterwards, have a great influence for good on the favoured portion of our race.

The proportion of weakly and misshapen individuals is not to be estimated by those whom we meet in the streets; the worst cases are out of sight. We should parade before our mind's eye the inmates of the lunatic, idiot, and pauper asylums, the prisoners, the patients in hospitals, the sufferers at home, the crippled, and the congenitally blind, and that large class of more or less wealthy persons who flee to the sunnier coasts of England, or expatriate themselves for the chance of life. There can hardly be a sadder sight than the crowd of delicate English men and women with narrow chests and weak chins, scrofulous, and otherwise gravely affected, who are to be found in some of these places. Even this does not tell the whole of the story; if there were a conscription in England, we should find, as in other countries, that a large fraction of the men who earn their living by sedentary occupations are unfit for military service. Our human civilised stock is far more weakly through congenital imperfection than that of any other species of animals, whether wild or domestic.

It is, however, by no means the most shapely or the biggest personages who endure hardship the best. Some very shabby-looking men have extraordinary stamina. Sickly-looking and puny residents in towns may have a more suitable constitution for the special conditions of their lives, and may in some sense be better knit and do more work and live longer than much haler men imported to the same locality from elsewhere. A wheel and a barrel seem to have the flimsiest possible constitutions; they

consist of numerous separate pieces all oddly shaped, which, when lying in a heap, look hopelessly unfitted for union; but put them properly together, compress them with a tire in the one case and with hoops in the other, and a remarkably enduring organisation will result. A wheel with a ton weight on the top of it in the waggons of South Africa will jolt for thousands of miles over stony, roadless country without suffering harm; a keg of water may be strapped on the back of a pack-ox or a mule, and be kicked off and trampled on, and be otherwise misused for years, without giving way.

I do not propose to enter further into the anthropometric differences of race, for the subject is a very large one, and this book does not profess to go into detail. Its intention is to touch on various topics more or less connected with that of the cultivation of race, or, as we might call it, with "eugenic"¹ questions, and to present the results of several of my own separate investigations.

ENERGY.

Energy is the capacity for labour. It is consistent with all the robust virtues, and makes a large practice of them possible. It is the measure of fulness of life; the more energy the more abundance of it; no energy at all is death; idiots are feeble and listless. In the inquiries I made on the antecedents of men of science no points came out more strongly than that the leaders of scientific thought were generally gifted with remarkable energy, and that they had

¹ That is, with questions bearing on what is termed in Greek, *eugenes*, namely, good in stock, hereditarily endowed with noble qualities. This, and the allied words, *eugeneia*, etc., are equally applicable to men, brutes, and plants. We greatly want a brief word to express the science of improving stock, which is by no means confined to questions of judicious mating, but which, especially in the case of man, takes cognisance of all influences that tend in however remote a degree to give to the more suitable races or strains of blood a better chance of prevailing speedily over the less suitable than they otherwise would have had. The word *eugenics* would sufficiently express the idea; it is at least a neater word and a more generalised one than *viticulture*, which I once ventured to use.

inherited the gift of it from their parents and grandparents. I have since found the same to be the case in other careers.

Energy is an attribute of the higher races, being favoured beyond all other qualities by natural selection. We are goaded into activity by the conditions and struggles of life. They afford stimuli that oppress and worry the weakly, who complain and bewail, and it may be succumb to them, but which the energetic man welcomes with a good-humoured shrug, and is the better for in the end.

The stimuli may be of any description: the only important matter is that all the faculties should be kept working to prevent their perishing by disuse. If the faculties are few, very simple stimuli will suffice. Even that of fleas will go a long way. A dog is continually scratching himself, and a bird pluming itself, whenever they are not occupied with food, hunting, fighting, or love. In those blank times there is very little for them to attend to besides their varied cutaneous irritations. It is a matter of observation that well washed and combed domestic pets grow dull; they miss the stimulus of fleas. If animals did not prosper through the agency of their insect plagues, it seems probable that their races would long since have been so modified that their bodies should have ceased to afford a pasture-ground for parasites.

It does not seem to follow that because men are capable of doing hard work they like it. Some, indeed, fidget and fret if they cannot otherwise work off their superfluous steam; but on the other hand there are many big lazy fellows who will not get up their steam to full pressure except under compulsion. Again, the character of the stimulus that induces hard work differs greatly in different persons; it may be wealth, ambition, or other object of passion. The solitary hard workers, under no encouragement or compulsion except their sense of duty to their generation, are unfortunately still rare among us.

It may be objected that if the race were too healthy and energetic there would be insufficient call for the exercise of the pitying and self-denying virtues, and the character of men would grow harder in consequence. But it does not seem reasonable to preserve sickly breeds for the sole purpose of tending them, as the breed of foxes is preserved

solely for sport and its attendant advantages. There is little fear that misery will ever cease from the land, or that the compassionate will fail to find objects for their compassion; but at present the supply vastly exceeds the demand: the land is overstocked and overburdened with the listless and the incapable.

In any scheme of eugenics, energy is the most important quality to favour; it is, as we have seen, the basis of living action, and it is eminently transmissible by descent.

SENSITIVITY.

The only information that reaches us concerning outward events appears to pass through the avenue of our senses; and the more perceptive the senses are of difference, the larger is the field upon which our judgment and intelligence can act. Sensation mounts through a series of grades of "just perceptible differences." It starts from the zero of consciousness, and it becomes more intense as the stimulus increases (though at a slower rate) up to the point when the stimulus is so strong as to begin to damage the nerve apparatus. It then yields place to pain, which is another form of sensation, and which continues until the nerve apparatus is destroyed. Two persons may be equally able just to hear the same faint sound, and they may equally begin to be pained by the same loud sound, and yet they may differ as to the number of intermediate grades of sensation. The grades will be less numerous as the organisation is of a lower order, and the keenest sensation possible to it will in consequence be less intense. An artist who is capable of discriminating more differences of tint than another man is not necessarily more capable of seeing clearly in twilight, or more or less intolerant of sunshine. A musician is not necessarily able to hear very faint sounds, nor to be more startled by loud sounds than others are. A mechanic who works hard with heavy tools and has rough and grimy thumbs, insensible to very slight pressures, may yet have a singularly discriminating power of touch in respect to the pressures that he can feel.

The discriminative faculty of idiots is curiously low;

they hardly distinguish between heat and cold, and their sense of pain is so obtuse that some of the more idiotic seem hardly to know what it is. In their dull lives, such pain as can be excited in them may literally be accepted with a welcome surprise. During a visit to Earlswood Asylum I saw two boys whose toe-nails had grown into the flesh and had been excised by the surgeon. This is a horrible torture to ordinary persons, but the idiot lads were said to have shown no distress during the operation; it was not necessary to hold them, and they looked rather interested at what was being done.¹ I also saw a boy with the scar of a severe wound on his wrist; the story being that he had first burned himself slightly by accident, and, liking the keenness of the new sensation, he took the next opportunity of repeating the experience, but, idiot-like, he overdid it.

The trials I have as yet made on the sensitivity of different persons confirms the reasonable expectation that it would on the whole be highest among the intellectually ablest. At first, owing to my confusing the quality of which I am speaking with that of nervous irritability, I fancied that women of delicate nerves who are distressed by noise, sunshine, etc., would have acute powers of discrimination. But this I found not to be the case. In morbidly sensitive persons both pain and sensation are induced by lower stimuli than in the healthy, but the number of just perceptible grades of sensation between them is not necessarily different.

I found as a rule that men have more delicate powers of discrimination than women, and the business experience of life seems to confirm this view. The tuners of pianofortes are men, and so I understand are the tasters of tea and wine, the sorters of wool, and the like. These latter occupations are well salaried, because it is of the first moment to the merchant that he should be rightly advised on the real value of what he is about to purchase or to sell. If the sensitivity of women were superior to that of men, the self-interest of merchants would lead to their being

¹ See "Remarks on Idiocy," by E. W. Graham, M.D., *Medical Journal*, January 16, 1875.

always employed; but as the reverse is the case, the opposite supposition is likely to be the true one.

Ladies rarely distinguish the merits of wine at the dinner-table, and though custom allows them to preside at the breakfast-table, men think them on the whole to be far from successful makers of tea and coffee.

Blind persons are reputed to have acquired in compensation for the loss of their eyesight an increased acuteness in their other senses; I was therefore curious to make some trials with my test apparatus, which I will describe in the next chapter. I was permitted to do so on a number of boys at a large educational blind asylum, but found that, although they were anxious to do their best, their performances were by no means superior to those of other boys. It so happened that the blind lads who showed the most delicacy of touch and won the little prizes I offered to excite emulation, barely reached the mediocrity of the various sighted lads of the same age whom I had previously tested. I have made not a few observations and inquiries, and find that the guidance of the blind depends mainly on the multitude of collateral indications to which they give much heed, and not in their superior sensitivity to any one of them. Those who see do not care for so many of these collateral indications, and habitually overlook and neglect several of them. I am convinced also that not a little of the popular belief concerning the sensitivity of the blind is due to exaggerated claims on their part that have not been verified. Two instances of this have fallen within my own experience, in both of which the blind persons claimed to have the power of judging by the echo of their voice and by certain other feelings, the one when they were approaching objects, even though the object was so small as a handrail, and the other to tell how far the door of the room in which he was standing was open. I used all the persuasion I could to induce each of these persons to allow me to put their assertions to the test; but it was of no use. The one made excuses, the other positively refused. They had probably the same tendency that others would have who happened to be defective in any faculty that their comrades possessed, to fight bravely against their disadvantage, and

at the same time to be betrayed into some overvaunting of their capacities in other directions. They would be a little conscious of this, and would therefore shrink from being tested.

The power of reading by touch is not so very wonderful. A former Lord Chancellor of England, the late Lord Hatherley, when he was advanced in years, lost his eyesight for some time owing to a cataract, which was not ripe to be operated on. He assured me that he had then learned and practised reading by touch very rapidly. This fact may perhaps also serve as additional evidence of the sensitivity of able men.

Notwithstanding many travellers' tales, I have thus far been unsuccessful in obtaining satisfactory evidence of any general large superiority of the senses of savages over those of civilised men. My own experience, so far as it goes, of Hottentots, Damaras, and some other wild races, went to show that their sense discrimination was not superior to those of white men, even as regards keenness of eyesight. An offhand observer is apt to err by assigning to a single cause what is partly due to others as well. Thus, as regards eyesight, a savage who is accustomed to watch oxen grazing at a distance becomes so familiar with their appearance and habits that he can identify particular animals and draw conclusions as to what they are doing with an accuracy that may seem to strangers to be wholly dependent on exceptional acuteness of vision. A sailor has the reputation of keen sight because he sees a distant coast when a landsman cannot make it out; the fact being that the landsman usually expects a different appearance to what he has really to look for, such as a very minute and sharp outline instead of a large, faint blur. In a short time a landsman becomes quite as quick as a sailor, and in some test experiments¹ he was found on the average to be distinctly the superior. It is not surprising that this should be so, as sailors in vessels of moderate size have hardly ever the practice of focussing their eyes sharply upon objects farther off than the length of the vessel or the top of the mast, say at a distance of fifty paces. The horizon itself as seen from the deck, and

¹ Gould's *Military and Anthropological Statistics*, p. 530. New York, 1869.

under the most favourable circumstances, is barely four miles off, and there is no sharpness of outline in the intervening waves. Besides this, the life of a sailor is very unhealthy, as shown by his growing old prematurely, and his eyes must be much tried by foul weather and salt spray.

We inherit our language from barbarous ancestors, and it shows traces of its origin in the imperfect ways by which grades of difference admit of being expressed. Suppose a pedestrian is asked whether the knapsack on his back feels heavy. He cannot find a reply in two words that cover more varieties than (1) very heavy, (2) rather heavy, (3) moderate, (4) rather light, (5) very light. I once took considerable pains in the attempt to draw up verbal scales of more than five orders of magnitude, using those expressions only that every cultivated person would understand in the same sense; but I did not succeed. A series that satisfied one person was not interpreted in the same sense by another.

The general intention of this chapter has been to show that a delicate power of sense discrimination is an attribute of a high race, and that it has not the drawback of being necessarily associated with nervous irritability.

SEQUENCE OF TEST WEIGHTS.

I will now describe an apparatus I have constructed to test the delicacy with which weights may be discriminated by handling them. I do so because the principle on which it is based may be adopted in apparatus for testing other senses, and its description and the conditions of its use will illustrate the desiderata and difficulties of all such investigations.

A series of test weights is a simple enough idea—the difficulty lies in determining the particular sequence of weights that should be employed. Mine form a geometric series, for the reason that when stimuli of all kinds increase by geometric grades the sensations they give rise to will increase by arithmetic grades, so long as the stimulus is neither so weak as to be barely felt, nor so strong as to excite

fatigue. My apparatus, which is explained more fully in the Appendix, consists of a number of common gun cartridge cases filled with alternate layers of shot, wool, and wadding, and then closed in the usual way. They are all identical in appearance, and may be said to differ only in their specific gravities. They are marked in numerical sequence with the register numbers, 1, 2, 3, etc., but their weights are proportioned to the numbers of which 1, 2, 3, etc., are the logarithms, and consequently run in a geometric series. Hence the numbers of the weights form a scale of equal degrees of sensitivity. If a person can just distinguish between the weights numbered 1 and 3, he can also just distinguish between 2 and 4, 3 and 5, and any other pair of weights of which the register number of the one exceeds that of the other by 2. Again, his coarseness of discrimination is exactly double of that of another person who can just distinguish pairs of weights differing only by 1, such as 1 and 2, 2 and 3, 3 and 4, and so on. The testing is performed by handing pairs of weights to the operatee until his power of discrimination is approximately made out, and then to proceed more carefully. It is best now, for reasons stated in the Appendix, to hand to the operatee sequences of three weights at a time, after shuffling them. These he has to arrange in their proper order, with his eyes shut, and by the sense of their weight alone. The operator finally records the scale interval that the operatee can just appreciate, as being the true measure of the coarseness (or the inverse measure of the delicacy) of the sensitivity of the operatee.

It is somewhat tedious to test many persons in succession, but any one can test his own powers at odd and end times with ease and nicety, if he happens to have ready access to suitable apparatus.

The use of tests, which, objectively speaking, run in a geometric series, and subjectively in an arithmetic one, may be applied to touch, by the use of wire-work of various degrees of fineness; to taste, by stock bottles of solutions of salt, etc., of various strengths; to smell, by bottles of attar of rose, etc., in various degrees of dilution.

The tests show the sensitivity at the time they are made, and give an approximate measure of the discrimination with

which the operatee habitually employs his senses. It does not measure his capacity for discrimination, because the discriminative faculty admits of much education, and the test results always show increased delicacy after a little practice. However, the requirements of everyday life educate all our faculties in some degree, and I have not found the performances with test weights to improve much after a little familiarity with their use. The weights have, as it were, to be played with at first, then they must be tried carefully on three or four separate occasions.

I did not at first find it at all an easy matter to make test weights so alike as to differ in no other appreciable respect than in their specific gravity, and if they differ and become known apart, the knowledge so acquired will vitiate future judgments in various indirect ways. Similarity in outward shape and touch was ensured by the use of mechanically-made cartridge cases; dissimilarity through any external stain was rendered of no hindrance to the experiment by making the operatee handle them in a bag or with his eyes shut. Two bodies may, however, be alike in weight and outward appearance and yet behave differently when otherwise mechanically tested, and, consequently, when they are handled. For example, take two eggs, one raw and the other hard boiled, and spin them on the table; press the finger for a moment upon either of them whilst it is still spinning: if it be the hard-boiled egg it will stop as dead as a stone: if it be the raw egg, after a little apparent hesitation, it will begin again to rotate. The motion of its shell had alone been stopped; the internal part was still rotating and this compelled the shell to follow it. Owing to this cause, when we handle the two eggs, the one feels "quick" and the other does not. Similarly with the cartridges, when one is rather more loosely packed than the others the difference is perceived on handling them. Or it may have one end heavier than the other, or else its weight may not be equally distributed round its axis, causing it to rest on the table with the same part always lowermost; differences due to these causes are also easily perceived when handling the cartridges. Again, one of two similar cartridges may balance perfectly in all directions, but the weight of one

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of them may be disposed too much towards the ends, as in a dumb-bell, or gathered too much towards the centre. The period of oscillation will differ widely in the two cases, as may be shown by suspending the cartridges by strings round their middle so that they shall hang horizontally, and then by a slight tap making them spin to and fro round the string as an axis.

The touch is very keen in distinguishing all these peculiarities. I have mentioned them, and might have added more, to show that experiments on sensitivity have to be made in the midst of pitfalls warily to be avoided. Our apparently simplest perceptions are very complex. We hardly ever act on the information given by only one element of one sense, and our sensitivity in any desired direction cannot be rightly determined except by carefully-devised apparatus judiciously used.

WHISTLES FOR AUDIBILITY OF SHRILL NOTES.

I contrived a small whistle for conveniently ascertaining the upper limits of audible sound in different persons, which Dr. Wollaston had shown to vary considerably. He used small pipes, and found much difficulty in making them. I made a very small whistle from a brass tube whose internal diameter was less than one-tenth of an inch in diameter. A plug was fitted into the lower end of the tube, which could be pulled out or pushed in as much as desired, thereby causing the length of the bore of the whistle to be varied at will. When the bore is long the note is low; when short, it is high. The plug was graduated, so that the precise note produced by the whistle could be determined by reading off the graduations and referring to a table. (See Appendix.)

On testing different persons, I found there was a remarkable falling off in the power of hearing high notes as age advanced. The persons themselves were quite unconscious of their deficiency so long as their sense of hearing low notes remained unimpaired. It is an only too amusing experiment to test a party of persons of various ages, including some rather elderly and self-satisfied personages. They are indignant at being thought deficient in the power of hearing, yet

Whistles for Audibility of Shrill Notes 27

the experiment quickly shows that they are absolutely deaf to shrill notes which the younger persons hear acutely, and they commonly betray much dislike to the discovery. Every one has his limit, and the limit at which sounds become too shrill to be audible to any particular person can be rapidly determined by this little instrument. Lord Rayleigh and others have found that sensitive flames are powerfully affected by the vibrations of whistles that are too rapid to be audible to ordinary ears.

I have tried experiments with all kinds of animals on their powers of hearing shrill notes. I have gone through the whole of the Zoological Gardens, using an apparatus arranged for the purpose. It consists of one of my little whistles at the end of a walking-stick—that is, in reality, a long tube; it has a bit of india-rubber pipe under the handle, a sudden squeeze upon which forces a little air into the whistle and causes it to sound. I hold it as near as is safe to the ears of the animals, and when they are quite accustomed to its presence and heedless of it, I make it sound; then if they prick their ears it shows that they hear the whistle; if they do not, it is probably inaudible to them. Still, it is very possible that in some cases they hear but do not heed the sound. Of all creatures, I have found none superior to cats in the power of hearing shrill sounds; it is perfectly remarkable what a faculty they have in this way. Cats, of course, have to deal in the dark with mice, and to find them out by their squealing. Many people cannot hear the shrill squeal of a mouse. Some time ago, singing mice were exhibited in London, and of the people who went to hear them, some could hear nothing, whilst others could hear a little, and others again could hear much. Cats are differentiated by natural selection until they have a power of hearing all the high notes made by mice and other little creatures that they have to catch. A cat that is at a very considerable distance, can be made to turn its ear round by sounding a note that is too shrill to be audible by almost any human ear. Small dogs also hear very shrill notes, but large ones do not. I have walked through the streets of a town with an instrument like that which I used in the Zoological Gardens, and made nearly all the little dogs turn round, but not the large ones. At Berne, where there appear to be more large dogs

lying idly about the streets than in any other town in Europe, I have tried the whistle for hours together, on a great many large dogs, but could not find one that heard it. Ponies are sometimes able to hear very high notes. I once frightened a pony with one of these whistles in the middle of a large field. My attempts on insect hearing have been failures.

ANTHROPOMETRIC REGISTERS.

When shall we have anthropometric laboratories, where a man may, when he pleases, get himself and his children weighed, measured, and rightly photographed, and have their bodily faculties tested by the best methods known to modern science? The records of growth of numerous persons from childhood to age are required before it can be possible to rightly appraise the effect of external conditions upon development, and records of this kind are at present non-existent. The various measurements should be accompanied by photographic studies of the features in full face and in profile, and on the same scale, for convenience of comparison.

We are all lazy in recording facts bearing on ourselves, but parents are glad enough to do so in respect to their children, and they would probably be inclined to avail themselves of a laboratory where all that is required could be done easily and at small cost. These domestic records would hereafter become of considerable biographical interest. Every one of us in his mature age would be glad of a series of pictures of himself from childhood onwards, accompanied by physical records, and arranged consecutively with notes of current events by their sides. Much more would he be glad of similar collections referring to his father, mother, grandparents, and other near relatives. It would be peculiarly grateful to the young to possess likenesses of their parents and those whom they look upon as heroes, taken when they were of the same age as themselves. Boys are too apt to think of their parents as having always been elderly men, because they have insufficient data to construct imaginary pictures of them as they were in their youth.

The cost of taking photographs in batches is so small, and

the time occupied is so brief, when the necessary preparations have been made and the sitters are ready at hand, that a practice of methodically photographing schoolboys and members of other large institutions might easily be established. I, for one, should dearly prize the opportunity of visiting the places where I have been educated, and of turning over pages showing myself and my companions as we were in those days. But no such records exist; the institutions last and flourish, the individuals who pass through them are dispersed and leave few or no memorials behind. It seems a cruel waste of opportunity not to make and keep these brief personal records in a methodical manner. The fading of ordinary photographic prints is no real objection to keeping a register, because they can now be reproduced at small charge in permanent printers' ink, by the autotype and other processes.

I have seen with admiration, and have had an opportunity of availing myself of, the newly-established library of well-ordered folios at the Admiralty, each containing a thousand pages, and each page containing a brief summary of references to the life of a particular seaman. There are already 80,000 pages, and owing to the excellent organisation of the office it is a matter of perfect ease to follow out any one of these references, and to learn every detail of the service of any seaman. A brief register of measurements and events in the histories of a large number of persons, previous to their entering any institution and during their residence in it, need not therefore be a difficult matter to those who may take it in hand seriously and methodically.

The recommendation I would venture to make to my readers is to obtain photographs and ordinary measurements periodically of themselves and their children, making it a family custom to do so, because, unless driven by some custom, the act will be postponed until the opportunity is lost. Let those periodical photographs be full and side views of the face on an adequate scale, adding any others that may be wished, but not omitting these. As the portraits accumulate have collections of them autotyped. Keep the prints methodically in a family register, writing by their side careful chronicles of illness and all such events as used to find a place on the fly-leaf of the Bible of former generations,

and inserting other interesting personal facts and whatever anthropometric data can be collected.

Those who care to initiate and carry on a family chronicle illustrated by abundant photographic portraiture, will produce a work that they and their children and their descendants in more remote generations will assuredly be grateful for. The family tie has a real as well as a traditional significance. The world is beginning to awaken to the fact that the life of the individual is in some real sense a prolongation of those of his ancestry. His vigour, his character, and his diseases are principally derived from theirs; sometimes his faculties are blends of ancestral qualities; but more frequently they are mosaics, patches of resemblance to one or other of them showing now here and now there. The life-histories of our relatives are prophetic of our own futures; they are far more instructive to us than those of strangers, far more fitted to encourage and to forewarn us. If there be such a thing as a natural birthright, I can conceive of none superior to the right of the child to be informed, at first by proxy through his guardians, and afterwards personally, of the life-history, medical and other, of his ancestry. The child is thrust into existence without his having any voice at all in the matter, and the smallest amend that those who brought him here can make, is to furnish him with all the guidance they can, including the complete life-histories of his near progenitors.

The investigation of human eugenics—that is, of the conditions under which men of a high type are produced—is at present extremely hampered by the want of full family histories, both medical and general, extending over three or four generations. There is no such difficulty in investigating animal eugenics, because the generations of horses, cattle, dogs, etc., are brief, and the breeder of any such stock lives long enough to acquire a large amount of experience from his own personal observation. A man, however, can rarely be familiar with more than two or three generations of his contemporaries before age has begun to check his powers; his working experience must therefore be chiefly based upon records. Believing, as I do, that human eugenics will become recognised before long as a study of the highest practical importance, it seems to me that no time ought to be lost in encouraging and directing a habit of compiling

personal and family histories. If the necessary materials be brought into existence, it will require no more than zeal and persuasiveness on the part of the future investigator to collect as large a store of them as he may require.

UNCONSCIOUSNESS OF PECULIARITIES.

The importance of submitting our faculties to measurement lies in the curious unconsciousness in which we are apt to live of our personal peculiarities, and which our intimate friends often fail to remark. I have spoken of the ignorance of elderly persons of their deafness to high notes, but even the existence of such a peculiarity as colour blindness was not suspected until the memoir of Dalton in 1794. That one person out of twenty-nine or thereabouts should be unable to distinguish a red from a green, without knowing that he had any deficiency of colour sense, and without betraying his deficiency to his friends, seems perfectly incredible to the other twenty-eight; yet as a matter of fact he rarely does either the one or the other. It is hard to convince the colour-blind of their own infirmity. I have seen curious instances of this: one was that of a person by no means unpractised in physical research, who had been himself tested in matching colours. He gave me his own version of the result, to the effect that though he might perhaps have fallen a little short of perfection as judged by over-refined tests, his colour sense was for all practical purposes quite good. On the other hand, the operator assured me that when he had toned the intensities of a pure red and a pure green in a certain proportion, the person ceased to be able to distinguish between them! Colour blindness is often very difficult to detect, because the test hues and tints may be discriminated by other means than by the normal colour sense. Ordinary pigments are never pure, and the test colours may be distinguished by those of their adventitious hues to which the partly colour-blind man may be sensitive. We do not suspect ourselves to be yellow-blind by candle light, because we enjoy pictures in the evening nearly or perhaps quite as much as in the day time; yet we may observe that a yellow primrose laid on

the white table-cloth wholly loses its colour by candle light, and becomes as white as a snowdrop.

In the inquiries I made on the hereditary transmission of capacity, I was often amused by the naïve remark of men who had easily distanced their competitors, that they ascribed their success to their own exertions. They little recognised how much they owed to their natural gifts of exceptional capacity and energy on the one hand, and of exceptional love for their special work on the other.

In future chapters I shall give accounts of persons who have unusual mental characteristics as regards imagery, visualised numerals, colours connected with sounds and special associations of ideas, being unconscious of their peculiarities; but I cannot anticipate these subjects here, as they all require explanation. It will be seen in the end how greatly metaphysicians and psychologists may err, who assume their own mental operations, instincts, and axioms to be identical with those of the rest of mankind, instead of being special to themselves. The differences between men are profound, and we can only be saved from living in blind unconsciousness of our own mental peculiarities by the habit of informing ourselves as well as we can of those of others. Examples of the success with which this can be done will be found farther on in the book.

I may take this opportunity of remarking on the well-known hereditary character of colour blindness in connection with the fact, that it is nearly twice as prevalent among the Quakers as among the rest of the community, the proportions being as 5·9 to 3·5 per cent.¹ We might have expected an even larger ratio. Nearly every Quaker is descended on both sides solely from members of a group of men and women who segregated themselves from the rest of the world five or six generations ago; one of their strongest opinions being that the fine arts were worldly snares, and their most conspicuous practice being to dress in drabs. A born artist could never have consented to separate himself from his fellows on such grounds; he would have felt the profession of those opinions and their accompanying

¹ *Trans. Ophthalmological Soc.*, 1881, p. 198.

practices to be a treason to his æsthetic nature. Consequently few of the original stock of Quakers are likely to have had the temperament that is associated with a love for colour, and it is in consequence most reasonable to believe that a larger proportion of colour-blind men would have been found among them than among the rest of the population.

Again, Quakerism is a decreasing sect, weakened by yearly desertions and losses, especially as the act of marriage with a person who is not a member of the Society is necessarily followed by exclusion from it. It is most probable that a large proportion of the deserters would be those who, through reversion to some bygone ancestor, had sufficient artistic taste to make a continuance of Quaker practices too irksome to be endured. Hence the existing members of the Society of Friends are a race who probably contained in the first instance an unduly large proportion of colour-blind men, and from whose descendants many of those who were not born colour blind have year by year been drafted away. Both causes must have combined with the already well-known tendency of colour blindness to hereditary transmission, to cause it to become a characteristic of their race. Dalton, who first discovered its existence, as a personal peculiarity of his own, was a Quaker to his death; Young, the discoverer of the undulatory theory of light, and who wrote specially on colours, was a Quaker by birth, but he married outside the body and so ceased to belong to it.

STATISTICAL METHODS.

The object of statistical science is to discover methods of condensing information concerning large groups of allied facts into brief and compendious expressions suitable for discussion. The possibility of doing this is based on the constancy and continuity with which objects of the same species are found to vary. That is to say, we always find, after sorting any large number of such objects in the order (let us suppose) of their lengths, beginning with the shortest and ending with the tallest, and setting them side by

side like a long row of park palings between the same limits, their upper outline will be identical. Moreover, it will run smoothly and not in irregular steps. The theoretical interpretation of the smoothness of outline is that the individual differences in the objects are caused by different combinations of a large number of minute influences; and as the difference between any two adjacent objects in a long row must depend on the absence in one of them of some single influence, or of only a few such, that were present in the other, the amount of difference will be insensible. Whenever we find on trial that the outline of the row is not a flowing curve, the presumption is that the objects are not all of the same species, but that part are affected by some large influence from which the others are free; consequently there is a confusion of curves. This presumption is never found to be belied.

It is unfortunate for the peace of mind of the statistician that the influences by which the magnitudes, etc., of the objects are determined can seldom if ever be roundly classed into large and small, without intermediates. He is tantalised by the hope of getting hold of sub-groups of sufficient size that shall contain no individuals except those belonging strictly to the same species, and he is almost constantly baffled. In the end he is obliged to exercise his judgment as to the limit at which he should cease to subdivide. If he subdivides very frequently, the groups become too small to have statistical value; if less frequently, the groups will be less truly specific.

A species may be defined as a group of objects whose individual differences are wholly due to different combinations of the same set of minute causes, no one of which is so powerful as to be able by itself to make any sensible difference in the result. A well-known mathematical consequence flows from this, which is also universally observed as a fact, namely, that in all species the number of individuals who differ from the average value, up to any given amount, is much greater than the number who differ more than that amount, and up to the double of it. In short, if an assorted series be represented by upright lines arranged side by side along a horizontal base at equal distances apart, and of lengths proportionate to the magnitude of the

quality in the corresponding objects, then their shape will always resemble that shown in Fig. 1.

The form of the bounding curve resembles that which is called in architectural language an ogive, from "augive," an old French word for a cup, the figure being not unlike the upper half of a cup lying sideways with its axis horizontal. In consequence of the multitude of mediocre values, we always find that on either side of the middlemost ordinate Cc , which is the median value and may be accepted as the average, there is a much less rapid change of height than elsewhere. If the figure were pulled out sideways to make it accord with such physical conceptions as that of a

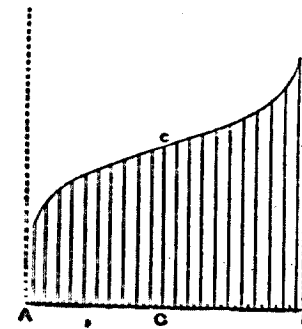


Fig. 1.

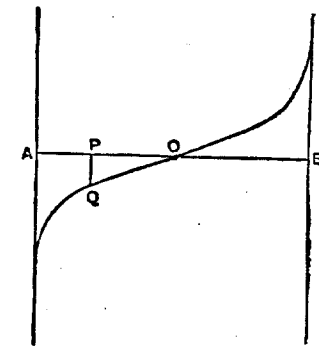


Fig. 2.

row of men standing side by side, the middle part of the curve would be apparently horizontal.

The mathematical conception of the curve is best expressed in Fig. 2, where PQ represents any given deviation from the average value, and the ratio of PO to AB represents the relative probability of its occurrence. The equation to the curve and a discussion of its properties will be found in the *Proceedings of the Royal Society*, No. 198, 1879, by Dr. M'Alister. The title of the paper is the "Law of the Geometric Mean," and it follows one by myself on "The Geometric Mean in Vital and Social Statistics."

We can lay down the ogive of any quality, physical or mental, whenever we are capable of judging which of any two members of the group we are engaged upon has the

larger amount of that quality. I have called this the method of statistics by intercomparison. There is no bodily or mental attribute in any race of individuals that can be so dealt with, whether our judgment in comparing them be guided by common-sense observation or by actual measurement, which cannot be gripped and consolidated into an ogive with a smooth outline, and thenceforward be treated in discussion as a single object.

It is easy to describe any given ogive which has been based upon measurements, so that it may be drawn from the description with approximate truth. Divide AB into a convenient number of fractional parts, and record the height of the ordinates at those parts. In reproducing the ogive from these data, draw a base line of any convenient length, divide it in the same number of fractional parts, erect ordinates of the stated lengths at those parts, connect their tops with a flowing line, and the thing is done. The most convenient fractional parts are the middle (giving the median), the outside quarters (giving the upper and lower quartiles), and similarly the upper and lower octiles or deciles. This is sufficient for most purposes. It leaves only the outer eighths or tenths of the cases undescribed and undetermined, except so far as may be guessed by the run of the intermediate portion of the curve, and it defines all of the intermediate portion with as close an approximation as is needed for ordinary or statistical purposes.

Thus the heights of all but the outer tenths of the whole body of adult males of the English professional classes may be derived from the five following ordinates, measured in inches, of which the outer pair are deciles:—

67·2; 67·5; 68·8; 70·3; 71·4

Many other instances will be found in the Report of the Anthropometric Committee of the British Association in 1881, pp. 245–257.

When we desire to compare any two large statistical groups, we may compare median with median, quartiles with quartiles, and octiles with octiles; or we may proceed

on the method to be described in the next paragraph but one.

We are often called upon to define the position of an individual in his own series, in which case it is most conformable to usage to give his centesimal grade—that is, his place on the base line AB—supposing it to be graduated from 0° to 100° . In reckoning this, a confusion ought to be avoided between “graduation” and “rank,” though it leads to no sensible error in practice. The first of the “park palings” does not stand at A, which is 0° , nor does the hundredth stand at B, which is 100° , for that would make 101 of them; but they stand at $0^\circ\cdot5$ and $99^\circ\cdot5$ respectively. Similarly, all intermediate *ranks* stand half a degree short of the *graduation* bearing the same number. When the class is large, the value of half a place becomes extremely small, and the rank and graduation may be treated as identical.

Examples of method of calculating a centesimal position:—

1. A child A is classed after examination as No. 5 in a class of 27 children; what is his centesimal graduation?

Answer.—If AB be divided into 27 graduations, his rank of No. 5 will correspond to the graduation $4^\circ\cdot5$; therefore if AB be graduated afresh into 100 graduations, his centesimal grade, x , will be found by the Rule of Three, thus—

$$x : 4^\circ\cdot5 :: 100 : 27; x = \frac{4^\circ\cdot5}{27} \cdot 100 = 16^\circ\cdot6.$$


2. Another child B is classed No. 13 in a class of 25.

Answer.—If AB be divided into 25 graduations, the rank of No. 13 will correspond to graduation $12^\circ\cdot5$, whence as before—

$$x : 12^\circ\cdot5 :: 100 : 25; x = \frac{12^\circ\cdot5}{25} \cdot 100 = 50^\circ; \text{ i.e. B is the median.}$$

The second method of comparing two statistical groups, to which I alluded in the last paragraph but one, consists in stating the centesimal grade in the one group that corresponds with the median or any other fractional grade in the other. This, it will be remarked, is a very simple method of comparison, absolutely independent of any theory, and applicable to any statistical groups whatever, whether of physical or of mental qualities. Wherever we can sort in order, there we can apply this method. Thus, in the above examples, suppose A and B had been selected because they

were equal when compared together, then we can concisely express the relative merits of the two classes to which they respectively belong, by saying that 16°·6 in the one is equal to 50° (the median) in the other.

I frequently make statistical records of form and feature, in the streets or in company, without exciting attention, by means of a fine pricker and a piece of paper. The pricker is a converted silver pencil-case, with the usual sliding piece; it is a very small one, and is attached to my watch chain. The pencil part has been taken out and replaced by a fine short needle, the open mouth of the case is covered with a hemispherical cap having a hole in the centre, and the adjustments are such that when the slide is pushed forward as far as it can go, the needle projects no more than one-tenth of an inch. If I then press it upon a piece of paper, held against the ball of my thumb, the paper is indelibly perforated with a fine hole, and the thumb is not wounded. The perforations will not be found to run into one another unless they are very numerous, and if they happen to do so now and then, it is of little consequence in a statistical inquiry. The holes are easily counted at leisure, by holding the paper against the light, and any scrap of paper will serve the purpose. It will be found that the majority of inquiries take the form of "more," "equal to," or "less," so I arrange the paper in a way to present three distinct compartments to the pricker, and to permit of its being held in the correct position and used by the sense of touch alone. I do so by tearing the paper into the form of a cross— that is, maimed in one of its arms—and hold it by the maimed part between the thumb and finger, the head of the cross pointing upward. The head of the cross receives the pricks referring to "more"; the solitary arm that is not maimed, those meaning "the same"; the long foot of the cross those meaning "less." It is well to write the subject of the measurement on the paper before beginning to use it, then more than one set of records can be kept in the pocket at the same time, and be severally added to as occasion serves, without fear of mistaking one for the other.

CHARACTER.

The fundamental and intrinsic differences of character that exist in individuals are well illustrated by those that distinguish the two sexes, and which begin to assert themselves even in the nursery, where all the children are treated alike. One notable peculiarity in the character of the woman is that she is capricious and coy, and has less straightforwardness than the man. It is the same in the female of every sex about the time of pairing, and there can be little doubt as to the origin of the peculiarity. If any race of animals existed in whom the sexual passions of the female were as quickly and as directly stirred as those of the male, each would mate with the first who approached her, and one essential condition of sexual selection would be absent. There would be no more call for competition among the males for the favour of each female; no more fighting for love, in which the strongest male conquers; no more rival display of personal charms, in which the best-looking or best-mannered prevails. The drama of courtship, with its prolonged strivings and doubtful success, would be cut quite short, and the race would degenerate through the absence of that sexual selection for which the protracted preliminaries of love-making give opportunity. The willy-nilly disposition of the female in matters of love is as apparent in the butterfly as in the man, and must have been continuously favoured from the earliest stages of animal evolution down to the present time. It is the factor in the great theory of sexual selection that corresponds to the insistence and directness of the male. Coyness and caprice have in consequence become a heritage of the sex, together with a cohort of allied weaknesses and petty deceits, that men have come to think venial and even amiable in women, but which they would not tolerate among themselves.

Various forms of natural character and temperament would no doubt be found to occur in constant proportions among any large group of persons of the same race, but what those proportions may be has never yet been investigated. It is extremely difficult to estimate it by observations of adults, owing to their habit of restraining natural ill

tendencies, and to their long-practised concealment of those they do not restrain but desire to hide. The necessary observations ought, however, to be easily made on young children in schools, whose manifestations of character are conspicuous, who are simultaneously for months and years under the eye of the same master or mistress, and who are daily classed according to their various merits. I have occasionally asked the opinion of persons well qualified to form them, and who have had experience of teaching, as to the most obvious divisions of character to be found among school children. The replies have differed, but those on which most stress was laid were connected with energy, sociability, desire to attract notice, truthfulness, thoroughness, and refinement.

The varieties of the emotional constitution and of likings and antipathies are very numerous and wide. I may give two instances which I have not seen elsewhere alluded to, merely as examples of variation. One of them was often brought to my notice at the time when the public were admitted to see the snakes fed at the Zoological Gardens. Rabbits, birds, and other small animals were dropped in the different cages, which the snakes, after more or less serpentine action, finally struck with their poison fangs or crushed in their folds. I found it a horrible but a fascinating scene. We lead for the most part such an easy and carpeted existence, screened from the stern realities of life and death, that many of us are impelled to draw aside the curtain now and then, and gaze for a while behind it. This exhibition of the snakes at their feeding-time, which gave to me, as it doubtless did to several others, a sense of curdling of the blood, had no such effect on many of the visitors. I have often seen people—nurses, for instance, and children of all ages—looking unconcernedly and amusedly at the scene. Their indifference was perhaps the most painful element of the whole transaction. Their sympathies were absolutely unawakened. I quote this instance, partly because it leads to another very curious fact that I have noticed as regards the way with which different persons and races regard snakes. I myself have a horror of them, and can only by great self-control, and under a sense of real agitation, force myself to touch one. A considerable proportion of the English race

would feel much as I do; but the remainder do not. I have questioned numbers of persons of both sexes, and have been astonished at the frequency with which I have been assured that they had no shrinking whatever from the sight of the wriggling mysterious reptile. Some persons, as is well known, make pets of them; moreover, I am told that there is no passage in Greek or Latin authors expressive of that form of horror which I myself feel, and which may be compared to what is said to be felt by hydrophobic sufferers at the undulating movements of water. There are numerous allusions in the classics to the venom fang or the crushing power of snakes, but not to an aversion inspired by its form and movement. It was the Greek symbol of Hippocrates and of healing. There is nothing of the kind in Hebrew literature, where the snake is figured as an attractive tempter. In Hindu fables the cobra is the ingenious and intelligent animal, corresponding to the fox in ours. Serpent worship was very widely spread. I therefore doubt whether the antipathy to the snake is very common among mankind, notwithstanding the instinctive terror that their sight inspires in monkeys.

The other instance I may adduce is that of the horror of blood which is curiously different in animals of the same species and in the same animals at different times. I have had a good deal of experience of the behaviour of oxen at the sight of blood, and found it to be by no means uniform. In my South African travels I relied chiefly on half-wild slaughter oxen to feed my large party, and occasionally had to shoot one on every second day. Usually the rest of the drove paid no particular heed to the place of blood, but at other rare times they seemed maddened and performed a curious sort of war-dance at the spot, making buck-leaps, brandishing their horns, and goring at the ground. It was a grotesque proceeding, utterly unlike the usual behaviour of cattle. I only witnessed it once elsewhere, and that was in the Pyrenees, where I came on a herd that was being driven homewards. Each cow in turn, as it passed a particular spot, performed the well-remembered antics. I asked, and learned that a cow had been killed there by a bear a few days previously. The natural horror at blood, and it may be the consequent dislike of red, is common

among mankind; but I have seen a well-dressed child of about four years old poking its finger with a pleased innocent look into the bleeding carcase of a sheep hung up in a butcher's shop, while its nurse was inside.

The subject of character deserves more statistical investigation than it has yet received, and none have a better chance of doing it well than schoolmasters; their opportunities are indeed most enviable. It would be necessary to approach the subject wholly without prejudice, as a pure matter of observation, just as if the children were the fauna and flora of hitherto undescribed species in an entirely new land.

CRIMINALS AND THE INSANE.

Criminality, though not very various in its development, is extremely complex in its origin; nevertheless certain general conclusions are arrived at by the best writers on the subject, among whom Prosper Despine is one of the most instructive. The ideal criminal has marked peculiarities of character: his conscience is almost deficient, his instincts are vicious, his power of self-control is very weak, and he usually detests continuous labour. The absence of self-control is due to ungovernable temper, to passion, or to mere imbecility, and the conditions that determine the particular description of crime are the character of the instincts and of the temptation.

The deficiency of conscience in criminals, as shown by the absence of genuine remorse for their guilt, astonishes all who first become familiar with the details of prison life. Scenes of heartrending despair are hardly ever witnessed among prisoners; their sleep is broken by no uneasy dreams—on the contrary, it is easy and sound; they have also excellent appetites. But hypocrisy is a very common vice; and all my information agrees as to the utter untruthfulness of criminals, however plausible their statements may be.

We must guard ourselves against looking upon vicious instincts as perversions, inasmuch as they may be strictly in accordance with the healthy nature of the man, and, being transmissible by inheritance, may become the normal characteristics of a healthy race, just as the sheep-dog, the retriever,

the pointer, and the bull-dog, have their several instincts. There can be no greater popular error than the supposition that natural instinct is a perfectly trustworthy guide, for there are striking contradictions to such an opinion in individuals of every description of animal. The most that we are entitled to say in any case is, that the prevalent instincts of each race are trustworthy, not those of every individual. But even this is saying too much, because when the conditions under which the race is living have recently been changed, some instincts which were adapted to the old state of things are sure to be fallacious guides to conduct in the new one. A man who is counted as an atrocious criminal in England, and is punished as such by English law in social self-defence, may nevertheless have acted in strict accordance with instincts that are laudable in less civilised societies. The ideal criminal is, unhappily for him, deficient in qualities that are capable of restraining his unkindly or inconvenient instincts; he has neither sympathy for others nor the sense of duty, both of which lie at the base of conscience; nor has he sufficient self-control to accommodate himself to the society in which he has to live, and so to promote his own selfish interests in the long-run. He cannot be preserved from criminal misadventure, either by altruistic sentiments or by intelligently egoistic ones.

The perpetuation of the criminal class by heredity is a question difficult to grapple with on many accounts. Their vagrant habits, their illegitimate unions, and extreme untruthfulness, are among the difficulties of the investigation. It is, however, easy to show that the criminal nature tends to be inherited; while, on the other hand, it is impossible that women who spend a large portion of the best years of their life in prison can contribute many children to the population. The true state of the case appears to be that the criminal population receives steady accessions from those who, without having strongly-marked criminal natures, do nevertheless belong to a type of humanity that is exceedingly ill suited to play a respectable part in our modern civilisation, though it is well suited to flourish under half-savage conditions, being naturally both healthy and prolific. These persons are apt to go to the bad; their daughters

consort with criminals and become the parents of criminals. An extraordinary example of this is afforded by the history of the infamous Jukes family in America, whose pedigree has been made out, with extraordinary care, during no less than seven generations, and is the subject of an elaborate memoir printed in the Thirty-first Annual Report of the Prison Association of New York, 1876. It includes no less than 540 individuals of Jukes blood, of whom a frightful number degraded into criminality, pauperism, or disease.

It is difficult to summarise the results in a few plain figures, but I will state those respecting the fifth generation, through the eldest of the five prolific daughters of the man who is the common ancestor of the race. The total number of these was 123, of whom thirty-eight came through an illegitimate granddaughter, and eighty-five through legitimate grandchildren. Out of the thirty-eight, sixteen have been in jail, six of them for heinous offences, one of these having been committed no less than nine times; eleven others led openly disreputable lives or were paupers; four were notoriously intemperate; the history of three had not been traced, and only four are known to have done well. The great majority of the women consorted with criminals. As to the eighty-five legitimate descendants, they were less flagrantly bad, for only five of them had been in jail, and only thirteen others had been paupers. Now the ancestor of all this mischief, who was born about the year 1730, is described as having been a jolly companionable man, a hunter, and a fisher, averse to steady labour, but working hard and idling by turns, and who had numerous illegitimate children, whose issue has not been traced. He was, in fact, a somewhat good specimen of a half-savage, without any seriously criminal instincts. The girls were apparently attractive, marrying early and sometimes not badly; but the gipsy-like character of the race was unsuited to success in a civilised country. So the descendants went to the bad, and such hereditary moral weaknesses as they may have had, rose to the surface and worked their mischief without check. Cohabiting with criminals, and being extremely prolific, the result was the production of a stock exceeding 500 in number, of a prevalent criminal type. Through disease and intemperance the breed is now rapidly

diminishing; the infant mortality has of late been horrible, but fortunately the women of the present generation bear usually but few children, and many of them are altogether childless.

The criminal classes contain a considerable portion of epileptics and other persons of instable, emotional temperament, subject to nervous explosions that burst out at intervals and relieve the system. The mad outbreaks of women in convict prisons is a most curious phenomenon. Some of them are apt from time to time to have a gradually increasing desire that at last becomes irresistible, to "break out," as it is technically called; that is, to smash and tear everything they can within reach, and to shriek, curse, and howl. At length the fit expends itself; the devil, as it were, leaves them, and they begin to behave again in their ordinary way. The highest form of emotional instability exists in confirmed epilepsy, where its manifestations have often been studied; it is found in a high but somewhat less extraordinary degree in the hysterical and allied affections. In the confirmed epileptic constitution the signs of general instability of nervous action are muscular convulsions, irregularities of bodily temperature, mobile intellectual activity, and extraordinary oscillations between opposed emotional states. I am assured by excellent authority that instable manifestations of extreme piety and of extreme vice are almost invariably shown by epileptics, and should be regarded as a prominent feature of their peculiar constitution. These unfortunate beings see no incongruity between the pious phrases that they pour out at one moment and their vile and obscene language in the next; neither do they show repentance for past misconduct when they are convicted of crimes, however abominable these may be. They are creatures of the moment, possessing no inhibitory check upon their desires and emotions, which drive them headlong hither and thither.

Madness is often associated with epilepsy; in all cases it is a frightful and hereditary disfigurement of humanity, which appears, from the upshot of various conflicting accounts, to be on the increase. The neurotic constitution

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from which it springs is however not without its merits, as has been well pointed out, since a large proportion of the enthusiastic men and women to whose labour the world is largely indebted, have had that constitution, judging from the fact that insanity existed in their families.

The phases of extreme piety and extreme vice which so rapidly succeed one another in the same individual among the epileptics, are more widely separated among those who are simply insane. It has been noticed that among the morbid organic conditions which accompany the show of excessive piety and religious rapture in the insane, none are so frequent as disorders of the sexual organisation. Conversely, the frenzies of religious revivals have not unfrequently ended in gross profligacy. The encouragement of celibacy by the fervent leaders of most creeds, utilises in an unconscious way the morbid connection between an over-restraint of the sexual desires and impulses towards extreme devotion.

Another remarkable phase among the insane consists in strange views about their individuality. They think that their body is made of glass, or that their brains have literally disappeared, or that there are different persons inside them, or that they are somebody else, and so forth. It is said that this phase is most commonly associated with morbid disturbance of the alimentary organs. So in many religions fasting has been used as an agent for detaching the thoughts from the body and for inducing ecstasy.

There is yet a third peculiarity of the insane which is almost universal, that of gloomy segregation. Passengers nearing London by the Great Western Railway must have frequently remarked the unusual appearance of the crowd of lunatics when taking their exercise in the large green enclosure in front of Hanwell Asylum. They almost without exception walk apart in moody isolation, each in his own way, buried in his own thoughts. It is a scene like that fabled in Vathek's hall of Eblis. I am assured that whenever two are seen in company, it is either because their attacks of madness are of an intermittent and epileptic character and they are temporarily sane, or otherwise that they are near recovery. Conversely, the curative influence of social habits is fully recognised, and they are promoted

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by festivities in the asylums. On the other hand, the great teachers of all creeds have made seclusion a prominent religious exercise. In short, by enforcing celibacy, fasting, and solitude, they have done their best towards making men mad, and they have always largely succeeded in inducing morbid mental conditions among their followers.

Floods of light are thrown upon various incidents of devotee life, and also upon the disgusting and not otherwise intelligible character of the sanctimonious scoundrel, by the everyday experiences of the madhouse. No professor of metaphysics, psychology, or religion can claim to know the elements of what he teaches, unless he is acquainted with the ordinary phenomena of idiocy, madness, and epilepsy. He must study the manifestations of disease and congenital folly, as well as those of sanity and high intellect.

GREGARIOUS AND SLAVISH INSTINCTS.

I propose in this chapter to discuss a curious and apparently anomalous group of base moral instincts and intellectual deficiencies, that are innate rather than acquired, by tracing their analogies in the world of brutes and examining the conditions through which they have been evolved. They are the slavish aptitudes from which the leaders of men are exempt, but which are characteristic elements in the disposition of ordinary persons. The vast majority of persons of our race have a natural tendency to shrink from the responsibility of standing and acting alone; they exalt the *vox populi*, even when they know it to be the utterance of a mob of nobodies, into the *vox Dei*, and they are willing slaves to tradition, authority, and custom. The intellectual deficiencies corresponding to these moral flaws are shown by the rareness of free and original thought as compared with the frequency and readiness with which men accept the opinions of those in authority as binding on their judgment. I shall endeavour to prove that the slavish aptitudes in man are a direct consequence of his gregarious nature, which itself is a result of the conditions both of his primeval barbarism and of the forms of his subsequent civilisation. My argument will be, that gregarious brute

animals possess a want of self-reliance in a marked degree ; that the conditions of the lives of these animals have made a want of self-reliance a necessity to them, and that by the law of natural selection the gregarious instincts and their accompanying slavish aptitudes have gradually become evolved. Then I shall argue that our remote ancestors have lived under parallel conditions, and that other causes peculiar to human society have acted up to the present day in the same direction, and that we have inherited the gregarious instincts and slavish aptitudes which have been needed under past circumstances, although in our advancing civilisation they are becoming of more harm than good to our race.

It was my fortune, in earlier life, to gain an intimate knowledge of certain classes of gregarious animals. The urgent need of the camel for the close companionship of his fellows was a never-exhausted topic of curious admiration to me during tedious days of travel across many North African deserts. I also happened to hear and read a great deal about the still more marked gregarious instincts of the llama ; but the social animal into whose psychology I am conscious of having penetrated most thoroughly is the ox of the wild parts of western South Africa. It is necessary to insist upon the epithet "wild," because an ox of tamed parentage has different natural instincts ; for instance, an English ox is far less gregarious than those I am about to describe, and affords a proportionately less valuable illustration to my argument. The oxen of which I speak belonged to the Damaras, and none of the ancestry of these cattle had ever been broken to harness. They were watched from a distance during the day, as they roamed about the open country, and at night they were driven with cries to enclosures, into which they rushed much like a body of terrified wild animals driven by huntsmen into a trap. Their scared temper was such as to make it impossible to lay hold of them by other means than by driving the whole herd into a clump, and lassoing the leg of the animal it was desired to seize, and throwing him to the ground with dexterous force. With oxen and cows of this description, whose nature is no doubt shared by the bulls, I spent more than a year in the closest companionship.

I had nearly a hundred of the beasts broken in for the waggon, for packs, and for the saddle. I travelled an entire journey of exploration on the back of one of them, with others by my side, either labouring at their tasks or walking at leisure ; and with others again who were wholly unbroken, and who served the purpose of an itinerant larder. At night, when there had been no time to erect an enclosure to hold them, I lay down in their midst, and it was interesting to observe how readily they then availed themselves of the neighbourhood of the camp fire and of man, conscious of the protection they afforded from prowling carnivora, whose cries and roars, now distant, now near, continually broke upon the stillness. These opportunities of studying the disposition of such peculiar cattle were not wasted upon me. I had only too much leisure to think about them, and the habits of the animals strongly attracted my curiosity. The better I understood them, the more complex and worthy of study did their minds appear to be. But I am now concerned only with their blind gregarious instincts, which are conspicuously distinct from the ordinary social desires. In the latter they are deficient ; thus they are not amiable to one another, but show on the whole more expressions of spite and disgust than of forbearance or fondness. They do not suffer from an ennui, which society can remove, because their coarse feeding and their ruminant habits make them somewhat stolid. Neither can they love society, as monkeys do, for the opportunities it affords of a fuller and more varied life, because they remain self-absorbed in the middle of their herd, while the monkeys revel together in frolics, scrambles, fights, loves, and chatterings. Yet although the ox has so little affection for, or individual interest in, his fellows, he cannot endure even a momentary severance from his herd. If he be separated from it by stratagem or force, he exhibits every sign of mental agony ; he strives with all his might to get back again, and when he succeeds, he plunges into its middle to bathe his whole body with the comfort of closest companionship. This passionate terror at segregation is a convenience to the herdsman, who may rest assured in the darkness or in the mist that the whole herd is safe whenever he can get a glimpse of a single ox. It is also the cause of great

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inconvenience to the traveller in ox-waggons, who constantly feels himself in a position towards his oxen like that of a host to a company of bashful gentlemen at the time when he is trying to get them to move from the drawing-room to the dinner-table, and no one will go first, but every one backs and gives place to his neighbour. The traveller finds great difficulty in procuring animals capable of acting the part of fore-oxen to his team, the ordinary members of the wild herd being wholly unfitted by nature to move in so prominent and isolated a position, even though, as is the custom, a boy is always in front to persuade or pull them onwards. Therefore, a good fore-ox is an animal of an exceptionally independent disposition. Men who break in wild cattle for harness watch assiduously for those who show a self-reliant nature, by grazing apart or ahead of the rest, and these they break in for fore-oxen. The other cattle may be indifferently devoted to ordinary harness purposes, or to slaughter; but the born leaders are far too rare to be used for any less distinguished service than that which they alone are capable of fulfilling. But a still more exceptional degree of merit may sometimes be met with among the many thousands of Damara cattle. It is possible to find an ox who may be ridden, not indeed as freely as a horse, for I have never heard of a feat like that, but at all events wholly apart from the companionship of others; and an accomplished rider will even succeed in urging him out at a trot from the very middle of his fellows. With respect to the negative side of the scale, though I do not recollect definite instances, I can recall general impressions of oxen showing a deficiency from the average ox standard of self-reliance, about equal to the excess of that quality found in ordinary fore-oxen. Thus I recollect there were some cattle of a peculiarly centripetal instinct, who ran more madly than the rest into the middle of the herd when they were frightened; and I have no reason to doubt from general recollections that the law of deviation from an average would be as applicable to independence of character among cattle as one might expect it theoretically to be. The conclusion to which we are driven is, that few of the Damara cattle have enough originality and independence of disposition to pass unaided through their daily risks in a

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tolerably comfortable manner. They are essentially slavish, and seek no better lot than to be led by any one of their number who has enough self-reliance to accept that position. No ox ever dares to act contrary to the rest of the herd, but he accepts their common determination as an authority binding on his conscience.

An incapacity of relying on oneself and a faith in others are precisely the conditions that compel brutes to congregate and live in herds; and, again, it is essential to their safety in a country infested by large carnivora, that they should keep closely together in herds. No ox grazing alone could live for many days unless he were protected, far more assiduously and closely than is possible to barbarians. The Damara owners confide perhaps 200 cattle to a couple of half-starved youths, who pass their time in dozing or in grubbing up roots to eat. The owners know that it is hopeless to protect the herd from lions, so they leave it to take its chance; and as regards human marauders they equally know that the largest number of cattle watchers they could spare could make no adequate resistance to an attack; they therefore do not send more than two, who are enough to run home and give the alarm to the whole male population of the tribe to run in arms on the tracks of their plundered property. Consequently, as I began by saying, the cattle have to take care of themselves against the wild beasts, and they would infallibly be destroyed by them if they had not safeguards of their own, which are not easily to be appreciated at first sight at their full value. We shall understand them better by considering the precise nature of the danger that an ox runs. When he is alone it is not simply that he is too defenceless, but that he is easily surprised. A crouching lion fears cattle who turn boldly upon him, and he does so with reason. The horns of an ox or antelope are able to make an ugly wound in the paw or chest of a springing beast when he receives its thrust in the same way that an over-eager pugilist meets his adversary's "counter" hit. Hence it is that a cow who has calved by the wayside, and has been temporarily abandoned by the caravan, is never seized by lions. The incident frequently occurs, and as frequently are the cow and calf eventually brought safe to

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the camp; and yet there is usually evidence in footprints of her having sustained a regular siege from the wild beasts; but she is so restless and eager for the safety of her young that no beast of prey can approach her unawares. This state of exaltation is of course exceptional; cattle are obliged in their ordinary course of life to spend a considerable part of the day with their heads buried in the grass, where they can neither see nor smell what is about them. A still larger part of their time must be spent in placid rumination, during which they cannot possibly be on the alert. But a herd of such animals, when considered as a whole, is always on the alert; at almost every moment some eyes, ears, and noses will command all approaches, and the start or cry of alarm of a single beast is a signal to all his companions. To live gregariously is to become a fibre in a vast sentient web overspreading many acres; it is to become the possessor of faculties always awake, of eyes that see in all directions, of ears and nostrils that explore a broad belt of air; it is also to become the occupier of every bit of vantage ground whence the approach of a wild beast might be overlooked. The protective senses of each individual who chooses to live in companionship are multiplied by a large factor, and he thereby receives a maximum of security at a minimum cost of restlessness. When we isolate an animal who has been accustomed to a gregarious life, we take away his sense of protection, for he feels himself exposed to danger from every part of the circle around him, except the one point on which his attention is momentarily fixed; and he knows that disaster may easily creep up to him from behind. Consequently his glance is restless and anxious, and is turned in succession to different quarters; his movements are hurried and agitated, and he becomes a prey to the extremest terror. There can be no room for doubt that it is suitable to the well-being of cattle in a country infested with beasts of prey to live in close companionship, and being suitable, it follows from the law of natural selection that the development of gregarious and therefore of slavish instincts must be favoured in such cattle. It also follows from the same law that the degree in which those instincts are developed is on the whole the most conducive to their safety. If they were more gregarious they

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would crowd so closely as to interfere with each other when grazing the scattered pasture of Damara land; if less gregarious, they would be too widely scattered to keep a sufficient watch against the wild beasts.

I now proceed to consider more particularly why the range of deviation from the average is such that we find about one ox out of fifty to possess sufficient independence of character to serve as a pretty good fore-ox. Why is it not one in five or one in five hundred? The reason undoubtedly is that natural selection tends to give but one leader to each suitably-sized herd, and to repress superabundant leaders. There is a certain size of herd most suitable to the geographical and other conditions of the country; it must not be too large, or the scattered puddles which form their only watering-places for a great part of the year would not suffice; and there are similar drawbacks in respect to pasture. It must not be too small, or it would be comparatively insecure; thus a troop of five animals is far more easy to be approached by a stalking huntsman than one of twenty, and the latter than one of a hundred. We have seen that it is the oxen who graze apart, as well as those who lead the herd, who are recognised by the trainers of cattle as gifted with enough independence of character to become fore-oxen. They are even preferred to the actual leaders of the herd; they dare to move more alone, and therefore their independence is undoubted. The leaders are safe enough from lions, because their flanks and rear are guarded by their followers; but each of those who graze apart, and who represent the superabundant supply of self-reliant animals, have one flank and the rear exposed, and it is precisely these whom the lions take. Looking at the matter in a broad way, we may justly assert that wild beasts trim and prune every herd into compactness, and tend to reduce it into a closely-united body with a single well-protected leader. That the development of independence of character in cattle is thus suppressed below its otherwise natural standard by the influence of wild beasts, is shown by the greater display of self-reliance among cattle whose ancestry for some generations have not been exposed to such danger.

What has been said about cattle, in relation to wild

beasts, applies with more or less obvious modifications to barbarians in relation to their neighbours, but I insist on a close resemblance in the particular circumstance, that many savages are so unamiable and morose as to have hardly any object in associating together, besides that of mutual support. If we look at the inhabitants of the very same country as the oxen I have described, we shall find them congregated into multitudes of tribes, all more or less at war with one another. We shall find that few of these tribes are very small, and few very large, and that it is precisely those that are exceptionally large or small whose condition is the least stable. A very small tribe is sure to be overthrown, slaughtered, or driven into slavery by its more powerful neighbour. A very large tribe falls to pieces through its own unwieldiness, because, by the nature of things, it must be either deficient in centralisation or straitened in food, or both. A barbarian population is obliged to live dispersedly, since a square mile of land will support only a few hunters or shepherds; on the other hand, a barbarian government cannot be long maintained unless the chief is brought into frequent contact with his dependants, and this is geographically impossible when his tribe is so scattered as to cover a great extent of territory. The law of selection must discourage every race of barbarians which supplies self-reliant individuals in such large numbers as to cause tribes of moderate size to lose their blind desire of aggregation. It must equally discourage a breed that is incompetent to supply such men in sufficiently abundant ratio to the rest of the population to ensure the existence of tribes of not too large a size. It must not be supposed that gregarious instincts are equally important to all forms of savage life; but I hold, from what we know of the clannish fighting habits of our forefathers, that they were every whit as applicable to the earlier ancestors of our European stock as they are still to a large part of the black population of Africa.

There is, moreover, an extraordinary power of tyranny invested in the chiefs of tribes and nations of men, that so vastly outweighs the analogous power possessed by the leaders of animal herds as to rank as a special attribute of human society, eminently conducive to slavishness. If any

brute in a herd makes itself obnoxious to the leader, the leader attacks him, and there is a free fight between the two, the other animals looking on the while. But if a man makes himself obnoxious to his chief, he is attacked, not by the chief single-handed, but by the overpowering force of his executive. The rebellious individual has to brave a disciplined host; there are spies who will report his doings, a local authority who will send a detachment of soldiers to drag him to trial; there are prisons ready built to hold him, civil authorities wielding legal powers of stripping him of all his possessions, and official executioners prepared to torture or kill him. The tyrannies under which men have lived, whether under rude barbarian chiefs, under the great despotisms of half-civilised Oriental countries, or under some of the more polished but little less severe governments of modern days, must have had a frightful influence in eliminating independence of character from the human race. Think of Austria, of Naples, and even of France under Napoleon III. It was stated¹ in 1870 that, according to papers found at the Tuileries, 26,642 persons had been arrested in France for political offences since 2nd December, 1851, and that 14,118 had been transported, exiled, or detained in prison.

I have already spoken in *Hereditary Genius* of the large effects of religious persecution in comparatively recent years, on the natural character of races, and shall not say more about it here; but it must not be omitted from the list of steady influences continuing through ancient historical times down, in some degree, to the present day, in destroying the self-reliant, and therefore the nobler races of men.

I hold that the blind instincts evolved under these long-continued conditions have been ingrained into our breed, and that they are a bar to our enjoying the freedom which the forms of modern civilisation are otherwise capable of giving us. A really intelligent nation might be held together by far stronger forces than are derived from the purely gregarious instincts. A nation need not be a mob of slaves, clinging to one another through fear, and for the most part incapable of self-government, and begging to be led; but it might consist of vigorous self-reliant men, knit to one

¹ *Daily News*, 17th October, 1870.

another by innumerable ties, into a strong, tense, and elastic organisation.

The character of the corporate action of a nation in which each man judges for himself, might be expected to possess statistical constancy. It would be the expression of the dominant character of a large number of separate members of the same race, and ought therefore to be remarkably uniform. Fickleness of national character is principally due to the several members of the nation exercising no independent judgment, but allowing themselves to be led hither and thither by the successive journalists, orators, and sentimentalists who happen for the time to have the chance of directing them.

Our present natural dispositions make it impossible for us to attain the ideal standard of a nation of men all judging soberly for themselves, and therefore the slavishness of the mass of our countrymen, in morals and intellect, must be an admitted fact in all schemes of regenerative policy.

The hereditary taint due to the primeval barbarism of our race, and maintained by later influences, will have to be bred out of it before our descendants can rise to the position of free members of an intelligent society: and I may add that the most likely nest at the present time for self-reliant natures is to be found in States founded and maintained by emigrants.

Servility has its romantic side, in the utter devotion of a slave to the lightest wishes and the smallest comforts of his master, and in that of a loyal subject to those of his sovereign; but such devotion cannot be called a reasonable self-sacrifice; it is rather an abnegation of the trust imposed on man to use his best judgment, and to act in the way he thinks the wisest. Trust in authority is a trait of the character of children, of weakly women, and of the sick and infirm, but it is out of place among members of a thriving resolute community during the fifty or more years of their middle life. Those who have been born in a free country feel the atmosphere of a paternal government very oppressive. The hearty and earnest political and individual life which is found when every man has a continual sense of public

responsibility, and knows that success depends on his own right judgment and exertion, is replaced under a despotism by an indolent reliance upon what its master may direct, and by a demoralising conviction that personal advancement is best secured by solicitations and favour.

INTELLECTUAL DIFFERENCES.

It is needless for me to speak here about the differences in intellectual power between different men and different races, or about the convertibility of genius as shown by different members of the same gifted family achieving eminence in varied ways, as I have already written at length on these subjects in *Hereditary Genius* and in *Antecedents of English Men of Science*. It is, however, well to remark that during the fourteen years that have elapsed since the former book was published, numerous fresh instances have arisen of distinction being attained by members of the gifted families whom I quoted as instances of heredity, thus strengthening my arguments.

MENTAL IMAGERY.

Anecdotes find their way into print, from time to time, of persons whose visual memory is so clear and sharp as to present mental pictures that may be scrutinised with nearly as much ease and prolonged attention as if they were real objects. I became interested in the subject and made a rather extensive inquiry into the mode of visual presentation in different persons, so far as could be gathered from their respective statements. It seemed to me that the results might illustrate the essential differences between the mental operations of different men, that they might give some clue to the origin of visions, and that the course of the inquiry might reveal some previously unnoticed facts. It has done all this more or less, and I will explain the results in the present and in the three following chapters.

It is not necessary to trouble the reader with my earlier tentative steps to find out what I desired to learn. After the inquiry had been fairly started it took the form of submitting a certain number of printed questions to a large number of

persons (see Appendix E). There is hardly any more difficult task than that of framing questions which are not likely to be misunderstood, which admit of easy reply, and which cover the ground of inquiry. I did my best in these respects, without forgetting the most important part of all—namely, to tempt my correspondents to write freely in fuller explanation of their replies, and on cognate topics as well. These separate letters have proved more instructive and interesting by far than the replies to the set questions.

The first group of the rather long series of queries related to the illumination, definition, and colouring of the mental image, and were framed thus :—

“Before addressing yourself to any of the Questions on the opposite page, think of some definite object—suppose it is your breakfast-table as you sat down to it this morning—and consider carefully the picture that rises before your mind’s eye.

1. *Illumination*.—Is the image dim or fairly clear? Is its brightness comparable to that of the actual scene?

2. *Definition*.—Are all the objects pretty well defined at the same time, or is the place of sharpest definition at any one moment more contracted than it is in a real scene?

3. *Colouring*.—Are the colours of the china, of the toast, bread-crust, mustard, meat, parsley, or whatever may have been on the table, quite distinct and natural?”

The earliest results of my inquiry amazed me. I had begun by questioning friends in the scientific world, as they were the most likely class of men to give accurate answers concerning this faculty of visualising, to which novelists and poets continually allude, which has left an abiding mark on the vocabularies of every language, and which supplies the material out of which dreams and the well-known hallucinations of sick people are built.

To my astonishment, I found that the great majority of the men of science to whom I first applied protested that mental imagery was unknown to them, and they looked on me as fanciful and fantastic in supposing that the words “mental imagery” really expressed what I believed everybody supposed them to mean. They had no more notion of its true nature than a colour-blind man, who has not discerned his defect, has of the nature of colour. They had a mental deficiency of which they were unaware, and

naturally enough supposed that those who affirmed they possessed it, were romancing. To illustrate their mental attitude it will be sufficient to quote a few lines from the letter of one of my correspondents, who writes :—

“These questions presuppose assent to some sort of a proposition regarding the ‘mind’s eye,’ and the ‘images’ which it sees. . . . This points to some initial fallacy. . . . It is only by a figure of speech that I can describe my recollection of a scene as a ‘mental image’ which I can ‘see’ with my ‘mind’s eye.’ . . . I do not see it . . . any more than a man sees the thousand lines of Sophocles which under due pressure he is ready to repeat. The memory possesses it, etc.”

Much the same result followed inquiries made for me by a friend among members of the French Institute.

On the other hand, when I spoke to persons whom I met in general society, I found an entirely different disposition to prevail. Many men and a yet larger number of women, and many boys and girls, declared that they habitually saw mental imagery, and that it was perfectly distinct to them and full of colour. The more I pressed and cross-questioned them, professing myself to be incredulous, the more obvious was the truth of their first assertions. They described their imagery in minute detail, and they spoke in a tone of surprise at my apparent hesitation in accepting what they said. I felt that I myself should have spoken exactly as they did if I had been describing a scene that lay before my eyes, in broad daylight, to a blind man who persisted in doubting the reality of vision. Re-assured by this happier experience, I recommenced to inquire among scientific men, and soon found scattered instances of what I sought, though in by no means the same abundance as elsewhere. I then circulated my questions more generally among my friends and through their hands, and obtained the replies that are the main subject of this and of the three next chapters. They were from persons of both sexes, and of various ages, and in the end from occasional correspondents in nearly every civilised country.

I have also received batches of answers from various educational establishments both in England and America,

which were made after the masters had fully explained the meaning of the questions, and interested the boys in them. These have the merit of returns derived from a general census, which my other data lack, because I cannot for a moment suppose that the writers of the latter are a haphazard proportion of those to whom they were sent. Indeed I know of some who, disavowing all possession of the power, and of many others who, possessing it in too faint a degree to enable them to express what their experiences really were, in a manner satisfactory to themselves, sent no returns at all. Considerable statistical similarity was, however, observed between the sets of returns furnished by the school-boys and those sent by my separate correspondents, and I may add that they accord in this respect with the oral information I have elsewhere obtained. The conformity of replies from so many different sources which was clear from the first, the fact of their apparent trustworthiness being on the whole much increased by cross-examination (though I could give one or two amusing instances of break-down), and the evident effort made to give accurate answers, have convinced me that it is a much easier matter than I had anticipated to obtain trustworthy replies to psychological questions. Many persons, especially women and intelligent children, take pleasure in introspection, and strive their very best to explain their mental processes. I think that a delight in self-dissection must be a strong ingredient in the pleasure that many are said to take in confessing themselves to priests.

Here, then, are two rather notable results : the one is the proved facility of obtaining statistical insight into the processes of other persons' minds, whatever *à priori* objection may have been made as to its possibility ; and the other is that scientific men, as a class, have feeble powers of visual representation. There is no doubt whatever on the latter point, however it may be accounted for. My own conclusion is, that an over-ready perception of sharp mental pictures is antagonistic to the acquirement of habits of highly-generalised and abstract thought, especially when the steps of reasoning are carried on by words as symbols, and that if the faculty of seeing the pictures was ever possessed by men who think hard, it is very apt to be lost

by disuse. The highest minds are probably those in which it is not lost, but subordinated, and is ready for use on suitable occasions. I am, however, bound to say, that the missing faculty seems to be replaced so serviceably by other modes of conception, chiefly, I believe, connected with the incipient motor sense, not of the eyeballs only but of the muscles generally, that men who declare themselves entirely deficient in the power of seeing mental pictures can nevertheless give life-like descriptions of what they have seen, and can otherwise express themselves as if they were gifted with a vivid visual imagination. They can also become painters of the rank of Royal Academicians.

The facts I am now about to relate are obtained from the returns of 100 adult men, of whom 19 are Fellows of the Royal Society, mostly of very high repute, and at least twice, and I think I may say three times, as many more are persons of distinction in various kinds of intellectual work. As already remarked, these returns taken by themselves do not profess to be of service in a general statistical sense, but they are of much importance in showing how men of exceptional accuracy express themselves when they are speaking of mental imagery. They also testify to the variety of experiences to be met with in a moderately large circle. I will begin by giving a few cases of the highest, of the medium, and of the lowest order of the faculty of visualising. The hundred returns were first classified according to the order of the faculty, as judged to the best of my ability from the whole of what was said in them, and of what I knew from other sources of the writers ; and the number prefixed to each quotation shows its place in the class-list.

VIVIDNESS OF MENTAL IMAGERY.

(From returns, furnished by 100 men, at least half of whom are distinguished in science or in other fields of intellectual work.)

Cases where the faculty is very high.

1. Brilliant, distinct, never blotchy.
2. Quite comparable to the real object. I feel as though I was dazzled, *e.g.* when recalling the sun to my mental vision.

3. In some instances quite as bright as an actual scene.
4. Brightness as in the actual scene.
5. Thinking of the breakfast-table this morning, all the objects in my mental picture are as bright as the actual scene.
6. The image once seen is perfectly clear and bright.
7. Brightness at first quite comparable to actual scene.
8. The mental image appears to correspond in all respects with reality. I think it is as clear as the actual scene.
9. The brightness is perfectly comparable to that of the real scene.
10. I think the illumination of the imaginary image is nearly equal to that of the real one.
11. All clear and bright; all the objects seem to me well defined at the same time.
12. I can see my breakfast-table or any equally familiar thing with my mind's eye, quite as well in all particulars as I can do if the reality is before me.

Cases where the faculty is mediocre.

46. Fairly clear and not incomparable in illumination with that of the real scene, especially when I first catch it. Apt to become fainter when more particularly attended to.
47. Fairly clear, not quite comparable to that of the actual scene. Some objects are more sharply defined than others, the more familiar objects coming more distinctly in my mind.
48. Fairly clear as a general image; details rather misty.
49. Fairly clear, but not equal to the scene. Defined, but not sharply; not all seen with equal clearness.
50. Fairly clear. Brightness probably at least one-half to two-thirds of original. [The writer is a physiologist.] Definition varies very much, one or two objects being much more distinct than the others, but the latter come out clearly if attention be paid to them.
51. Image of my breakfast-table fairly clear, but not quite so bright as the reality. Altogether it is pretty well defined; the part where I sit and its surroundings are pretty well so.
52. Fairly clear, but brightness not comparable to that of the actual scene. The objects are sharply defined; some of them are salient, and others insignificant and dim, but by separate efforts I can take a visualised inventory of the whole table.
53. Details of breakfast-table *when the scene is reflected on* are fairly defined and complete, but I have had a familiarity of many years with my own breakfast-table, and the above would not be the case with a table seen casually unless there were some striking peculiarity in it.
54. I can recall any single object or group of objects, but not

the whole table at once. The things recalled are generally clearly defined. Our table is a long one; I can in my mind pass my eyes all down the table and see the different things distinctly, but not the whole table at once.

Cases where the faculty is at the lowest.

89. Dim and indistinct, yet I can give an account of this morning's breakfast-table; split herrings, broiled chickens, bacon, rolls, rather light-coloured marmalade, faint green plates with stiff pink flowers, the girls' dresses, etc. etc. I can also tell where all the dishes were, and where the people sat (I was on a visit). But my imagination is seldom pictorial except between sleeping and waking, when I sometimes see rather vivid forms.
90. Dim and not comparable in brightness to the real scene. Badly defined with blotches of light; very incomplete.
91. Dim, poor definition; could not sketch from it. I have a difficulty in seeing two images together.
92. Usually very dim. I cannot speak of its brightness, but only of its faintness. Not well defined and very incomplete.
93. Dim, imperfect.
94. I am very rarely able to recall any object whatever with any sort of distinctness. Very occasionally an object or image will recall itself, but even then it is more like a generalised image than an individual image. I seem to be almost destitute of visualising power, as under control.
95. No power of visualising. Between sleeping and waking, in illness and in health, with eyes closed, some remarkable scenes have occasionally presented themselves, but I cannot recall them when awake with eyes open, and by daylight, or under any circumstances whatever when a copy could be made of them on paper. I have drawn both men and places many days or weeks after seeing them, but it was by an effort of memory acting on study at the time, and assisted by trial and error on the paper or canvas, whether in black, yellow, or colour, afterwards.
96. It is only as a figure of speech that I can describe my recollection of a scene as a "mental image" which I can "see" with my "mind's eye." . . . The memory possesses it, and the mind can at will roam over the whole, or study minutely any part.
97. No individual objects, only a general idea of a very uncertain kind.
98. No. My memory is not of the nature of a spontaneous vision, though I remember well where a word occurs in a page, how furniture looks in a room, etc. The ideas not felt to be mental pictures, but rather the symbols of facts.

99. Extremely dim. The impressions are in all respects so dim, vague, and transient, that I doubt whether they can reasonably be called images. They are incomparably less than those of dreams.

100. My powers are zero. To my consciousness there is almost no association of memory with objective visual impressions. I recollect the breakfast-table, but do not see it.

These quotations clearly show the great variety of natural powers of visual representation, and though the returns from which they are taken have, as I said, no claim to be those of 100 Englishmen taken at haphazard, nevertheless, to the best of my judgment, they happen to differ among themselves in much the same way that such returns would have done. I cannot procure a strictly haphazard series for comparison, because in any group of persons whom I may question there are always many too indolent to reply, or incapable of expressing themselves, or who from some fancy of their own are unwilling to reply. Still, as already mentioned, I have got together several groups that approximate to what is wanted, usually from schools, and I have analysed them as well as I could, and the general result is that the above returns may be accepted as a fair representation of the visualising powers of Englishmen. Treating these according to the method described in the chapter of statistics, we have the following results, in which, as a matter of interest, I have also recorded the highest and the lowest of the series:—

Highest.—Brilliant, distinct, never blotchy.

First Suboctile.—The image once seen is perfectly clear and bright.

First Octile.—I can see my breakfast-table or any equally familiar thing with my mind's eye quite as well in all particulars as I can do if the reality is before me.

First Quartile.—Fairly clear; illumination of actual scene is fairly represented. Well defined. Parts do not obtrude themselves, but attention has to be directed to different points in succession to call up the whole.

Middlemost.—Fairly clear. Brightness probably at least from one-half to two-thirds of the original. Definition varies very much, one or two objects being much more distinct than

the others, but the latter come out clearly if attention be paid to them.

Last Quartile.—Dim, certainly not comparable to the actual scene. I have to think separately of the several things on the table to bring them clearly before the mind's eye, and when I think of some things the others fade away in confusion.

Last Octile.—Dim and not comparable in brightness to the real scene. Badly defined, with blotches of light; very incomplete; very little of one object is seen at one time.

Last Suboctile.—I am very rarely able to recall any object whatever with any sort of distinctness. Very occasionally an object or image will recall itself, but even then it is more like a generalised image than an individual one. I seem to be almost destitute of visualising power as under control.

Lowest.—My powers are zero. To my consciousness there is almost no association of memory with objective visual impressions. I recollect the table, but do not see it.

I next proceed to colour, as specified in the third of my questions, and annex a selection from the returns classified on the same principle as in the preceding paragraph.

COLOUR REPRESENTATION.

Highest.—Perfectly distinct, bright, and natural.

First Suboctile.—White cloth, blue china, argand coffee-pot, buff stand with sienna drawing, toast—all clear.

First Octile.—All details seen perfectly.

First Quartile.—Colours distinct and natural till I begin to puzzle over them.

Middlemost.—Fairly distinct, though not certain that they are accurately recalled.

Last Quartile.—Natural, but very indistinct.

Last Octile.—Faint; can only recall colours by a special effort for each.

Last Suboctile.—Power is nil.

Lowest.—Power is nil.

It may seem surprising that one out of every sixteen persons who are accustomed to use accurate expressions should speak of their mental imagery as perfectly clear and bright;

but it is so, and many details are added in various returns emphasising the assertion. One of the commonest of these is to the effect, "If I could draw, I am sure I could draw perfectly from my mental image." That some artists, such as Blake, have really done so is beyond dispute, but I have little doubt that there is an unconscious exaggeration in these returns. My reason for saying so is that I have also returns from artists, who say as follows: "My imagery is so clear, that if I had been unable to draw I should have unhesitatingly said that I could draw from it." A foremost painter of the present day has used that expression. He finds deficiencies and gaps when he tries to draw from his mental vision. There is perhaps some analogy between these images and those of "faces in the fire." One may often fancy an exceedingly well-marked face or other object in the burning coals, but probably everybody will find, as I have done, that it is impossible to draw it, for as soon as its outlines are seriously studied, the fancy flies away.

Mr. Flinders Petrie, a contributor of interesting experiments on kindred subjects to *Nature*, informs me that he habitually works out sums by aid of an imaginary sliding rule, which he sets in the desired way and reads off mentally. He does not usually visualise the whole rule, but only that part of it with which he is at the moment concerned (see Plate II. Fig. 34, where, however, the artist has not put in the divisions very correctly). I think this is one of the most striking cases of accurate visualising power it is possible to imagine.

I have a few returns from chess-players who play games blindfolded; but the powers of such men to visualise the separate boards with different sets of men on the different boards, some ivory, some wood, and so forth, are well known, and I need not repeat them. I will rather give the following extract from an article in the *Pall Mall Gazette*, 27th June 1882, on the recent chess tournament at Vienna:—

"The modern feats of blindfold play (without sight of board) greatly surpass those of twenty years ago. Paul Morphy, the American, was the first who made an especial study of this kind of display, playing some seven or eight games blindfold and simultaneously against various inferior opponents,

and making lucrative exhibitions in this way. His abilities in this line created a scare among other rivals who had not practised this test of memory. Since his day many chess-players who are gifted with strong and clear memory and power of picturing to the mind the ideal board and men, have carried this branch of exhibition play far beyond Morphy's pitch; and, contemporaneously with this development, it has become acknowledged that skill in blindfold play is not an absolute test of similarly relative powers over the board: *e.g.* Blackburne and Zukertort can play as many as sixteen, or even twenty, blindfold games at a time, and win about 80 per cent of them at least. Steinitz, who beats them both in match play, does not essay more than six blindfold at a time. Mason does not, to our knowledge, make any *spécialité* at all of this sort."

I have many cases of persons mentally reading off scores when playing the pianoforte, or manuscript when they are making speeches. One statesman has assured me that a certain hesitation in utterance which he has at times, is due to his being plagued by the image of his manuscript speech with its original erasures and corrections. He cannot lay the ghost, and he puzzles in trying to decipher it.

Some few persons see mentally in print every word that is uttered; they attend to the visual equivalent and not to the sound of the words, and they read them off usually as from a long imaginary strip of paper, such as is unwound from telegraphic instruments. The experiences differ in detail as to size and kind of type, colour of paper, and so forth, but are always the same in the same person.

A well-known frequenter of the Royal Institution tells me that he often craves for an absence of visual perceptions, they are so brilliant and persistent. The Rev. George Henslow speaks of their extreme restlessness; they oscillate, rotate, and change."

It is a mistake to suppose that sharp sight is accompanied by clear visual memory. I have not a few instances in which the independence of the two faculties is emphatically commented on; and I have at least one clear case where great interest in outlines and accurate appreciation of straightness, squareness, and the like, is unaccompanied by the power of visualising. Neither does the faculty go with dreaming. I have cases where it is powerful, and at the same time where dreams are rare and faint or altogether

absent. One friend tells me that his dreams have not the hundredth part of the vigour of his waking fancies.

The visualising and the identifying powers are by no means necessarily combined. A distinguished writer on metaphysical topics assures me that he is exceptionally quick at recognising a face that he has seen before, but that he cannot call up a mental image of any face with clearness.

Some persons have the power of combining in a single perception more than can be seen at any one moment by the two eyes. It is needless to insist on the fact that all who have two eyes see stereoscopically, and therefore somewhat round a corner. Children, who can focus their eyes on very near objects, must be able to comprise in a single mental image much more than a half of any small object they are examining. Animals such as hares, whose eyes are set more on the side of the head than ours, must be able to perceive at one and the same instant more of a panorama than we can. I find that a few persons can, by what they often describe as a kind of touch-sight, visualise at the same moment all round the image of a solid body. Many can do so nearly, but not altogether round that of a terrestrial globe. An eminent mineralogist assures me that he is able to imagine simultaneously all the sides of a crystal with which he is familiar. I may be allowed to quote a curious faculty of my own in respect to this. It is exercised only occasionally and in dreams, or rather in nightmares, but under those circumstances I am perfectly conscious of embracing an entire sphere in a single perception. It appears to lie within my mental eyeball, and to be viewed centripetally.

This power of comprehension is practically attained in many cases by indirect methods. It is a common feat to take in the whole surroundings of an imagined room with such a rapid mental sweep as to leave some doubt whether it has not been viewed simultaneously. Some persons have the habit of viewing objects as though they were partly transparent; thus, if they so dispose a globe in their imagination as to see both its north and south poles at the same time, they will not be able to see its equatorial parts. They can also perceive all the rooms of an imaginary house by a single mental glance, the walls and floors being as if made of glass. A fourth class of persons have the habit of

recalling scenes, not from the point of view whence they were observed, but from a distance, and they visualise their own selves as actors on the mental stage. By one or other of these ways, the power of seeing the whole of an object, and not merely one aspect of it, is possessed by many persons.

The place where the image appears to lie, differs much. Most persons see it in an indefinable sort of way, others see it in front of the eye, others at a distance corresponding to reality. There exists a power which is rare naturally, but can, I believe, be acquired without much difficulty, of projecting a mental picture upon a piece of paper, and of holding it fast there, so that it can be outlined with a pencil. To this I shall recur.

Images usually do not become stronger by dwelling on them; the first idea is commonly the most vigorous, but this is not always the case. Sometimes the mental view of a locality is inseparably connected with the sense of its position as regards the points of the compass, real or imaginary. I have received full and curious descriptions from very different sources of this strong geographical tendency, and in one or two cases I have reason to think it allied to a considerable faculty of geographical comprehension.

The power of visualising is higher in the female sex than in the male, and is somewhat, but not much, higher in public schoolboys than in men. After maturity is reached, the further advance of age does not seem to dim the faculty, but rather the reverse, judging from numerous statements to that effect; but advancing years are sometimes accompanied by a growing habit of hard abstract thinking, and in these cases—not uncommon among those whom I have questioned—the faculty undoubtedly becomes impaired. There is reason to believe that it is very high in some young children, who seem to spend years of difficulty in distinguishing between the subjective and objective world. Language and book-learning certainly tend to dull it.

The visualising faculty is a natural gift, and, like all natural gifts, has a tendency to be inherited. In this faculty the tendency to inheritance is exceptionally strong, as I have abundant evidence to prove, especially in respect to certain rather rare peculiarities, of which I shall speak in the next

chapter, and which, when they exist at all, are usually found among two, three, or more brothers and sisters, parents, children, uncles and aunts, and cousins.

Since families differ so much in respect to this gift, we may suppose that races would also differ, and there can be no doubt that such is the case. I hardly like to refer to civilised nations, because their natural faculties are too much modified by education to allow of their being appraised in an off-hand fashion. I may, however, speak of the French, who appear to possess the visualising faculty in a high degree. The peculiar ability they show in prearranging ceremonials and *fêtes* of all kinds, and their undoubted genius for tactics and strategy, show that they are able to foresee effects with unusual clearness. Their ingenuity in all technical contrivances is an additional testimony in the same direction, and so is their singular clearness of expression. Their phrase, "figurez-vous," or "picture to yourself," seems to express their dominant mode of perception. Our equivalent of "imagine" is ambiguous.

It is among uncivilised races that natural differences in the visualising faculty are most conspicuous. Many of them make carvings and rude illustrations, but only a few have the gift of carrying a picture in their mind's eye, judging by the completeness and firmness of their designs, which show no trace of having been elaborated in that step-by-step manner which is characteristic of draughtsmen who are not natural artists.

Among the races who are thus gifted are the commonly despised, but, as I confidently maintain from personal knowledge of them, the much underrated Bushmen of South Africa. They are no doubt deficient in the natural instincts necessary to civilisation, for they detest a regular life, they are inveterate thieves, and are incapable of withstanding the temptation of strong drink. On the other hand, they have few superiors among barbarians in the ingenious methods by which they supply the wants of a difficult existence, and in the effectiveness and nattiness of their accoutrements. One of their habits is to draw pictures on the walls of caves of men and animals, and to colour them with ochre. These drawings were once numerous, but they have been sadly destroyed by advancing colonisation, and few of them, and

indeed few wild Bushmen, now exist. Fortunately a large and valuable collection of facsimiles of Bushman art was made before it became too late by Mr. Stow, of the Cape Colony, who has very lately sent some specimens of them to this country, in the hope that means might be found for the publication of the entire series. Among the many pictures of animals in each of the large sheets full of them, I was particularly struck with one of an eland as giving a just idea of the precision and purity of their best work. Others, again, were exhibited last summer at the Anthropological Institute by Mr. Hutchinson.

The method by which the Bushmen draw is described in the following extract from a letter written to me by Dr. Mann, the well-known authority on South African matters of science. The boy to whom he refers belonged to a wild tribe living in caves in the Drakenberg, who plundered outlying farms, and were pursued by the neighbouring colonists. He was wounded and captured, then sent to hospital, and subsequently taken into service. He was under Dr. Mann's observation in the year 1860, and has recently died, to the great regret of his employer, Mr. Proudfoot, to whom he became a valuable servant.

Dr. Mann writes as follows:—

"This lad was very skilful in the proverbial Bushman art of drawing animal figures, and upon several occasions I induced him to show me how this was managed among his people. He invariably began by jotting down upon paper or on a slate a number of isolated dots which presented no connection or trace of outline of any kind to the uninitiated eye, but looked like the stars scattered promiscuously in the sky. Having with much deliberation satisfied himself of the sufficiency of these dots, he forthwith began to run a free bold line from one to the other, and as he did so the form of an animal—horse, buffalo, elephant, or some kind of antelope—gradually developed itself. This was invariably done with a free hand, and with such unerring accuracy of touch, that no correction of a line was at any time attempted. I understood from the lad that this was the plan which was invariably pursued by his kindred in making their clever pictures."

It is impossible, I think, for a drawing to be made on this method unless the artist had a clear image in his

mind's eye of what he was about to draw, and was able, in some degree, to project it on the paper or slate.

Other living races have the gift of drawing, but none more so than the Eskimo. I will therefore speak of these and not of the Australian and Tasmanian pictures, nor of the still ruder performances of the old inhabitants of Guiana, nor of those of some North American tribes, as the Iroquois. The Eskimos are geographers by instinct, and appear to see vast tracts of country mapped out in their heads. From the multitude of illustrations of their map-drawing powers, I may mention one of those included in the journals of Captain Hall, at p. 224, which were published in 1879 by the United States Government, under the editorship of Professor J. E. Nourse. It is the facsimile of a chart drawn by an Eskimo who was a thorough barbarian in the accepted sense of the word; that is to say, he spoke no language besides his own uncouth tongue, he was wholly uneducated according to our modern ideas, and he lived in what we should call a savage fashion. This man drew from memory a chart of the region over which he had at one time or another gone in his canoe. It extended from Pond's Bay, in lat. 73° , to Fort Churchill, in lat. $58^{\circ}44'$, over a distance in a straight line of more than 960 nautical, or 1100 English miles, the coast being so indented by arms of the sea that its length is six times as great. On comparing this rough Eskimo outline with the Admiralty chart of 1870, their accordance is remarkable. I have seen many MS. route maps made by travellers a few years since, when the scientific exploration of the world was much less advanced than it is now, and I can confidently say that I have never known of any traveller, white or brown, civilised or uncivilised, in Africa, Asia, or Australia, who, being unprovided with surveying instruments, and trusting to his memory alone, has produced a chart comparable in extent and accuracy to that of this barbarous Eskimo. The aptitude of the Eskimos to draw, is abundantly shown by the numerous illustrations in Rink's work, all of which were made by self-taught men, and are thoroughly realistic.

So much for the wild races of the present day; but even the Eskimo are equalled in their power of drawing by the

men of old times. In ages so far gone by, that the interval that separates them from our own may be measured in perhaps hundreds of thousands of years, when Europe was mostly icebound, a race who, in the opinion of all anthropologists, was closely allied to the modern Eskimo, lived in caves in the more habitable places. Many broken relics of that race have been found; some few of these are of bone engraved with flints or carved into figures, and among these are representations of the mammoth, elk, and reindeer, which, if made by an English labourer with the much better implements at his command, would certainly attract local attention and lead to his being properly educated, and in much likelihood to his becoming a considerable artist if he had intellectual powers to match.

It is not at all improbable that these prehistoric men had the same geographical instincts as the modern Eskimo, whom they closely resemble in every known respect. If so, it is perfectly possible that scraps of charts scratched on bone or stone, of prehistoric Europe, when the distribution of land, sea, and ice was very different to what it is now, may still exist, buried underground, and may reward the zeal of some future cave explorer.

There is abundant evidence that the visualising faculty admits of being developed by education. The testimony on which I would lay especial stress is derived from the published experiences of M. Lecoq de Boisbaudran, late director of the *École Nationale de Dessin*, in Paris, which are related in his *Education de la Mémoire Pittoresque*.¹ He trained his pupils with extraordinary success, beginning with the simplest figures. They were made to study the models thoroughly before they tried to draw them from memory. One favourite expedient was to associate the sight memory with the muscular memory, by making his pupils follow at a distance the outlines of the figures with a pencil held in their hands. After three or four months' practice, their visual memory became greatly strengthened. They had no difficulty in summoning images at will, in holding them steady, and in drawing them. Their copies

¹ Republished in an 8vo, entitled *Enseignement Artistique*. Morel et Cie. Paris, 1879.

were executed with marvellous fidelity, as attested by a commission of the Institute, appointed in 1852 to inquire into the matter, of which the eminent painter Horace Vernet was a member. The present Slade Professor of Fine Arts at University College, M. L  gros, was a pupil of M. de Boisbaudran. He has expressed to me his indebtedness to the system, and he has assured me of his own success in teaching others in a somewhat similar way.

Colonel Moncrieff informs me that, when wintering in 1877 near Fort Garry in North America, young Indians occasionally came to his quarters, and that he found them much interested in any pictures or prints that were put before them. On one of these occasions he saw an Indian tracing the outline of a print from the *Illustrated News* very carefully with the point of his knife. The reason he gave for this odd manoeuvre was, that he would remember the better how to carve it when he returned home.

I could mention instances within my own experience in which the visualising faculty has become strengthened by practice; notably one of an eminent electrical engineer, who had the power of recalling form with unusual precision, but not colour. A few weeks after he had replied to my questions, he told me that my inquiries had induced him to practise his colour memory, and that he had done so with such success that he was become quite an adept at it, and that the newly-acquired power was a source of much pleasure to him.

A useful faculty, easily developed by practice, is that of retaining a retinal picture. A scene is flashed upon the eye; the memory of it persists, and details, which escaped observation during the brief time when it was actually seen, may be analysed and studied at leisure in the subsequent vision.

The memories we should aim at acquiring are, however, such as are based on a thorough understanding of the objects observed. In no case is this more surely effected than in the processes of mechanical drawing, where the intended structure has to be portrayed so exactly in plan, elevation, side view, and sections, that the workman has simply to copy the drawing in metal, wood, or stone, as the case may be. It is undoubtedly the fact that mechanics,

engineers, and architects usually possess the faculty of seeing mental images with remarkable clearness and precision.

A few dots like those used by the Bushmen give great assistance in creating an imaginary picture, as proved by our general habit of working out ideas by the help of marks and rude lines. The use of dolls by children also testifies to the value of an objective support in the construction of mental images. The doll serves as a kind of skeleton for the child to clothe with fantastic attributes, and the less individuality the doll has, the more it is appreciated by the child, who can the better utilise it as a lay figure in many different characters. The chief art of strengthening visual, as well as every other form of memory, lies in multiplying associations; the healthiest memory being that in which all the associations are logical, and toward which all the senses concur in their due proportions. It is wonderful how much the vividness of a recollection is increased when two or more lines of association are simultaneously excited. Thus the inside of a known house is much better visualised when we are looking at its outside than when we are away from it, and some chess-players have told me that it is easier for them to play a game from memory when they have a blank board before them than when they have not.

There is an absence of flexibility in the mental imagery of most persons. They find that the first image they have acquired of any scene is apt to hold its place tenaciously in spite of subsequent need of correction. They find a difficulty in shifting their mental view of an object, and examining it at pleasure in different positions. If they see an object equally often in many positions the memories combine and confuse one another, forming a "composite" blur, which they cannot dissect into its components. They are less able to visualise the features of intimate friends than those of persons of whom they have caught only a single glance. Many such persons have expressed to me their grief at finding themselves powerless to recall the looks of dear relations whom they had lost, while they had no difficulty in recollecting faces that were uninteresting to them.

Others have a complete mastery over their mental images. They can call up the figure of a friend and make it sit on a chair or stand up at will; they can make it turn round and

attitudinise in any way, as by mounting it on a bicycle or compelling it to perform gymnastic feats on a trapeze. They are able to build up elaborate geometric structures bit by bit in their mind's eye, and add, subtract, or alter at will and at leisure. This free action of a vivid visualising faculty is of much importance in connection with the higher processes of generalised thought, though it is commonly put to no such purpose, as may be easily explained by an example. Suppose a person suddenly to accost another with the following words:—"I want to tell you about a boat." What is the idea that the word "boat" would be likely to call up? I tried the experiment with this result. One person, a young lady, said that she immediately saw the image of a rather large boat pushing off from the shore, and that it was full of ladies and gentlemen, the ladies being dressed in white and blue. It is obvious that a tendency to give so specific an interpretation to a general word is absolutely opposed to philosophic thought. Another person, who was accustomed to philosophy, said that the word "boat" had aroused no definite image, because he had purposely held his mind in suspense. He had exerted himself not to lapse into any one of the special ideas that he felt the word boat was ready to call up, such as a skiff, wherry, barge, launch, punt, or dingy. Much more did he refuse to think of any one of these with any particular freight or from any particular point of view. A habit of suppressing mental imagery must therefore characterise men who deal much with abstract ideas; and as the power of dealing easily and firmly with these ideas is the surest criterion of a high order of intellect, we should expect that the visualising faculty would be starved by disuse among philosophers, and this is precisely what I found on inquiry to be the case.

But there is no reason why it should be so, if the faculty is free in its action, and not tied to reproduce hard and persistent forms; it may then produce generalised pictures out of its past experiences quite automatically. It has no difficulty in reducing images to the same scale, owing to our constant practice in watching objects as they approach or recede, and consequently grow or diminish in apparent size. It readily shifts images to any desired point of the field of view, owing to our habit of looking at bodies in motion to

the right or left, upward or downward. It selects images that present the same aspect, either by a simple act of memory or by a feat of imagination that forces them into the desired position, and it has little or no difficulty in reversing them from right to left, as if seen in a looking-glass. In illustration of these generalised mental images, let us recur to the boat, and suppose the speaker to continue as follows:—"The boat was a four-oared racing-boat, it was passing quickly to the left just in front of me, and the men were bending forward to take a fresh stroke." Now at this point of the story the listener ought to have a picture well before his eye. It ought to have the distinctness of a real four-oar going to the left, at the moment when many of its details still remained unheeded, such as the dresses of the men and their individual features. It would be the generic image of a four-oar formed by the combination into a single picture of a great many sight memories of those boats.

In the highest minds a descriptive word is sufficient to evoke crowds of shadowy associations, each striving to manifest itself. When they differ so much from one another as to be unfitted for combination into a single idea, there will be a conflict, each being prevented by the rest from obtaining sole possession of the field of consciousness. There could, therefore, be no definite imagery so long as the aggregate of all the pictures that the word suggested of objects presenting similar aspects, reduced to the same size, and accurately superposed, resulted in a blur; but a picture would gradually evolve as qualifications were added to the word, and it would attain to the distinctness and vividness of a generic image long before the word had been so restricted as to be individualised. If the intellect be slow, though correct in its operations, the associations will be few, and the generalised image based on insufficient data. If the visualising power be faint, the generalised image will be indistinct.

I cannot discover any closer relation between high visualising power and the intellectual faculties than between verbal memory and those same faculties. That it must afford immense help in some professions stands to reason, but in ordinary social life the possession of a high visualising power, as of a high verbal memory, may pass quite unobserved.

I have to the last failed in anticipating the character of the answers that my friends would give to my inquiries, judging from my previous knowledge of them; though I am bound to say that, having received their answers, I could usually persuade myself that they were justified by my recollections of their previous sayings and conduct generally.

The faculty is undoubtedly useful in a high degree to inventive mechanics, and the great majority of those whom I have questioned have spoken of their powers as very considerable. They invent their machines as they walk, and see them in height, breadth, and depth as real objects, and they can also see them in action. In fact, a periodic action of any kind appears to be easily recalled. But the powers of other men are considerably less; thus an engineer officer who has himself great power of visual memory, and who has superintended the mathematical education of cadets, doubts if one in ten can visualise an object in three dimensions. I should have thought the faculty would be common among geometers, but many of the highest seem able somehow to get on without much of it. There is a curious dictum of Napoleon I. quoted in Hume's *Précis of Modern Tactics*, p. 15, of which I can neither find the original authority nor do I fully understand the meaning. He is reported to have said that "there are some who, from some physical or moral peculiarity of character, form a picture (*tableau*) of everything. No matter what knowledge, intellect, courage, or good qualities they may have, these men are unfit to command." It is possible that "tableau" should be construed rather in the sense of a pictorial composition, which, like an epigrammatic sentence, may be very complete and effective, but not altogether true.

There can, however, be no doubt as to the utility of the visualising faculty when it is duly subordinated to the higher intellectual operations. A visual image is the most perfect form of mental representation wherever the shape, position, and relations of objects in space are concerned. It is of importance in every handicraft and profession where design is required. The best workmen are those who visualise the whole of what they propose to do, before they take a tool in their hands. The village smith and the carpenter who are employed on odd jobs employ it no less for their work than

the mechanic, the engineer, and the architect. The lady's maid who arranges a new dress requires it for the same reason as the decorator employed on a palace, or the agent who lays out great estates. Strategists, artists of all denominations, physicists who contrive new experiments, and in short all who do not follow routine, have need of it. The pleasure its use can afford is immense. I have many correspondents who say that the delight of recalling beautiful scenery and great works of art is the highest that they know; they carry whole picture galleries in their minds. Our bookish and wordy education tends to repress this valuable gift of nature. A faculty that is of importance in all technical and artistic occupations, that gives accuracy to our perceptions, and justness to our generalisations, is starved by lazy disuse, instead of being cultivated judiciously in such a way as will on the whole bring the best return. I believe that a serious study of the best method of developing and utilising this faculty, without prejudice to the practice of abstract thought in symbols, is one of the many pressing desiderata in the yet unformed science of education.

NUMBER-FORMS.

Persons who are imaginative almost invariably think of *numerals* in some form of visual imagery. If the idea of *six* occurs to them, the word "six" does not sound in their mental ear, but the figure 6 in a written or printed form rises before their mental eye. The clearness of the images of numerals, and the number of them that can be mentally viewed at the same time, differs greatly in different persons. The most common case is to see only two or three figures at once, and in a position too vague to admit of definition. There are a few persons in whom the visualising faculty is so low that they can mentally see neither numerals nor anything else; and again there are a few in whom it is so high as to give rise to hallucinations. Those who are able to visualise a numeral with a distinctness comparable to reality, and to behold it as if it were before their eyes, and not in some sort of dreamland, will define the direction in which it seems to lie, and the distance at which it appears to be. If they were looking at a ship on the horizon at the

moment that the figure 6 happened to present itself to their minds, they could say whether the image lay to the left or right of the ship, and whether it was above or below the line of the horizon; they could always point to a definite spot in space, and say with more or less precision that that was the direction in which the image of the figure they were thinking of, first appeared.

Now the strange psychological fact to which I desire to draw attention, is that among persons who visualise figures clearly there are many who notice that the image of the same figure invariably makes its first appearance in the same direction, and at the same distance. Such a person would always see the figure when it first appeared to him at (we may suppose) one point of the compass to the left of the line between his eye and the ship, at the level of the horizon, and at twenty feet distance. Again, we may suppose that he would see the figure 7 invariably half a point to the left of the ship, at an altitude equal to the sun's diameter above the horizon, and at thirty feet distance; similarly for all the other figures. Consequently, when he thinks of the series of numerals 1, 2, 3, 4, etc., they show themselves in a definite pattern that always occupies an identical position in his field of view with respect to the direction in which he is looking.

Those who do not see figures with the same objectivity, use nevertheless the same expressions with reference to their mental field of view. They can draw what they see in a manner fairly satisfactory to themselves, but they do not locate it so strictly in reference to their axis of sight and to the horizontal plane that passes through it. It is with them as in dreams, the imagery is before and around, but the eyes during sleep are turned inwards and upwards.

The pattern or "Form" in which the numerals are seen is by no means the same in different persons, but assumes the most grotesque variety of shapes, which run in all sorts of angles, bends, curves, and zigzags as represented in the various illustrations to this chapter. The drawings, however, fail in giving the idea of their apparent size to those who see them; they usually occupy a wider range than the mental eye can take in at a single glance, and compel it to wander. Sometimes they are nearly panoramic.

These Forms have for the most part certain characteristics in common. They are stated in all cases to have been in existence, so far as the earlier numbers in the Form are concerned, as long back as the memory extends; they come into view quite independently of the will, and their shape and position, at all events in the mental field of view, is nearly invariable. They have other points in common to which I shall shortly draw attention, but first I will endeavour to remove all doubt as to the authenticity and trustworthiness of these statements.

I see no "Form" myself, and first ascertained that such a thing existed through a letter from Mr. G. Bidder, Q.C., in which he described his own case as a very curious peculiarity. I was at the time making inquiries about the strength of the visualising faculty in different persons, and among the numerous replies that reached me I soon collected ten or twelve other cases in which the writers spoke of their seeing numerals in definite forms. Though the information came from independent sources, the expressions used were so closely alike that they strongly corroborated one another. Of course I eagerly followed up the inquiry, and when I had collected enough material to justify publication, I wrote an account which appeared in *Nature* on 15th January 1880, with several illustrations. This has led to a wide correspondence and to a much-increased store of information, which enables me to arrive at the following conclusions. The answers I received whenever I have pushed my questions, have been straightforward and precise. I have not unfrequently procured a second sketch of the Form even after more than two years' interval, and found it to agree closely with the first one. I have also questioned many of my own friends in general terms as to whether they visualise numbers in any particular way. The large majority are unable to do so. But every now and then I meet with persons who possess the faculty, and I have become familiar with the quick look of intelligence with which they receive my question. It is as though some chord had been struck which had not been struck before, and the verbal answers they give me are precisely of the same type as those written ones of which I have now so many. I cannot doubt of the authenticity of independent statements

which closely confirm one another, nor of the general accuracy of the accompanying sketches, because I find now that my collection is large enough for classification, that they might be arranged in an approximately continuous series. I am often told that the peculiarity is common to the speaker and to some near relative, and that they had found such to be the case by accident. I have the strongest evidence of its hereditary character after allowing, and over-allowing, for all conceivable influences of education and family tradition.

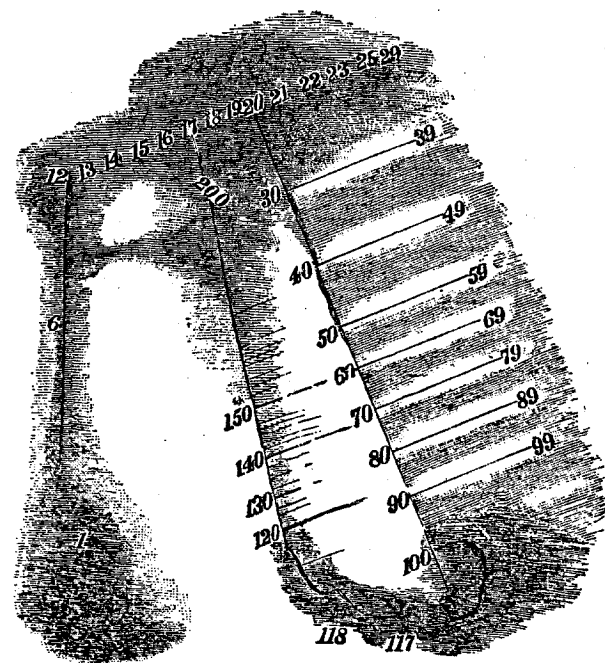
Last of all, I took advantage of the opportunity afforded by a meeting of the Anthropological Institute to read a memoir there on the subject, and to bring with me many gentlemen well known in the scientific world, who have this habit of seeing numerals in Forms, and whose diagrams were suspended on the walls. Amongst them are Mr. G. Bidder, Q.C., the Rev. Mr. G. Henslow, the botanist; Prof. Schuster, F.R.S., the physicist; Mr. Roget, Mr. Woodd Smith, and Colonel Yule, C.B., the geographer. These diagrams are given in Plate I. Figs. 20-24. I wished that some of my foreign correspondents could also have been present, such as M. Antoine d'Abbadie, the well-known French traveller and Membre de l'Institut, and Baron v. Osten Sacken, the Russian diplomatist and entomologist, for they had given and procured me much information.

I feel sure that I have now said enough to remove doubts as to the authenticity of my data. Their trustworthiness will, I trust, be still more apparent as I proceed; it has been abundantly manifest to myself from the internal evidences in a large mass of correspondence, to which I can unfortunately do no adequate justice in a brief memoir. It remains to treat the data in the same way as any other scientific facts and to extract as much meaning from them as possible.

The peculiarity in question is found, speaking very roughly, in about 1 out of every 30 adult males or 15 females. It consists in the sudden and automatic appearance of a vivid and invariable "Form" in the mental field of view, whenever a numeral is thought of, in which each numeral has its own definite place. This Form may consist of a mere line of any shape, of a peculiarly arranged row or rows of figures, or of a shaded space.

I give woodcuts of representative specimens of these Forms, and very brief descriptions of them extracted from the letters of my correspondents. Sixty-three other diagrams on a smaller scale will be found in Plates I., II. and III., and two more which are coloured are given in Plate IV.

D. A. "From the very first I have seen numerals up to nearly 200, range themselves always in a particular manner, and

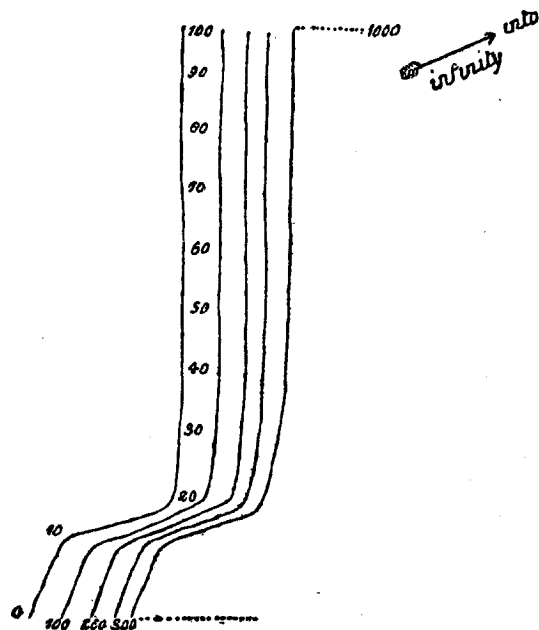


in thinking of a number it always takes its place in the figure. The more attention I give to the properties of numbers and their interpretations, the less I am troubled with this clumsy framework for them, but it is indelible in my mind's eye even when for a long time less consciously so. The higher numbers are to me quite abstract and unconnected with a shape. This rough and untidy¹ production is the best I can do towards repre-

¹ The engraver took much pains to interpret the meaning of the rather faint but carefully made drawing, by strengthening some of the shades. The result was very very satisfactory, judging from the author's own view of it, which is as follows:—"Certainly if the engraver has been as successful with all the other representations as with that of my shape and its accompaniments, your article must be entirely correct."

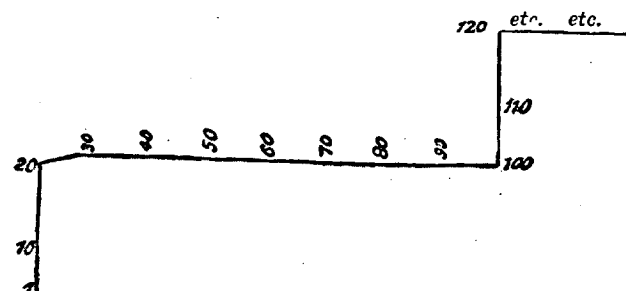
sending what I see. There was a little difficulty in the performance, because it is only by catching oneself at unawares, so to speak, that one is quite sure that what one sees is not affected by temporary imagination. But it does not seem much like, chiefly because the mental picture never seems *on* the flat but *in* a thick, dark gray atmosphere deepening in certain parts, especially where 1 emerges, and about 20. How I get from 100 to 120 I hardly know, though if I could require these figures a few times without thinking of them on purpose, I should soon notice. About 200 I lose all framework. I do not see the actual figures very distinctly, but what there is of them is distinguished from the dark by a thin whitish tracing. It is the place they take and the shape they make collectively which is invariable. Nothing more definitely takes its place than a person's age. The person is usually there so long as his age is in mind."

T. M. "The representation I carry in my mind of the numerical series is quite distinct to me, so much so that I cannot think of any number but I at once see it (as it were) in its peculiar place in the diagram. My remembrance of dates is also nearly entirely dependent on a clear mental vision of their *loci* in the diagram. This, as nearly as I can draw it, is the following :—



It is only approximately correct (if the term 'correct' be at all applicable). The numbers seem to approach more closely as I ascend from 10 to 20, 30, 40, etc. The lines embracing a hundred numbers also seem to approach as I go on to 400, 500, to 1000. Beyond 1000 I have only the sense of an infinite line in the direction of the arrow, losing itself in darkness towards the millions. Any special number of thousands returns in my mind to its position in the parallel lines from 1 to 1000. The diagram was present in my mind from early childhood; I remember that I learnt the multiplication table by reference to it at the age of seven or eight. I need hardly say that the impression is not that of perfectly straight lines, I have therefore used no ruler in drawing it."

J. S. "The figures are about a quarter of an inch in length, and in ordinary type. They are black on a white ground. The numeral 200 generally takes the place of 100 and obliterates it. There is no light or shade, and the picture is invariable."



In some cases, the mental eye has to travel along the faintly-marked and blank paths of a Form, to the place where the numeral that is wanted is known to reside, and then the figure starts into sight. In other cases all the numerals, as far as 100 or more, are faintly seen at once, but the figure that is wanted grows more vivid than its neighbours; in one of the cases there is, as it were, a chain, and the particular link rises as if an unseen hand had lifted it. The Forms are sometimes variously coloured, occasionally very brilliantly (see Plate IV.). In all of these the definition and illumination vary much in different parts. Usually the Forms fade away into indistinctness after 100; sometimes they come to a dead stop. The higher numbers very rarely fill so large a space in the Forms as the lower

ones, and the diminution of space occupied by them is so increasingly rapid that I thought it not impossible they might diminish according to some geometrical law, such as that which governs sensitivity. I took many careful measurements and averaged them, but the result did not justify the supposition.

It is beyond dispute that these forms originate at an early age; they are subsequently often developed in boyhood and youth so as to include the higher numbers, and, among mathematical students, the negative values.

Nearly all of my correspondents speak with confidence of their Forms having been in existence as far back as they recollect. One states that he knows he possessed it at the age of four; another, that he learnt his multiplication table by the aid of the elaborate mental diagram he still uses. Not one in ten is able to suggest any clue as to their origin. They cannot be due to anything written or printed, because they do not simulate what is found in ordinary writings or books.

About one-third of the figures are curved to the left, two-thirds to the right; they run more often upward than downward. They do not commonly lie in a single plane. Sometimes a Form has twists as well as bends, sometimes it is turned upside down, sometimes it plunges into an abyss of immeasurable depth, or it rises and disappears in the sky. My correspondents are often in difficulties when trying to draw them in perspective. One sent me a stereoscopic picture photographed from a wire that had been bent into the proper shape. In one case the Form proceeds at first straightforward, then it makes a backward sweep high above head, and finally recurves into the pocket, of all places! It is often sloped upwards at a slight inclination from a little below the level of the eye, just as objects on a table would appear to a child whose chin was barely above it.

It may seem strange that children should have such bold conceptions as of curves sweeping loftily upward or downward to immeasurable depths, but I think it may be accounted for by their much larger personal experience of the vertical dimension of space than adults. They are lifted, tossed and swung, but adults pass their lives very much on a level, and only judge of heights by inference

from the picture on their retina. Whenever a man first ventures up in a balloon, or is let, like a gatherer of sea-birds' eggs, over the face of a precipice, he is conscious of having acquired a much extended experience of the third dimension of space.

The character of the forms under which historical dates are visualised contrast strongly with the ordinary Number-Forms. They are sometimes copied from the numerical ones, but they are more commonly based both clearly and consciously on the diagrams used in the schoolroom or on some recollected fancy.

The months of the year are usually perceived as ovals, and they as often follow one another in a reverse direction to those of the figures on the clock, as in the same direction. It is a common peculiarity that the months do not occupy equal spaces, but those that are most important to the child extend more widely than the rest. There are many varieties as to the topmost month; it is by no means always January.

The Forms of the letters of the alphabet, when imaged, as they sometimes are, in that way, are equally easy to be accounted for, therefore the ordinary Number-Form is the oldest of all, and consequently the most interesting. I suppose that it first came into existence when the child was learning to count, and was used by him as a natural mnemonic diagram, to which he referred the spoken words "one," "two," "three," etc. Also, that as soon as he began to read, the visual symbol figures supplanted their verbal sounds, and permanently established themselves on the Form. It therefore existed at an earlier date than that at which the child began to learn to read; it represents his mental processes at a time of which no other record remains; it persists in vigorous activity, and offers itself freely to our examination.

The teachers of many schools and colleges, some in America, have kindly questioned their pupils for me; the results are given in the two first columns of Plate I. It appears that the proportion of young people who see numerals in Forms is greater than that of adults. But for the most part their Forms are neither well defined nor complicated. I conclude that when they are too faint to be of service they are gradually neglected, and become wholly forgotten; while

if they are vivid and useful, they increase in vividness and definition by the effect of habitual use. Hence, in adults, the two classes of seers and non-seers are rather sharply defined, the connecting link of intermediate cases which is observable in childhood having disappeared.

These Forms are the most remarkable existing instances of what is called "topical" memory, the essence of which appears to lie in the establishment of a more exact system of division of labour in the different parts of the brain, than is usually carried on. Topical aids to memory are of the greatest service to many persons, and teachers of mnemonics make large use of them, as by advising a speaker to mentally associate the corners, etc., of a room with the chief divisions of the speech he is about to deliver. Those who feel the advantage of these aids most strongly are the most likely to cultivate the use of numerical forms. I have read many books on mnemonics, and cannot doubt their utility to some persons; to myself the system is of no avail whatever, but simply a stumbling-block, nevertheless I am well aware that many of my early associations are fanciful and silly.

The question remains, why do the lines of the Forms run in such strange and peculiar ways? the reply is, that different persons have natural fancies for different lines and curves. Their handwriting shows this, for handwriting is by no means solely dependent on the balance of the muscles of the hand, causing such and such strokes to be made with greater facility than others. Handwriting is greatly modified by the fashion of the time. It is in reality a compromise between what the writer most likes to produce, and what he can produce with the greatest ease to himself. I am sure, too, that I can trace a connection between the general look of the handwritings of my various correspondents and the lines of their Forms. If a spider were to visualise numerals, we might expect he would do so in some web-shaped fashion, and a bee in hexagons. The definite domestic architecture of all animals as seen in their nests and holes shows the universal tendency of each species to pursue their work according to certain definite lines and shapes, which are to them instinctive and in no way, we may presume, logical. The same is seen in the groups and formations of flocks of gregarious animals and in the flights of gregarious birds, among which

the wedge-shaped phalanx of wild ducks and the huge globe of soaring storks are as remarkable as any.

I used to be much amused during past travels in watching the different lines of search that were pursued by different persons in looking for objects lost on the ground, when the encampment was being broken up. Different persons had decided idiosyncracies, so much so that if their travelling line of sight could have scored a mark on the ground, I think the system of each person would have been as characteristic as his Number-Form.

Children learn their figures to some extent by those on the clock. I cannot, however, trace the influence of the clock on the Forms in more than a few cases. In two of them the clock-face actually appears, in others it has evidently had a strong influence, and in the rest its influence is indicated, but nothing more. I suppose that the complex Roman numerals in the clock do not fit in sufficiently well with the simpler ideas based upon the Arabic ones.

The other traces of the origin of the Forms that appear here and there, are dominoes, cards, counters, an abacus, the fingers, counting by coins, feet and inches (a yellow carpenter's rule appears in one case with 56 in large figures upon it), the country surrounding the child's home, with its hills and dales, objects in the garden (one scientific man sees the old garden walk and the numeral 7 at a tub sunk in the ground where his father filled his watering-pot). Some associations seem connected with the objects spoken of in the doggerel verses by which children are often taught their numbers.

But the paramount influence proceeds from the names of the numerals. Our nomenclature is perfectly barbarous, and that of other civilised nations is not better than ours, and frequently worse, as the French "quatre-vingt dix-huit," or "four score, ten and eight," instead of eighty-eight. We speak of ten, eleven, twelve, thirteen, etc., in defiance of the beautiful system of decimal notation in which we write those numbers. What we see is one-naught, one-one, one-two, etc., and we should pronounce on that principle, with this proviso, that the word for the "one" having to show both the place and the value, should have a sound suggestive of "one" but not identical with it. Let us suppose it to be the

letter *o* pronounced short as in "on," then instead of ten, eleven, twelve, thirteen, etc., we might say *on-naught*, *on-one*, *on-two*, *on-three*, etc.

The conflict between the two systems creates a perplexity, to which conclusive testimony is borne by these numerical forms. In most of them there is a marked hitch at the 12, and this repeats itself at the 120. The run of the lines between 1 and 20 is rarely analogous to that between 20 and 100, where it usually first becomes regular. The teens frequently occupy a larger space than their due. It is not easy to define in words the variety of traces of the difficulty and annoyance caused by our unscientific nomenclature, that are portrayed vividly, and, so to speak, painfully in these pictures. They are indelible scars that testify to the effort and ingenuity with which a sort of compromise was struggled for and has finally been effected between the verbal and decimal systems. I am sure that this difficulty is more serious and abiding than has been suspected, not only from the persistency of these twists, which would have long since been smoothed away if they did not continue to subserve some useful purpose, but also from experiments on my own mind. I find I can deal mentally with simple sums with much less strain if I audibly conceive the figures as *on-naught*, *on-one*, etc., and I can both dictate and write from dictation with much less trouble when that system or some similar one is adopted. I have little doubt that our nomenclature is a serious though unsuspected hindrance to the ready adoption by the public of a decimal system of weights and measures. Three quarters of the Forms bear a duodecimal impress.

I will now give brief explanations of the Number-Forms drawn in Plates I., II., and III., and in the two front figures in Plate IV.

DESCRIPTION OF PLATE I.

Fig. 1 is by Mr. Walter Larden, science-master of Cheltenham College, who sent me a very interesting and elaborate account of his own case, which by itself would make a memoir; and he has collected other information for me. The Number-Forms of one of his colleagues and of that

PLATE I.
Examples of Number-Forms.

