

## CHAPTER XI

### PSYCHOLOGICAL INVESTIGATIONS

“While recognising the awful mystery of conscious existence and the inscrutable background of evolution, we find that as the foremost outcome of many and long birth-throes, intelligent and kindly man finds himself in being. He knows how petty he is, but he also perceives that he stands here on this particular earth, at this particular time, as the heir of untold ages and in the van of circumstance. He ought therefore, I think, to be less diffident than he is usually instructed to be, and to rise to the conception that he has a considerable function to perform in the order of events, and that his exertions are needed. It seems to me that he should look upon himself more as a freeman, with power of shaping the course of future humanity, and that he should look upon himself less as the subject of a despotic government, in which case it would be his chief merit to depend wholly upon what had been regulated for him, and to render abject obedience.”

FRANCIS GALTON, *Inquiries into Human Faculty*, 1883.

*Introductory.* We have marked the transition of Galton's mind from interest in geographical to interest in anthropological studies. But once deeply interested in physical anthropology, he very soon grasped that the superficial anthropometric characters were no adequate index to the real man himself. Probably to the day of his death he would have been unwilling to admit that the size of a man's head had no real prognostic value as a measure of his intelligence. But he gradually came to the conclusion that the static anthropometric superficial characters afforded little index to a man's mentality, and from the middle of the seventies onwards Galton's thoughts turned more and more to the psychometric side of anthropology. He thus grew to have less and less faith in any superficial or bodily measurements being of psychological importance. He did not, I think, consider whether the dynamic anthropometric characters were more closely related than the static to mental efficiency; indeed the measurement of the correlation between the physiological functioning of the various organs of the body and its psychical activities is a problem of quite recent days; and we stand only at its threshold as far as scientific—by which I understand quantitative—solution goes. Galton was, however, among the first, if not absolutely the first, in this country to insist that anthropometry cannot make real progress without psychometric observation and experiment. He was the first to insist upon the importance of experimental psychology—and he approached the subject from the standpoint of the anthropologist. It is perfectly true that Germans were working at experimental psychology at least as early as Galton. Wundt reversed Galton's process and passed with



doubtful success from psychology to anthropology<sup>1</sup>. But it seems to me that the work of the two men was wholly independent and that Galton was the pioneer of experimental psychology in this country. Indeed very little real progress was possible in this new science without the aid of Galton's correlational calculus, and psychologists not only owe Galton a great debt for his suggestive experiments and actual apparatus, but also for those mathematical methods which are now the commonplace tools of psychological investigation.

I do not speak without careful examination of the facts, when I claim for Galton a pioneer position in experimental psychology in Great Britain. His *Inquiries into Human Faculty and its Development* appeared in 1883, but it was a *résumé* of work which had occupied Galton for at least seven years previously, and if we include folk psychology, for twelve years<sup>2</sup>. Galton's notebooks and queries to himself and friends begin as early as 1876, and one docket is inscribed by himself "Psychometric Inquiries 1876."

In March, 1883, Galton printed and issued a four-page pamphlet in the preparation of which he had the aid of the late Professor G. Croom-Robertson<sup>3</sup>. Galton opens with the statement that:

"I am endeavouring to compile a list of instruments suitable for the outfit of an Anthropometric Laboratory, especially those for testing and measuring the efficiency of the various mental and bodily powers. The simplest instruments and methods for adequately determining the delicacy of the several senses are now under discussion. After these shall have been disposed of, the next step will be to consider the methods of measuring the quickness and the accuracy of the Higher Mental Processes. Any information you can give, or suggestions that you can make, will be thankfully accepted."

The remainder of the pamphlet deals with the measurement of sensitivity, giving an analysis of the facts of sensation, and a programme of what has to be measured in (I) Skin-sensation, (*a*) Temperature, and (*b*) Touch, (II) Sight, (III) Hearing, (IV) Smell, (V) Taste, and (VI) the so-called muscular sense. Much of this is of course very familiar now. But it led Galton himself to devise various instruments for testing skin-sensation, hearing, smell, etc. As the pamphlet states, having the facts clearly before us, we must next "proceed to consider the most suitable apparatus to afford the measurements (or other tests) suggested by the several paragraphs." This pamphlet was followed by a proposal to hold an exhibition of psycho-

<sup>1</sup> Compare the great difference in value between Wundt's *Psychologische Studien* and his *Völkerpsychologie*.

<sup>2</sup> As evidenced by correspondence in the Galton Laboratory. The first published paper was that on the *Whistles* of 1877, and the *Composite Portraits* and *Generic Images* followed in 1878 and 1879 respectively.

<sup>3</sup> Galton's friendship with Croom-Robertson began in 1876, when the latter was just starting *Mind*. Galton had sent him two of his papers on Heredity, and Croom-Robertson said they should not be overlooked in the second issue of that Journal. He also asked Galton for psychological contributions. "There was no one to whose intelligent cooperation I then owed more than Professor Croom-Robertson (1842-1892) of University College. His genius and temperament were of the most attractive Scottish type—exact, sane and very genial.... He was a thorough friend whose death left a void in my own life that has never been wholly filled." *Memories*, p. 267.



metric instruments which was circulated among the leading English psychologists<sup>1</sup>. The noteworthy fact that resulted was that very little apparatus of the kind existed in England, and practically none had been invented there. One distinguished psychologist wrote to Galton:

"I regard you as a public benefactor and only wish I could be of more use to you. For some time I have been intending to get together some psychophysical apparatus but the difficulty has been to get the money. Just as that difficulty was to some extent surmounted I found myself committed to a biggish piece of literary work which will take all my time for some months to come.

One of the first things I meant to do was to write to you and ask to be allowed to see some of your apparatus; that I shall now be able to do when this exhibition comes off. I expect you know a great deal more about the whole thing than I do. I may, however, mention two or three books and papers in which apparatus has been described."

And then follows a list of references, almost entirely to German papers.

"But I am afraid in saying all this to you I am making myself very offensive, sending slack to Newcastle. However you must forgive me, if you will, and believe that I am only anxious to be of use to you if I can."

These sentences seem to suggest that in 1884 a leading psychologist could recognise Galton as a pioneer. The same authority, writing in 1911, says:

"The position I think is this: Galton deserves to be called the first Englishman to publish work that was strictly what is now called Experimental Psychology, but the development of the movement academically has, I believe, in no way been influenced by him."

Possibly it would have been better for English psychology had it been more influenced by Galton. We should then have had an original English School of Psychology, not handicapped by German dominance. But no one can to-day examine American and English psychological papers without recognising that their chief superiority over German and French work lies in the adoption of Galton's correlational calculus. It has given them a methodology far superior to that of their continental competitors, and on

<sup>1</sup>

42, RUTLAND GATE, S.W. Jan. 28/84.

DEAR MR — I have undertaken to arrange and exhibit at the large forthcoming Health Exhibition a suitable outfit for an Anthropometric Laboratory. Its object would be to afford means of defining and measuring personal peculiarities of Form and Faculty, more especially to test whether any given person, regarded as a human machine, was at the time of trial more or less effective than others of the same age and sex. Again, to show by means of testings repeated at intervals during life, whether the rate of his development and decay was normal. The apparatus should refer to:—

1. Ordinary weighing and measuring, spirometer, colour of hair and eyes, etc.
2. Muscular action,—strength, estimate of range of motion, right and left-handedness, steadiness of hand, etc.
3. Effectiveness of the various senses, duration of impressions, after-images, reaction-times, waxing and waning stimuli, etc.
4. Higher mental processes, judgment of lengths, angles, memory of eye and ear. Elementary judgments, maps and apparatus.

(This is but a brief offhand and not a well methodised description, but it will serve for the present.)

Have you any special apparatus that you would allow me to exhibit in your name? Either the apparatus itself, a picture of it, or any hints from which I could have apparatus made? I should be most *grateful* for any hints. Very faithfully yours, FRANCIS GALTON.



this account alone it is impossible to assert that experimental psychology in our universities has been in no way influenced by Galton. There are not wanting signs also, that academic psychology may awake to a truer sense of what Galton achieved in this field and will cease, while adopting his calculus, to disregard both his apparatus and observational work. Four years before Galton started his exhibition he was, however, collecting his information and distributing his schedules. The following letter to Professor James Ward written in 1880 will indicate how Galton was then working on visualised numbers:

42, RUTLAND GATE, Feb. 9/80.

DEAR MR WARD, What a charming, interesting and full letter you have sent me. I wish Pythagoras was in reach of the penny post that I might send him a schedule. But failing that, please tell me if I rightly catch your explanation. Is it that Pythagoras who (to use your numerical equivalents) always visualised "a clever boy" whenever there was any question of the number five,—five men, five shields, five dinners etc.,—came to think that the "clever boy" was more of a reality than the men, shields or dinners? I could better understand that "numbers are the *μίμησις* of things" than the converse way in which it is put by him. Will you kindly write and tell me?.....

The association between number and colour has, I find, to be criticised rather closely to be sure that it has not a trivial origin. A young lady of apparently more than average ability had astonished her Father by an accidental allusion to these things. He told me of it and I questioned her. One very decided association was red with "million"; she told me she thought it due to the play of the word "*vermillion*." Another correspondent (indeed 2 or 3 I think) speaks of much the same thing as regards letters. One wrote to me this morning saying that *e* was always green; but he believed this due to the *ee* in the word. But there is no doubt that blue has a calming effect and red an irritating one, for the Italian mad-doctors find an advantage in putting their irritable patients in a room lighted with blue light, and their apathetic ones under a red light.

As regards the preference for particular numbers, it would indeed be a curious inquiry. I had some experience more than once in that myself;—thus in getting census returns of age, 30 is a favourite answer, there are a paucity of 29's and 31's and a superabundance of 30's. Also in meteorological readings a tendency of that kind shows itself. The Hebrew 40, etc., are similar cases. (In my own family 16 was an habitual noun of indefinite magnitude, I could not conceive why.) Your suggestion, however, throws much light on the usual causes for preference.

I quite understand your  $\therefore$  etc. in the sense you mentioned, but I see that I have somewhat bungled in the use of it notwithstanding. It often seems to me that there is a perverse demon, who somehow makes one write or do differently to what one intended to do. I can recall one gross error that I once made in pure defiance of my better judgment; it seemed temporarily sent to sleep while the hand wrote. A poor excuse!

What you say about your rudimentary diagram of figures is doubly interesting. It helps to show continuity between total absence and full existence and it is the first clear account I have received of *motor* sensation associated with number. The absence of these has hitherto astonished me, because my own representations are eminently motor. I can't think of "gratitude" without mentally acting the part of a grateful man, etc.

I really think there will turn up as you suppose, some facts bearing on teaching arithmetic. A girl of French parentage (the father is a mathematician settled in England) had her system sent me by her Father, together with his own. It shows clearly the influence of the French *names* for numerals. With many thanks for all you have sent.

Yours faithfully, FRANCIS GALTON.



## A. PSYCHOMETRIC INSTRUMENTS

I think it will be best in dealing with Francis Galton's psychometric work to start with some account of the instruments devised by him. In 1876 there was exhibited at South Kensington a "Special Loan Collection of Scientific Apparatus," and in connection with this exhibition a series of conferences was held in the month of May. At these conferences discussions on various subjects took place, largely in relation to the instruments exhibited. Spottiswoode was President of the section of Physics, and among the Vice-Presidents were De la Rue, Helmholtz, Tyndall and Sir William Thomson (Lord Kelvin). On May 19, one of the subjects for discussion was "The Limits of Audible Sound," and among other papers Galton gave an account of his "Whistles for determining the upper limits of audible sound in different persons<sup>1</sup>."

Galton notes that the number of vibrations perceived of a "closed pipe" or whistle depends upon its length. Accordingly he alters its length by a screwed plug at the closed ends; the number of turns and part turns of the screw are registered on a scale fixed to the walls of the whistle and on the screw head. The pitch of the screw is 25 to the inch. Hence one turn of the head shortens the tube by  $\frac{1}{25}$ th of an inch and the head of the screw being divided into ten parts it is possible to shorten the whistle by  $\frac{1}{250}$  of an inch with perfect ease. Now the velocity of sound in ordinary conditions of temperature and pressure being 13,440 inches per second, the note of the whistle may be found by dividing 13,440 by four times the length in inches, i.e. by  $4n \times \frac{1}{250}$ , where  $n$  is the reading on the scale, or  $840,000/n$  is the number of vibrations per second<sup>2</sup>. For example, if the screw be set at 10, there are 84,000 vibrations a second, if at 70, 12,000, while a setting of 120 denotes 7000 vibrations per second. This rule of course applies only to strictly longitudinal vibrations. Galton very properly observes that it ceases to apply when the length of the tube is less than one-and-a-half times its diameter. When the tube is reduced to a shallow pan, it is the transverse vibrations which are all important. The necessity of preserving a fair proportion between diameter and length, led Galton to reduce the bore of his tube in some cases to a very minute dimension. On this account he considered that his whistles could not be relied on for vibrations of more than 14,000 to the second.

Galton notes than when the limits of audibility for a given person are reached "the sound usually gives place to a peculiar sensation, which is not sound but more like dizziness, and which some persons experience in a high degree." He further remarks that young people hear shriller sounds than

<sup>1</sup> *South Kensington Museum Conferences held in connection with the Special Loan Collection of Scientific Apparatus, 1876. Physics and Mechanics Volume, p. 61.* Published by Chapman and Hall. Galton's account was reproduced with some introductory matter in a pamphlet entitled "Galton's Whistles," issued by Tisley and Co., who manufactured the whistles commercially. They are still manufactured, but not by this firm's successors.

<sup>2</sup> The original gives  $84,000/n$  by a slip.



older people, and cites a Dorsetshire proverb "that no agricultural labourer who is more than forty years old, can hear a bat squeak." He distinguishes between the sharpness of hearing and the hearing of high notes, and indicates that the position of the whistle—opposite to the auricular orifice—may be of importance.

Dalby 'the aurist' had already used one of Galton's whistles for diagnosis, and Galton himself had tried experiments with them on all kinds of animals at the Zoological Gardens and on insects. He put one of his whistles at the end of a hollow walking-stick which had a bit of india-rubber piping under the handle, brought the stick as near as was safe to the animal's ear, and when it was accustomed to it, squeezed the tube, and observed whether it pricked its ears. If it did, it probably heard the whistle. Cattle and ponies, much more than horses, hear high notes. If you pass through the streets of a town, working the walking-stick whistle, all the *little* dogs turn round, but it does not seem to have any effect on the large ones.

"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..... You can make a cat, who is at a very considerable distance, turn its ear round by sounding a note that is too shrill to be audible by any human ear."

Galton attributes this faculty in cats to natural selection, differentiating them so that they can hear the shrill notes of mice and other animals they need to catch. Some of Galton's audience at the conference heard the high notes of his whistles, others failed to catch them at all. Among the former was Alexander J. Ellis, translator of Helmholtz's *Lehre von der Tonempfindungen*, who stated that he heard all the high notes perfectly.

It is clear that very useful work might be done to-day by testing the members of families and forming pedigrees for cases in which there is a faculty for hearing very high notes, and probably Galton's whistles would be an adequate means of investigation. I do not remember ever seeing a frequency curve for a large general population of the limit of audibility<sup>1</sup>.

An addendum to the above paper on whistles was contributed to *Nature*<sup>2</sup> by Galton in March, 1883. He notes that while his little whistle, set at  $\cdot 14$  of an inch, would give about 24,000 vibrations per second if air were puffed through it, the vibrations will be some 86,500 a second if hydrogen be used, because the number of vibrations per second is inversely proportional to the square root of the specific gravity of the gas blown through, and hydrogen is thirteen times lighter than air. Galton tested first with coal-gas, the specific gravity of which is not much more than half that of common air. He found that a length of  $\cdot 13$  of the whistle gave him personally no audible note for air; but he heard the note at  $\cdot 14$ ; he could for coal-gas get no audible note at  $\cdot 24$ . Galton suggests that the whistle-lengths at limit of audibility, being as  $\cdot 14$  to  $\cdot 25$ , or as  $\cdot 56$  to 1, are nearly in the ratio of  $\cdot 60$  to 1, or the specific gravities. But if the audibility depends on the period and not the square of the period,  $\cdot 56$  to 1 should be as the *square roots*

<sup>1</sup> Galton's published data do not really provide material for such a curve (see our p. 221).

<sup>2</sup> Vol. xxvii, p. 491, corrected Vol. xxviii, p. 54.



of the specific gravities. The experiment may possibly indicate that the subject appreciated the notes not by their number of vibrations, but by their energy.

As some persons can hear a musical note with the air whistle set at much less than .14, it may be concluded that 173,000 vibrations per second are possible with a hydrogen whistle.

“Mr Hawksley is making for me an apparatus with small gas bag for hydrogen pure or diluted, and an india-rubber ball to squeeze to enable hydrogen to be used with the whistle when desired. The whistle is fixed to the end of a small india-rubber tube in order to be laid near the insect whose notice it may be desired to attract.”

Galton thought it possible that some insects may hear notes quite inaudible to man and he proposed to put this to the test of experiment. I do not know of any report on the results of experiments with this hydrogen whistle on insects. The difficulty for fieldwork, as apart from laboratory experiment, would be the transport of the hydrogen.

From Hearing Galton turned his attention to the “muscular sense,” or rather to that combination of senses which tests by lifting weights what difference, if any, there is between them<sup>1</sup>. Galton, adopting Weber’s law, took his weights in geometrical progression, i.e. as

$$WR^0, WR^1, WR^2, WR^3, \text{ etc.}$$

He chose  $W = 1000$  grains and  $R = 1020$  grains and had ten varieties taking  $R$  to the powers:

$$0, 1, 2, 3, 3\frac{1}{2}, 4\frac{1}{2}, 5, 6, 7, 9, 12.$$

He made his weights by charging cartridge cases with shot and closing in the usual way with a wad. If the weights be numbered with the power of  $R$ , Galton obtained a series of triplets of the following kind :

Just Perceptible Ratio	Grade of Sensibility	Sequence of Weights
1.020	I	1, 2, 3
1.030	I $\frac{1}{2}$	2, 3 $\frac{1}{2}$ , 5
1.040	II	3, 5, 7
1.050	II $\frac{1}{2}$	2, 4 $\frac{1}{2}$ , 7
1.061	III	0, 3, 6
1.071	III $\frac{1}{2}$	0, 3 $\frac{1}{2}$ , 7
1.082	IV	1, 5, 9
1.093 <sup>2</sup>	IV $\frac{1}{2}$	0, 4 $\frac{1}{2}$ , 9
1.104	V	2, 7, 12 <sup>2</sup>
[1.115	V $\frac{1}{2}$	0, 5 $\frac{1}{2}$ , 11] <sup>3</sup>
1.126 <sup>2</sup>	VI	0, 6, 12

Galton chose his lowest weight ( $WR^0$ ) so that it gave a decided sense of weight, and his highest so that it could be handled without sense of fatigue. The test consisted in placing the weights in each series in correct order of

<sup>1</sup> “An Apparatus for Testing the Delicacy of the Muscular and other Senses in different Persons.” *Journal of the Anthropological Institute*, Vol. XII, pp. 469–75.

<sup>2</sup> Corrected values; these are errors in the original paper.

<sup>3</sup> Interpolated to complete series, but not available with Galton’s original ten weights.



magnitude. The grade, beyond which the order was not correctly given, measured the muscular sensitivity of the individual. Galton emphasised the fact that beyond true appreciation, the correct order might be given by chance in, perhaps, one or another case.

The important points here are: (i) How far the sense measured is touch and how far muscular appreciation. In Galton's method of handling even inertia might be a factor of the appreciation<sup>1</sup> (pp. 473-4). (ii) Galton assumes the geometrical law, and this plays a large part in his later work. (iii) He does not suppose with Weber that  $W$  and  $R$  vary from individual to individual. He assumes a sort of population average value for  $W$  and  $R$ . I am by no means sure that his purpose could not have been accomplished with equal effectiveness by taking the first weight the same in each triplet (or quartet) and making the others proceed, not by equal ratios, but by equal differences; in fact his geometrical series, except in the lowest grades of sensitivity, are very approximately arithmetic series.

Galton remarks:

"Blind persons are reputed to have acquired, in compensation for the loss of their eyesight, an increased acuteness of their other senses. I was therefore curious to make some trials with my test apparatus, and 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 sighted lads of the same ages, 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 occasional exaggerated statements that have not been experimentally verified." (p. 475.)

So Galton destroyed another of the beliefs, which are only held because men in general have been too sluggish to test their truth experimentally.

In a footnote added in March of the following year, 1883<sup>2</sup>, Galton endeavoured to distinguish between the sense of touch and the sense of muscular effort. He supposes the test object held in the palm of the hand, palm uppermost, while the back of the extended hand rests on a broad and padded stirrup, connected by a string with fixed pulleys and a counterbalance weight. There is then no muscular effort to support the weight, and the hand can distinguish easily between the localised pressure of the weight on the palm and the "soft and broad pressure" of the stirrup on the back of the hand. The counterbalance is then removed and the "operator" experiences at once the muscular efforts necessary to support the weight and distinguishes it from the mere pressure of the weight on the palm. I believe Galton was the first investigator anywhere to measure muscular sensitivity by the discrimination of weight boxes.

As Galton's anthropometric measurements of sensitivity and of physique

<sup>1</sup> In the Anthropometric Room of the Galton Laboratory four not three weights are used for each test. Each weight consists of a circular tin box loaded with shot, and is lifted by the thumb and two fingers *without rocking*.

<sup>2</sup> The paper was read Nov. 14, 1882.



increased in range he invented further instruments. Thus we find, in 1889, an "Instrument for testing the perception of differences of Tint<sup>1</sup>." This might be described as a double wedge photometer, one photometer being set by the examiner and the other by the examinee, who endeavours to match the known tint set by the examiner. Actually Galton got over the expense of wedge photometers by using sheets of coloured glass, each rotating on a horizontal wheel on the same axis, and which could thus be set at any angle to the examinee's line of sight; a rotation of either wheel caused the light from an illuminated screen to pass through a greater thickness of the coloured glass. For the measurement of white light Galton replaced the sheets of coloured glass by gratings. The whole apparatus was extremely simple; the examinee, with his head screened from the light, looked through a slit into a horizontal tube blackened inside, at the other end of which were two windows, with outlook on an illuminated screen. Inside the tube in front of the two windows were placed the two wheels carrying the examiner's and the examinee's photometric sheets of glass diametrically, one was controlled by the examiner and the other by the examinee, and the former recorded the angular settings of both. The difference was a measure of the goodness of the colour matching. The great advantage of the instrument over a wedge photometer system lies not only in economy, but in the power it gives the experimenter of changing his colours<sup>2</sup>. Some disadvantage arises from the varying amount of light reflected from sheets at varying angles.

Another instrument exhibited at the same time<sup>3</sup>, but the details of which belong to an earlier period, was a pendulum for "Determining Reaction-Time." This consisted of a fairly massive seconds pendulum, which could be released at an angle of 18° from the vertical; during its descent it gave a light-signal by brushing against a very light and small mirror which reflected a light off or onto a screen, or on the other hand it gave a sound-signal by a light weight being thrown off the pendulum by impact with a hollow box<sup>4</sup>. The position of the pendulum at either of these occurrences is known. The position of the pendulum, when the response is made to the signal, is obtained by means of a thread stretched parallel to the axis of the pendulum by two elastic bands above and below and in a plane perpendicular to that of the motion of the pendulum. This thread moves freely between two parallel bars in a horizontal plane, and pressing a key causes the bars to clamp on the thread, just, for illustration, as the bars of a parallel ruler might close on the thread. This determines the response-position of the pendulum, the motion of which is not suddenly checked by the clamping of the thread, owing to the elastic bands. The horizontal bars are just below

<sup>1</sup> *Journal of the Anthropological Institute*, Vol. xix, pp. 27-29, 1889.

<sup>2</sup> I have recently had such a piece of apparatus constructed in the Biometric Laboratory for testing personal equation. Some mechanical difficulty arose in bringing the two coloured windows adequately close together for reasonable comparison. I surmounted this by aid of a prism of Iceland spar, the image of the ordinary ray of one could be juxtaposed to the image of the extraordinary ray of the other, the other images being cut off by a diaphragm. The slight colouring of the border of the extraordinary image was found negligible. <sup>3</sup> *Ibid.* p. 28.

<sup>4</sup> A similar pendulum, adjustable to any time of oscillation, in the Galton Laboratory, just touches a delicately-balanced hammer which falls on a bell.



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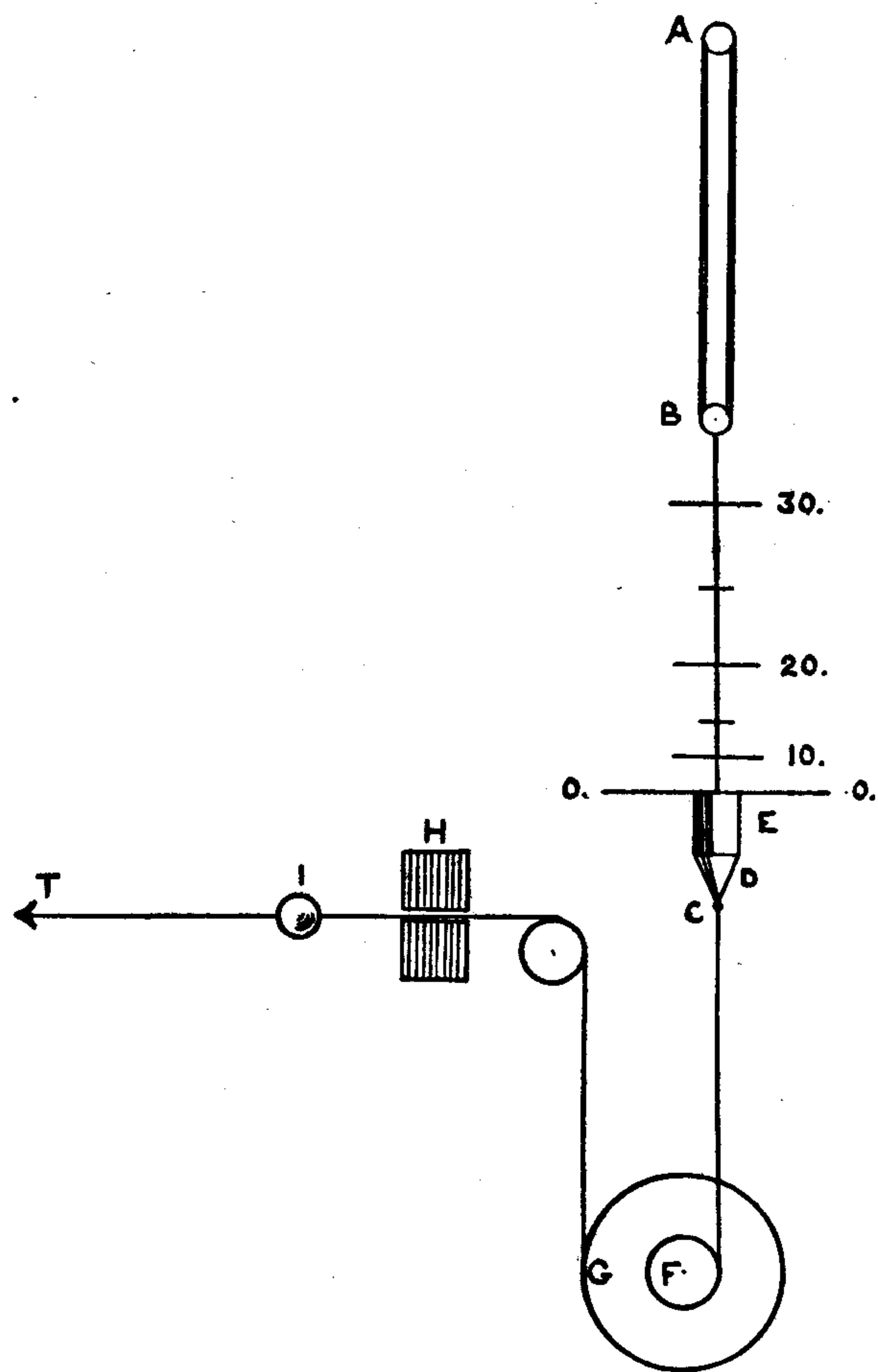
<sup>1</sup> In the Anthropometric Room of the Galton Laboratory four not three weights are used for each test. Each weight consists of a circular tin box loaded with shot, and is lifted by the thumb and two fingers *without rocking*.

<sup>2</sup> The paper was read Nov. 14, 1882.



a horizontal scale which is 800 mm. below the point of suspension of the pendulum. Galton provides a table for reading off the distances along the scale from the vertical position of the pendulum in terms of the time the pendulum takes from the vertical position to the position in which the thread is clamped. The reaction time is thus ascertainable on the assumption that the time from pressing the key to the mechanical clamping of the thread is negligible compared with the reaction time. It would however be easy to correct for this, if we arranged occasionally for the pendulum to work the clamping key itself, and so ascertained the time of clamping independently of the living being's reaction and response.

Another instrument designed by Galton was intended to measure the rapidity of a blow, or indeed the rate of movement of any limb<sup>1</sup>. The principle of the mechanism is that the limb is attached by a string to a light mechanism which draws in the string at a faster rate than the limb moves. The motion of the string is checked when the limb reaches its full extension, but a light weight on a platform continues to rise freely and measures by the height it reaches the velocity of the platform (and of the string) when the string was checked. The whole scheme is indicated in the accompanying diagram. *AB* is a stretched india-rubber band; in the actual machine as worked this was much longer than indicated in the diagram. *BC* is a thin steel wire to which the conical platform *D* is firmly attached, an ivory cylinder *E* rests on the platform and runs loosely on the steel wire. When the platform *D* is checked, *E* goes forward with *D*'s final velocity and this velocity is measured on the scale behind *BC* according to the height to which *E* rises. A string passes from the vertex of *C* and is wound round and ultimately fastened to one wheel *F* of a differential pulley. Another string is wound round the second wheel *G* of the differential pulley and ultimately fastened to it; the remainder of this string is made horizontal by being carried over a small pulley. To the



<sup>1</sup> *Journal of the Anthropological Institute*, Vol. xx, pp. 200-204, 1890. "A new Instrument for Measuring the Rate of Movement of the various Limbs."



horizontal portion a small india-rubber ball *I* is firmly attached, which rests against the fixed buffer *H*, when the top of the cylinder *E* is at the zero of the scale. The ball *I* must be against *H* when the limb is fully extended. *T* represents the direction of the string carried to the moving limb. The differential pulley reduces the motion to  $\frac{1}{3}$  that of the moving limb. The height *h* in inches reached by *E* for a given velocity *w* of *I* on impact is  $0.0207 \times w^2$ , which allows of an easy graduation of the scale.

To measure the velocity of a blow Galton places the examinee with his back to a wall, and he strikes at a long feather, so adjusted that (i) when the fist reaches the feather the india-rubber ball strikes the buffer. Care must be taken (ii) that the wrist is not bent, and (iii) that the extended horizontal limb is in the horizontal line of the string: the free end of the string is attached to the fist. The machine requires vertical and horizontal adjustments to allow of the fulfilment of (i) and (iii). Galton states that the instrument had worked successfully in his laboratory. It neglects the resistance of the air on the small bead or cylinder *E*, together with the possible friction of the steel wire, and the additional acceleration due to the pull of the string on the limb; all these are however very secondary factors, and might, were it necessary, be allowed for. As usual with Galton's apparatus, the constituents are of the simplest character, and any man with a modest mechanical knowledge could rig up such an instrument.

A different arrangement for measuring the velocity of a blow was used by Galton in 1882. It is figured by Galton in his account of his first Anthropometric Laboratory<sup>1</sup>, to which we shall refer later, but the instrument was discarded as it was liable to be injured if the blow was not a straight one, and occasionally in that case the experimentee injured himself! The instruments were chiefly devised by Galton himself, and included:

(a) For Hearing: both *Acuteness* and the *Highest audible Note*.

Under sound we first reach a point on which Galton was rather insistent, namely that the sensitivity of women, the fineness of touch, of hearing, of taste, etc., was not greater than that of men, although the contrary had been often asserted. Galton tested with four of his whistles, giving 20,000, 30,000, 40,000 and 50,000 vibrations a second<sup>2</sup>, with the following results:

Sex	Ages	Percentage of cases in which the undermentioned numbers of vibrations were perceived as a musical note				Number of cases
		Number of vibrations per second				
		20,000	30,000	40,000	50,000	
Males ...	23—26	99	96	34	18	206
	40—50	100	70	13	1	
Females ...	23—26	100	94	28	11	176
	40—50	100	63	8	1	

<sup>1</sup> "On the Anthropometric Laboratory at the late International Health Exhibition." *Journal of the Anthropological Institute*, Vol. xiv, pp. 205-212, 1885.

<sup>2</sup> I feel some doubt as to the accurate standardisation of these whistles.



On this Galton remarks: "It will be seen here, as in every other faculty that has been discussed, the male surpasses the female<sup>1</sup>." Elsewhere Galton writes<sup>2</sup>:

"The trials I have as yet made on the sensibility of different persons confirm 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 with 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 the two is not necessarily altered.

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

The suggestion here made was worth consideration, but only limited weight can be given to it, when we consider how many callings at that date were closed to women, without their being really unfitted for them. Greater stress must, however, be placed upon Galton's actual observations such as those just recorded for the audibility of high notes. At a later date<sup>3</sup> Galton made experiments on the sensitivity of men and women with regard to their discrimination in touch, using as an aesthesiometer a pair of dividers applied to the nape of the neck. He found that women were *superior* to men in tactile sensibility in the ratio of about 7 to 6. Galton's result has been confirmed by many later investigators. He also shows in the same paper that women are more variable in sensitivity of touch than men. He dealt with 932 males and 377 females, and worked by the method of median and quartiles. There are irregularities in the tabled data, however, which suggest some anomalies in the recorder's (Sergeant Randall's) method of measurement; they are probably inadequate to influence the main results.

Thus Galton's original generalisation was too sweeping. If we look to the evolutionary standpoint and indulge for a moment in hypotheses, we might suppose natural selection endowed the hunter and warrior with great sensitivity in the matter of sight and sound, while sensitivity to touch after capture may well have played a part in the surrender of the female and successful mating in a much earlier stage of living forms than the human<sup>4</sup>.

(b) For Sight: *Keeness of Vision*, measured by an ingenious arrangement, one size of type, diamond, only being used, and the specimen cards, all

<sup>1</sup> *Loc. cit.* pp. 278, 286.

<sup>2</sup> *Journal of the Anthropological Institute*, Vol. XII, pp. 472-3, 1883.

<sup>3</sup> "The Relative Sensitivity of Men and Women," *Nature*, Vol. I, p. 40, 1894 (May).

<sup>4</sup> One may reasonably recognise female sensitivity to touch in the play of tail, rubbing of fur, and other excitatory actions of the male dog in courtship.



fastened square to the line of sight at distances 7", 9", 11" and so on up to 41". The curve of the frame along which the test blocks are placed was actually an equiangular spiral. *Colour sense.* A series of bars packed closely with coloured wools wound round their centres, and the examinee had to place pegs against such of the bars as had any shade of green wound round them.

*Judgment of the Eye: As regards Length.* A first bar is shifted along until a pointer is considered to bisect it, and a second bar until a pointer is considered to trisect it. A hinged lid in both cases screens a scale on the top of the bar, which has a central fiducial mark and  $\frac{1}{100}$ th graduations of its whole length on either side. *As regards Perpendicularity*<sup>1</sup>. A bar rotates about a screened pivot on a horizontal table; this bar must be set perpendicular to a line drawn on the table. When set, a lid is raised, and a protractor rendered visible on which the difference of the setting and of true perpendicularity can be read off.

(c) Instruments for measuring *Sense of Touch* were also exhibited but not used. Some years afterwards Galton adopted as aesthesiometer dividers applied to the nape of the neck<sup>2</sup>.

(d) Later Galton dealt with the *Sense of Smell*, and in the Galton Laboratory we still use his method and his very bottles! The tests consist: (a) in sorting out by smell from a number of bottles those having the same contents and (b) in placing in order a number of bottles having various intensities of smell of the same material.

(e) In the test of the *Eye and Hair Colours* Galton used artificial glass eyes respectively dark blue, blue, grey, dark grey, brown grey (green, light hazel), brown, dark brown, black. He also used standard samples of hair: flaxen, light brown, dark brown, black, and three shades of red: fair red (golden), red, dark red (chestnut auburn). He was certainly among the first to introduce standard scales of this kind, and, what is more, to realise the difficulty of reproducing them. Such eye and hair scales are common enough now, but were by no means so in 1882, yet the difficulty remains of reproducing them accurately even when manufactured by one firm. The glass eyes of two standard scales are found not to have the same amount of pigment in them, and the spun glass silk used for standard hair scales not always the same

<sup>1</sup> Galton terms it "judgment of squareness," but I think such a name is better reserved for another sort of test which I have personally used. A number of rectangles, not diverging widely from squares in both directions and containing one true square, are given in confused order to the examinee and he is asked to give the number of the rectangle he considers square. In the same way a number of ellipses differing slightly from a circle are given, and he is asked to choose the circle; of course in both cases without correcting glasses. By giving each member of an audience a slip of paper as he enters, and throwing ellipses and rectangles on the screen by a lantern, I have been able to measure the astigmatism of 400 or 500 persons in a few minutes, and thus find not only the average astigmatism but the frequency distribution of astigmatism at the same time. The method was suggested to me by the contour of the dome of St Paul's, which always seems to me to have its major axis vertical, and to look ungraceful, until I rotate my head to the horizontal position, when it becomes gracefully proportioned. I found several of my friends thought the minor axis of the dome vertical. This "judgment of squareness" of course involves the error of judgment as well as astigmatism, but the latter is, I think, the chief contributory factor.

<sup>2</sup> See our p. 222.



amount of dye. Galton felt keenly the need for a standard and permanent set of colours, and made a suggestion on this point of great value. In 1869 he had been struck by the great variety of permanent colours which are produced for mosaic work. He had been over the *Fabbrica* of mosaics attached to the Vatican and seen their 25,000 numbered trays or bins of coloured mosaic. He realised at once the opportunity thus afforded not only for the establishment of a general colour scale in this country, but, as the mosaics were manufactured for the representation of human figures among other things, for skin, hair and eye-colour scales for anthropometric purposes<sup>1</sup>.

On Feb. 3, 1870, Galton sent the following letter to the *Science and Art Department, South Kensington*. I cite from a rough draft in the *Galtoniana*:

“Certain scientific inquiries in which I am engaged have brought forcibly before my notice the great desideratum of being able to obtain an accepted standard scale of colours, by reference to which a person’s meaning might be expressed with precision whenever he desired to designate a particular hue or tint. The exhibition of such a standard would fall, I venture to say, most legitimately within the province of the South Kensington Museum, and I will now show how very easily and efficiently this desideratum might be supplied. In the *Fabbrica* of mosaics at the Vatican in Rome there are no less than 25 thousand trays or bins, numbered consecutively, and each filled with cakes of mosaic material, each separate bin being devoted to a different colour. The workers on the mosaics in the *Fabbrica* send, as they require, to the superintendent of this department for so many pounds weight from such and such specified bins, the colours they want being solely expressed by the numbers attached to the bins. I have read cursory accounts of this large and most remarkable factory and I have visited it myself as an ordinary though much interested sightseer, but I cannot find any full description of its management either in the Art Library of the South Kensington Museum, or elsewhere. However it may be taken for granted that the facts of the case are substantially as I have stated them.

Now I beg to propose that the authorities of the South Kensington Art Department should make application to the Pope for mosaic tablets containing in order specimens of each of their 25 thousand bins to be suspended in the Museum for the purpose of reference as a standard of colour.”

Galton then proceeds to discuss the space that such a scale of colour would occupy; if each fragment of mosaic were  $1'' \times \frac{1}{2}''$ , the space required would be about ten square yards. Supposing we arranged our tablets in series of 10 in file and 10 in rank, we should have for 20 rows deep, a length of about 52 feet for the scale. For square specimens  $\frac{1}{2}'' \times \frac{1}{2}''$ , which would probably be adequate, with 40 rows deep, the length of the scale would be about seven yards. Galton continues:

“It might be disposed as a frieze running along the wall at a height convenient for reference, the bits of mosaic perhaps arranged in tablets of 100 containing 10 ranks and 10 files, with dark lines at the 5th division each way for convenience of immediately ascertaining the number appertaining to each several bit.....

The *Fabbrica* at the Vatican is maintained by the Papal Government solely for the purpose of mosaics for public buildings in the Roman States and for making gifts to foreign potentates. Presents of art works are given in this way that required, I am afraid to say how many separate pieces of material for their construction and that have demanded the lifetime of a skilled artist for their completion. But the series of tablets of which I speak would be far more easily made.

<sup>1</sup> Many years after Galton’s suggestion Professor von Luschan’s useful mosaic skin colour scale came into existence. I have also procured mosaics from the *Hof-Fabrik* in Berlin and formed permanent scales for coat colour in mammals. Galton’s proposal was a most fruitful one, and it is to be regretted that it was never carried out in its entirety.



They would be built up as readily as a wall is built with bricks. Even if it occupied a man a whole day to make a single tablet ( $10 \times 10$ ), the entire affair would fill less than a year of his time.

It is not to be supposed that the Vatican scale of colour is scientifically regular in the interval between the several graduations, neither have I reason to believe that scrupulous pains have been taken to keep the tints and hues of each bin identical in their character for consecutive centuries, or even for shorter periods; but this at least is certain: that the series is as minute and as comprehensive as it is possible to be; that it exists in the most durable of all materials, that it would be exceedingly useful to England to possess such a scale, that it might be had almost for the asking and that it would be a highly interesting and ornamental adjunct to the South Kensington Museum.

It might well be a subject for the subsequent consideration of the authorities of South Kensington whether they should not select by means of the large amount of skill and science at their disposal say one tenth of the Vatican series to create what might be called a South Kensington scale of colours, and distribute identical copies of it in mosaic, which would occupy a space according to the above calculation of less than 10 feet  $\times$  1 foot, among the art schools of the United Kingdom."

In a postscript sent two days later Galton suggested that to avoid difficulty and delay in Rome, it might be adequate to ask for rough specimens with their numbers from every bin and let the grinding to the required size be done in England, where the machinery to do it was better and more accessible than in Italy. Galton's letter was written on Feb. 3, the correspondence from the Museum up to May 16th is a series of letters saying that the subject "will receive consideration." After which date Galton, I presume, gave up asking for an answer to his letter! *Sixteen* years later (1886) Galton returned to his suggestion impressed by the fading of the original paintings of Broca for skin tints<sup>1</sup>, and by a further brief stay in Rome where he had again visited the Vatican factory and made further inquiries. He now found that there were 40,000 bins of mosaics, and of these 10,752 were classified; they occupied 24 cases in each of which were 16 rows of 28 samples. The flesh tints appropriate to European nations were about 500 in number, so that the Vatican factory provided ample material for the selection of a series of tints such as anthropologists desired. Topinard, Galton stated, was preparing a new scale of only five or six tints for hair colour to be correlated with Broca's numbers, the latter's original tints having changed colour. Galton had asked for a copy of this new scale in order to match it by mosaics; he had promised to provide the cost, and he suggested that such scales in mosaics should be circulated among anthropological institutes and museums. He now adds that it may not be possible to get such mosaics from the Vatican factory to judge by a former experience, but they could possibly be obtained elsewhere. He then refers to his proposal of 1870 to the South Kensington authorities and states that Mr Odo Russell—later Lord Ampthill—our semi-official representative at the Vatican (till 1870) was ultimately asked to inquire as to the feasibility of carrying out the scheme,

"but the price asked by the Papal Government was altogether excessive, and so the matter dropped. Now, however, resulting not improbably from my then abortive suggestions, I find that such samples are being produced. I saw one set in process of being made." (p. 146.)

<sup>1</sup> *Journal of the Anthropological Institute*, Vol. XVI, p. 145, 1886. "Notes on Permanent Colour Types in Mosaic."



Galton exhibited cakes of Roman enamel suitable for anthropometric standards of colour<sup>1</sup>. And then in this century we have the idea carried out by a German with German made mosaics, and no one gives Galton credit for originating the idea!

I cannot trace that Galton got either the simple Topinard hair scale, or Broca's scale reproduced in mosaics. Before the war I found that painted scales sent to Berlin were very speedily and accurately matched in mosaics.

It seems in place here to summarise a further paper of a later date "On recent Designs for Anthropometric Instruments" in so far as it deals with the subject of our present chapter<sup>2</sup>. The pioneer work of Galton is here recognised to the full. His instruments had passed from South Kensington to Cambridge, and an anthropometric laboratory had been opened there. Messrs Horace Darwin and Dew Smith were improving old and devising new anthropometric instruments in Cambridge, and a good deal of this paper concerns their work.

A Japanese professor had sent Galton money to provide an outfit for an anthropometric laboratory in Tokio. Professor Giuseppe Sergi wished to add to his anthropological cabinet a set of instruments suitable for school work, and desired Galton to select a list for him. Topinard, one of the leading French anthropologists, wrote:

"I have written nothing as yet concerning physiological instructions to travellers, awaiting a convenient moment for doing so. I am disposed to take directly your system, and will ask to have all your apparatus sent to me. We possess no samples of colours for hair and eyes beyond the polychromatic table of Broca, which the Anthropological Institute employs, but I am about to undertake new work of this kind, and intend shortly to have some samples made; but not many of them, probably five for eyes and five for hair. My present difficulty is to select the exact shades and tints; if you have yourself made any such sets, I should be much obliged if you would let me have one." (p. 4.)

The impetus given by Galton's anthropometric laboratories was indeed universal, and he was admitted then to have led the way in this matter, an admission which has been almost overlooked since.

Among matters which concern us in this chapter are standards for hair and eye colours. Here Galton directly suggests "glass spun by a glass blower for comparison with hair." Thus before 1886 he had proposed sets of standard glass eyes, mosaics for skin colour and spun glass for hair; all three of these suggestions have been carried out in this century—by Germans—in the well-known eye-scale of Professor R. Martin, in Professor von Luschan's skin-scale and Professor G. Fischer's glass-silk hair scale. Thus the best of what we can do *now*, was suggested by Galton twenty to thirty years earlier.

Horace Darwin showed (i) a very simple chronograph designed by Francis Galton, (ii) an instrument for measuring the relative sensitiveness of the eye to various colours, designed at the suggestion of Galton, and (iii) an instrument for testing an individual's keenness in distinguishing small differences

<sup>1</sup> The originals are not in the *Galtoniana*, and I have not succeeded in tracing them.

<sup>2</sup> *Journal of the Anthropological Institute*, Vol. xvi, pp. 2-9, 1886.





Francis Galton in holiday garb; taken at Vichy, August, 1878, when aged 56 years. The Galtons were at Vichy again in 1880: see our p. 196.



in the pitch of a musical note, presumably designed entirely by Darwin himself. All these instruments are very simple in character and ought not to be overlooked by the anthropometrician. In particular the chronograph is very ingenious. Darwin thus describes it:

“A wooden rod is supported at its upper end by a detent, and can be released at will. The rod then falls freely in space passing through a hole in a fixed diaphragm. A weight in the form of a ring larger than the hole in the diaphragm, rests on a collar near the top of the rod. Thus, after rod and weight together have fallen a definite distance, the weight is caught by the diaphragm and makes the signal sound, while the rod still continues to fall. On hearing the signal sound the person to be tested presses down a lever, thereby releasing a spring clamp which grips the falling rod firmly. The interval of time between the signal sound and this operation is measured by the space the rod has fallen through, and is read at once in hundredths of a second from graduations on the rod itself.” (p. 9.)

Lastly, we may note that early in 1890 the Royal Society appointed a committee of which Lord Rayleigh was Chairman, Captain Abney, Secretary, and Sir George G. Stokes, then President of the Society, Brudenell Carter, Church, Evans, Michael Foster, Dr Farquharson, Galton and W. Pole were members. The average attendance was six to eight and Galton appears to have attended with the greatest regularity. At the fifth meeting he presented a memorandum as to testing colour blindness, (i) “under not dissimilar conditions to those in which signals are seen by sailors and engine drivers,” (ii) in which the attendant does not know the colour being exhibited, and (iii) the subject indicates the colour not by its name, but by turning a thumb and finger piece attached to each colour box, with rough side up for red, smooth side up for green, and into an intermediate position for neutral tinted colour. The whole takes place in the dark, and the subject’s answers are ascertained by examining the colour-boxes later. There were to be nine colour-boxes, three for red, three for green, three for neutral tint; each series with one, two and three thicknesses of glass. A good many other methods of measuring colour sense were described, and much evidence taken. I do not know whether Galton’s apparatus ever came into practical use: like all his instruments, it was very simple, the light being provided by a policeman’s “bull’s eye.”

Galton’s investigation of mental characters led him directly to the Weber-Fechner Law of the geometrical mean. Such a law appears directly opposed to the Gaussian hypothesis that the arithmetic mean gives the best “medium,” i.e. the most probable or modal value of a series of observations. Galton accordingly proposed the following problem: Assuming the geometrical mean and not the arithmetical mean to give the best “medium,” what is the mathematical form of the frequency distributions<sup>1</sup>? Galton seems to have held that not only in tint and length judgments<sup>2</sup>, but in many

<sup>1</sup> *R. Soc. Proc.* Vol. xxix, pp. 365-6, 1879. “The Geometric Mean in Vital and Social Statistics.”

<sup>2</sup> “Three rods” Galton writes “of lengths  $a, b, c$  if taken successively in the hand appear to differ by equal intervals when  $a : b :: b : c$  and not when  $a - b = b - c$ ” (p. 366). I have made a number of individual tests on myself, but my judgment supports an arithmetic not a geometric mean in the case of the three rods. I once asked between 200 and 300 individuals to select on



sociological categories, the geometric mean would dominate the frequency distributions:

“My purpose is to show that an assumption which lies at the basis of the well-known law of “Frequency of Error” (commonly expressed by the formula  $y = e^{-h^2 x^2}$ ) is incorrect in many groups of vital and social phenomena, although that law has been applied to them by statisticians with partial success and corresponding convenience.” (p. 365.)

By “vital phenomena” Galton here refers to those assumed to be governed by the Weber-Fechner law; as illustrations of “social phenomena” he cites growth of population following a geometrical increase, or increase of capital in a business which is proportional to its size.

“In short, sociological phenomena, like vital phenomena, are as a general rule subject to the condition of the geometric mean.” (p. 367.)

That many sociological phenomena do lead to markedly skew distributions is I think a point of very great importance, and Galton’s attention had soon been drawn to it. It is, however, very questionable whether the theory of the geometrical mean is the only, or a wide enough avenue of approach.

Galton put the matter in the hands of Mr (now Sir) Donald MacAlister, who deduced the frequency distribution at once<sup>1</sup>, on the assumption that the logarithms of these vital and sociological variates would obey the frequency of error-curve. I am unaware of any comprehensive investigation being ever undertaken to test the “goodness of fit” of this geometric mean curve to actual observations. MacAlister gives no numerical illustration, and I do not think Galton ever returned to the topic. It would still form the subject of an interesting research, but I fear the Galton-MacAlister curve would be found wanting. See *Biometrika*, Vol. iv, pp. 193 *et seq.*

## B. PSYCHOMETRIC OBSERVATIONS AND EXPERIMENTS

Perhaps the most significant evidence of how Galton’s mind was turning from physical to psychical anthropometry is to be found as early as 1877, in his “Address to the Anthropological Department of the British Association,” at the Plymouth meeting of that year<sup>2</sup>. He there made, what for that

a tint scale a tint exactly intermediate between two tints *A* and *B*, which actually contained 1/10 and 9/10 of black. The geometric mean would have given the mode at 3/10; it was actually about 7/10. This was confirmed by a second series of guesses. It is possible that the eye measured the amount of white not of black in the tint shades.

<sup>1</sup> “The Law of the Geometric Mean.” *R. Soc. Proc.* Vol. xxix, pp. 367 *et seq.*, 1879. The

curve is  $y = y_0 \frac{h}{\sqrt{\pi}} \frac{e^{-h^2 (\log x/a)^2}}{x}$ .

<sup>2</sup> There is an historically very instructive series of letters which were interchanged between Galton and Huxley preserved in the *Galtoniana*, regarding the foundation of the “Department” of Anthropology in 1866. Huxley was president of Section D Biology, from which had sprung the “Departments” of Physiology and Anthropology, and he practically nominated all the officers of all three branches and Botany as well. “I think I mentioned to you that I proposed to ask Humphry to be President of the Physiol. Department and Wallace to take charge of the gentle Anthropol’s. Both have consented.”...“X. is the one man who won’t do for any office in division Anthropology! *Dix mille fois, non!* Rolleston would go into convulsions at the mere rumour, and I confess that the less often that young gentleman comes in my way—the



time was a bold proposal, that all anthropologists should turn for a time from physical anthropology and study prevalent types of human character and temperament. He points out how it has now become possible to inquire by exact measurement into certain fundamental qualities of the mind; the new science of what has been termed Psychophysics shows that the difference in the mental qualities of man and man admits of being gauged by a suitable scale. Galton further suggested that mental qualities such as 'personal equation' and its basis in reaction time should be measured with a view of correlating them with temperament and external physical characters. Among other things he suggests the classification of individuals by the time they occupy in forming a judgment. He notes that the interval of time between the perception of a signal and the recording of it by tapping a key, is modified when there are alternative signals *A* and *B*, and the recording of *A* is to be done by the right and of *B* by the left hand. An interval is required to discriminate between the signals and between the hands. In such a way the individual time in forming a judgment can be to some extent measured. Galton compares the advance of that day in the measurement of mental characters with the numerical measurement by the thermometer of heat and cold in the days of old. As Dr John Beale wrote to Boyle in 1663:

"If we can discourse of heat and cold in their several degrees so as we may signify the same intelligibly...it is more than our forefathers have taught us to do hitherto."

The pity is that so much psychometric apparatus is far more expensive than thermometers! If we can, however, obtain a group with differentiated mental characters, how shall we ascertain the external physical features most commonly associated with its members? And here Galton turns, I think for the first time, to photography for assistance.

He suggests, in the first place, a standard form of photography in which by the aid of three mirrors, a direct three-quarter face, and reflected profile, full-face and top of head aspects would be obtained on the same plate at the same time. Unfortunately he does not describe adequately the positions of these mirrors, and I have been unable to determine them. I can get by reflection *norma facialis*, *norma lateralis* and *norma verticalis* (as they are termed in craniometry), but then the direct aspect appears to be a three-quarter occipital view! Galton next makes what I believe is his first announcement as to composite photography; that is the method he proposes of ascertaining whether those with differentiated mental characters have differentiated physical features. He writes:

"Having obtained drawings or photographs of several persons alike in most respects but differing in minor details, what sure method is there of extracting the typical characteristics from them? I may mention a plan which had occurred both to Mr Herbert Spencer and myself, the principle of which is to superimpose optically the various drawings and to accept the aggregate result. Mr Spencer suggested to me in conversation that the drawings reduced to the same scale might be traced on separate pieces of transparent paper and secured one upon

sweeter my temper is likely to be.—He is such a choice specimen of the Snob scientific." X. is dead now, without leaving his impress on science, but the term Huxley found in his wrath to characterise the young gentleman is perhaps worthy of preservation.



another, and then held between the eye and the light. I have attempted this with some success. My own idea was to throw faint images of the several portraits, in succession, upon the same sensitised photographic plate. I may add that it is perfectly easy to superimpose optically two portraits by means of a stereoscope and that a person who is used to handling instruments will find a common double eye-glass fitted with stereoscopic lenses to be almost as effectual and far handier than the boxes sold in shops<sup>1</sup>. (pp. 9-10.)

Thus was launched the first idea of composite photographs. But Galton very rarely made a suggestion without already having applied it himself<sup>2</sup>, and in this case he had chosen as his subject "the criminals of England who have been condemned to long terms of penal servitude for various heinous crimes."

He had formed his own views on "the ideal criminal." He has three peculiarities of character: (i) his conscience is almost deficient, (ii) his instincts are vicious, and (iii) his power of self-control is very weak. His instincts determine the description of his crime, and the absence of self-control may be due to ungovernable temper, to sensual passion, or to mere imbecility.

Galton as a biologist is very cautious in his discussion of "vicious instincts." He says:

"The subject of vicious instincts is a very large one: we must guard ourselves against looking upon them 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, 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. All that we are entitled to say is, that the prevalent instincts of each race are trustworthy, not those of every individual. A man who is counted as an atrocious criminal by society, and is punished as such by law may nevertheless have acted in strict accordance with his instincts. The ideal criminal is deficient in qualities that oppose his vicious instincts; he has neither the natural regard for others which lies at the base of conscience, nor has he sufficient self-control to enable him to consider his own selfish interests in the long run. He cannot be preserved from criminal mis-adventure, either by altruistic or by intelligently egoistic sentiments." (pp. 11-12.)

Having defined the mental characters which he considers peculiar to the criminal Galton next proceeded to investigate how far these peculiarities are correlated with the physical characters, in particular with the physiognomy. He divided his criminals into three main groups taking in all cases the photographs<sup>3</sup> only of men sentenced to long terms of penal servitude; the groups were (a) Murder, Manslaughter and Burglary, (b) Felony and Forgery, (c) Sexual offences. Galton believed that by continually sorting the photographs in tentative ways certain natural classes began to appear, some very well marked, and that the proportion of these in the three crime-

<sup>1</sup> Galton's double eyeglass with stereoscopic lenses is in the *Galtoniana*.

<sup>2</sup> I think an exception must be made to this rule in the case of the four aspects on our photographic plates referred to above. But I may have overlooked some possible mirror arrangement, and if not we have to remember that Galton's address was prepared in great haste, for he had been suddenly called upon to occupy the chair owing to the ethnologist who would otherwise have presided being debarred by illness.

<sup>3</sup> Identification photographs of the Home Office provided by the Surveyor-General of Prisons, Sir Edmund Du Cane.



groups was significantly different. If this were substantiated, the composite photographs of the three crime-groups should be markedly differentiated. The reader who has studied carefully the above account will appreciate what Galton was seeking in the composite photograph. He looked upon the mental traits as "transmissible by inheritance," he held that the physical traits were also inherited, and he was searching to divide man up into varieties in which the physiognomic characters should be indices of the mental traits. The common inheritance of both was fundamental to his idea.

"The Anthropologist has next to consider the life-history of those varieties, and especially their tendency to perpetuate themselves, whether to displace other varieties and to spread, or else to die out. In illustration of this, I will proceed with what appears to be the history of the criminal class. Its perpetuation by heredity is a question that deserves more careful investigation than it has received; but it is on many accounts more difficult to grapple with than it may at first sight appear to be. The vagrant habits of the criminal classes, their illegitimate unions, and extreme untruthfulness, are among the difficulties. 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 accessions from classes 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 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." (pp. 13-14.)

Galton then cites the now famous Jukes family<sup>1</sup>, of which an account had been published in the preceding year.

"I have alluded to the Jukes family in order to show what extremely important topics lie open to inquiry in a single branch of anthropological research and to stimulate others to follow it out. There can be no more interesting subject to us than the quality of the stock of our countrymen and of the human race generally, and there can be no more worthy inquiry than that which leads to an explanation of the conditions under which it deteriorates or improves<sup>2</sup>." (p. 15.)

The genealogy of other "criminal" families published since, confirms Galton's views, but his call to scientific criminology met with little response for nearly thirty years. Even to the present day English anthropologists do not seem to grasp that a study of the *mental* varieties of their own race may be of more importance than recording the discovery of another Romano-Briton or the funereal trappings of an Egyptian monarch.

From the time of this paper onwards for several years Galton worked hard at composite photographs. There has been on the whole a great deal of unjustified disappointment in regard to them. This has largely arisen from a misunderstanding of what was expected from them, and a neglect of Galton's purpose in suggesting their use. That purpose is quite evident from this first paper: It was to ascertain whether men's mental characteristics were *intraracially* correlated with their facial characteristics. The fact that

<sup>1</sup> *Thirty-first Annual Report of the Prison Association of New York*, 1876.

<sup>2</sup> In these words Galton definitely lays down the principle that anthropology is not a mere antiquarian investigation, but is essentially occupied with some of the most urgent of our present social problems.



intra-racial groups markedly differentiated in mental characters do not give markedly differentiated composite photographs, should not be considered merely negative and disappointing. It should have been interpreted as a most valuable anthropometric result, namely that mental characters are not highly correlated with external physical characters. That conclusion is confirmed by modern research on quite different lines; there is little or no correlation between human mentality and external anthropometric characters. I am fully aware that this result cuts directly at the whole of popular belief in physiognomy and phrenology and of the old anatomical ideas of craniometry. But this principle statistically demonstrated will stand, and composite photographs pointed at an earlier date in the same direction. The characters of the mind, the workings of the brain depend in the main upon commissures and linkages, matters of a far more subtle nature than the shape of the brain case. Whether the efficiency of the mind is more closely correlated with the physiological processes of the body, i.e. with its dynamic qualities, than with its static properties is another question, still *sub judice*. But one fundamental result of Galton's introduction of psychometry into anthropometric measurements has been to demonstrate the very small relation of mentality to external bodily characters. It is from this standpoint that Galton's composite photographs did and may still do useful work.

It may be argued that the American Indian, the Negro and the Western European have as markedly divergent and individual mental characters as they have divergent and individual physical characters (see our p. 81), and that both are inherited within these races of men. That there is *interracial* correlation between mental and physical attributes goes without saying as long as races are inbred. Each race simply transmits its own mentality and its own physique, but that is no proof of a high *intra-racial* correlation between the two. Any geneticist knows how relatively easy it is to separate the mental and superficial characters of one breed by crossing it with another, much easier than it is to combine the forelimbs of one breed with the hindlimbs of a second; the simple reason being the relatively high correlation of the two members<sup>1</sup>. Goring has shown<sup>2</sup> that the average criminal is not differentiated markedly from the normal man by his physical characters; in England at any rate he is not the physically anomalous being of the Lombrosian school of criminologists.

The non-differentiation in a markedly significant manner of the composites of groups selected by mental characters contained a fundamental scientific fact, which has had to wait many years for us to grasp its full significance, and will possibly have to wait more years still for its general popular recognition.

<sup>1</sup> In breeding several hundred dogs from crosses of Pekingese and Pommeranians, there has only been one instance in which it might be supposed that a Pekingese forelimb was combined with a Pommeranian hindlimb; but it has been quite possible to obtain a pointed muzzle and chocolate coat combined with the strong mental individuality of the Pekingese. I feel certain that a differentiation by mental qualities of our hybrids would not on composite photography reproduce Pommeranian and Pekingese external characters.

<sup>2</sup> *The English Convict, A Statistical Study*. By Charles Goring, M.D., H.M. Stationery Office.



There have been many unconsidered opinions expressed about composite photography; they may be chiefly summed up in the view expressed by a well-known zoologist at the British Association Meeting at Plymouth in 1898<sup>1</sup>. He said that he had never been able to see the scientific value of the composite photograph. It represented the haphazard obliteration of one element by another. To which Galton fitly replied that the value of the composite photograph was that it brought out what was common to all the components, while eliminating that which was exceptional.

We shall postpone all further discussion of Galton's work on Composite Photography until the following chapter, but that work is only interpretable when we remember its psychological origin: Galton was inquiring into the extent to which mentality is associated with physiognomy.

In 1879 Galton published his first investigation into the working of his own mind. It was issued in two forms differing a good deal in detail. The first paper, entitled "Psychometric Facts," appeared in the *Nineteenth Century*<sup>2</sup>, and the second paper, with the title "Psychometric Experiments," in *Brain*<sup>3</sup>. The two articles were independently written, the latter being the more statistical.

The latter opens with the words:

"Psychometry, it is hardly necessary to say, means the art of imposing measurement and number upon operations of the mind, as in the practice of determining the reaction-time of different persons. I propose in this memoir to give a new instance of psychometry, and a few of its results. They may not be of any very great novelty or importance, but they are at least definite, and admit of verification; therefore I trust it requires no apology for offering them to the readers of this Journal, who will be prepared to agree in the view, that until the phenomena of any branch of knowledge have been submitted to measurement and number, it cannot assume the status and dignity of a science." (p. 148<sup>4</sup>.)

Galton divides thought into two main categories. In the first category ideas present themselves by association with some object newly perceived by the senses, or with previous ideas. In the second such of these associated ideas, as happen to be germane to the topic on which the mind is set, are fixed by attention. Galton's investigation applied entirely to the first category, the automatic arising of ideas by association; they come of their own accord and cannot, except in indirect and imperfect ways, be compelled to come. The inquiry dealt with the rate at which these associated ideas come; their sameness and their difference, and the periods of life in which they were originally formed. He remarks that the experiments were "exceedingly trying and irksome, and that it required much resolution to go through with them, using the scrupulous care they demanded." This it is easy for the reader to verify; I have personally tried it on Galton's actual test list of words; my chief difficulty being the reluctance of associated ideas to appear, and their utter triviality compared with Galton's experience. As Galton himself says:

"When we attempt to trace the first step in each operation of our mind, we are usually balked by the difficulty of keeping watch, without embarrassing the freedom of its action.

<sup>1</sup> *Times* Report of Section D, September 10th, 1898.

<sup>2</sup> *March*, 1879, pp. 425-33.

<sup>3</sup> *Vol. II*, pp. 149-57.

<sup>4</sup> The last sentence was adopted many years ago as the motto of the *Biometric Laboratory*.



The difficulty is much more than the common and well-known one of attending to two things at once. It is especially due to the fact that the elementary operations of the mind are exceedingly faint and evanescent, and that it requires the utmost painstaking to watch them properly..... My method consists in allowing the mind to play freely for a very brief period, until a couple or so of ideas have passed through it, and then while the traces or echoes of those ideas are still lingering in the brain to turn the attention upon them with a sudden and complete reawakening; to arrest, scrutinise them, and to record their exact appearance; afterwards I collate the records at leisure, and discuss them and draw conclusions." (p. 150.)

Galton's first experiment was a leisurely walk of 450 yards down Pall Mall, on an occasion when he felt himself unusually capable of the kind of effort required. He reckoned that 300 objects caught his eye, although he never allowed his mind to ramble.

"It was impossible for me to recall in other than the vaguest way the numerous ideas that had passed through my mind; but of this, at least I was sure, that samples of my whole life had passed before me, that many bygone incidents, which I never suspected to form part of my stock of thoughts, had been glanced at as objects too familiar to awaken the attention. I saw at once that the brain was vastly more active than I had previously believed it to be, and I was perfectly amazed at the unexpected width of the fields of its everyday operations."

After an interval of some days in which he kept his mind from dwelling on his first experiences, Galton took a second experimental walk. He was struck as before by the variety of ideas that presented themselves, but his admiration for the activity of the mind was reduced by the observation that there was a great deal of repetition in his thought. He next devised an experiment for testing these associations and repetitions. He selected a list of 75 suitable words and sitting at a table with a stop-watch, started it on exposing a word of which he was previously ignorant. He waited till the word called up two directly associated ideas and then stopped the watch and recorded these ideas. The second associated idea was always derived from the word itself and not from the first associated idea, for he kept his attention firmly concentrated on the word itself. Sometimes he only got one associated idea; sometimes three or four occurred together and he was able to record them, but as a rule he only managed to record two with precision. Galton went through the 75 words on four occasions at intervals of a month, "but it was a most repugnant and laborious work, and it was only by strong self-control that I went through my schedule according to programme."

The total number of associated ideas was 505, and took 660 seconds to form; or at the rate of about 46 per minute or 2755 in an hour<sup>1</sup>. Of the 505 ideas, however, 29 occurred in all four trials, 36 in three, 57 in two and 107 in one trial only. Galton concluded therefore that reiterated association, even under the very different conditions of place and time of his experiments, was a much more marked feature than he had anticipated. He held from the proved number of faint and barely conscious thoughts and from the proved iteration of them, that the mind is perpetually travelling over familiar ways without the memory retaining any impression of its excursions.

"My associated ideas were for the most part due to my own unshared experiences, and the list of them would necessarily differ widely from that which another person would draw

<sup>1</sup> There were 13 cases of "puzzle" in which nothing sufficiently definite occurred in the maximum of time, 4 seconds, allowed for each test.



up who might repeat my experiments. Therefore one sees clearly, and I may say one can see *measurably* how impossible it is in a general way for two grown-up persons to lay their minds side by side together in perfect accord. The same sentence cannot produce precisely the same effect on both, and the first quick impressions that any given word in it may convey, will differ widely in the two minds." (p. 157.)

Galton was able in 124 cases of associated ideas to determine the period of life at which they became associated with the word. His results may be thus abstracted :

*Associations formed at following periods of Life.*

	No.	Percentages				
		Total	Four times	Three times	Twice	Once
Boyhood and Youth ...	48	39	10	9	7	13
Subsequent Manhood ...	57	46	8	7	5	26
Quite Recent Events ...	19	15	0	3	1	11
Total ...	124	100	18	19	13	50

The greater fixity of the earlier associations is clear as well as the fact that half the associations date from the period of life before leaving college. Associations are largely fixed in childhood and adolescence, but I do not think it necessarily follows as Galton seems to suggest that early *education* has a large effect in fixing our associations. The result may flow from mental plasticity, or the unstocked condition of the mental storehouse of youth.

Lastly Galton divides the original words into three classes, and the associated ideas into four.

The original words :

- (i) were capable of mental images, as 'abbey,' 'aborigines,' 'abyss.'
- (ii) represented actions or states of mind as 'abasement,' 'abhorrence,' 'ablution.'
- (iii) formed more abstract notions as 'aptness,' 'ability,' 'abnormal.'

The associated ideas were :

- (a) Sense imagery, chiefly visual.
- (b) Histrionic, the mind visualised itself acting a part.
- (c) Merely verbal associations as names of persons.
- (d) Verbal associations as in phrases and quotations.

Galton gives the following analysis :

*Per cent. nature of Associated Ideas.*

No.	Nature of Words	Sense Imagery	Histrionic	Verbal Associations		Per cent.
				Persons	Phrases and Quotations	
26	Capable of Mental Images	43	11	30	16	100
20	Actions or States of Mind	32	33	13	22	100
29	Abstract Notions ...	22	25	16	37	100



Of these results Galton writes that they

“have forcibly shown to me the great imperfection in my generalising powers; and I am sure that most persons would find the same if they made similar trials. Nothing is a surer sign of high intellectual capacity than the power of quickly seizing and easily manipulating ideas of a very abstract nature. Commonly we grasp them very imperfectly, and hold on to their skirts with great difficulty. In comparing the order in which the ideas presented themselves, I find that a decided precedence is assumed by the Histrionic ideas, whenever they occur; that verbal associations occur first and with great quickness on many occasions, but on the whole they are only a little more likely to occur first than second; and that Imagery is decidedly more likely to be the second, than the first of the associations called up by a word. In short, gesture-language appeals the most quickly to our feelings.” (pp. 161-2.)

“Perhaps the strongest of the impressions left by these experiments regards the multifariousness of the work done by the mind in a state of half-unconsciousness, and the valid reason they afford for believing in the existence of still deeper strata of mental operations, sunk wholly below the level of consciousness, which may account for such mental phenomena as cannot otherwise be explained<sup>1</sup>. We gain an insight by these experiments into the marvellous number and nimbleness of our mental associations, and we also learn that they are very far indeed from being infinite in their variety. We find that our working stock of ideas is narrowly limited, but that the mind continually recurs to them in conducting its operations, therefore its tracks necessarily become more defined and its flexibility diminished as age advances.” (p. 162.)

There can be little doubt that Galton broke new ground in these papers both as to substance and method. But they produced little repercussion among English psychologists; not improbably because it is an easier task to experiment on another's mind than on one's own mind.

Galton's work of 1879 undoubtedly turned his thoughts to Mental Imagery, and he issued in November of that year a schedule containing Questions on the Faculty of Visualising<sup>2</sup>. On the data obtained from this questionnaire Galton published in *Mind* for July, 1880, a paper entitled: “Statistics of Mental Imagery<sup>3</sup>.” The scope of this paper was twofold: namely to indicate how very varied is the intensity of visualising in the male members of the English Race and to indicate how Galton's method of ranking or of percentiles (see our Chapter XII) could be applied to such psychometric statistics.

<sup>1</sup> In the *Nineteenth Century* (p. 433) Galton writes: “The unconscious operations of the mind frequently far transcend the conscious ones in intellectual importance. Sudden inspirations and those flashings out of results which cost a great deal of conscious effort to ordinary people, but are the natural outcome of what is known as genius, are undoubtedly products of unconscious cerebration. Conscious actions are motived, and motives can make themselves attended to, whether consciousness be present or not. Consciousness seems to do little more than attest the fact that the various organs of the brain do not work with perfect ease or cooperation. Its position appears to be that of a helpless spectator of but a minute fraction of a huge amount of automatic brain work.”

<sup>2</sup> Galton suggested the morning's breakfast table as an object for visualisation and requested answers to the following questions: (1) Illumination? (2) Definition? (3) Completeness? (4) Colouring? (5) Extent of Field of View? He then turned to various concrete examples of visualisation and asked his examinees to state whether they could visualise (6) Printed pages? (7) Furniture? (8) Persons? (9) Scenery? (10) Geography? (11) Military Movements? (12) Mechanism? (13) Geometry? (14) Numerals? (15) Card Playing? (16) Chess? There is no doubt that the answers he received under (14) were the original source of his later work on “Visualised Numerals.”

<sup>3</sup> Vol. v, pp. 301-18.



Galton confesses that the first results of his inquiry amazed him. He had begun by questioning friends in the scientific world, because he thought they were the most likely persons to give accurate answers, and to his astonishment most of the men of science replied that mental imagery was unknown to them.

“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 were normally endowed were romancing.” (p. 302.)

The members of the French Institute exhibited a like incredulity as to the reality of the visualising faculty. On the other hand in general society Galton found many men and women with the power of visualising. He was thus compelled to the conclusion that, whatever its cause might be, scientific men as a class have feeble powers of visual representation.

“My own conclusion is, that an over-readiness to perceive clear mental pictures is antagonistic to the acquirement of highly generalised and abstract thought, and that if the faculty of producing them 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 motor sense, that men who declare themselves entirely deficient in the power of seeing mental pictures can nevertheless give lifelike 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.” (p. 304.)

Galton data were collected from 100 adult men, of whom 19 were Fellows of the Royal Society, three times as many more of distinction in other kinds of intellectual work, and the remainder of less note. He had also returns from 172 Charterhouse boys who had been interested in the matter by their Science Master Mr W. H. Poole. The whole of the original material—with much that Galton collected later for a new edition of the *Inquiries into Human Faculty*—is in the *Galtoniana*, and would be well worth working up by more modern statistical methods than were available in 1879.

What Galton does in this paper is to arrange the answers to each of his questions—vividness of imagery, colour representation, extent of field of mental view—in ranks by order of intensity, for his 100 adult males and for two groups of the Charterhouse boys: *A* for the upper classes, *B* for the five lower classes of the school. When the material was ranked Galton cited the Highest, the first Suboctile, the first Octile, the first Quartile, the Median, the last Quartile, the last Octile, the last Suboctile and the Lowest Answers. The intensities exhibited by the two Charterhouse groups at the various selected ranks were very similar, and the adult males were not very dissimilar from these, but they did not form as regular a series as the boys. They were avowedly not members of a true statistical group:

“being an aggregate of one class of persons who replied because they had remarkable powers of imagery and had much to say, of another class of persons, the scientific, who on the whole are very deficient in that gift, and of a third class who may justly be considered as fair samples of adult males.” (p. 312.)



The reader of the paper will certainly realise—probably for the first time—how very varied is the power of mental imagery among individuals. But unless the reader is very familiar with the process of ‘ranking’ he is unlikely to extract at once from that system such results as that: 12 per cent. of persons see the mental image as vividly as the real thing, 12 per cent. only recall colours by a special effort for each, and more than 6 per cent. have a larger field of mental than of normal view, i.e. can see more than a hemisphere, all the faces of a die at once or the three walls of a room, and even the fourth simultaneously by an effort. It may be doubted whether the ranking scheme was best adapted to attract attention to a most interesting investigation. The paper concludes with a few observations on “visualised numerals.”

I had frequently been puzzled by a number of lantern slides in the *Galtoniana*, which besides giving various phenomena associated with mental imagery provided illustrations of Bushman, Eskimo and palaeolithic drawings and carvings. They undoubtedly belonged to some public lecture, but there was nothing in the three lists of papers prepared by Galton himself to indicate that this lecture was ever published, nor was there any statement on p. 339 of the *Inquiries into Human Faculty* to say that the “1880 Mental Imagery, *Fortnightly Review*; *Mind*” referred to practically distinct papers. They are, however, distinct, and although the *Fortnightly*<sup>1</sup> paper, entitled “Mental Imagery,” does not cover the whole ground of the lantern slides, there is little doubt that it contains a great deal of the substance of the lecture to which they belonged. The lecture was certainly one on “Mental Imagery,” and, although it was not published *in extenso*, the *Fortnightly* probably contained the substance of it. There is little doubt that both slides and *Fortnightly* paper deal with the matter of Galton’s popular lecture at the Swansea Meeting of the British Association in 1880. According to *L. G.’s Record* that meeting was attended by Galton and his wife. Mrs Galton makes no reference to the lecture, nor have I discovered any manuscript of it in the *Galtoniana*. It is possible that it was needful to cut out a good deal of the material of the lecture from the *Fortnightly* article as it would not be intelligible without illustrations.

The paper commences with what Galton himself calls vague physiological considerations concerning the difference between a sensation received by the optic nerve and transmitted to the brain, and a mental image where the sequence of events would occur in the *reverse* order, there being the propagation of a central impulse from the brain towards the optic nerve. This reverse process can be so vigorous that the mental image is vivid, and may in certain cases amount to a hallucination. These considerations

“justify us in ascribing the marked differences in the quality, as well as the vividness, of the mental imagery of different persons, to the various degrees in which the several links of a long nervous chain are apt to be affected.” (p. 313.)

Galton states that

“his purpose is to point out the conditions under which mental imagery as above defined is

<sup>1</sup> *Fortnightly Review*, Vol. xxviii, N.S. pp. 312–24, September, 1880. The *Mind* paper is entitled “Statistics of Mental Imagery.” (*Brit. Assoc. Report*, 1880, p. lxxviii.)



most useful, and the particular forms of it which we ought to aim at developing, and I shall adduce evidence to show that the visualising faculty admits of being educated, although no attempt has ever yet been made, as far as I know, to bring it systematically and altogether under control." (p. 313.)

Galton applies his "ogive curve" here, as in *Mind*, and concludes that "the medium quality of mental imagery among Englishmen may be briefly described as fairly vivid but incomplete." Owing to the flatness of the curve between the quartiles, our author holds that it should be feasible to educate the faculty among the great majority of men to the degree in which it manifests itself without any education at all in at least one person out of sixteen, i.e. to the suboctile value, where the image is firm and clear. I must confess that I do not feel convinced of the great "educability" of the general population in visual imagery, by the rather slender evidence Galton gives from the *École Nationale de Dessin* in Paris, and from an eminent engineer, who had great visual faculty in form, and acquired it by practice in colour also (pp. 322-3). The visual faculty may be largely innate in such selected populations as engineers and artists, and may merely need exercising. It is difficult also to reconcile Galton's view that education could span the gap from lower quartile to upper suboctile with his statement in the following sentences:

"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 rare peculiarities, of which I shall speak [number forms and colour associations], 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<sup>1</sup>." (p. 314.)

From families Galton turns to races, and while admitting the difficulty in civilised races of the modification by education considers that the French possess the visualising factor in a high degree, noting their power of pre-arranging ceremonials and fêtes, and their genius for tactics and strategy, which show that they are able to foresee effects with unusual clearness. Their phrase "figurez-vous" or "picture to yourself," he says, seems to express their dominant mode of perception. Galton next turns to uncivilised races and stresses the cave drawings of the Bushmen of South Africa. He considers that the drawings of uncivilised races are largely the products of "mental imagery." This he justifies from a letter to himself from Dr Mann, of the Cape, who in 1860 observed a Bushman lad at work:

"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 this lad that this was the plan which was invariably pursued by his kindred in making their clever pictures." (p. 316.)

<sup>1</sup> Galton states that the fact that scattered members of the same family had number forms was often discovered for the first time by his own inquiries.



Galton concludes from Dr Mann's account that a drawing by this method would be impossible if the artist had not a clear image<sup>1</sup> of the animal in his mind's eye. He refers also to the engravings of mammoth, elk and reindeer on bone by the men of the ice-age as illustrating the same visualising faculty. His argument would have been much strengthened had the cave-drawings of palaeolithic man been known in 1880, for these must have been made in semi-obscurity without the presence of the model being possible.

Among other illustrations of the visual imagery of the uncivilised races Galton cites the Eskimo performances, in particular, a chart drawn from memory of the coast from Pond's Bay to Fort Churchill<sup>2</sup>, a straight line distance of more than 1100 miles, which the draughtsman must at one time or another have visited in his canoe, and which was in remarkable accordance with the Admiralty Chart of 1870 (p. 316).

Galton next turns to number forms and colour associations, that is colours associated with numbers, letters or more particularly vowels. He had formed a collection of hundreds of such cases, not only from English, but from American, French, German, Italian, Austrian and Russian correspondents. He points out how in many cases the visualising faculty is not under control, the first acquired image of any scene holds its place, and cannot be subsequently corrected. Many persons find no difficulty in recalling faces uninteresting to them but are powerless to summon up the looks of dear relatives lost to them (p. 319). Galton gives an amusing experiment he made with a young lady and a philosophising friend. Both he accosted with the words: "I want to tell you about a boat." The young lady immediately visualised a rather large boat pushing off from the shore, filled with gentlemen and with ladies dressed in blue and white. The philosopher said that the word 'boat' called up no definite visual image, for he at once exerted himself to hold his mind in suspense, refusing to think of any particular boat, with any particular freight from any particular point of view. Galton suggests that:

"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 have found on inquiry to be the case." (p. 319.)

Galton points out that while our readings with mental visualisation may be dangerous it is equally inadvisable to starve this power. He suggests that if the boat-experience had been carried a stage further, the speaker saying: "the boat was a four-oared racing boat, it was passing quickly just in front of me, and the men were bending forward to take a fresh stroke," the listener ought to have had a definite picture well before his or her eyes. It ought to have the distinctness of a real four-oar going either to the right

<sup>1</sup> Later in the paper (p. 322) Galton refers to the rare power of throwing a mental image on to a sheet of white paper and holding it fast there while it is outlined with a pencil. He considers the Bush-boy had something of this faculty.

<sup>2</sup> Lat. 73° to lat. 58° 44'. The chart was published on p. 224 of *Captain Hall's Journals* issued by the U.S. Government in 1879.



or left, in short to be a generic image of a four-oar formed by a combination into a single picture of many sight-memories of such boats. "I argue," he writes, "that the mind of a man whose visualising faculty is free in its action forms these generalised images of its own accord out of its past experiences" (p. 320).

Galton states the forms of the visualising faculty which he thinks ought to be aimed at in education:

"The capacity of calling up at will a clear, steady and complete mental image of any object that we have recently examined and studied. We should be able to visualise that object freely from any aspect; we should be able to project any of its images on paper and draw its outline there; we should further be able to embrace all sides of the object simultaneously in a single perception, or at least to sweep all sides of it successively with so rapid a mental glance as to arrive at practically the same result. We ought to be able to construct images from description or otherwise, and to alter them in whatever way we please. We ought to acquire the power of combining separate, but more or less similar images into a single generic one. Lastly we should learn to carry away pictures at a glance of a more complicated scene than we can succeed at the moment in analysing<sup>1</sup>." (p. 322.)

A final point which Galton makes in this extraordinarily interesting paper is that the will cannot render vivid a faint image; its action is negative being limited to the suppression of what is not wanted and would confuse:

"It cannot create thought, but it can prevent thoughts from establishing themselves which lead in a false direction; so it keeps the course clear for a logical sequence of them. But if appropriate ideas do not come of their own accord, the will is powerless to evoke them. Thus we forget a familiar name, it is impossible to recall it by force of will. The only plan in such a case is to think of other things, till some chance association suggests the name. The mind may be seriously dulled by over-concentration, and it will only recover its freshness by such change of scene and occupation as will encourage freedom and discursiveness in the flow of ideas." (p. 324.)

The paper concludes with the extract which we have cited in the fuller form from the *Inquiries into Human Faculty* (see our p. 211).

Galton's investigation of visualised numerals or number forms sprang directly from his inquiries as to mental imagery. Several of his correspondents referred to their "number forms," i.e. the schemes in which they visualised the numerals from 1 to 200, or in some cases to a thousand or even a million. Closely allied to these number forms were arrangements of months of the year and of the days of the week. Others visualised in much the same way the years of their life and even the centuries of history. Not a few of these "forms" were associated with colours or shading. Galton collected both before and after the publication of his *Inquiries into Human Faculty* large quantities of these forms, and there is very ample correspondence with regard

<sup>1</sup> About this Galton writes: "A useful faculty, easily developed by practice, is that of retaining a mere 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." This point needs very full investigation. Personally I have tried in vain to get any detail of scene or action, which I had not individually taken in on the occurrence. I feel grave doubts whether the details "which escaped observation" would not be supplied later because they were probable accompaniments, and to give evidence in a court of law of what happened by aid of such a visualising faculty would be for me a very real danger.



to them. Much of the data has never been published; Galton continued to collect for a revised edition of the *Inquiries* which he never issued. In particular there is a docket dealing with heredity in number forms, and he accumulated much evidence to show—not that the particular number forms—but that the tendency to visualise numbers runs in families. Before he discussed the matter in his *Inquiries into Human Faculty*, he published two memoirs on the topic. The first, entitled “Visualised Numerals,” appeared in *Nature* Jan. 15, 1880<sup>1</sup>. And the second, with the same title, in the *Journal of the Anthropological Institute*, being a paper read on March 9, 1880<sup>2</sup>. At this time Galton had collected eighty such number forms and he found that about one person in thirty adult males and one in fifteen adult females possessed a number form. Among children they appeared to be more frequent, but were less fixed and distinct and tended to fade away with age. The ‘form,’ Galton considered, was of an older date than that at which a child began to learn to read, and represented his mental processes at a time of which no other record remains (*J. A. I.* p. 93 and especially *Nature*, p. 495). The ‘forms,’ he held, were the most remarkable existing instances of what has been termed “topical memory,” the establishment of an association between position and the thing to be remembered; a link emphasised by teachers of mnemonics when they advise speakers to associate mentally the corners of a room with the different topics of a speech they are about to deliver. Discussing the relative frequency of number forms in the two sexes Galton writes:

“I have been astonished to find how superior women usually are to men in the vividness of their mental imagery and in their powers of introspection..... I find the attention of women, especially women of ability, to be instantly aroused by these inquiries. They eagerly and carefully address themselves to consider their modes of thought, they put pertinent questions, they suggest tests, they express themselves in well-weighed language and with happy turns of expression, and they are evidently masters of the art of introspection. I do not find any peculiar tendency to exaggeration in this matter either among women or men; the only difference I have observed between them is that the former usually show an unexpected amount of intelligence, while many of the latter are unexpectedly obtuse. The mental difference between the two sexes seems wider in the vividness of their mental imagery and the power of introspecting it than in respect to any other combination of mental faculties of which I can think.” (*Nature*, p. 252.)

The paper read before the Anthropological Institute was not only fuller than that in *Nature*, but was of special interest because Mr George Bidder, Colonel Yule, the Rev. G. Henslow, Mr (now Sir) Arthur Schuster, and others each described their own number forms. It would seem that these gentlemen were unaware, until Francis Galton began his inquiry, that there was anything unusual in the possession of a number form. This experience I also have had not infrequently, when I have found a person with a number form; he seemed to suppose everybody had a number form, and to be rather incredulous when I asserted that this was not so. Galton himself, it is of interest to note, did not visualise numerals. He writes:

<sup>1</sup> Vol. XXI, pp. 252–3, 323, 494–5.  
these memoirs in the *Galtoniana* contain the names of the various contributors of number forms.

<sup>2</sup> Vol. X, pp. 85–102. The copies of both



“Another general experience is that the power of seeing vivid images in the mind’s eye has little connection with high or low ability, or any other obvious characteristic, so that at present I am often puzzled to guess from my general knowledge of a friend, whether he will prove on inquiry to have the faculty or not. I have instances in which the highest ability is accompanied by a large measure of this gift, and others in which the faculty appears to be almost wholly absent. It is not possessed by all artists, nor by all mathematicians, nor by all mechanics, nor by all men of science. It is certainly not possessed by all metaphysicians, who are too apt to put forward generalisations, based solely on the experiences of their own special way of thinking, in total disregard of the fact that the mental operations of other men may be conducted in very different ways to their own.” (*Nature*, p. 252.)

And again:

“Although philosophers may have written to show the impossibility of our discovering what goes on in the minds of others, I maintain an opposite opinion. I do not see why the report of a person on his own mind should not be as intelligible and trustworthy as that of a traveller upon a new country, whose landscapes and inhabitants are of a different type to any which we ourselves have seen. It appears to me that inquiry into the mental constitution of other people is a most fertile field for exploration, especially as there is much in the facts adduced here, as well as elsewhere, to show that original differences in mental constitution are permanent, being little modified by the accidents of education<sup>1</sup>, and that they are strongly hereditary.” (*Nature*, p. 256.)

Our Plates (XXI and XXII) give specimens of number forms. The *Galtoniana* contains many more and further slides of a certain number of coloured ones which do not appear in the published papers.

The next paper we reach was given as a Friday evening discourse at the Royal Institution, May 13, 1881<sup>2</sup>. It is entitled: “The Visions of Sane Persons.” The object of this lecture was to show the unexpected prevalency of a visionary tendency among persons who form a part of ordinary society. Visions, illusions, hallucinations are stages of the same mental phenomenon, and may grade in intensity up to the star of Napoleon I or the *daimon* of Socrates and ultimately link up with a touch of madness.

Galton commences his lecture with referring in succession to:

(a) *Number Forms*. “Strange visions for such they must be called, extremely vivid in some cases, but almost incredible to the great majority of mankind,” who are inclined to set them down as fantastic nonsense.

(b) *The Association of Colour with Sound*. The persistence of colour association with sound is fully as remarkable as that of Number Forms with numbers; generally it is concerned with the vowel sounds, and it is not a mere general colour, but a very distinct tint of that colour, which is associated with the given sound. The association is permanent, but very arbitrary, no two persons agreeing in their distribution of tints to sounds.

(c) *Association of Words with visualised Pictures*. Sometimes this curious fantasy occurs in a vague fleeting way, but occasionally the pictures are strangely vivid and permanent. Thus in Mrs Haweis’ mind the interrogation

<sup>1</sup> This sentence since visualisation is part of the mental constitution does not seem wholly in accord with Galton’s view that it should be possible by education to raise the intensity of that faculty in the general population so that the present grade at the upper suboctile should represent that of the lower quartile of the new population.

<sup>2</sup> Published also in the *Fortnightly Review*, June, 1881; *Proceedings, Royal Institution*, Vol. ix, pp. 644–55, 1882.



'What?' always excited the idea of a fat man cracking a long whip. And such pictures are the regular concomitants of the words and go back as long as memory is able to recall.

(d) *Pictures in the Field of View, when the eyes are closed, or in perfect darkness.* Many persons appear to have this kaleidoscopic change of forms, if they simply close their eyes and wait; thus Galton himself had these forms to a slight extent, but too fugitive to describe or draw. The Rev. George Henslow had them in a marked degree, and Goethe apparently also<sup>1</sup>.

(e) *Phantasmagoria.* A common form of vision is the appearance of a crowd of phantoms hurrying past like men in the street. They are occasionally seen in broad daylight, but generally come to a person in bed, after putting the candle out and preparing to sleep, but by no means yet asleep. Galton reports that he knew three scientific men of eminence who had such phantasmagoria in one form or another<sup>2</sup>. Galton concludes with actual hallucinations occurring to sane people in good working health corresponding to the familiar hallucinations of the insane.

"I have," he writes, "a sufficient variety of cases to prove the continuity between all the forms of visualisation, beginning with an almost total absence of it and ending with a complete hallucination. The continuity is, however, not simply that of varying degrees of intensity, but of variations in the character of the process itself, so that it is by no means uncommon to find two very different forms of it concurrent in the same person. There are some who visualise well and who also are seers of visions, who declare that the vision is not a vivid visualisation, but altogether a different phenomenon. In short if we call all sensations due to external impressions '*direct*,' and all others '*induced*,' then there are many channels through which '*induction*' may take place, and the channel of ordinary visualisation in the persons just mentioned is different from that through which the visions arise." (p. 649.)

"It is remarkable how largely the visionary temperament has manifested itself in certain periods of history and epochs of national life. My interpretation of the matter, to a certain extent, is this—that the visionary tendency is much more common among sane people than is generally suspected. In early life it seems to be a hard lesson to an imaginative child to distinguish between the real and visionary world. If the fantasies are habitually laughed at and otherwise discouraged, the child soon acquires the power of distinguishing them; any incongruity or non-conformity is quickly noted, the vision is found out and discredited, and is no further attended to. In this way the natural tendency to see them is blunted by repression. Therefore, when popular opinion is of the matter-of-fact kind, the seers of visions keep quiet; they do not like to be thought fanciful or mad, and they hide their experiences, which only come to light through inquiries such as those that I have been making. But let the tide of

<sup>1</sup> The present writer has them somewhat vividly, first colour patterns, then floral devices, succeeded by the abrupt appearance of highly characteristic faces, corresponding to no individuals known to him, and with traits emphasised to caricature.

<sup>2</sup> I do not know whether Galton would have classed under vision or phantasmagoria another form of visualisation which comes to the present writer without any willing or power of control. Waking in the morning he lies on his back and looks eyes wide open at the empty white washed ceiling. In a varying number of seconds it will become closely covered with written matter in long narrow columns. It is never print, but has finely made, heavy black vertical letters, as those of a medieval MS. *Hortulus animae*. The words although apparently on the ceiling and of normal size are perfectly clear and legible, but on attempting to read them only a word, here or there, will be grasped before the whole script either vanishes, or changes. The author recently caught two words widely apart 'mathematics' and 'faithful' in the vision. He can well imagine that more easily moved natures, unaware of the frequency of such phantasmagoria, might by pondering on them intensify them and read from them supernatural messages directing their conduct, thus crossing the border line between sanity and insanity.





Miss Millicent Adèle Galton (Mrs Bunbury). Died in 1883.  
From a photograph taken in the 'sixties.



opinion change and grow favourable to supernaturalism and the seers of visions come to the front. It is not that a faculty previously non-existent has been suddenly evoked, but that a faculty long smothered in secret has been suddenly allowed freedom to express itself, and it may be to run into extravagance owing to the removal of reasonable safeguards." (p. 655.)

We may consider here Galton's last published experimental investigation on introspection. In 1884, the year after the appearance of the *Inquiries into Human Faculty*, he issued in *Mind*<sup>1</sup> a paper entitled: "Free-will, Observations and Inferences." The experiment was actually made in 1883, "during the somewhat uneventful but pleasant months of a summer spent in the country". Galton explains his aims in the following words:

"The cases appear rare in which any of the numerous writers on Free-will have steadily, and for a long time together, watched the operations of their own mind whenever it was engaged in such an act, and discussions on Free-will have certainly been much more frequent than systematic observations of it. Consequently for my own information, I undertook a course of introspective inquiry last year; it was carried on almost continuously during six weeks, and has been proceeded with, off and on, for many subsequent months. As the results were not what I expected and as they were very distinct, I publish them, of course on the understanding that I profess to speak only of the operations of my own mind. If others will do the same, we shall be hereafter in a position to generalise.

My course of observation was that, whenever I caught myself engaged in a feat of what might fairly be called Free-will, I checked myself and recalled the antecedents and noted any circumstances that might have influenced my decision and forthwith wrote down an account of the whole transaction. After I had collated several notes I found that the variety of processes to be observed was small: I therefore discontinued my notes, but maintained the observations, until I felt satisfied that I could describe as much of what goes on in my own mind as falls within the ken of its consciousness.

I may say that, after some preliminary maladroitness had been overcome, I did not find the task difficult, nor even irksome; not nearly so much as in other introspective inquiries I have made. It is true that facility in any kind of introspection is difficult to acquire; it depends on the establishment of a habit something like that of writing in the midst of [other] avocations. When the latter has once been attained, the writer recovers the thread of thought that has been dropped at each interruption, and rarely finds it broken. So it is with introspection." (p. 406.)

Galton at once discards acts of 'Will' as distinguished from free-will as they are usually automatic; tenacity of purpose does not denote free-will, and is not usually considered to be a high order of psychical activity<sup>2</sup>.

<sup>1</sup> Vol. ix, pp. 406-13.

<sup>2</sup> The Galtons were "done up by London whirl and grief for Mr Spottiswoode's death and the funeral in the Abbey, July 5th, and I became so unwell at the Jenkinsons that we began our summer outing at Boscombe and Bournemouth and spent a pleasant month meeting pleasant people. All the time I was on starvation diet. Then we went to Newton Abbot near Torquay and visited Totnes and Dartmouth and Torquay; also a pleasant time, and with nice dry weather such as one seldom enjoys in England. Still I prefer a foreign climate and think it suits my tiresome ailment better." *L. G.'s Record*.

Galton's sister Adèle Bunbury died on Dec. 31st and Montagu Butler's first wife Georgina during this year, so that the Galtons lost three close connections in the year following Darwin's death. Francis Galton wrote an obituary notice of Spottiswoode for the Royal Geographical Society (*Proceedings N. M. S.*, 1883, Vol. v, pp. 489-91) and concluded it with the words: "his name will assuredly take its place in the national memory as one of those upon whose ability, moral character, and resolute work, the credit of the English nation is mainly founded." Spottiswoode and Galton had been joint Honorary Secretaries of the Royal Geographical Society and intimate friends for many years.

<sup>3</sup> "As obstinate as a mule" or more vulgarly "as obstinate as a pig" are cited by Galton to express his meaning.



Again, appetites as motives automatically direct the will, and these cases may be disregarded, nor did Galton trouble about cases in which two motives of the same kind were in conflict and the greater prevailed. "There is no more anomaly in these than there is in the heavier scale-pan of a balance descending." Galton ultimately associated the possible cases of free-will with cases of irresolution, and to his great surprise found that not more than about one such case arose in the day. "All the rest of my actions seemed clearly to lie within the province of normal cause and consequence."

Galton classified these classes of "irresolution" into three categories:

(i) Each of two alternative plans grew less attractive the longer it was looked at, and so the mind "swung to and fro incapable of wholly fixing itself on either."

(ii) A fitfulness in the growth of a desire to change one's condition or occupation. "The resolution was delayed until a considerable rise of the new desire corresponded with a sudden fall of the old one." Galton illustrates this by the daily act of waking up and rising in the morning.

(iii) A change of Ego. An Ego which wants to continue staying comfortably in bed, and an Ego with a faint voice preaching the merits of early rising.

"To this I may give intellectual assent, but before it is possible for me to will to rise the Ego that is subsisting in content must somehow be abolished and a transmigration must take place into a different Ego, that of wide-awake life."

The mind may be shifted into a new position of stable equilibrium, by such a small matter as a twig tapping against the window.

"I suspect that much of what we stigmatise as irresolution is due to our Self being by no means one and indivisible, and that we do not care to sacrifice the Self of the moment for a different one. There are, I believe, cases in which we are wrong in reproaching ourselves sternly, saying, 'The last week was not spent in the way you now wish it had been' because the Self was not the same throughout. There is room for applying the greatest happiness of the greatest number, the particular Self at the moment of making retrospect being not the only one to be considered." (p. 409.)

Galton next turns<sup>1</sup> to what he terms 'incommensurable motives,' cases in which

"the one that was not the most keenly felt, nor gave the greatest pleasure in any sense of the word, emerged triumphant." (p. 409.)

He argues that the 'apparently' stronger psychical motive may not be the physiologically stronger motive, had we an exact cognisance of the battles

<sup>1</sup> He gives the following illustration: "An imperious old lady, infirm and garrulous, called at my house just as I had finished much weary work and was preparing with glee for a long walk. Hearing that I was at home, she dismissed her carriage for three quarters of an hour, so I was her prisoner for all that time. As she talked with little cessation, I had full opportunity for questioning myself on the feeling that supported me through the infliction. The response always shaped itself in the same way, 'social duties may not be disregarded; besides this is a capital occasion for introspection.'" Galton comments: "Leaving aside the last clause of the reply we see here...how a keen desire may wither under the influence of something about which our consciousness is scarcely exercised; some one of the many habits, whose quiet and firm domination gives a steadiness and calm to mature life that children cannot comprehend." (p. 410.)



in our brain; the appearance of relative strength is deceptive. Galton draws attention to the startling spontaneity with which some of the ideas that determine the will seem to arise. He suggests a subconscious chain of ideas a part of which suddenly comes into consciousness and may dominate the will. "Most of our ideas are partially shaped when they are first consciously perceived, and frequently they are fully shaped."

Those who with closed eyes witness a whole series of transformations not called up by any act of will of their own, and of which they cannot change the sequence by any conscious effort, will be prepared to consider favourably Galton's view that every form of sudden presentation, every new idea, has an analogous source to these visual ones.

"Moreover, as the imagination works in obscure depths out of the usual ken of consciousness, there seems reason for supposing that the 'something' upon which it works may in most cases be equally beyond its view. It is also certain that those who introspect, and those who study the genesis of dreams, succeed in discovering plain causes for numerous images and thoughts that had seemed to have arisen spontaneously. If these explanations are correct, as I feel assured they are, we must understand the word 'spontaneity' in the same sense that a scientific man understands the word 'chance.' He thereby affirms his ignorance of the precise causes of an event, but he does not in any way deny the possibility of determining them. The general results of my introspective inquiry support the views of those who hold that man is little more than a conscious machine, the larger part of whose actions are predictable. As regards such residuum as there may be, which is not automatic and which a man however wise and well informed could not possibly foresee, I have nothing to say, but I have found that the more carefully I inquired, whether it was into the facts of hereditary similarities of conduct, into the life-histories of very like or very unlike twins, or now introspectively into the processes of what I should have called my own Free-will, the smaller seems the room left for the possible residuum." (pp. 412-3.)

Galton would have been the last to claim finality for his conclusions, but his investigation raises many points of interest, and like so much of his psychological work emphasises the wide field of subconscious mental activity springing at odd intervals into consciousness. This Galton compares with the sudden and silent appearance of the head of a seal above the surface of still water and its just as sudden and silent disappearance, the observer being yet aware that the seal has been continuously active in a manner unperceived below the surface.

Three other psychological experiments on himself were made by Galton, but the results were not published. He refers to them in his *Memories*<sup>1</sup>. In the first, made in his youthful days, he was guided by a passionate desire to subjugate the body to the spirit, and determined that the will should replace automatic acts. He applied this to breathing, and every breath was submitted to the will. The normal power of breathing was dangerously interfered with and he felt as if he should suffocate, if he ceased to will. He had a terrible half-hour in which by slow and irregular steps the lost automatic power was recovered. Secondly Galton determined to gain some of the commoner feelings of Insanity. He adopted the plan of investing everything he met with the imaginary attributes of a spy. Galton found the experiment only too successful; in the course of a morning stroll by the time he had

<sup>1</sup> Pp. 276-7.



walked from Rutland Gate to the Green Park cabstand in Piccadilly every horse even on the stand seemed watching him, either with pricked ears, or else disguising its espionage. Hours elapsed before the uncanny sensation wore off and Galton said that he could only too easily re-establish it.

In his third experiment Galton strove to gain an insight into the abject feeling which a savage has for his fetish or idol, and he fixed on the grotesque figure on *Punch's* wrapper, and made believe in *Punch's* possession of divine attributes, and his mighty power to reward or punish men according to their treatment of him. The experiment gradually succeeded, and for a long time he retained for *Punch's* image a large share of the feelings that a barbarian has for his idol and learnt "to appreciate the enormous potency they might have over him."

Personally I have been much puzzled by the resurrection in modern days of the mascot, and by the apparent depth of feeling in some minds with regard to mascots; re-reading Galton's experiment with *Punch*, explained to my unimaginative mind how easily such reversion to fetishism may arise in the case of more emotional natures among modern men.

These three experiments aptly illustrate what serious endeavours Galton made to understand and appreciate the workings of his own and other men's minds.

#### C. INQUIRIES INTO HUMAN FACULTY AND ITS DEVELOPMENT, 1883.

This is the third of the larger works of Francis Galton, but it differs to some extent from the earlier two in being more completely a summary of the memoirs of the preceding ten to twelve years<sup>1</sup>. It is true there is a good deal added, but there is a considerable amount omitted, and those omissions to some extent may lead the reader of the book to suppose the conclusions based on less substantial evidence than a reader of the memoirs would have before him. On this account I have considered it best to discuss the memoirs at length, and in this section merely to supplement the earlier sections of this and those of the following chapter by drawing attention to novel points.

Writing of the memoirs he had published since the appearance of *Hereditary Genius* in 1869 Galton says:

"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 rewritten, 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 encyclopaedic. I have indeed, with that object, avoided going into details in not a few cases where I should otherwise have written with fullness, especially in the anthropometric part. My general object has been to take note of the

<sup>1</sup> Of the twenty-two memoirs on which the work is based seventeen have been already considered in this or earlier chapters, four will be dealt with in Chapter XII and one in Chapter XIII. For the titles of these memoirs: see Appendix, pp. 338-9 of the work. Three memoirs on composite photography (including that on 'Generic Images'), the memoir on the fertility of Town and Country populations, that on Test Weights and that on Galton's Whistles, together with the questionnaire on visualising, are reproduced on pp. 340-80 of the Appendix.



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.....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." (pp. 1-2.)

It is clear from this passage that Galton recognised he was a pioneer. He was, indeed, the first to grasp that if evolution be the true doctrine of the development of living forms, then it is desirable for rational man to take stock of his varieties, mental and physical, to measure their evolutionary value, and to throw himself into sympathy with the changes Nature foreshadows for his kind. The intention of Galton's work is to touch on various topics more or less connected with the cultivation of race or, as he puts it (p. 24), with "eugenic" questions<sup>1</sup>. Galton proposes to tell us the range of qualities found in man and therein must lie man's possibility of improvement. Is it not a *religious* duty of the men of to-day to leave their race better than they found it? Or, as Romanes phrased Galton's idea: Is it not man's high prerogative to cooperate with the unknown Worker in promoting the great work? The world was not ripe for such a doctrine in 1883, and, needless to say, it raised theological ire. *The Guardian* published a thoroughly hostile review from which I cite a few sentences:

"The author cannot even refrain from trespassing upon the territory of those with whom he is at issue, a territory which for him is not matter, which cannot be seen, or touched or measured or weighed—and so cannot be proved (by his method of proof) to exist. We are henceforth to apply ourselves to elicit the '*religious* significance' of the doctrine of evolution; whether if we substitute for religious *anti-religious*, Mr Galton would be able to demonstrate any difference in the meaning conveyed by the words he uses we take leave to doubt."

Speaking of Galton's remarks on the herd (see our p. 74) the critic writes:

"A small tribe is sure to be slaughtered or enslaved; a large one falls to pieces through its own 'unwieldiness.' It must be 'either deficient in centralisation or straightened for food or both.' 'Self-reliant individuals' are required; but neither too few nor too many. The importance of gregarious instincts in savage life is fully set forth; but they are not equally important to 'all forms of savage life.' Natural selection tends to give one leader 'and to repress superabundant leaders.' As we have been taught before, this wonderful law of natural selection creates and destroys, reduces and enlarges, raises and represses, originates and annihilates."

Galton, as we know, discussed only the *objective* efficacy of prayer (see our pp. 115-17), and the critic cites his words with the comment we give following them:

<sup>1</sup> "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 cognizance 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 *viriculture*, which I once ventured to use." (pp. 24-5; see our p. 110.) Thus the name for the science of eugenics was invented just forty years ago.



“We simply look to the main issue—Do sick persons who pray or are prayed for, recover on the average more rapidly than others?”

‘I have discovered hardly any instance in which a medical man of repute has attributed recovery to the influence of prayer.’ ‘The universal habit of the scientific world to ignore the power of prayer is a very important fact.’

Is this a fact at all? What evidence has Mr Galton to bring forward in support of this outrageous assertion concerning the scientific world<sup>1</sup>?”

And again:

“A nation, he informs us, ought not to hold together by purely gregarious instincts, ‘a mob of slaves clinging to one another through fear,’ it should consist of ‘vigorous self-reliant men, knit to one another by innumerable ties,’ and as he ought to have added, well versed in the new doctrines of evolution and determined to destroy their weaker brethren in obedience to the great law of the survival of the fittest in the struggle for existence. Instead of wasting his time upon the records of the past and preparing for a future state, the new animal man is to ‘awake to a fuller knowledge of his relatively great position, and begin to assume a deliberate part in furthering the great work of evolution.’ It is his ‘religious duty,’ says Mr Galton, to do this ‘deliberately and systematically.’ This is the practical outcome of the new philosophy for the new animal—the only religious duty he has to perform in the new Cosmos<sup>2</sup>.”

I have cited these passages—very characteristic of the ecclesiastical feeling of that day—to show how the anti-Darwinian *odium theologicum* was within a year of Darwin’s death transferred to his cousin, because, going farther than Darwin, he had seen that if the doctrine of evolution through heredity and natural selection be true, then man ought to use this principle as any other natural law to raise his kind. The thoughts and purposes of the Deity, Florence Nightingale held, are only to be discovered by the statistical study of natural phenomena, and both Francis Galton and Florence Nightingale believed that application of the results of such study was the *religious* duty of man. Are we any nearer to-day than the theological world was in 1883 to a true appreciation of that position? Are Dean Inge and Canon Barnes average representatives of the modern Church, or is their grade, as Galton would have put it, somewhere about the “suboctile”? We sadly fear that Father Wasmann, Mr G. K. Chesterton, and Herr Bumüller would more nearly reproduce the median theological mind of to-day. In 1883 it was probably Romanes alone who recognised the fact that Galton was virtually marking out the lines of what may be appropriately called a new religion.

“We have of late had so many manufactures of this kind that the market is somewhat glutted, and therefore it is very doubtful how far this new supply will meet with an appropriate demand; but we can safely recommend Mr Galton’s wares to all who deal in such commodities as the best which have hitherto been turned out. They are the best because the materials of their composition are honesty and commonsense without admixture with folly or metaphor<sup>3</sup>.”

After this slight indication of the reception the publication of Galton’s work met with, I turn to its contents. The earlier pages discuss material

<sup>1</sup> Yet surely Galton was merely stating a universal experience! What chance of publication by a recognised scientific society would a memoir have if the author, describing the sequence of any physical or vital phenomena, added: “but according to my experience the sequence is modified in  $x\%$  of cases by the power of prayer”? We must go back to Cuvier practically to find breaks in the sequences of natural phenomena directly attributed in a “scientific” memoir to theocratic intervention.

<sup>2</sup> *The Guardian*, July 4, 1883, p. 1001.

<sup>3</sup> *Nature*, Vol. xxviii, p. 98, Mar. 31, 1883.



with which the reader of the present volume is familiar; they deal chiefly with the anthropometric characters, with the variety in features, with the type face as reached by composite portraiture, with the healthy, the diseased and the criminal. Galton then reiterates his view on the influence of town life (see our pp. 123-25). He next turns to a very important matter, which had been thrust on his attention when dealing with English men of science, namely *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 fullness 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 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 disease. 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<sup>1</sup>." (pp. 25-6.)

Galton further remarks that it does not follow that because men are capable of doing hard work that they like doing it. Some may fret if they cannot let off their superfluous steam, but others need a strong stimulus such as wealth, ambition or passion to compel them to action.

"The solitary hard workers, under no encouragement or compulsion except their sense of duty to their generation, are unfortunately rare among us." (p. 26.)

"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." (p. 27.)

Galton next deals with sensitivity, describing his weight-lifting and whistle test for touch and sound. Speaking of discrimination by the senses, he remarks on the limitation of language to express various degrees of difference by what we now term broad categories. He writes:

"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

<sup>1</sup> The humour of this passage quite escaped one critic. Otherwise he might have realised that Galton's production in the critic's case of "cutaneous irritations" was a most useful stimulus against the critic himself growing dull.



that cover more varieties than (1) very heavy, (2) rather heavy, (3) moderate, (4) rather light, (5) very light<sup>1</sup>. 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 any 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." (p. 33.)

The general aim of this section of Galton's work is to show that the range of sense discrimination in man is wide, that delicate discrimination is an attribute of a high race, and that it is not, as some have supposed, necessarily associated with nervous irritability.

The author next emphasises the importance of family anthropometric registers, a matter to which we shall shortly return. We may note his concluding remarks:

"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." (pp. 44–5.)

Then follows a discussion of statistical methods, in particular of the "ogive curve" (see our Chapter XII); it is followed by a study of character (see our pp. 268–271), by a discussion of the criminal (see our pp. 229–231) and the insane, and their heredity; and then we have the salient points of the paper on gregarious and slavish instincts reproduced (see our pp. 72–74). Galton next turns to the great variation in the visualising power of man and summarises, and to some extent expands, the memoirs we have already discussed (see our pp. 236–45). He refers in more detail to blindfolded chess-players, who play several games at once, and notes cases of orators mentally reading manuscript in making speeches.

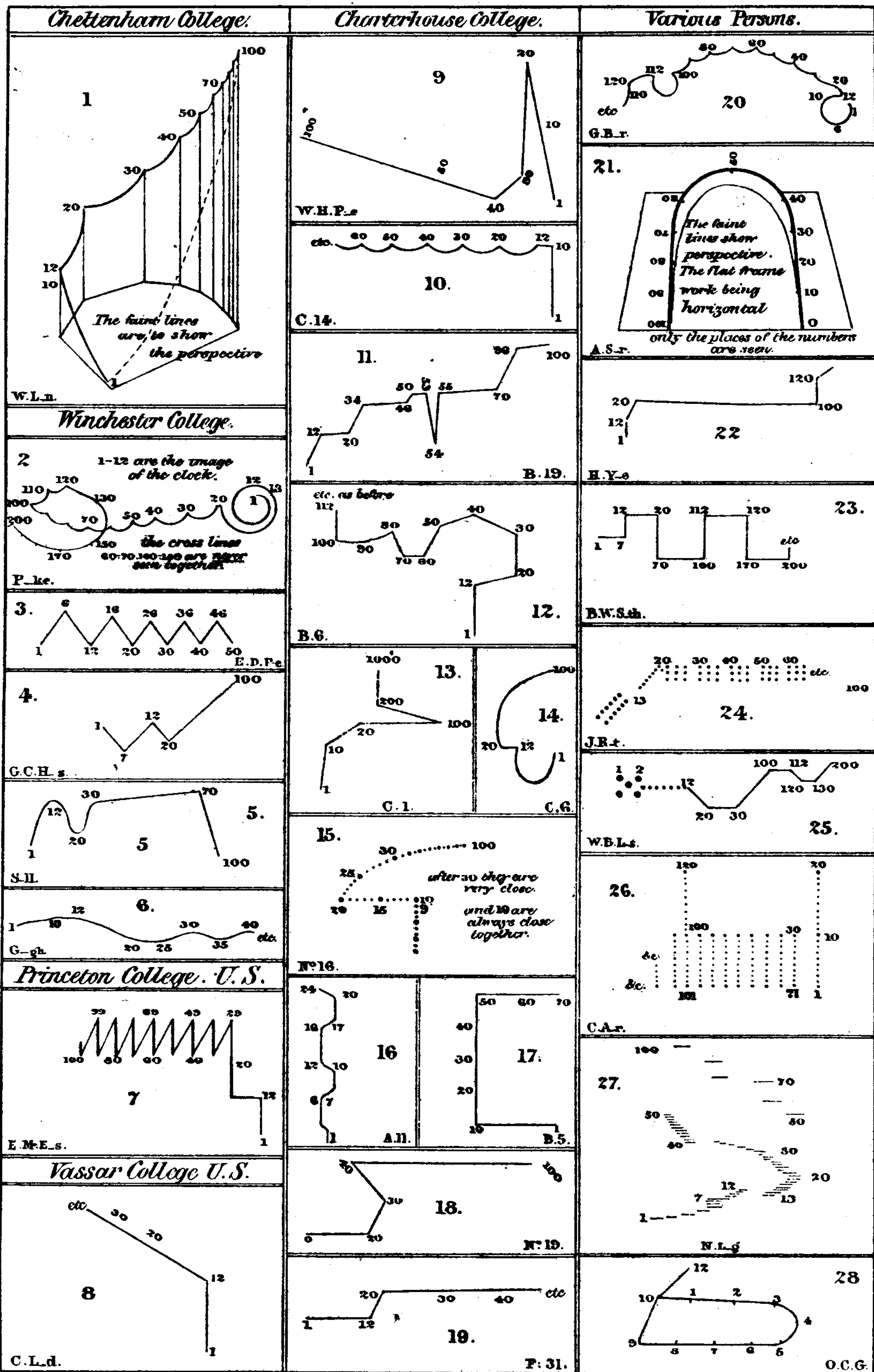
"One statesman has assured me that a certain hesitation in utterance, which he has at times, is due to his being plagued by the image of his manuscript speech with its original erasures and corrections. He cannot lay the ghost, and he puzzles in trying to decipher it.

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 slip 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." (p. 96.)

Galton next deals at some length with the visualising power of uncivilised races; he notes that Bushmen and Eskimo are an exception to the rule

<sup>1</sup> Five categories are usually adequate for the statistician; he has unfortunately often to content himself with three. But if seven are desirable then not unreasonable results may be obtained by such a system as (1) extremely heavy, (2) heavy, (3) rather heavy, (4) medium, (5) rather light, (6) light, (7) extremely light,—provided personal equation is considered, eliminated, or standardised.







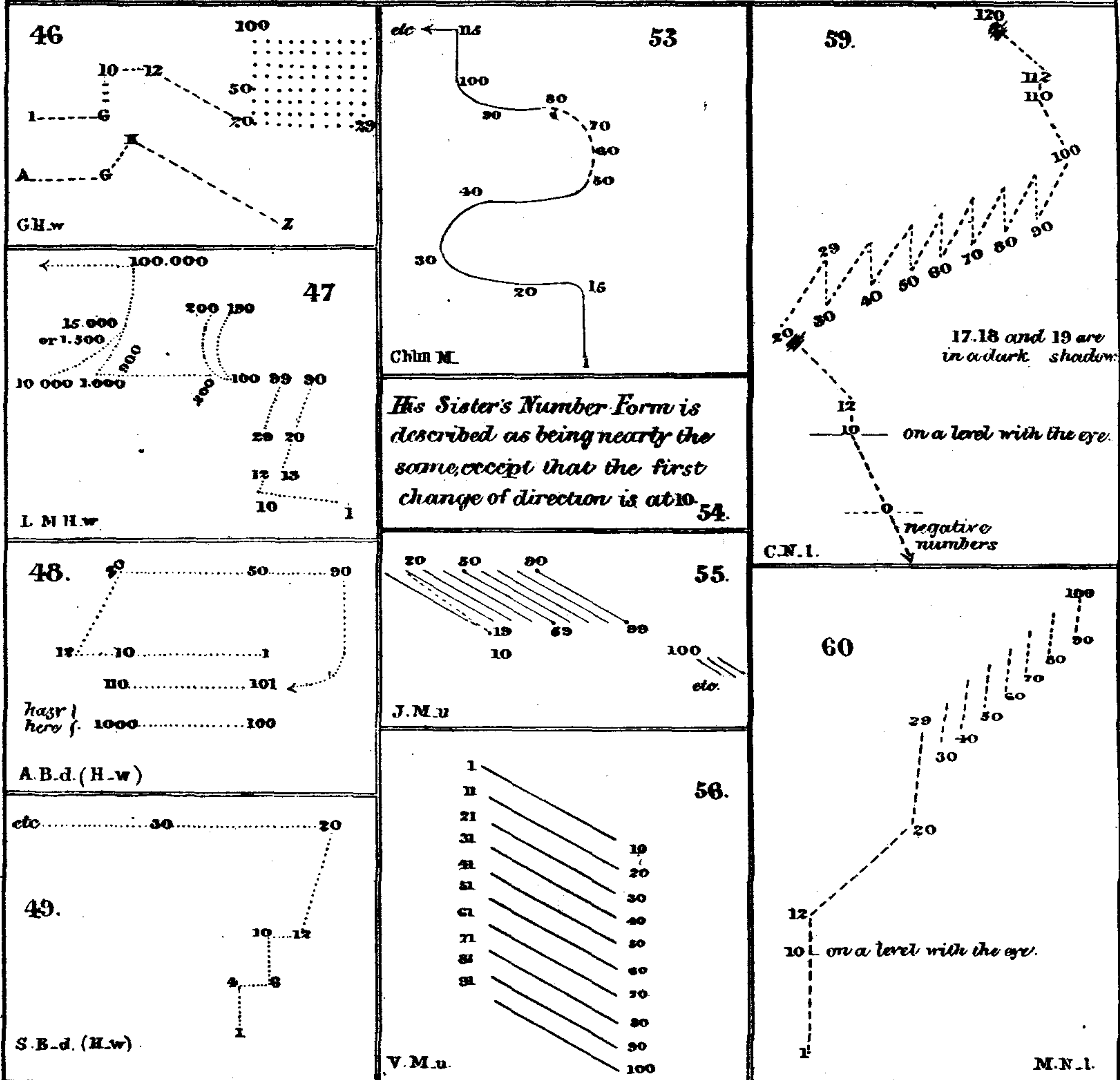
# EXAMPLES OF NUMBER FORMS.

<p style="text-align: center;"><b>29</b></p> <p style="font-size: small;">C.d.</p>	<p style="text-align: center;"><b>35</b></p> <p style="font-size: small;">G.E.r.</p>	<p style="text-align: center;"><b>42.</b></p> <p style="font-size: small;">M.T.F.</p>
<p style="text-align: center;"><b>30</b></p> <p style="font-size: small;">E.N.s</p>	<p style="text-align: center;"><b>37</b></p> <p style="font-size: x-small;">The most prominent numbers are those that occur on the multiplication table. The multipliers of 12 are especially prominent</p> <p style="font-size: small;">H.M.d.</p>	
<p style="text-align: center;"><b>31.</b></p> <p style="font-size: small;">T.H.W.r.</p>	<p style="text-align: center;"><b>38</b></p> <p style="font-size: x-small;">E.O.C.r.</p> <p style="font-size: small;">S.R.s.</p>	
<p style="text-align: center;"><b>32</b></p> <p style="font-size: small;">G.B.h.</p>	<p style="text-align: center;"><b>43.</b></p> <p style="font-size: small;">S.R.s.</p>	
<p style="text-align: center;"><b>33.</b></p> <p style="font-size: small;">C.by D.A.d.</p>	<p style="text-align: center;"><b>39</b></p> <p style="font-size: small;">J.A.S.t.</p>	<p style="text-align: center;"><b>44</b></p> <p style="font-size: small;">A.d.A.e.</p>
<p style="text-align: center;"><b>34</b></p> <p style="font-size: small;">W.M.F.P.e</p>	<p style="text-align: center;"><b>45.</b></p> <p style="font-size: small;">Z by A.d.A.e.</p>	
<p style="text-align: center;"><b>35</b></p> <p style="font-size: small;">J.D.r</p>	<p style="text-align: center;"><b>41.</b></p> <p style="font-size: small;">E.S.J.l.</p>	

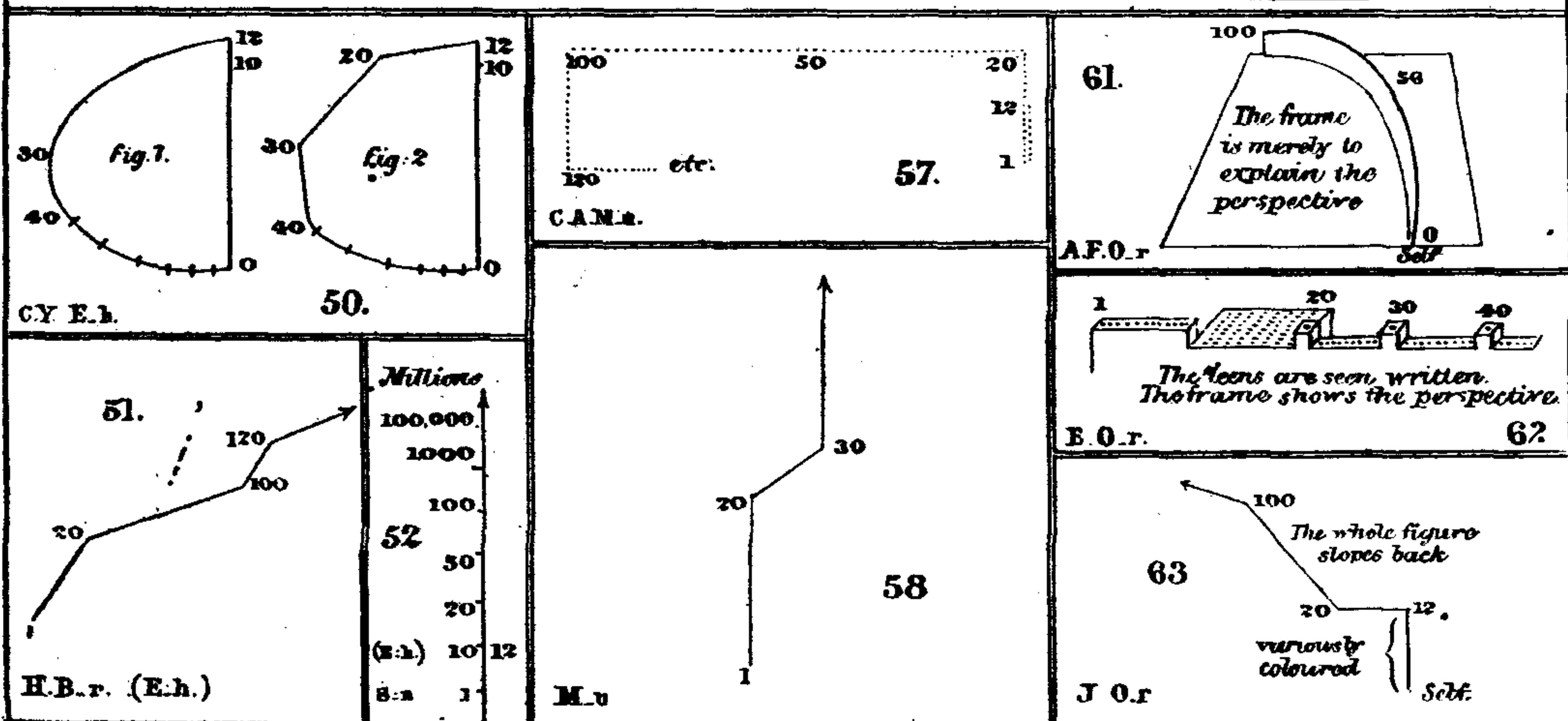


*Examples of an Hereditary Tendency to see Number-Forms.*

*4. Instances where the Number Forms in same family are alike*



*3 Instances where the Number Forms in same family are unlike*





and quotes from his paper in the *Fortnightly* of September 1880 (see our pp. 238-41), and in concluding the subject expands the last paragraph of that paper into his final expression of opinion:

"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 whenever 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 require it no less for their work than the mechanician, 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<sup>1</sup>, 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<sup>2</sup>, without prejudice to the practice of abstract-thought in symbols, is one of the many pressing desiderata in the yet unformed science of education." (pp. 113-4.)

Galton next passes to "Number Forms" and gives here the fullest account that he has provided of them, although in no way comparable with the range of his collected material. He publishes three plates of "Number Forms" and a fourth plate showing some typical associations of numbers with colours. He also indicates that some persons associate character with numerals, but rarely, except in the case of 12, to which most pay great respect, is there any agreement in the characterisation. Thus 3 may be a "treacherous sneak," a "feeble edition of 9," "a good old friend" and "delightful and amusing." There is no agreement as to the *sex* of numbers, although Galton himself imagined that the even numbers must *of course* be male (p. 144).

He then refers to the very strong evidence he had collected for the hereditary character, not of particular number forms, but of the tendency to visualise numbers. He next turns to colour associations and describes them at considerable length (pp. 145-54). He emphasises the fact that while to the ordinary man these associations of colour with letters or numbers appear equally "wild and lunatic<sup>3</sup>," no two colour visionaries agree in their schemes, and one seer is scandalised and almost angry at the heresies of another!

<sup>1</sup> Napoleon I seems to have held that men who formed mental pictures (*tableaux*), no matter what their intellect, courage and knowledge, were unfit to command. *Maximes de Guerre et Pensées*, No. 73.

<sup>2</sup> Galton, notwithstanding his evidence for the hereditary character of this faculty, yet held that it could be developed by training, and cited Légros' old teacher Lecoq de Boisbaudran, who had developed at the *École Nationale de Dessin* in Paris a complete training in visualisation. It can, no doubt, where it exists be developed by practice, but it may be questioned whether it can be originated in an individual without it, any more than musical sense or mechanical ingenuity can be developed in those in whom they are not innate.

<sup>3</sup> The complexity of some of the colour schemes as shown on Galton's Plate IV is marvellous; that plate required 14 colour stones to produce it lithographically; and therefore, fascinating as it is, I cannot reproduce it here!



As I have remarked, Galton describes and figures only a small part of his material, but enough to succeed

“in leaving a just impression of the vast variety of mental constitution that exists in the world, and how impossible it is for one man to lay his mind strictly alongside that of another, except in the rare instances of close hereditary resemblance.” (p. 154.)

The next section of the work is entitled *Visionaries*, and consists substantially of the material we have discussed in our *résumé* of the “Visions of Sane Persons” (see our pp. 243–45). The essential point is the frequency with which the automatic construction of fantastic figures takes place, and their continued sequence without control of the volition. The transition of such visions to hallucinations was regarded by Galton as only a matter of the intensity of nerve excitement, which might be produced by ill-health, brain-storms or drugs. The following section of the book under discussion is termed “Nurture and Nature.”

“Man,” writes our author, “is so educable an animal that it is difficult to distinguish between that part of his character which has been acquired through education and circumstance and that which was in the original grain of his constitution.” (p. 177.)

Galton considers that the character of a nation may not change, but a different phase or mood of it may become dominant owing to some accident causing the special representatives of that phase to be for a time national leaders.

“The love of art, gaiety, adventure, science, religion may be severally paramount at different times.” (p. 178.)

Now follows a passage which I think must be cited as a whole, for it needs some consideration:

“One of the most notable changes that can come over a nation is from a state corresponding to that of our past dark ages into one like that of the Renaissance. In the first case the minds of men are wholly taken up with routine work, and in copying what their predecessors have done; they degrade into servile imitators and submissive slaves to the past. In the second case some circumstance or idea has finally discredited the authorities that impeded intellectual growth, and has unexpectedly revealed new possibilities. Then the mind of the nation is set free, a direction of research is given to it, and all the exploratory and hunting instincts are awakened. These sudden eras of great intellectual progress cannot be due to any alteration in the natural faculties of the race, because there has not been time for that, but to their being directed to productive channels. Most of the leisure of the men of every nation is spent in a round of reiterated actions; if it could be spent in continuous advance along new lines of research in unexplored regions, vast progress would be sure to be made. It has been the privilege of this generation to have had fresh fields of research pointed out to them by Darwin, and to have undergone a new intellectual birth under the inspiration of his fertile genius.” (pp. 178–9.)

The comparison of the Darwinian movement with that of the Renaissance is a very apt one. But in neither case was it the “mind of the nation” which was set free. The movement in Germany, for instance, merely transferred the masses of the people physically and mentally from one bondage to a second, and where the new ideas did reach them they became symbols of an economic revolt, as in the Peasants’ Rebellion, rather than marks of great intellectual progress. So it has been with the Darwinian doctrines, they did just reach and interest the more thinking working men in the seventies,



but they have ceased to have any meaning for the bulk of the population to-day; its problems are essentially economic, and it will accept as an intellectual faith any doctrine which apparently offers better economic conditions<sup>1</sup>. The error is that we assume great progress in the intellectual views of the leaders of thought in a nation always corresponds to some mental development, or to some change in the culture of the mass of the people.

Galton concludes this section (p. 182) by stating that while we know "that the bulk of the respective provinces of nature and of nurture are totally different, and although the frontier between them may be uncertain," yet "we are perfectly justified in attempting to appraise their relative importance."

Our author now turns to *Associations*. He writes:

"The furniture of a man's mind chiefly consists of his recollections and the bonds that unite them. As all this is the fruit of experience, it must differ greatly in different minds according to their individual experiences. I have endeavoured to take stock of my own mental furniture in the way described in the next chapter, in which it will be seen how large a part consists of childish recollections, testifying to the permanent effect of many of the results of early education." (p. 182)..... "The character of our abstract ideas, therefore, depends to a considerable degree on our nurture." (p. 183.)

I think in these remarks Galton does not allow adequately for the difference in receptivity in the material educated. Galton and his brothers, Darwin and Erasmus, had very similar early natures, but what made the elder brothers merely country gentlemen in ideas and habits, and the younger brother a foremost man of science of his day? Surely it was a differentiated receptivity, which caused Francis to store his mind—from practically the same environment—in a wholly different way; and there can be little doubt that this receptivity, which stored experiences wholly otherwise than his brothers did, was an innate faculty, a result of nature not of nurture. Again, many lads had the training of a classical school and of a university, precisely as Charles Darwin had, but their receptivity was very different in its selection from his, and the result left them largely mediocrities. That basal distinction was one of nature. Again, it is not only the selective action in storing experiences, but the manner in which the brain associates them, which is important. I cannot think, therefore, that because Galton in his *Psychometric Experiments*<sup>2</sup> found many of his associations were from early childhood that this denotes a large part played by nurture in mental efficiency. I think the effectiveness of the brain in summoning fitting associations is recognised by Galton in the following section of his book entitled *Antechamber of Consciousness*. Here he writes:

<sup>1</sup> A recent talk with a Russian Soviet professor from Moscow threw some light on the idealist views of the Soviet leaders. The results of modern science were to be broadcasted among the people, and the ecclesiastics who opposed this were to be removed; it was to be science for the people as against theological bondage, but the new scientific faith was to be associated with an economic revolution, which would benefit the masses. There certainly is a philosophic reading of history—what we might term an anthropological sense—in this combination. And I await with greater interest and more understanding the outcome of these idealistic scientists and politicians!

<sup>2</sup> He reproduces largely his papers on this subject (see our pp. 233-36) in pp. 185-203 of the *Inquiries*.



“When I am engaged in trying to think anything out, the process of doing so appears to me to be this: the ideas that lie at any moment within my full consciousness seem to attract of their own accord the most appropriate out of a number of other ideas which are lying close at hand, but imperfectly within the range of my consciousness. There seems to be a presence-chamber in my mind where full consciousness holds court, and where two or three ideas are at the same time in audience, and an antechamber full of more or less allied ideas, which is situated just beyond the full ken of consciousness. Out of this antechamber the ideas most nearly allied to those in the presence-chamber appear to be summoned in a mechanically logical way, and to have their turn of audience. The successful progress of thought appears to depend—first, on a large attendance in the antechamber; secondly, on the presence there of no ideas except such as are strictly germane to the topic under consideration; thirdly, on the justness of the logical mechanism that issues the summons. The thronging of the antechamber is, I am convinced, altogether beyond my control; if the ideas do not appear, I cannot create them, nor compel them to come. The exclusion of alien ideas is accompanied by a sense of mental effort and volition; whenever the topic under consideration is unattractive, otherwise it proceeds automatically, for if an intruding idea find nothing to cling to, it is unable to hold its place in the antechamber and slides back again.” (pp. 203–4.)

Galton’s analysis suggests the importance of (i) the selective action of the brain in storing ideas drawn from experiences, and of (ii) its efficiency in associating these ideas. In both these faculties it seems to me that we are dealing with an innate quality of the brain, which distinguishes two brothers reared under the same environment, or two youths educated in the same way in the same school and the same university. It is impossible to reproduce here the whole of Galton’s suggestive thought in this section of his work on the *Antechamber of Consciousness*; we must refer the reader to the work itself. One further citation of a characteristic kind may be given:

“Extreme fluency and a vivid and rapid imagination are gifts naturally and healthfully possessed by those who rise to be great orators or literary men, for they could not have become successful in those careers without them. The curious fact already alluded to of five editors of newspapers being known to me as having phantasmagoria, points to a connection between two forms of fluency, the literary and the visual. Fluency may be also a morbid faculty, being markedly increased by alcohol (as poets are never tired of telling us), and by various drugs, and it exists in delirium, insanity, and states of high emotion. The fluency of a vulgar scold is extraordinary.” (pp. 205–6.)

Galton’s next section is entitled “Early Sentiments” (pp. 208–16), and in it he endeavours to show that

“the power of nurture is very great in implanting sentiments of a religious nature, of terror and of aversion, and of giving a fallacious sense of their being natural instincts.” (p. 216.)

He states that:

“The models upon whom the child or boy forms himself are the boys or men whom he has been thrown amongst, and whom from some incidental cause he may have learnt to love and respect. The every-day utterances, the likes and dislikes of his parents, their social and caste feelings, their religious persuasions are absorbed by him; their views or those of his teachers become assimilated and made his own.”... “He is born prepared to attach himself as a climbing plant is naturally disposed to climb, the kind of stick being of little importance.” (p. 208.)

It seems to me that Galton overlooks here the fact that “slavish acceptance” is very frequently an inherited character. The child accepts the first thing placed before it, not necessarily because it is the first thing or comes from its parents, but because it lacks desire to inquire for itself. Galton asserts that mere chance of birthplace makes religion a matter of accident,



but it is not chance, but mental inertia which leads many persons to retain the religion of their childhood without further inquiry. I cannot lay the stress Galton does on the danger of dogma or sentiments instilled in early youth becoming ingrained in the character. One sees too many young people now-a-days who have changed the religious and social faiths of their childhood, to lay exaggerated stress in this respect on nurture. It may have been true 40 years ago that:

“In subjects unconnected with sentiment, the freest inquiry and the fullest deliberation are required before it is thought decorous to form a final opinion; but whenever sentiment is involved, and especially in questions of religious dogma, about which is more sentiment and more difference of opinion among wise, virtuous and truth-seeking men than about any other subject whatever, free inquiry is peremptorily discouraged. The religious instructor in every creed is one who makes it his profession to saturate his pupils with prejudice.” (p. 210.)

Whatever the religious instructor of to-day may say or do, I think it would have small effect on the youth of to-day! They have won their freedom, or, perhaps, it were truer to say, it has been won for them, and in my experience they think and choose for themselves both their social and their religious creeds. Those that do not, fail, not so much from prejudices inculcated by parents and pastors, as from intellectual inertia, which the careful observer will probably recognise as the really vital contribution of the parents to their offspring<sup>1</sup>. Still we may well agree with Galton that

“there are a vast number of foolish men and women in the world who marry and have children, and because they deal lovingly with their children it does not at all follow that they can instruct them wisely.” (p. 210.)

Galton points out that the wisest men of all ages may have led upright and consistent lives and been honoured by a wide circle for their unselfish furtherance of the public good, but that they have belonged to many races, and have been claimed by many dogmatic faiths (pp. 211-13).

Conscience is next dealt with and it is stated that it arises from two sources (*a*) inheritance, and (*b*) early training. Ethnologists have shown that conscience varies from race to race and age to age; it is partly transmitted by inheritance in the way and under the conditions suggested by Darwin<sup>2</sup>:

“The value of inherited conscience lies in its being the organised result of the social experience of many generations, but it fails in so far as it expresses the experience of generations whose habits differed from our own. The doctrine of evolution shows that no race can be in perfect harmony with its surroundings; the latter are continually changing while the organism of the race hobbles after, vainly trying to overtake them. Therefore the inherited part of conscience cannot be an infallible guide, and the acquired part of it may, under the influence of dogma, be a very bad one. The history of fanaticism shows too clearly that this is not only a theory but a fact. Happy the child, especially in these inquiring days, who has been taught a religion that mainly rests on the moral obligations between man and man in domestic and national life, and which, so far as it is necessarily dogmatic, rests chiefly on the proper interpretation of facts about which there is no dispute,—namely, on those habitual occurrences which are always open to observation, and which form the basis of so-called natural religion.” (p. 212.)

<sup>1</sup> Discussing recently with a friend whether Galton's views applied to the young people of to-day, I mentioned a number of them known to us both who had certainly thought for themselves. The reply came: “Yes, but *they* have minds,” and not till the words were out of the mouth did the speaker realise that the case had been given away.

<sup>2</sup> *The Descent of Man*, 1871, Vol. I, p. 102, etc.



Terror, Galton asserts, is early learnt and he refers to the manner in which gregarious animals learn it from each other. In man, he mentions the inculcation in medieval times by preachers and artists of a belief in the horrible torments of the damned, and suggests that as torture was practised in the judicial proceedings of those days and was considered an appropriate attribute of the highest authority, so there appeared no inconsistency in a supremely powerful ruler, however beneficent, making the freest use of it. Aversion, like terror, is easily taught, and Galton points to the ideas concerning clean and unclean of Jews and Mussulmans. He even notes that his sojourn in the East during a very receptive stage of his life (see our Vol. I, Chap. VI) had impressed upon him the nobler aspects of Mussulman civilisation (see Vol. I, p. 207 and II, p. 28), and that he then adopted some of their aversions, even 40 years later looking upon his left hand as unclean (p. 216).

Whatever present-day readers may feel as to the power of nurture in implanting dogmatic belief, or in creating terrors and aversions in the mind of the child which it is not able thereafter to cast off, there is no doubt that the theological readers of 1883 were vastly incensed by Galton's book and gave expression to it in a series of hostile criticisms.

Galton's final answer<sup>1</sup> to the problem of the relative strengths of Nurture and Nature is based, as we have indicated elsewhere (pp. 126-29), on the "History of Twins." This subject occupies pp. 216-43 of his treatise, but it is unnecessary to repeat its conclusions here. He finishes his section by reference to the small effect that nurture has on the nature of the young cuckoo.

Then follows a reproduction of the memoir of 1865 on the *Domestication of Animals* (see our pp. 70-72). Galton claims that the facts cited show the small power of nurture against adverse natural tendencies. By this he means that every wild animal has practically had its chance of being domesticated, but that nurture has in the great bulk of cases failed to achieve domestication. Those who fail, sometimes only in one small particular, are destined to perpetual wildness so long as their race continues. "As civilisation extends they are doomed to be gradually destroyed off the face of the earth as useless consumers of cultivated produce." Galton infers that because very slight differences may make domestication impossible in related species, so very slight differences in the natural dispositions of human races may either lead them irresistibly to a certain career or make that career impossible (p. 271). Galton's next section is entitled: *Possibilities of Theocratic Intervention* and here again he commits the unpardonable offence of trespassing fearlessly upon the territory of those with whom he is at issue (see our p. 249); I fear this practice is rather the rule in the case of warfare, which is not unusually carried even into the enemy's camp. Be this as it may, Galton replies to the criticism that it is idle to compare the intensities of nature and nurture, because these may not be the only influences at work. There is the possibility of theocratic interference either on the Deity's own initiative or as a response to prayer. Galton endeavours

<sup>1</sup> "There is no escape from the conclusion that nature prevails enormously over nurture when the differences of nurture do not exceed those commonly found among persons of the same rank of society and in the same country." (p. 241.)



to show that there is only one mode of theocratic interference, which could upset the statistical comparison of the relative intensities of nature and nurture. He illustrates his point by supposing a caretaker tending a large number of silkworms of various breeds and fed in different ways, and that an observer watched his proceedings as well as he could, but only during the day-time and through a telescope. Now the caretaker might have a custom, of which the observer was ignorant, of feeding the silkworms in various ways during the night, and Galton asks how this would affect the statistical conclusions. He suggests four possibilities and considers in each case that the caretaker's unobserved interference would not affect the statistical conclusions based upon classifications by nature and by nurture. But, I think, the reason of this is that Galton supposes the caretaker to pay attention in his secret proceedings only to race (i.e. nature) and to the day feedings of these races (i.e. nurture). What if he thought nothing about race or day feedings, but classified his worms by some characteristic of the individuals? Suppose he fed them differentially so as to bring all worms up to practically the same size and colour, which might be the very characteristics by which the observer had classified respectively for nurture and breed? Clearly no comparison of the effects of nurture and nature would be possible, and by less complete changes the observer might be led to very false conclusions. Further, this would be done without the caretaker knowing, as Galton supposes in his fifth alternative, that he was watched and, because he objected to being watched, devising plans to deceive the observer. There is no necessity to suppose

"the homologue would be a god with the attributes of a devil, who misled humble and earnest inquirers after truth by malicious artifice." (p. 275.)

There is in fact no need to appeal to Milton's God, who could be moved to laughter by man's quaint attempts to understand his works<sup>1</sup>.

Surely the problem is of a different kind. Either theocratic interference is perpetual and consistent, in which case it is as definite as any law of nature, and cannot be distinguished from it, and will not alter statistical results; or, it is occasional and capricious, in which case statistical samples taken under apparent sameness of physical environment will give divergent results. The general stability of statistical ratios, like the general fulfilment of prediction from so-called physical laws of nature, is the best argument against occasional and capricious theocratic interference. On pp. 277-94 Galton repeats his statistical arguments (see our pp. 115-17) against the "Objective Efficacy of Prayer." He expands to some extent his earlier arguments:

"The cogency of all these arguments is materially increased by the recollection that many items of ancient faith have been successively abandoned by the Christian world to the domain

<sup>1</sup> *Paradise Lost*, Bk VIII, ll. 70 *et seq.*:

"Or if they list to try  
Conjecture, he his fabric of the Heavens  
Hath left to their disputes, perhaps to move  
His laughter at their quaint opinions wide  
Hereafter, when they come to model Heaven,  
And calculate the stars."



of recognised superstition. It is not two centuries ago, long subsequent to the days of Shakespeare and other great men whose opinions still educate our own, that the sovereign of this country was accustomed to lay hands on the sick for their recovery, under the sanction of a regular Church service, which was not omitted from our prayerbooks till the time of George II. Witches were unanimously believed in and were regularly exorcised, and punished by law, up to the beginning of the last century. Ordeals and duels, most reasonable solutions of complicated difficulties according to the popular theory of religion, were found untrustworthy in practice. The miraculous power of relics and images, still so general in Southern Europe, is scouted in England. The importance attributed to dreams, the barely extinct claims of astrology, and auguries of good and evil lucks, and many other well-known products of superstition which are found to exist in every country, have ceased to be believed in by us. This is the natural course of events, just as the Waters of Jealousy, and the Urim and Thummim of the Mosaic Law had become obsolete in the times of the later Jewish kings. The civilised world has already yielded an enormous amount of honest conviction to the inexorable requirements of solid fact; and it seems to me clear that all belief in the efficacy of prayer, in the sense in which I have been considering it, must be yielded also. The evidence I have been able to collect bears wholly and solely in that direction, and in the face of it the *onus probandi* must henceforth lie on the other side." (pp. 293-4.)

The following section is termed *Enthusiasm* (pp. 294-98), and is concerned not so much with "ardent zeal" in any kind of work, as with the definition of the word in its proper range—"a belief or conceit of private revelation; the vain confidence or opinion of a person that he has special divine communications from the Supreme Being or familiar intercourse with him<sup>1</sup>." Galton remarks that to a large number of the ablest class of mankind the idea of an indwelling divine Spirit, with which they can commune, is so habitual and vivid as to be an axiomatic truth to them. This possibility, he says, has been to him a real and almost lifelong subject of thought, and has been a motive for many of the inquiries in his book, for were this "enthusiasm" a reality and not a vain confidence, it is clear that those races should be encouraged who are characterised by spiritual-mindedness, for they would be far more worthy occupants of the earth than the generality of ourselves (p. 395). Those who have known Francis Galton, and so realised his innate simplicity of mind, will appreciate as no others can that there was no flippancy in his words.

"There is no subject more worthy of reverent but thorough investigation than the objective evidence for or against the existence of inspiration from an unseen world, and none that up to the present time has so tantalised the anxious and honest inquirer with unperformed promise of solution. The arguments scattered or hinted at throughout this book are negative so far as they go, but it must be borne in mind that they would be scattered to the winds by solid objective evidence on the other side, such as could be seriously entertained by scientific men desiring above all things to arrive at truth." (pp. 295-6.)

Galton then cites the points in his *Inquiries* which bear on the axiomatic assumption of inspiration, the visions of apparently objective character, the fluency which is considered automatic unless it deals with devout subjects, the prevalence of extreme forms of religious rapture among the hysterical and insane, the axiomatic necessity, to those that perceive them, of their individual number forms or colour associations. Lastly, Galton claims—and here the dogmatic theologians would not be at one with him—that "it appears to be tacitly recognised by all that the absolute and final court of appeal is not

<sup>1</sup> Galton cites this definition as occurring in a "recent" dictionary.



subjective but objective." We cannot assert that our own instinctive convictions alone are to be trusted, we are forced to grant no less trustworthiness to the convictions and fancies of others. All such convictions should be tested, whenever possible, by appeal to facts which admit of *repetition*, for experience shows that only observations of such facts lead to results which can be universally acknowledged. Galton insists on the duty of suspending our belief and maintaining the freedom of our mental attitude whenever there is strong reason to doubt (p. 298). The section on *Enthusiasm* closes with a fine paragraph, which indicates how far astray the critics went, when they labelled Galton a materialist:

"There is nothing in any hesitation that may be felt as to the possibility of receiving help and inspiration from an unseen world, to discredit the practice that is dearly prized by most of us, of withdrawing from the crowd and entering into quiet communion with our hearts, until the agitations of the moment have calmed down, and the distorted mirage of the worldly atmosphere has subsided, and the greater objects and more enduring affections of our life have reappeared in their due proportions. We may then take comfort and find support in the sense of our forming part of whatever has existed or will exist, and this need be the motive of no idle service, but of an active conviction that we possess an influence which may be small but cannot be inappreciable, in defining the as yet undetermined possibilities of an endless future. It may inspire a vigorous resolve to use all the intelligence and perseverance we can command to fulfil our part as members of one great family that strives as a whole towards a fuller and a higher life." (p. 298.)

It was a great revolution in thought that Galton was proposing and probably few grasped its extent in 1883. He had in mind a new religion, a religion which should not depend on revelation, physical to a few selected men, or psychical to a few individuals. Man was to study the purpose of the universe in its past evolution, and by working to the same end, he was to make its progress less slow and less painful in the future. Darwin had taught evolution as a scientific doctrine; Galton proposed that this new knowledge should be applied to racial and social problems, and that understanding of, sympathy with, and aid in the progress of the general evolution of living forms should be accepted as religious duties. If the purpose of the Deity be manifested in the development of the universe, then the aim of man should be, with such limited powers as he may at present possess, to facilitate the divine purpose. Before Darwin, living forms, indeed the world itself, had no history; there was held to be no serious ethnological difference between the first man and modern civilised man; the reptile and the mammal were coeval. Darwin for the first time gave a real history to living forms, and Galton following him said: Study that history, study the Bible of Life, and you will find your religion in it, and a new and higher morality as well. Thereby he raised Darwinism on to a higher, a spiritual plane. Thus it comes about that the last 40 pages of Galton's *Inquiries into Human Faculty* contain some of the finest passages he ever wrote, for they are devoted to his philosophical or rather religious views, and to their Darwinian basis. Galton saw in his doctrine a new moral freedom for man and a new religion based on scientific knowledge. His theological critics found it pure materialism, a fresh war against Heaven. Who shall determine which party was in the right? These



extreme divergences at least confirm Galton's statement that the mental differences of mankind are so great that evolution has ample material to select from!

Galton starts his philosophical creed with a section on *The Observed Order of Events*: his thesis here is that the universe is a single entity and we ourselves are part of a mysterious whole "behind which lies the awful mystery of the origin of all existence," the purpose of the universe. He considers that the conditions which direct the evolution of living forms are on the whole marked by their persistence in improving the birthright of successive generations.

"They determine at much cost of individual comfort, that each plant and animal shall on the general average be endowed at its birth with more suitable natural faculties than those of its representative in the preceding generation. They ensure, in short, that the inborn qualities of the terrestrial tenantry shall become steadily better adapted to their homes and to their mutual needs." (p. 299.)

"If we summon before our imagination in a single mighty host, the whole number of living things from the earliest date at which terrestrial life can be deemed to have probably existed, to the latest future at which we may think it can probably continue, and if we cease to dwell on the mis-carriages of individual lives or single generations, we shall plainly perceive that the actual tenantry of the world progresses in a direction that may in some sense be described as the greatest happiness of the greatest number." (p. 300.)

Galton remarks how, while the motives of individuals in the lowest stages were purely self-regarding, they have broadened out as evolution went on. Subjects of affection and interest other than self become increasingly numerous as intelligence and depth of character develop, and as civilisation extends. He notes that as civilisation has advanced the sacrifice of personal repose to the performance of social duties has become more common.

"Life in general may be looked upon as a republic where the individuals are for the most part unconscious that while they are working for themselves they are also working for the public good." (p. 300.)

This was indeed a refreshingly optimistic opinion! Even the period which the physics of that day fixed for the available heat of the sun, upon which organic life depends, did not daunt Galton. There are countless abortive seeds and germs; among a thousand men selected at random some are crippled, others insane, idiotic or otherwise incurably imperfect in body or mind; what if our "world may rank among other worlds as one of these"? We know that our own life is built up of the separate lives of billions of cells of which our body is composed. They form a vast nation, members of which are always dying, while others grow to take their place. The continual sequence of these little lives—unconscious of the whole—has its outcome in the larger and conscious life of the man as a whole. Even this world of ours and

"our part in the universe may possibly in some distant way be analogous to that of cells in an organised body, and our personalities may be the transient but essential elements of an immortal and cosmic mind." (p. 302.)

Thus Galton, the pantheist, again puts forth as a possibility his beautiful, but unproven and unprovable dream (cf. our p. 114). All he can say of it is that at least it is not inconsistent with observed facts. Yet even while he



admits that the slow progress of evolution is due to antecedents and inherent conditions of which we have not yet the slightest conception, he throws out an idea which foreshadows in a startling way Einstein, and in itself predicts how his doctrine may modify man's religious views. I have not seen this strange passage quoted, nor do I know what Galton's readers may have made of it in pre-relativity days.<sup>4</sup> It runs:

"It is difficult to withstand a suspicion that the three dimensions of space and the fourth dimension of time may be four independent variables of a system which is neither space nor time, but something else wholly unconceived by us. Our present enigma as to how a First Cause could itself have been brought into existence—how the tortoise of the fable that bears the elephant, that bears the world, is itself supported,—may be wholly due to our necessary mistranslation of the four or more variables of the universe, limited by inherent conditions, into the three unlimited variables of space and the one of Time." (p. 302).

An obscure passage, indeed, which one of us ought to have asked Galton to interpret, but which now we can only place against Clifford's concept that "matter is a wrinkle in space." Both men might have taught us to think had our minds then been receptive.

Putting these high theories and suggestions on one side, Galton notes two great and indisputable facts:

(i) That the whole of the living world moves steadily and continuously towards the evolution of races that are progressively more and more adapted to their complicated mutual needs and to their external circumstances.

(ii) That this process of evolution has been hitherto carried on with what men from their standpoint must reckon as great waste of opportunity and life, and with little if any consideration for individual mischance.

Measured by man's criterion of intelligence and mercy,

"the process of evolution on this earth has been carried out neither with intelligence nor ruth, but entirely through the routine of various sequences, commonly called 'laws,' established or necessitated we know not how." (p. 303.)

Intelligent man has now been evolved. He has enormously modified the surface of the earth and altered its distribution of plants and animals. This new animal, man, endowed with a little power and some intelligence, ought, Galton holds, to assume a deliberate and conscious part in furthering the great work of evolution.

"He may infer the course it is bound to pursue, from his observation of that which it has already followed, and he might devote his modicum of power, intelligence and kindly feeling to render its future progress less slow and painful. Man has already furthered evolution very considerably, half unconsciously, and for his own personal advantages, but he has risen to the conviction that it is his religious duty to do so deliberately and systematically." (p. 304.)

Thus was the Darwinian doctrine raised by Galton to a religious creed.

The next section of the book, entitled *Selection and Race*, needs, I venture to think, some modification. Galton, having only dealt with the correlation of two variates, misunderstood, as I shall show later, the phenomena of regression. His statement here that the stringent selection of the best specimens of a race to rear and breed from can never lead to any permanent result, is, I feel sure, erroneous, and due to a wrong interpretation of multiple regression. Further, I doubt his assumption of the



diminished fertility of highly-bred animals, unless he supposed, as in the case of the race-horse, a selection by *one* character, say, speed, only. There is, I think, no evidence that a selection of man by *both* physique and mentality would lead to an infertile race.

With Galton's statement that a low race, subjected to conditions of life that demand a high level of efficiency, must be submitted to a very rigorous selection involving great pain and misery, we can certainly agree. And we can also do so in the suggestion that the terrible suffering would disappear did we replace it by a higher race.

"The most merciful form," writes Galton, "of what I ventured to call 'eugenics' would consist in watching for the indications of superior strains or races, and in so favouring them that their progeny shall outnumber and gradually replace that of the old one." (p. 307.)

The following section of the *Inquiries* is concerned with the *Influence of Man upon Race* (pp. 308-17). Galton gives in a very few pages an able ethnographical survey of the world; he shows that in almost every known country there are three or four races or sub-races of man competing consciously or unconsciously for dominance. The process of evolution is still going on around us, and we disregard it instead of studying it and facilitating it. He raises a strong protest against that misleading word "aborigines," and points out that it dates from a time when a false cosmogony thought the world young and life to be of very recent appearance. There are to-day practically no original inhabitants of any district; all hold their lands only by the robber-rights of their ancestors. It would be difficult indeed to find a country which being unoccupied was colonised by its *present* inhabitants, and thence to assert their right of occupation<sup>1</sup>. Such reasoning carried to its logical conclusion might demand the complete surrender of Australia to the marsupials or even the monotremes.

"There exists," writes Galton, "a sentiment for the most part quite unreasonable, against the gradual extinction of an inferior race. It rests on some confusion between the race and the individual, as if the destruction of a race was equivalent to the destruction of a large number of men. It is nothing of the kind where the process of extinction works silently and slowly through the earlier marriage of members of the superior race, through their greater vitality under equal stress, through their better chances of getting a livelihood, or through their prepotency in mixed marriages. That the members of an inferior class should dislike being elbowed out of the way is another matter; but it may be somewhat brutally argued that whenever two individuals struggle for a single place, one must yield, and that there will be no more unhappiness on the whole, if the inferior yield to the superior than conversely, whereas the world will be permanently enriched by the success of the superior<sup>2</sup>." (p. 309.)

<sup>1</sup> The preliminary discussion of the recent peace terms at Versailles was accompanied by much futile talk about the 'rights' of small nations and of racial units. No small people, because it at present occupies a certain area, can be said to have a 'right' to mineral resources vastly exceeding its own consumption and essential to the needs of a larger adjacent population. Any allotment of lands based solely on 'aboriginal' or even present occupational 'rights' is certain to be called in question by the pressure of race against race. The peace-makers of Versailles lacked the knowledge that springs from a study of evolution.

<sup>2</sup> A great deal of the missionary argument in favour of the retention of the negro in tropical Africa, as against the Indian, or, as Galton proposed, the Chinese immigrant (see our p. 33), arises from the fact that the negro's emotional nature makes him a more ready convert than the more highly civilised Asiatics. Africa, like Europe of the folk-wandering days, has always been the



Galton notes what enormous influence the men of former generations have exercised unconsciously over the human stock of to-day. How differently world-history would have developed had our forefathers left the 'aborigines' of America, South Africa and Australia to the free occupation of their lands.

"The power in man of varying the future human stock vests a great responsibility in the hands of each fresh generation, which has not yet been recognised at its just importance, nor deliberately employed. It is foolish to fold the hands and to say that nothing can be done, inasmuch as social forces and self-interests are too strong to be resisted. They need not be resisted; they can be guided." (p. 317.)

In the following section, termed *Population*, Galton refers to the increased danger of over-population owing to improved sanitation, lesser mortality and the filling-up of the spare places of the world. He expresses, as Darwin did (see our p. 111), strong disapproval of Malthus' prudential check as prejudicial to the better elements of the race who alone would be prudent and self-denying, while the thriftless and improvident would crowd the vacant space left by the prudent<sup>1</sup>. The 'misery-check'—as Malthus called all influences other than the prudential, such as deaths through lack of food and shelter, overcrowding, war, etc.—does not seem to Galton to cover all the causes which make one race decay in the presence of a second. He thinks that an inferior race becomes listless and apathetic in the presence of a superior one, and loses its virility. He believes that such apathy is less a 'misery' than the prudential restraint where there is a keen desire for marriage (p. 320).

Galton then turns to his own direct proposals for racial betterment. He refers first to Dr J. Mathews Duncan's data for fertility and he uses these as if (i) they represented the survivors at adult ages of those born, (ii) they applied equally to all classes of intelligence and physique; he does not discuss the differential infantile death-rate, nor the differential fertility rate of his selected and rejected classes, nor the important question of the relative number of *survivors* of early and of late marriages. He takes two groups, one of 100 mothers who marry at 20, and another of 100 mothers who marry at 29, and considers their families would be 8.2 and 5.4 respectively. He then says that they would contribute to the next 200 in the ratio of 115 to 85. It seems to me that the ratio should be 121 to 79. He makes the length of a generation on the average 31.5 years, but takes 20 as being 4.5 years earlier and

melting pot of races, and it is safe to say that not a single race is 'aboriginal' in Africa to-day. The Bushman and the Hottentot would have greater 'rights' than the negro to large parts of Africa, but their claim might be worsted by the Rhodesian Man. He having no lineal descendants, would compel us in justice possibly to ascend to a prot-simio-human, whence descending to the rightful heirs, we might find the chimpanzees as the true aborigines!

<sup>1</sup> While criticising Malthus' main conclusion Galton pays him a high compliment: "I must take this opportunity of paying my humble tribute of admiration to his great and original work, which seems to me like the rise of a morning star before a day of free social investigation. There is nothing whatever in his book which would be in the least offensive to this generation, but he wrote in advance of his time and consequently roused virulent attacks, notably from his fellow clergymen, whose doctrinaire notions upon the paternal dispensation of the world were rudely shocked." (pp. 318-19.)



29 years as 4·5 years later than the average age at marriage and so takes 27 and 36 years as the lengths of generations in the two classes. Thus in 108 years the early marrying class will have had four and the late marrying class three generations. Galton's numbers on p. 322 should, I think, be replaced by the following:

*Relative contributions to Maternal Populations.*

Years	Early marriages (20)	Late marriages (29)
108	214	49
216	459	24
324	985	12

The changes emphasise considerably Galton's argument, although exception may well be taken to some of its stages, in particular to the equality of death-rates in large and small families. However, his general principle is probably a correct one: namely that for the physically fit early marriage means more numerous offspring. Galton's next two sections indicate how he proposed to make use of this greater fertility in the case of the early married. His first suggestion is to give marks in competitive examinations for 'family merit.' Thus able youths would be favourably handicapped in civil service examinations if they came of superior breed. A superior breed is one which has been successful in its callings and is physically fit.

"A thriving family may be sufficiently defined or inferred by the successive occupations of its several male members in the previous generation, and of the two grandfathers. These are patent facts ascertainable by almost every youth, which admit of being verified in his neighbourhood and attested in a satisfactory manner. A healthy and long-lived family may be defined by the patent facts of ages at death, and number and ages of living relations, within the degrees mentioned above, all of which can be verified and attested. A knowledge of the existence of longevity in the family would testify to the stamina of the candidate, and be an important addition to the knowledge of his present health in forecasting the probability of his performing a large measure of experienced work." (p. 325.)

Galton would feel his way gradually in these matters, but even a small allowance to family merit would be great in its effect as indicating "that ancestral qualities are of present current value." The second factor is that of 'Endowment' of the able who have 'family merit.' As money has often been left for marriage portions for poor girls, so it might be left for the worthier purpose of marriage portions for able young people of 'family merit.' In the seventies the college statutes of the older universities enforced celibacy on the Fellows.

"The college statutes to which I referred were very recently relaxed at Oxford, and have just been reformed at Cambridge. I am told that numerous marriages have ensued in consequence, or are ensuing. In *Hereditary Genius* I showed that scholastic success runs strongly in families; therefore in all seriousness, I have no doubt, that the number of Englishmen naturally endowed with high scholastic faculties will be sensibly increased in future generations by the repeal of these ancient statutes." (pp. 329-30.)

As Galton very truly states, the wealth of the English race in hereditary gifts has never been properly explored; and when it has been, the natural



impulses of man ought to be sufficient to ensure that such wealth should no more be neglected than the existence of any other possession suddenly revealed to man.

In his *Conclusion* Galton sums up the third of the various inquiries in his volume; he points out the vast variety of natural faculty, both advantageous and not, to be found in individuals, and the great differences between human races. Man is variable and has changed widely in the course of hundreds of thousands of years. This idea of growth in man had not been grasped by the early cosmogony makers. Its recognition compels us

“to reconsider what may be the true place and function of man in the order of the world.” (p. 332.)

Galton confesses to having examined this question from many points of view, for

“whatever may be the vehemence with which particular opinions are insisted upon, its solution is unquestionably doubtful. There is a wide and growing conviction among truthseeking, earnest, humble-minded and thoughtful men, both in this country and abroad, that our cosmic relations are by no means so clear and simple as they are popularly supposed to be, while the worthy and intelligent teachers of various creeds, who have strong persuasions on the character of these relations, do not concur in their several views.” (p. 332.)

He says the results of such inquiries as he has been able to make do not confirm the common doctrines as to our relations with the unseen universe. The one thing that he can see is that man has immensely modified humanity by his action, and if he would only consciously take its betterment in hand, as a freeman shaping the course of future humanity, he might achieve great ends far less ruthlessly and more economically than Nature alone.

“The chief result of these Inquiries has been to elicit the religious significance of the doctrine of evolution. It suggests an alteration in our mental attitude, and imposes a new moral duty.” (p. 337.)

Thus Galton finally summarised his labours of more than 12 years. Few of those who, in the following century, have quoted Galton's statement namely that eugenics was a religion, have grasped fully its relation to Darwin and Evolution. Huxley attacked the old orthodox beliefs because he thought they fettered the development of science. Galton attacked them because he thought current religion fettered the development of a higher morality and a more rational religion. Huxley spoke at the ripe moment and produced immediate effect. Galton spoke—as he himself recognised—before he could be understood. But those who know that even Norway, Switzerland and Roumania have now established their Institutes for the Study of Eugenics, realise that Galton's teaching is likely to affect civilised man—now and in the future—in a manner only comparable with the influence of a new religious faith. He brought the logical application of the doctrine of evolution to the betterment of the human race. That in Galton's judgment was a science, a morality and the only rational religious faith.



## D. LATER PSYCHOMETRIC RESEARCHES

After the publication of the *Inquiries into Human Faculty*, Galton's psychological researches ceased to flow with the amplitude of the years 1876-1884, but, as in the case of Geography, he never lost his interest in these matters, and this is shown in a number of minor papers which he continued to issue till at least 1896. These papers may be referred to here, but they mark the transition of his mind to the more definite statistical standpoint of his later years. His anthropometry was largely psychometric, but the statistical basis was growing more developed and more satisfactory.

The first paper of this series which we must consider is entitled "Measurement of Character." It was published in the *Fortnightly* for August, 1884<sup>1</sup>, and the material appears to have been largely that of Galton's Rede Lecture in the Senate House at Cambridge<sup>2</sup>. The opening paragraph explains Galton's purpose:

"I do not plead guilty to taking a shallow view of human nature, when I propose to apply, as it were, a footrule to its heights and depths. The powers of man are finite, and if finite they are not too large for measurement. Those persons may justly be accused of shallowness of view, who do not discriminate a wide range of difference, but quickly lose all sense of proportion, and rave about infinite heights and unfathomable depths, and use such like expressions, which are not true and betray their incapacity. Examiners are not I believe much stricken with the sense of awe and infinitude when they apply their footrules to the intellectual performances of the candidates they examine; neither do I see any reason why we should be awed at the thought of examining our fellow creatures as best we may, in respect to other faculties than intellect. On the contrary, I think it anomalous that the art of measuring intellectual faculties should have become highly developed, while that of dealing with other qualities should have been little practised or even considered." (p. 179.)

Galton then emphasises the importance of measuring the emotional characters in man, for only by so doing can the individual know where he stands among his fellow-men, and whether he is getting on or falling back.

"The art of measuring various human faculties now occupies the attention of many inquirers in this and other countries..... New processes of inquiry are yearly invented, and it seems as though there was a general lightening up of the sky in front of the path of the anthropometric experimenter, which betokens the approaching dawn of a new and interesting science. Can we discover landmarks in character to serve as bases of a survey or is it altogether too indefinite and fluctuating to admit of measurement? Is it liable to spontaneous changes, or to be in any way affected by a caprice that renders the future necessarily uncertain? Is man, with his power of choice and freedom of will, so different from a conscious machine, that any proposal to measure his moral qualities is based upon a fallacy? If so it would be ridiculous to waste thought on the matter, but if our temperament and character are durable realities, and persistent factors of our conduct, we have no Proteus to deal with in either case, and our attempts to grasp and measure them are reasonable." (pp. 179-80.)

<sup>1</sup> Vol. xxxvi, N.S. pp. 179-85.

<sup>2</sup> I cannot find that this Rede Lecture was ever independently issued. "He [Frank] was Rede Lecturer at Cambridge on May 27th, and we went to the Vice-Chancellor's and after to Mrs Darwin's, and greatly enjoyed the four days; fortunately I was well at the time." *L. G.'s Record* under 1884.



Galton next gives his reasons for believing that character and temperament are persistent. These are summed up in:

(a) Heredity. A son who inherits somewhat exclusively the qualities of his father, "fails with his failures, sins with his sins, surmounts with his virtues." His course of life has been predetermined by his inborn faculties.

(b) The life-histories of like twins, who behave like one person. "Whatever spontaneous feeling the one twin may have had, the other twin at the very same moment must have had a spontaneous feeling of exactly the same kind." If we had in our keeping the twin of a man, who was his "double," we could obtain a trustworthy forecast of what the man would do under any new conditions by submitting the twin to those conditions and watching his conduct. (pp. 180-1.)

(c) The result of Galton's own inquiry into Free-will (see our p. 245), which indicated how small seems the room left for a possible residuum of free-will.

Galton concluded on the basis of these three researches that the character which shapes our conduct is

"a definite and durable 'something,' and that therefore it is reasonable to attempt to measure it." (p. 181.)

Now-a-days one might think that the statistical material on which Galton based his conclusions was rather meagre, but most of his results have been confirmed by more extensive researches<sup>1</sup>. He appears to have considered that 'character' was in some way a unit entity:

"We must guard ourselves against supposing that the moral faculties which we distinguish by different names, as courage, sociability, niggardness, are separate entities. On the contrary, they are so intermixed that they are never singly in action. I tried to gain an idea of the number of the more conspicuous aspects of the character by counting in an appropriate dictionary the words used to express them. Roget's *Thesaurus* was selected for the purpose, and I examined many pages of its index here and there as samples of the whole, and estimated that it contained fully one thousand words expressive of character, each of which had a separate shade of meaning, while each shares a large part of its meaning with some of the rest." (p. 181.)

From the more modern standpoint it would seem that the direct course would be to measure various factors of character in individuals and to study the extent of the inter-correlations of these factors. At any rate in children it may be doubted whether such factors as shyness, conscientiousness, self-consciousness, temper, etc., are *very highly* correlated together. One would rather anticipate that character was a hotch-potch of factors mixed in different proportions for each individual.

However, Galton starts with 'character' as an entity like intellectual capacity and suggests that as the latter may be sounded by definite tests at individual points, so in character definite acts in definite emergencies may be noted.

<sup>1</sup> For example, that the factors of character are inherited, see *Biometrika*, Vol. III, pp. 131-190; that growth and education have little influence on character, see *Drapers' Research Memoirs*, Biometric Series, No. 4.



"Emergencies need not be waited for, they can be extemporised; traps as it were can be laid..... A sudden excitement, call, touch, gesture, or incident of any kind evokes, in different persons, a response that varies in intensity, celerity and quality." (p. 182.)

Galton suggests that the cardiograph, the sphygmograph, and Mosso's blood-pressure apparatus should be used to test the effect of various small emotional shocks. To those conversant with relatively recent attempts by similar means to measure emotional changes, it will possibly be surprising that Galton suggested such investigations 40 years ago. He even wished to meet the criticism that the presence of the recording instrument might make itself felt and check the expression of the emotion. He accordingly experimented on himself by wearing a Marey's pneumo-cardiograph

"during the formidable ordeal of delivering the Rede Lecture in the Senate House at Cambridge..... I had no connection established between my instrument and any recording apparatus but wore it merely to see whether or no it proved in any way irksome. If I had had a table in front of me, with the recording apparatus out of sight below, and an expert assistant near at hand to turn a stopcock at appropriate moments, he could have obtained samples of my heart's action without causing me any embarrassment whatever. I should have forgotten all about the apparatus while I was speaking." (pp. 183-4.)

Methods of measuring the unmeasured, or trapping unobserved the emotional changes in men and women, delighted Galton above all things. He was particularly pleased with Tennyson's where he tells us that

"Lancelot returning to court after a long illness through which he had been nursed by Elaine, sent to crave an audience of the jealous queen. The messenger utilises the opportunity for observing her in the following ingenious way like a born scientist:

'Low drooping till he well nigh kissed her feet  
For loyal awe, saw with a sidelong eye  
The shadow of a piece of pointed lace  
In the Queen's shadow, vibrate on the wall  
And parted, laughing in his courtly heart.'

And again—with a suggestion of grim possibilities at a social meal in Rutland Gate, which the actuality never to my knowledge fulfilled—

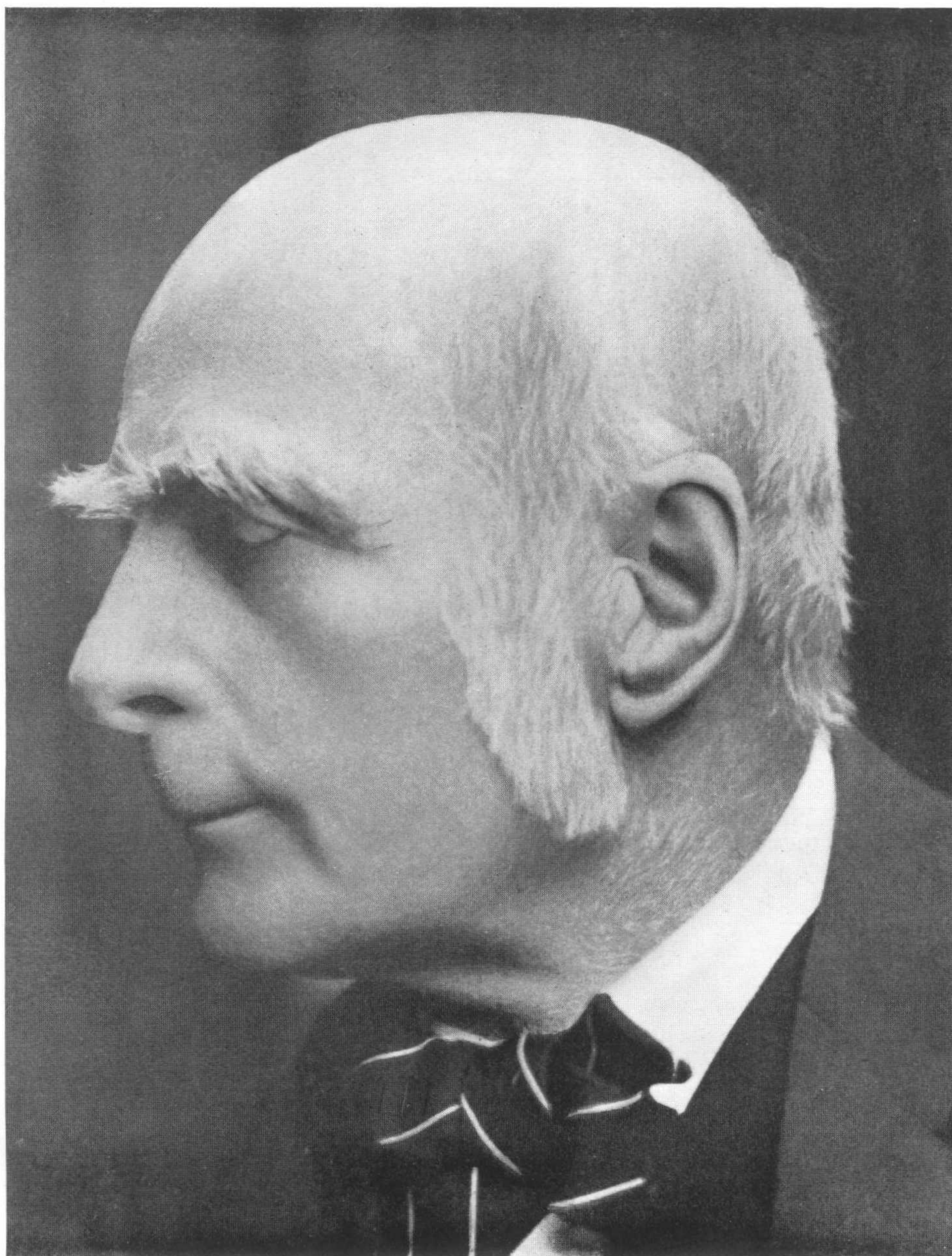
"The poetical metaphors of ordinary language suggest many possibilities of measurement. Thus when two persons have an 'inclination' to one another, they visibly incline or slope together when sitting side by side, or at a dinner table, and they then throw the stress of their weights on the near legs of their chairs. It does not require much ingenuity to arrange a pressure gauge with an index and dial to indicate changes in stress, but it is difficult to devise an arrangement, that shall fulfil the threefold condition of being effective, not attracting notice and being applicable to ordinary furniture. I made some rude experiments, but being busy with other matters, have not carried them on, as I had hoped." (p. 184.)

Other suggestions in the paper dealt with the measurement of temper and fault-finding. Galton concludes:

"The points I have endeavoured to impress are chiefly these. First, that character ought to be measured by carefully recorded acts, representative of conduct. An ordinary generalisation is nothing more than a muddle of vague memories of mixed observations. It is an easy vice to generalise. We want lists of facts, every one of which may be separately verified, valued and revalued, and the whole accurately summed. It is the statistics of each man's conduct in small every day affairs, that will probably be found to give the simplest and most precise measure of his character. The other chief point that I wish to impress is, that a practice of deliberately and methodically testing the character of others and of ourselves is not wholly fanciful but deserves consideration and experiment." (p. 185.)

Galton's Rede Lecture was a very graceful address; it was full of these





Francis Galton in the 'seventies, from a photograph.



new, if now familiar ideas, but it was a lecture of *suggestion*, and accordingly the reader must not expect to find in it statistics of actual measurements of character. It serves to explain, however, the links in Galton's own mind between his work on Heredity, his paper on Twins and his study of Free-will. At the very time Galton was writing this lecture he was collecting data by aid of his Family Records (see our Chapter XIII) on the distribution of one phase of character, namely, Temper in English Families. A First Report on his results was published in the *Fortnightly Review*, July, 1887<sup>1</sup>. The paper from more than one standpoint is slightly disappointing, and as Galton himself remarks he had to set to work on rough materials with rude tools (p. 29). The criticisms that one may raise are of the following kinds. The descriptions of temper are all verbal, and although many epithets are used, Galton in the main classifies into 'Good Temper' and 'Bad Temper.' His 'Good Temper' contains not only the 'forbearing' and 'self-controlled' but the 'submissive,' 'timid' and 'yielding.' His 'Bad Temper' contains not only the 'quick tempered,' but the 'bickering' and the 'sullen.' My own investigations seem to suggest a fundamental difference in 'Good Temper' between the Self-controlled and the Weak class, and the Sullen cannot profitably be put in the same category with the Choleric. Galton does indeed make a five-group classification, namely: (1) mild; (2) docile; (3) fretful; (4) violent; (5) masterful. The distinction, however, between (1) and (2) is not that of self-controlled and weak good temper, and it is not clear whether such a marked class as the sullen has been put into (3), (4) or (5). Another defect of Galton's material was the large proportion of cases, over 50%, in which no record of temper was given at all. He calls these neutral and says that approximately

Good Tempered : Neutral Tempered : Bad Tempered :: 1 : 2 : 1,

and he finds in the approximate equality of the Good and Bad Tempered, and their total being equal to the Neutral Tempered, definite evidence of the correctness of the records in this respect. I fail to be convinced by Galton's arguments, for it seems to me that they would have equal application to any classification into alternate categories, e.g. criminal and non-criminal, with a neutral class for those of whom nothing was known, or nothing recorded. On the basis of his classification, omitting the 50% of 'neutrals,' Galton deduces that there is no selective mating in human marriage with regard to temper<sup>2</sup>, but he concludes that there is emphatic testimony to the heredity of temper. His method of establishing the latter conclusion is somewhat arbitrary and somewhat elementary, but it has undoubtedly been confirmed by later work. He rather weakens his position, however, by introducing a caveat that he does not propose to deal with temper as an unchangeable characteristic. It is difficult to grasp how under such conditions it is possible to assert that temper is

"nevertheless as hereditary as any other quality." (p. 30.)

<sup>1</sup> "Good and Bad Temper in English Families," Vol. XLII, N.S. pp. 21-30. A wrong year and *locus* are assigned to this paper in Galton's *Memories*, p. 328.

<sup>2</sup> This is not confirmed by more recent researches.



The more modern statistician would feel compelled to investigate to what extent temper does change with growth, education and environment before he could assert that it was as hereditary as any other quality. Putting aside these criticisms, Galton undoubtedly indicated in this paper for the first time that statistics of factors of character could be dealt with and inferences drawn as to their distribution and hereditary character.

In the previous year, 1886, Galton had published at least two papers dealing with psychometry. Mr Joseph Jacobs had been interesting himself in "Experiments on Prehension," which he defined as the mind's power of *taking on* certain material, in this case auditory sensations. Nonsense syllables, letters or numerals were delivered at about half-second intervals in a monotonous voice, and the test consisted in the number the subject could repeat<sup>1</sup>. Mr Jacobs found that the 'span,' i.e. number correctly repeated, (a) increased with age, (b) was greater for those higher in the class than for those lower, and argued that the 'span of prehension' should be an important factor in mental groups, and its determination a test of mental capacity. Galton suggested that the inquiry should be extended to idiots, and visited on June 18, 1886, the Earlswood Asylum with Professor Alexander Bain, and on June 30, 1886, the Asylum for Idiots at Darent with Professor James Sully. The general conclusion obtained by Galton was that the idiots' 'span of prehension' was only about half that of Mr Jacobs' normal children, three to four figures instead of seven to eight.

In 1886 Romanes published a theory of the origin of varieties, attributing them to peculiarities in the reproductive system of certain individuals which render them more or less sterile to other members of the common stock while they remain fertile among themselves. Galton, who, as we have seen (p. 271), had been working on assortative mating in man, considered that special sexual attractiveness rather than sterility due to peculiarities of the reproductive system was the source of varieties. He writes<sup>2</sup>:

"It has long seemed to me that the primary characteristic of a variety resides in the fact that the individuals who compose it do not, as a rule, *care to mate* with those who are outside their pale, but form through their own sexual inclinations a caste by themselves. Consequently that each incipient variety is probably rounded off from the parent stock by means of *peculiarities of sexual instinct*, which prompt what anthropologists call endogamy (or marriage within the tribe or caste), and which check exogamy (or marriage outside of it). If a variety should arise in the way supposed by Mr Romanes, merely because its members were more or less infertile with others sprung from the same stock, we should find numerous cases in which members of the variety consorted with outsiders. These unions might be sterile, but they would occur all the same, supposing of course the period of mating to have remained unchanged. Again we should find many hybrids in the wild state, between varieties which were capable of producing them when mated artificially. But we hardly ever observe pairings between animals of different varieties when living at large in the same or contiguous districts, and we hardly ever meet with hybrids that testify to the existence of unobserved pairings. Therefore it seems to me that the hypothesis of Mr Romanes would in these cases fail while that which I have submitted would stand." (p. 395.)

Galton then suggests that even in the case of plants insects may exhibit

<sup>1</sup> *Mind*, Vol. XII, pp. 75-9.

<sup>2</sup> "The Origin of Varieties," *Nature*, Vol. XXXIV, pp. 395-6, August 26, 1886.



a selective appetite, and so a variety be preserved from intercrossing with the parent stock. He observes that where we just distinguish two varieties by one or two differences, these may connote a host of differences unknown to us—especially those recognised by the sense of smell, so weak with us and so strong in many of the animals—“whose aggregate would amply suffice to erect a barrier of sexual indifference or even repugnance between their members<sup>1</sup>.” Galton, considering the case of man, writes:

“No theme is more trite than that of the sexual instinct. It forms the main topic of each of the many hundred (I believe about 800) novels annually published in England alone, and of most of the still more numerous poems, yet one of its main peculiarities has never, so far as I know, been clearly set forth. It is the relation that exists between different degrees of unlikeness and different degrees of sexual attractiveness. A male is little attracted by a female who closely resembles him. The attraction is rapidly increased as the difference in any given respect between the male and female increases, but only up to a certain point. When this is passed, the attraction again wanes, until the zero of indifference is reached. When the diversity is still greater, the attractiveness becomes negative and passes into repugnance, such as most fair complexioned men appear to feel towards negresses, and *vice versa*. I have endeavoured to measure the amount of difference that gives rise to the maximum of attractiveness between men and women, both as regards eye-colour and stature, chiefly using the data contained in my collection of ‘Family Records,’ and have succeeded in doing so roughly and provisionally. To determine it thoroughly and to lay down a curve of attractiveness in which the abscissae shall be proportional to the amounts of difference, and the ordinates to the strength of attraction, would require fresh and special data.....” (p. 395.)

I have not succeeded in finding in the *Galtoniana* Galton’s rough and provisional results, which, if found, would probably throw light on his method. I have thought over the possibility of his curve and find great difficulties about its determination. Is the man equally attracted by a *plus* or *minus* difference? If so, the curve of attractiveness would have two maxima; but clearly the man’s opportunities of mating with both these groups would not be the same, as one would be more frequent than the other, unless the man himself were mediocre. If the man prefers a woman with darker eyes than himself, then the woman’s taste—for the system to work—would have to be the reverse of the man’s, or she must prefer a man with lighter eyes than herself. I have not found in contingency tables for eye colour in man and wife signs of this double maximum in the arrays<sup>2</sup>. If the preferential difference is in one direction only, say a man prefers a woman relatively shorter than himself, then the tallest class of women and the shortest class of men will have to go without mates or *faute de mieux* marry each other, which will upset badly the curve of attractiveness, if it be based on statistical records. The curve of attractiveness is a fascinating idea, but I do not see how it is to be determined, and Galton’s hypothesis that sexual taste and distaste are

<sup>1</sup> The fastidiousness of certain sires is a real trouble to the dog breeder. A bitch may be perfectly willing to mate and other dogs desirous of mating with her, but she may have no attraction for the particular sire chosen until a very late stage of her season, when he becomes excited. Such “last moment” dogs often miss their opportunity.

<sup>2</sup> A little consideration will show that it is very difficult indeed to conceive a surface of frequency of which the arrays both ways are bimodal and yet such that the wife-modes of husband accord with the husband-modes of wife! One is almost driven to the conclusion either that there is no assortative mating, or that after all like must prefer to mate with like.



more important in the creation of varieties than intervarietal sterility is not really affected by it.

In the following year (1887) Galton had a considerable discussion in *Nature*<sup>1</sup> with Professor Max Müller on "Thought without Words." The latter in his *Science of Thought* had propounded theories of the descent of man entirely based on the hypothesis that the most rudimentary processes of true thought cannot be carried on without words. Hence Max Müller asserted that the constitution of the mind of the only truly speaking animal, man, separates him immeasurably from the brutes, and no process of evolution which advanced by small steps could stride over such a gulf. Galton states that if a single instance can be substantiated of man thinking without words the whole of Max Müller's anthropological theory must collapse. Galton then appeals to results he had observed by his own introspection, and holds that he has often thought entirely without words. For example:

"It happens that I take pleasure in mechanical contrivances, and the simpler of these are thought out by me absolutely without the use of any mental words. Suppose something does not fit; I examine it, go to my tools, pick out the right ones, and set to work and repair the defect, often without a single word crossing my mind." (p. 28.)

He then refers to billiards and chess; where the strokes and moves are visualised without words beforehand; also to fencing, where there is no time to think in words, before the counter is given. It seems undoubtedly clear that those who visualise vividly will think in pictures as readily as in words, or even more readily<sup>2</sup>. Galton considers that Max Müller failed in reaching a true hypothesis because he generalised from his own mind, and considered that the mind of every one else was like his own (see our p. 243).

"Before a just knowledge can be attained concerning any faculty of the human race we must inquire into its distribution among all sorts and conditions of men, and on a large scale, and not among those persons alone who belong to a highly specialised literary class. I have inquired myself so far as opportunities admitted, and arrived at a result that contradicts the fundamental proposition in the book before us, having ascertained to my own satisfaction at least, that in a relatively small number of persons true thought is habitually carried on without use of mental or spoken words." (p. 29.)

The reader who wishes to follow the discussion further will find two letters of Max Müller and a further letter from Galton in *Nature*. To the present writer Max Müller's reasoning seems very obscure. Replying to Galton's illustration of chess-playing, he writes:

"You cannot move queen or knight as mere dolls. In chess each one of these figures can be moved according to its name and concept only. Otherwise chess would be a chaotic scramble, not an intelligent game." (p. 101.)

But surely the moves of any piece at chess may be associated with the *form* of the piece and not with its name? Max Müller obscures the matter by adding the words "and concept." A concept may be attached to an

<sup>1</sup> May 12 and June 2, Vol. xxxvi, pp. 28-9 and 100-101.

<sup>2</sup> Some of Galton's correspondents in discussing mental imagery, stated that they depended so much on mental pictures, that if they lost the power of seeing them, they would not be able to think at all.



image or form without any idea of a word. Galton and Max Müller appear to be discussing on wholly different planes. "I add," writes Galton, "nothing about the advantage to modern inquirers due to their possession of Darwinian facts and theories, because we do not rate them in the same way." It was only possible for a pre-Darwinian or at any rate an anti-Darwinian to deny that animals think as well as man. "Dogs, Sir, do a deal of pondering," was a conception which had not and could not reach Max Müller. Galton broke a lance for Darwin, but he might as well have tilted at a windmill as at the Oxford nominalist.

The matter of this controversy remained long in Galton's mind, and seven years later he published a short paper in the *Psychological Review* entitled "Arithmetic by Smell<sup>1</sup>." The purpose of the paper is to show that mental processes may be conducted by the sole medium of imaginary smells, just as well as by visual or auditory images, in other words, to prove that thought does not depend on words. Galton first devised an apparatus by which a whiff of scented air could be sent out as often as required beneath the nostrils. A separate simple apparatus was used for each scent and he worked with the eyes shut. He was thus able to produce at will a whiff of peppermint, camphor, carbolic acid, ammonia, aniseed, etc. He taught himself to associate two whiffs of peppermint with one whiff of camphor, three of peppermint with one of carbolic acid, and so on. He next practised simple addition sums with the scents themselves, and afterwards solely with *the imagination of them*.

"There was not the slightest difficulty in banishing all visual and auditory images from the mind, leaving nothing in the consciousness but real or imaginary scents..... Subtraction succeeded as well as addition. I did not go so far as to associate separate scents with the attitudes of mind severally appropriate to subtraction and addition, but determined by my ordinary mental processes which attitude to assume, before isolating myself in the world of scents."

Galton did not attempt multiplication by smell, because he had convinced himself that arithmetic by scents only, and by imaginary scents, was possible with considerable speed and accuracy. He did, however, try some experiments on taste, using salt, sugar, citric acid, quinine, etc., and found that arithmetic by taste was as feasible as arithmetic by smell. Thus Galton proposed to rout the nominalists<sup>2</sup>.

In *Nature* for Nov. 15, 1894 (Vol. LI, pp. 73-4) Galton gave an account of Alfred Binet's book *Psychologie des Grands Calculateurs et Joueurs d'Échecs*. He refers to Inaudi, a Piedmontese, who did his mental sums by the sounds of the numbers, and to Diamandi, a Greek, who worked with

<sup>1</sup> Vol. I, pp. 61-2. New York and London, 1894.

<sup>2</sup> I fear Max Müller might have retorted that without the earlier association of numbers with names arithmetic by smell or taste would be impossible. Such an assertion is like that of the theologian who holds that the agnostic either fails to act morally, or only does so owing to a Christian training or the Christian environment. The one neglects the ages long evolution of morality for which Christianity is a thing of yesterday and the other would neglect the ages long evolution of mind prior to language.



mental images of the figures. Galton had tested Inaudi, in whom he found the visual form of the imagination practically absent. Binet considers that mental 'calculating boys' did not as a rule inherit their gifts, the Bidder family being a conspicuous instance of exception. Galton was not prepared to accept this view; he believed that two mental peculiarities must concur to make a calculating boy, namely (i) special capacity for mental calculation, and (ii) a passion for exercising it. Both are rare and are not necessarily coordinated, so that the chance of their concurrence may be very small indeed. He thought that (i) without (ii) might be commoner than is usually believed, and he cited the case of a lady of remarkable ability, whom he had known, and who did not discover that she possessed (i) until on a long and dull railway journey in middle life. He then gives some account of his own experience in performing arithmetic by imaginary smells and tastes.

In 1888 Galton published a paper on "Mental Fatigue<sup>1</sup>." This was a subject in which from personal experience he felt great interest. Over-fatigue of the brain in schools had been recently discussed and illustrated by experiences which flatly contradicted one another. After the heat of controversy had somewhat cooled Galton was asked to occupy the chair at a meeting of the educational Section of the Teachers' Guild, and he was so struck by the audience on that occasion that he considered that the Guild might be a powerful instrument for the solution of statistical problems, if its intelligent members could be interested in educational inquiries. Galton accordingly issued a schedule of selected questions bearing on mental fatigue. He met with an experience, often repeated in the case of the present writer, namely that circularising societies constituted for definite educational or social work, even on points directly connected with their aims, produces very little by way of useful statistical returns. Galton, although his schedule was accompanied by a covering letter from the Vice-Chairman of the Guild, received only 116 replies to his questionnaire, and all Galton was able to do was to set down in an orderly way the replies received. The questions asked applied not only to the taught, but to the teachers themselves. Of the teachers themselves one-fifth, 23, had at some period in their lives broken down, and no less than 21 of these had never wholly recovered from the effects. The teachers also reported with detail 59 cases known to them of more or less serious prostration from mental overwork. At the same time it is possible that those teachers, who had themselves suffered from or closely observed others suffering from overwork, would be most likely to be interested in Galton's questionnaire, and thus the 116 replies be not a random sample of all teachers. While the answers showed many views on the signs of mental fatigue, and on the studies which could or could not be undertaken when the mind was fatigued, there was little light thrown on the best means of testing mental fatigue, or of *measuring* it in a school-class at large. In fact the only real light on this matter came from Galton himself.

<sup>1</sup> "Remarks on Replies by Teachers to Questions respecting Mental Fatigue," *Journal of the Anthropological Institute*, Vol. XVIII, pp. 157-68.



He refers to his statement in *Nature*, of June 25, 1885<sup>1</sup>, entitled "Measure of Fidget." In that paper he described how he had counted in a section of an audience during the reading of a wearisome memoir the varying rate of fidget<sup>2</sup>.

"I have since frequently tried this method; it is an amusing way of passing an otherwise dull evening, but in drawing conclusions from the number of movements the average age of the audience and their habits of thought have to be taken into account. The method, however, rather measures the dullness of the performance than the true mental fatigue of the audience."

The second suggestion Galton gives is based upon the experimental fact that the quickness and magnitude of the individual's reaction to a stimulus are greatly affected by fatigue.

"There is an experiment, not so well known as it should be, that after a class has had practice in performing it, can be repeated at any time in a few seconds, which gives an excellent measure of the varying amount of reaction time. The class take hands all round, the teacher being included in the circle, a watch with a seconds hand lies on the table before him. All the pupils shut their eyes. When the seconds hand of the watch comes over a division the teacher gives a squeeze with his left hand to the right hand of the pupil next to him. That pupil forthwith with his left hand squeezes the right hand of the next pupil, and so on. Thus the squeeze travels round the class and is finally received by the right hand of the teacher, who then records the elapsed time since he started it; or he may let it make many circuits before he does so. This interval divided by the number of pupils in the class and by the number of circuits gives the average reaction time of each pupil. The squeeze takes usually about a second of time to pass through each dozen or fifteen persons. We should expect to find

<sup>1</sup> Vol. xxxii, p. 174. In this paper Galton refers first to "the unequal horizontal interspace between head and head" in a bored audience, while in an attentive audience all sit upright with their heads almost equi-distant. In a bored audience the bodies sway from side to side, and the intervals between faces vary greatly. But Galton failed to find any numerical expression for this variability of distance. He was more successful when he counted fidgets as an expression against this "mutiny of constraint." The hall in which the uninteresting paper was read was semicircular and divided by columns into sectors each containing about 50 people. He watched one of these sectors repeatedly and counted the number of distinct movements; this was very uniform, amounting to about 45 per minute or nearly one per person. The audience was elderly, the young would have been more mobile. When occasionally the audience was roused to temporary attention the frequency of fidget was not only reduced to less than one half, but the amplitude as well as the period of the motion were notably reduced. "The swaying of head, trunk and arms had before been wide and sluggish, and when rolling from side to side the individuals seemed to 'yaw,' that is to say they lingered in extreme positions. Whenever they became intent this peculiarity disappeared, and they performed their fidgets smartly. Let this suggest to observant philosophers when the meetings they attend may prove dull to occupy themselves in estimating the frequency, amplitude and duration of the fidgets of their fellow sufferers. They must do so during periods both of intenseness and of indifference, so as to estimate what may be called natural fidget, and then I think they may acquire the new art of giving numerical expression to the amount of boredom expressed by the audience generally during the reading of any particular memoir."

<sup>2</sup> Ignorant of Galton and in a much less scientific manner I can recall practising his method as a child in the sixties. The *locus* was a family pew in the chapel of the Foundling Hospital; there was an old and dull chaplain, the last clergyman of the Church of England that I remember in a Genevan gown. He used to preach for about 35 minutes, and I was accustomed to amuse myself and to measure the dullness of his discourse by counting the number of coughs given in that Sunday's 35 minutes. My brother and sister would remember the text, but I could only say on the basis of my sinful and secret statistics, that the preacher had been rather more or rather less inspiring than usual.



uniformity in successive experiments when the pupils are fresh; irregularity and prevalent delay when they are tired. I wish that teachers would often try this simple, amusing, and attractive experiment, and when they have assured themselves that their class enters into its performance with interest and curiosity, they might begin to make careful records at different periods of the day and see whether it admits of being used as a test of incipient fatigue. I should be exceedingly glad to receive accounts of their experiences. Deception must of course be guarded against." (p. 160.)

I have not so far come across any data in the *Galtoniana*, which suggest that any experiences were communicated to Galton.

From the teachers' replies Galton in the memoir draws two conclusions:

The first suggests the reason why mental fatigue leaves effects so much more serious than bodily fatigue. When a man is fatigued in body he has many of the same symptoms as arise in mental fatigue, but

"as soon as the bodily exertion has closed for the day, the man lies down and his muscles have rest; but when the mentally fatigued man lies down, his enemy continues to harass him during his weary hours of sleeplessness. He cannot quiet his thoughts and he wastes himself in a futile way." (p. 166.)

I am not clear that this diagnosis is of universal truth, especially in the case of men not habitually used to excessive work. Over physical exertion—a fifty-mile walk, or a very strenuous bicycle ride, or a whole day of heavy gardening work—may be followed by muscular fidgets, by unrestrainable fits of shivering, and by actual mental excitement which renders sleep or muscle rest impossible, and the effects may be felt for days afterwards. It says much for Galton's constitution that no experience of this kind seems to have suggested to him that for some individuals bodily and mental fatigue run much the same course<sup>1</sup>.

The second conclusion that Galton reaches is that breakdowns usually occur among those who work by themselves, and not among pupils whose teachers keep a reasonable oversight. Too zealous pupils are rare. The chief danger occurs when

"young persons are qualifying themselves for the profession of a teacher, and have also to support themselves and perhaps to endure domestic trials at the same time. Dull persons protect their own health of brain by refusing to overwork. It is among those who are zealous and eager, who have high aims and ideas, who know themselves to be mentally gifted, and are too generous to think much of their own health, that the most frequent victims of overwork are chiefly found." (p. 166.)

There is much in this paper on Mental Fatigue which is of high suggestiveness, and it should certainly be read by any one planning a more elaborate statistical inquiry into a subject still far from completely explored. The recent discovery and discussion of shell-shock show how large a section of a modern population—and not the least intelligent and zealous—bears the terrible load of inherited neuroses. One of the points not touched on in Galton's questionnaire is the family history of those who have suffered serious prostration from mental overwork. We should not be surprised to find a link between this category and that of the shell-shocked. In the

<sup>1</sup> It would be of much interest to inquire into the extent to which nervous breakdowns can be directly traced to over strenuous physical exertion.



present state of our knowledge it should not be impossible to give some warning to those young persons who run a danger if they follow a very strenuous mental occupation, such as that of the school teacher.

Galton, as I have noted, remained interested for many years in psychology although, as in the corresponding case of geography, his main work changed its character. Any mental idiosyncrasy had special attraction for him, and in May, 1896, he published a note on what he considered a very curious mental peculiarity<sup>1</sup>. This occurred in a certain Colonel M. who when in the army had seen flogging, wounds or death without special sensations. But the sight or talk of an injured finger nail at once made him feel sick and faint, and would even bring on a deadly cold perspiration. So much was this the case that at a large dinner party in the prime of life the persistent talk of a guest about a small injury of this kind caused him first to turn faint and then to slide under the table unconscious. His mother apparently attributed the idiosyncrasy to maternal impression, she having pricked her finger (without permanent injury) shortly before his birth. Colonel M. said that his father, brother, three sisters and nephews and nieces had no analogous peculiarity. He had no children; it is not directly stated that his *mother* herself had not the peculiarity. Galton thinks it could not have come by inheritance, and that

“it would be silly to suppose a sickly horror of wounded finger nails or claws to have been so advantageous to ancient man or his brute progenitors as to have formerly become a racial characteristic through selection, and though it fell into disuse under changed conditions and apparently disappeared, it was not utterly lost, the present case showing a sudden reversion to ancestral traits. Such an argument would be nonsense.”

He looks upon the idiosyncrasy as a mutation, and fresh evidence of the wide range of possibilities in the further evolution of human faculty. In other words he assumes that it was not inherited, but would have been transmitted had Colonel M. had offspring. The note is interesting as illustrating the working of Galton's mind. It does not seem to me that the evidence for non-inheritance is any more adequate than in the case of Huggins' dog Keppler (see our pp. 66 and 148). But an inquiry into the hereditary character—i.e. the origin and transmissibility of such mental idiosyncrasies—would be well worth making<sup>2</sup>.

Another memoir which can best be considered in this chapter is that of the same year, 1896; it deals with the problem of “Intelligible Signals between Neighbouring Stars<sup>3</sup>.” Galton tells us that in 1892 Mars made a

<sup>1</sup> *Nature*, Vol. LIV, p. 76, “A curious Idiosyncrasy.”

<sup>2</sup> For example there are persons who are made to feel sick by the tearing of a piece of calico in their presence; there are others in whom the mere *imagination* of drawing a knitted glove between their teeth sends a cold shiver through all their limbs; while recently I heard of a workman who was employed to whitewash a room in which there were a few skulls in a glass case throwing up his job, because it made him “ill to work in a charnel house.” I think this sort of mental discomfort extends to lower living forms; I have known dogs seriously uneasy when a dressed and cured dog skin was brought to their notice, and seriously distrustful of familiar friends, if they wore gloves made from wool spun from the combings of dogs' coats.

<sup>3</sup> *The Fortnightly Review*, Vol. LX, N.S. pp. 657-64.

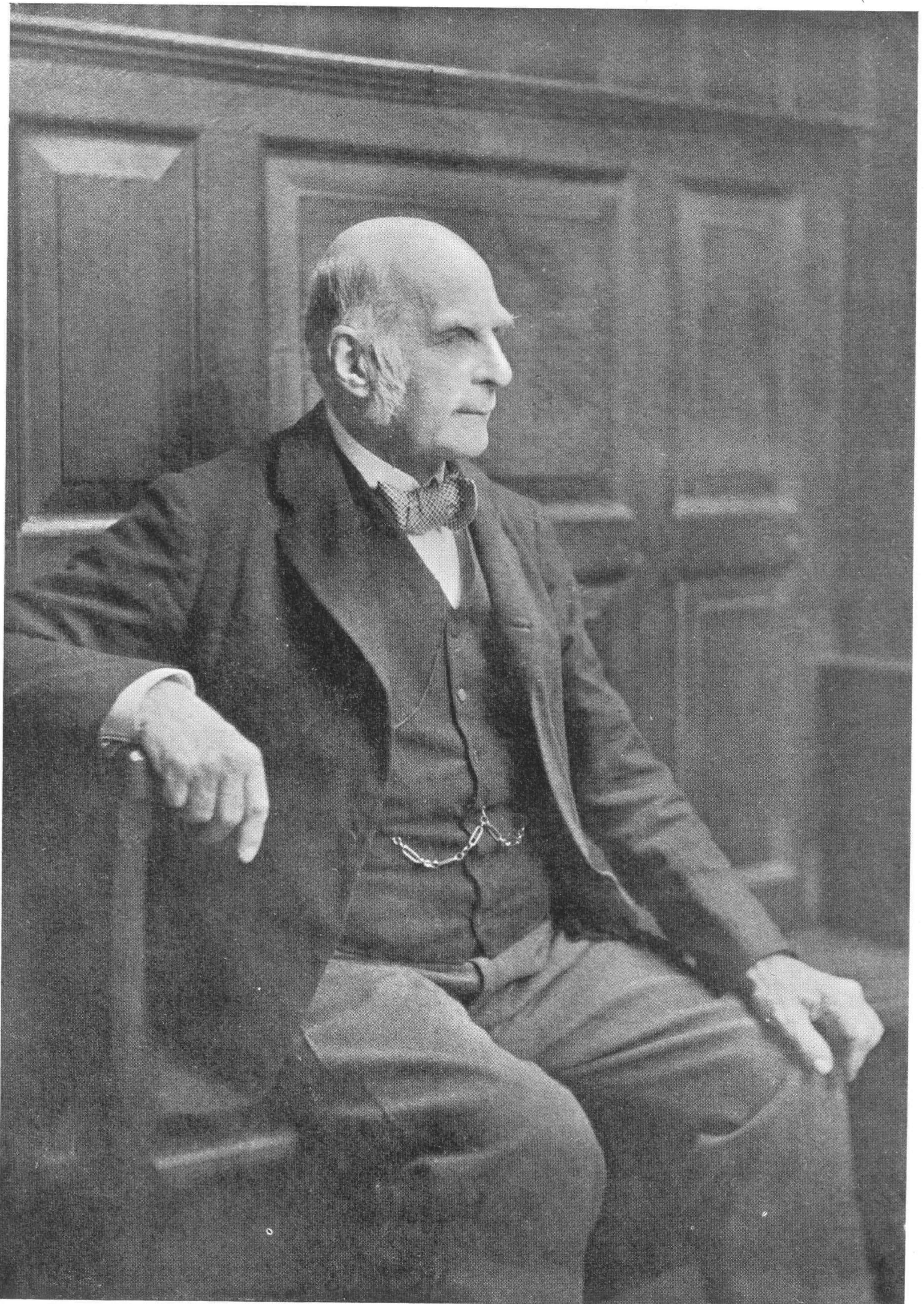


near approach to the earth, and that the possibility of exchanging signals with Mars was then discussed in the newspapers; it was considered not impossible, if enormously difficult, to send signals. But there was a general conclusion that if sent, the only thing that could be learnt from them would be that there existed observant, intelligent and mechanical people capable of great enterprises on the other planet. Galton thought that much more might be achieved, and that an *intrinsically* intelligible system of signals could be devised, if the people on the other planet were equally advanced with ourselves in pure and applied science. He amused himself accordingly in thinking out the ground plan of the present paper, but laid it aside for four years during which the craze about Mars died out, "being cooled by copious douches of astronomical common sense." Then, in 1896, came an attack of gastric catarrh, which developed into more serious trouble owing to a visit to Kew—to attend the Observatory—with a temperature of 102. Galton was invalided to Wildbad and its hot baths, and amid their relaxing accompaniments, being able to work only in a desultory fashion, he wrote up his paper on signals from Mars<sup>1</sup>. The main point of this paper is the building up of a system of signals from which ultimately pictures can be constructed. It is half humorous and half serious. It starts with the idea that arithmetical and mathematical notions will be common knowledge of both planet's inhabitants. Signals of  $1\frac{1}{4}$ ,  $2\frac{1}{2}$  and 5 seconds are given and termed dot, dash, line. These lead up to a system of numerals. Then comes the ratio of the circumference of a circle to its diameter, the value of the familiar  $\pi$ . Thence the ratio of the circumference to the radius of the various regular polygons, which introduces signals for the polygons. The 24-sided regular polygon is then indicated as a method of direction, and so angles all round the  $360^\circ$  are gradually learnt in the same way as are the points of a compass, but direction of lines and length of lines being given it becomes possible to give signals indicating a picture by successive "stitches" of definite lengths in definite directions. That is to say, Galton has reached the picture formula of his lecture on the "Just Perceptible Difference" (see the following Chapter, p. 307). But once it is possible to signal pictures, all becomes possible. It becomes possible to indicate motion, and motion will enable one to indicate signals for action, i.e. verbs. Such, very briefly, is the outline of Galton's system of star signals:

"It would be tedious, and is unnecessary to elaborate further, for it must be already evident to the reader that a small fraction of the care and thought bestowed, say, on the decipherment of hieroglyphics, would suffice to place the inhabitants of neighbouring stars in intelligible communication if they were both as far advanced in science and arts as the civilised nations of the earth are at the present time. In short, that an efficient interstellar language admits of being established under these conditions, between stars that are sufficiently near together for signalling purposes."

<sup>1</sup> Both Galtons were much depressed during this year. Emily Gurney died, and Sir William Grove died on the anniversary of the Galtons' wedding day (August 1st). The season was very wet and Galton suffered much from colds; he complained for the first time (aged 74!) that his brain power was not as vigorous as formerly, that he could not work quickly and that his deafness interfered with his committees.





Galton, aged about 75 years.



Mrs Galton, all unconscious of the near future, after noting the events of 1896, including this paper on star signals, continues in her *Record*:

“So surely do the good things come to us and pass from us, and I try to be thankful for the innumerable blessings we have had even with the pain of feeling them gone. So ends our year, not an eventful one, but a calmly happy one, ending with a merry Xmas at Spencer’s [Spencer Butler’s], the young folk full of life and ambitions.”

Calmly happy sentences—not the depressed or fretful words of some few of the earlier entries of the *Record*—and fitly concluding that brief account of the 43 years of Louisa Butler’s married life with Francis Galton.

There is only one more year of entry, 1897, in the *Record*, and something of it may be fitly quoted here, for it will indicate, better than the remarks of some superficial onlookers, the real relationship of the pair. It is hardly necessary to remark that the union could not fail to have been richer had it been blessed with children. Galton’s affection for his nieces shows what this would have meant for him.

“1897. It is with painful reluctance that I set down the incidents of this fatal year, and do so on Jan. 6 the anniversary of the day, when I first became acquainted with dear Louisa at the Dean’s house, next door to our own at Dover in 1853.

In the early part of the year I was more of an invalid than she was, but we had some pleasant outings together—as to Nansen’s great meeting on Feb. 28. Chiefly on account of my persistent asthmatic cough we went to Bournemouth, March 22, partly to be near Dr Chepmell, whose remaining eye was threatened. He told me to go to Cauterets or Royat. Montagu and Agnata [the Master of Trinity and his wife] came to us for a day from Lyndhurst, while we were there. We had had alarming news from time to time of Emma [‘Sister Emmy’] from the middle of Feb. onwards. At length she was better, and we went to her April 20–23. Louisa was well enough for some small festivities—a tea party, her last, on May 7th, and the military tournament. We went to Oxford, to Arthur’s [Mrs Galton’s brother’s] June 5–8. June 21, Jubilee day, we went with Mrs Lyell to the Athenaeum and they had excellent places and Louisa was not overtired. Next day Bessie [Galton’s sister Mrs Wheler] came to tea and Mrs Lyell. 26th I went to the Naval Review, L. not well enough to go with me. July 14 left for Royat, slept at Boulogne; next day, a weary waiting till 10 p.m. at the Lyons Station, but the night journey comfortable, Louisa not suffering at all. July 24th Puy de Dôme with Mr Livett and a young lady. L. remained in the garden at the *auberge* while we went up, and she had luncheon set out. I never saw her more pleased or nicer as a hostess than when we came down. Aug. 1, M<sup>me</sup> de Falbe arrived in far from good health. Aug. 3, L. awoke with diarrhoea,—we all had it, but recovered. Very sultry. Arranged for Pont St Laurent in Dauphiné, and wrote to have letters sent to Grenoble. On Sunday 8th she was apparently quite well and half packed for a start next morning. Monday 9th she was ill and sick in the night, not worse than frequently before. Tuesday, Aug. 10 she was worse; I had Dr Petit in, who made light of it, but said he would come the next morning. Wed. 11th she was very ill, but saw M<sup>me</sup> de Falbe, who was able to leave her bed for the purpose. L. wrote a post-card to Chumley [her maid] in case she was wanted. In afternoon she was very weak indeed..... Thursday 12th worse and in a very serious state. That night, or rather Friday morning early at 2 hrs  $\frac{3}{4}$ , she quietly passed away. On Saturday she was buried in the cemetery of Clermont-Ferraud in plot 419, which I purchased as a concession *in perpétuité*. So our long married life came to an end. Writing as I do now after nearly 5 months have passed, and I am able to take a fair retrospect, I think that the inevitable blow occurred at a more seasonable period than at any other time. Dear Louisa’s vigour was distinctly declining; she was still able to enjoy much, but was I fear rapidly on the way towards permanent invalidism, and she was conscious of a weakening of her mental power, small things fatiguing her much more than formerly. Had I died first, I fear her strength would have been inadequate to carrying on life unaided. She has been in many respects a most valued as well as a loved example to me. May her good influence abide, though she personally is gone. All her friends



lay stress on her power of sympathy. How I pulled through the terrible strain and hurried requirements of the occasion I cannot conceive, but I did, thanks largely to the hearty and tactful sympathy received from M<sup>me</sup> de Falbe and Mr Jennings, who had made Louisa's acquaintance and returned to help. I could not leave Royat on account of letters, till Tuesday night, arriving in London Wed<sup>y</sup> afternoon, where the sympathy of Spencer, and Mary and of Gertrude [Butler] awaited me. Some few days were spent in sorting her possessions and carrying out Louisa's wishes. Then to dear Emma's at Leamington for a week; thence to the Douglas Galtons' at Himbleton also for nearly a week; thence to Mrs Hills'<sup>1</sup> at Corby, all of which greatly braced me. The general kindness of Louisa's and my relations was extreme. On returning Sept. 13 Frank Butler was ready to live with me, a most valuable help against the sense of isolation..... My own occupations were the inquiries into the Bassett hounds, which led to the "Average Constitution of each Ancestor etc." *Proc. Roy. Soc.*<sup>2</sup>, also "Inquiries into Speed of American Trotters," *Proc. Roy. Soc.*<sup>3</sup> and the method of photographic measurement of horses etc., published to-day Jan. 7, '98<sup>4</sup>. The Committee on a Physical National Laboratory has been appointed and is taking evidence. The Evolution Committee has not done much, Kew Observatory prospers; Meteorological Council, the usual routine."

Thus it is when one of our number falls out, the ranks close up; social life as a whole goes on; our intellectual tasks are resumed, and our thoughts are turned again from the immediate environment to the non-personal problems of science. Galton rarely referred to the personal in conversation, or in letters, and it has seemed best to his biographer to maintain his reticence, allowing merely the one entry with which he concludes Louisa Galton's *Record* to tell its own tale.

To sum up the contents of this chapter, I venture to assert that no psychologist, no statistician of energy and imagination can read its pages and not feel that they have provided him with suggestions of many still unsolved problems, for whose solution the world would be not only the wiser but the better. Such is always the outcome of Galton's suggestive mind, and it is on this account—the generosity of ideas—that the reader willingly pardons an occasional conclusion based on apparently scanty data. Beyond those data was always the rich experience of a mind during the whole of a long life perpetually observing and placing in appropriate categories the actions and thoughts of other men as well as of himself.

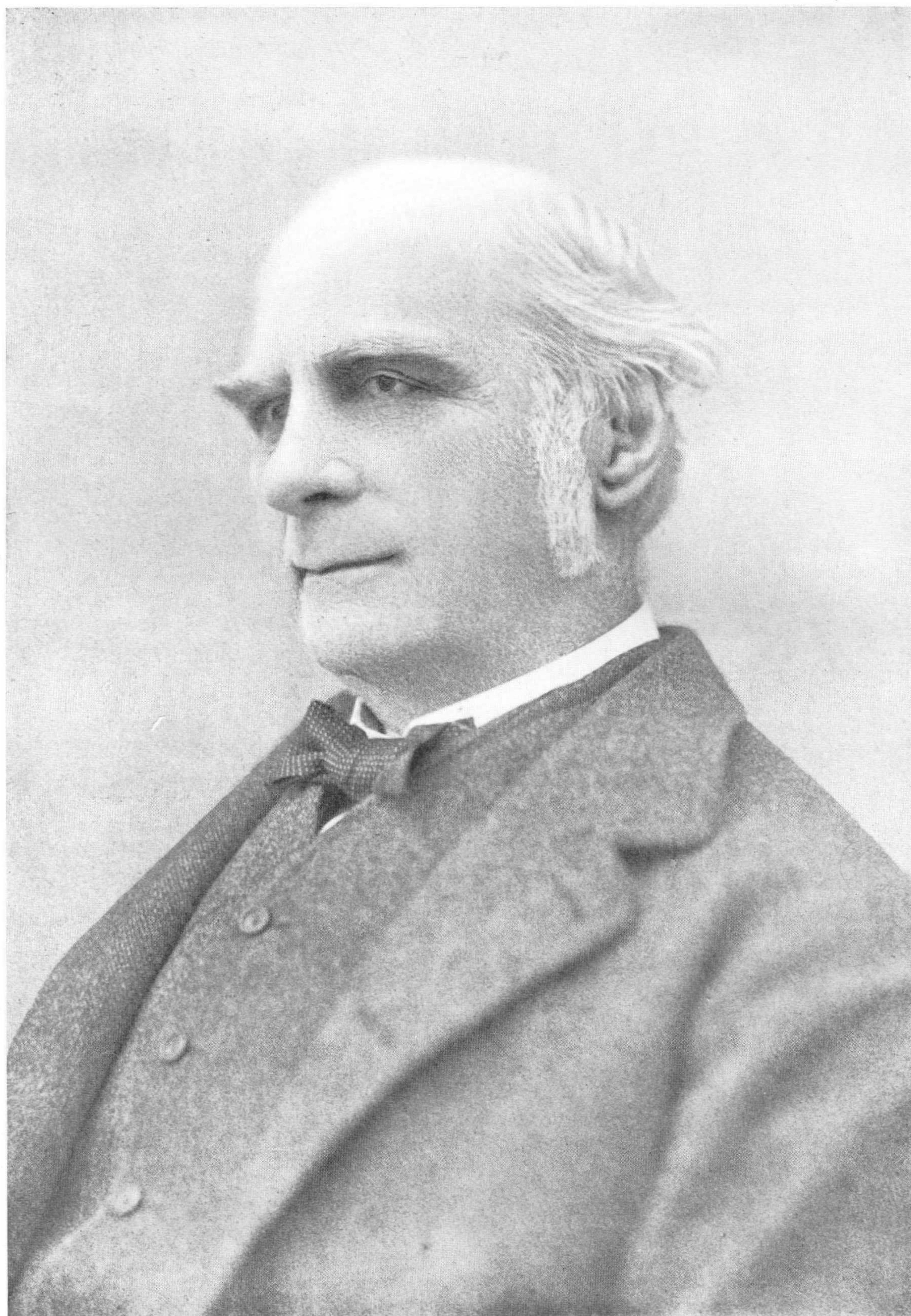
<sup>1</sup> Wife of Judge Hills of Alexandria, and daughter of Sir William Grove, Galton's close friend. A number of Galton's letters to Mrs Hills have recently been purchased from a bookseller for the Galton Laboratory.

<sup>2</sup> Vol. LXI, pp. 401-43.

<sup>3</sup> Vol. LXII, pp. 310-15.

<sup>4</sup> Galton probably wrote the last sentences of this entry on the day following that, Jan. 6, on which he had started to give the account of Mrs Galton's death.





Francis Galton in the 'sixties, from a photograph.