WEEKLY EVENING MEETING,

Friday, May 25, 1888.

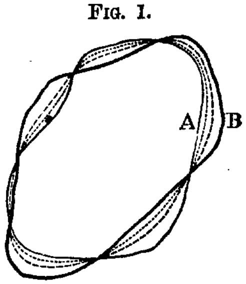
JOHN RAE, M.D. LL.D. F.R.S. Vice-President, in the Chair.

FRANCIS GALTON, Esq. M.A. F.R.S. *M.R.I.*

*Personal Identification and Description.**

IT is strange that we should not have acquired more power of describing form and personal features than we actually possess. For my own part I have frequently chafed under the sense of inability to verbally explain hereditary resemblances and types of features, and to describe irregular outlines of many different kinds, which I will not now particularise. At last I tried to relieve myself as far as might be from this embarrassment, and took considerable trouble, and made many experiments. The net result is that while there appear to be many ways of approximately effecting what is wanted, it is difficult as yet to select the best of them with enough assurance to justify a plunge into a rather serious undertaking. According to the French proverb, the better has thus far proved an enemy to the passably good, so I cannot go much into detail at present, but will chiefly dwell on general principles.

FIG. 1.



Measure of Resemblance.—We recognise different degrees of likeness and unlikeness, though I am not aware that attempts have as yet been made to measure them. This can be done if we take for our unit the *least discernible difference.* The application of this principle to irregular contours is particularly easy. Fig. 1 shows two such contours, A and B, which might be meteorological, geographical, or anything else. They are drawn with firm lines, but of different strengths for the sake of distinction. They contain the same area, and are so superimposed as to lie as fairly one over the other as may be. Now draw a broken contour which we will call C, equally subdividing the intervals between A and B; then C will be more like A than B was. Again draw a dotted contour, D, equally subdividing the intervals between C and A; the likeness of D to A will be again

* The substance of the lecture is here reprinted from 'Nature' of June 21 and 28, with the kind permission of the Editor, and after some slight revision by the author.

closer. Continue to act on the same principle until a stage is reached when the contour last drawn is undistinguishable from A. Suppose it to be the fourth stage; then as $2^4 = 16$, there are sixteen grades of least-discernible differences between A and B. If one of the contours differs greatly in a single or few respects from the other, reservation may be made of those peculiarities. Thus, if A has a deep notch in its lower right-hand border, we might either state that fact, and say that in other respects it differed from B by only 16 grades of unlikeness, or we might make no reservation, and continue subdividing until all trace of the notch was smoothed away. It is purely a matter of convenience which course should be adopted in any given case. The measurement of resemblance by units of least-discernible differences is applicable to shades, colours, sounds, tastes, and to sense-indications generally. There is no such thing as infinite unlikeness, because the number of just discernible difference between any objects, however dissimilar, is always finite. A point as perceived by the sense of sight is not a mathematical point, but an object so small that its shape ceases to be discernible. Mathematically, it requires an infinitude of points to make a short line; sensibly, it requires a finite and not a large number of what the vision reckons as points, to do so. If from thirty to forty points were dotted in a row across the disk of the moon, they would appear to the naked eyes of most persons as a continuous line.

Description within Specified Limits.—It is impossible to verbally define an irregular contour with such precision that a drawing made from the description shall be undistinguishable from the original, but we may be content with a lower achievement. Much would be gained if we could refer to a standard collection of contours drawn with double lines, and say that the contour in question falls between the double lines of the contour catalogued as number so-and-so. This would at least tell us that none of the very many contours that fell outside the specified limits could be the one to which the description applied. It is an approximate and a negative method of identification. Suppose the contour to be a profile, and for simplicity's sake let us suppose it to be only the portion of a profile that lies below the notch that separates the brow from the nose, and extending only so far downwards as the parting between the lips. Suppose it also to be the mere outline of a shadow sharply cast upon the wall by a single source of light, such as is excellently seen when a person stands sideways between the electric lantern and the screen in a lecture-room. All human profiles of this kind, when they have been reduced to a uniform vertical scale, fall within a small space. I have taken those given by Lavater, which are in many cases of extreme shapes, and have added others of English faces, and find that they all fall within the space shown in Fig. 2. The outer and inner limits of the space are of course not the profiles of any real faces, but the limits of many profiles, some of which are exceptional at one point, and others at another. We can classify the great majority of profiles so that

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each of them shall be included between the double borders of one, two, or some small number of standard portraits, such as Fig. 3. I am as yet unprepared to say how near together the double borders of such standard portraits should be drawn; in other words, what is the smallest number of grades of unlikeness that we can satisfactorily deal with. The process of sorting profiles into their proper classes and of gradually building up a well-selected standard collection, is a laborious undertaking if attempted by any obvious way, but I believe it can be effected with comparative ease on the basis of measurements, as will be explained later on, and by an apparatus that will be described.

FIG. 2.

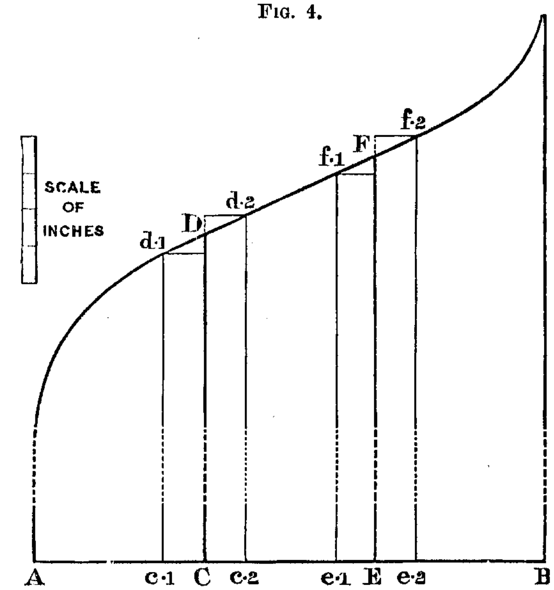
FIG. 3.

Classification of Sets of Measures.—Prisoners are now identified in France by the measures of their heads and limbs, the set of measures of each suspected person being compared with the sets that severally refer to each of many thousands of convicts. This idea, and the practical application of it, is due to M. Alphonse Bertillon. The actual method by which this is done is not all that could be theoretically desired, but it is said to be effective in action, and enables the authorities quickly to assure themselves whether the suspected person is or is not an old malefactor. The primary measures in the classification are four—namely, the head length, head breadth, foot length, and middle-finger length of the left foot and hand respectively. Each of these is classified according as it is large, medium or small. There are thus three, and only three, divisions of head lengths, each of which is subdivided into three divisions of head breadth; again, each of these is further subdivided into three of foot length, and these again into three of middle-finger length; thus the number of primary classes is equal to three multiplied into itself four times—that is to say, their number is eighty-one, and a separate pigeon-hole is assigned to each. All the exact measures and other notes on each criminal are written on the same card, and this card is stored in its appropriate pigeon-hole. The contents of each pigeon-hole are themselves sub-sorted on the same principle of three-fold classification in respect to other measures. This process can, of course, be extended indefinitely, but how far it admits of being carried on advantageously is another question. The fault of all hard-and-fast lines of classification, when variability is continuous, is the doubt where to place and where to look for values that are near the limits between two adjacent classes. Let us take Stature as an illustration of what must occur in every case, and let us represent its distribution by what I have called a "Scheme," as shown in Fig. 4.

Here the statures of any large group of persons are represented by lines of proportionate length. The lines are arranged side by side at equal distances apart on a base, A B, of convenient length.

A curve drawn through their tops gives the upper boundary of the scheme; the lines themselves are then wiped out, having served their purpose. If the base A B be divided into three equal parts and perpendiculars, C, D; E, F, be erected at the divisions between them, reaching from the base up to the curve, then the lengths of those

FIG. 4.



perpendiculars will be proportionate to the limiting values between the small and the medium group, and between those of the medium and the large group, respectively. The difference between these perpendiculars in the case of stature is about 2·3 inches. In other words, the shortest and tallest men in the medium class differ only by that amount. We have next to consider how much ought reasonably to be allowed for error of measurement. Considering that a man differs in height by a full third of an inch between the time of getting up in the morning and lying down at night; considering also that measures are recorded to the nearest tenth of an inch at the closest, also the many uncertainties connected with the measurement of stature, it would be rash not to allow for a possible (I do not say "probable") error of at least ± half an inch. Prolong C D, and note the points upon it at the distance of half an inch above and below D; draw horizontal lines from those points to meet the curve at *d*.1, *d*.2, and from the points of intersection drop perpendiculars reaching the base at *c*.1, *c*.2. A similar figure is drawn at F.

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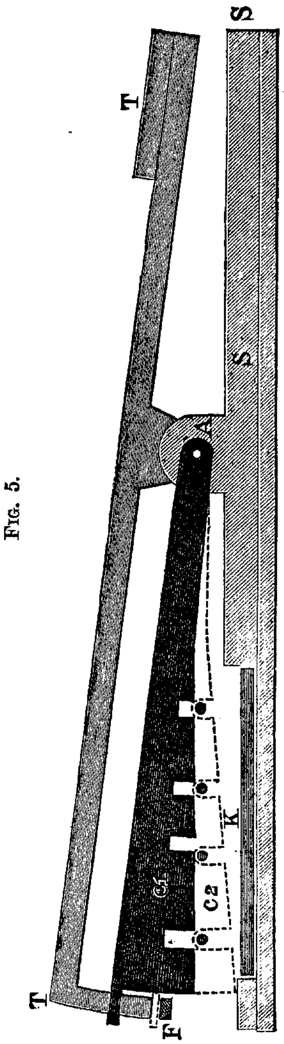
Then the ratio borne by the uncertain entries to the whole number of entries is as $c_1 c_2 + e_1 e_2$ to A B. This, as seen by the diagram, is a very large proportion. There is a dilemma from which those who adopt hard-and-fast lines of classification cannot escape: either the fringe of uncertainty must be dangerously wide, or else the delicacy with which measures are made cannot be turned to anything like its full account. If the delicacy is small, the fringe of uncertainty must be very wide; if the delicacy is great, the summed widths of all the fringes will be narrow, so long as there are only a few classes; but, on the other hand, by having only a few classes, most of the advantages of possessing delicate observations are wasted. The bodily measurements are so dependent on one another that we cannot afford to neglect small distinctions in an attempt to make an effective classification. Thus long feet and long middle-fingers usually go together. We therefore want to know whether the long feet in some particular person are accompanied by very long, or moderately long, or barely long fingers, though the fingers may in all three cases have been treated as long in M. Bertillon's system of classes, because they would be long as compared with those of the general population. Certainly his eighty-one combinations are far from being equally probable. The more numerous the measures the greater would be their interdependence, and the more unequal would be the distribution of cases among the various possible combinations of large, small, and medium values. No attempt has yet been made to estimate the degree of their interdependence. I am therefore having the above measurements (with slight necessary variation) recorded at my anthropometric laboratory for the purpose of doing so. This laboratory, I may add, is now open to public use under reasonable restrictions. It is entered from the Science Collections in the Western Galleries at South Kensington.

Mechanical Selector.—Feeling the advantage of possessing a method of classification that did not proceed upon hard and fast lines, I contrived an apparatus that is quite independent of them, and which I call a mechanical selector. Its object is to find which set, out of a standard collection of many sets of measures, resembles any one given set within any given degree of unlikeness. No one measure in any of the sets selected by the instrument can differ from the corresponding measure in the given set by more than a specified value. The apparatus is very simple; it applies to sets of measures of every description, and ought to act on a large scale as well as it does on a small one, with great rapidity, and be able to test several hundred sets by each movement. It relieves the eye and brain from the intolerable strain of tediously comparing a set of many measures with each of a large number of successive sets, in doing which a mental allowance has to be made for a *plus* or *minus* deviation of a specified amount in every entry. It is not my business to look after prisoners, and I do not fully know what need may really exist for new methods of quickly identifying suspected persons. If there be any real need, I should

think that this apparatus, which is contrived for other purposes, might, after obvious modifications, supply it.

The apparatus consists, in principle, of a large number of strips of card or metal *c* 1, *c* 2 (Fig. 5), say 8 or 9 inches long, and having a common axis A passing through all their smaller ends. A tilting-frame T, which turns on the same axis, has a front cross-bar F (whose section is seen in Fig. 5), on which the tips of the larger ends of all the cards rest whenever the machine is left alone. In this condition a counterpoise at the other end of T suffices to overcome the weight of all the cards, and this heavier end of T lies on the base-board S. When the heavy end of T is lifted, as shown in Fig. 5, its front-bar F is of course depressed, and the cards being individually acted on by their own weights, are free to descend with the cross-bar unless they are otherwise prevented. The lower edge of each card is variously notched to indicate the measures of the person it represents. Only four notches are shown in the figure, but six could be employed in a card of 8 or 9 inches long, allowing compartments of 1 inch in length to each of six different measures. The position of the notch in the compartment allotted to it, indicates the corresponding measure according to a suitable scale. When the notch is in the middle of a compartment, it means that the measure is of mediocre amount; when at one end of it, the measure is of some specified large value or of any other value above that; when at the other end the measure is of some specified small value or of any other value below it. Intermediate positions represent intermediate values according to the scale. Each of the cards corresponds to one of the sets of measures in the standard collection. The set of measures of the given person are indicated by the positions

FIG. 5.



Section of the apparatus, but the bridges and rods are not shown, only the section of the wires.

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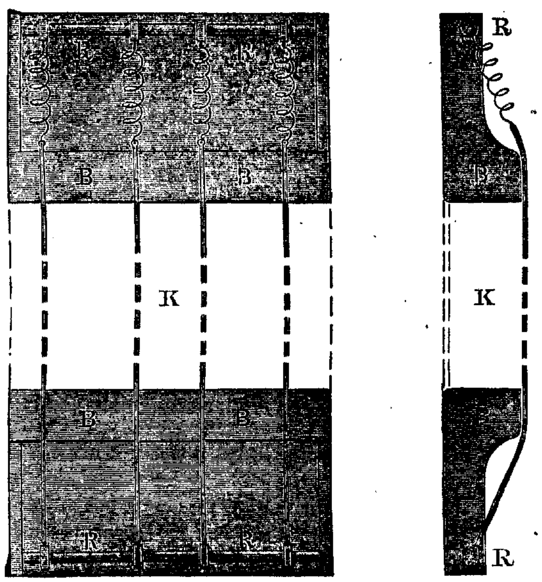
of parallel strings or wires, one for each measure, that are stretched between Rods and across Bridges at either end of a long board set cross-ways to the cards. Their positions on the bridges are adjusted by the same scale as that by which the notches were cut in the cards. Figs. 6*a* and 6*b* are views of this portion of the apparatus, which acts as a key, and is of about 30 inches in effective length. The whole is shown in working position in Fig. 7. When the key is slid into its place, and the heavy end of the tilting-frame T is raised, all the cards are free to descend so far as the tilting-frame is concerned, but they

Fig. 6*a*. 6*b*.

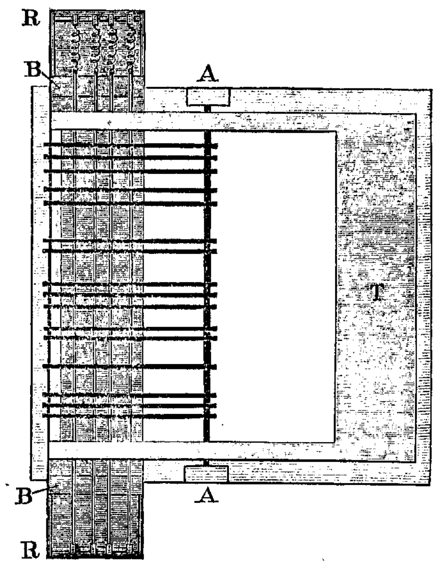


Plan and section of the key-board K.

are checked by one or more of the wires from descending below a particular level, except those few, if any, whose notches correspond throughout to the positions of the underlying wires. This is the case with the card *c*2 (Fig. 5), drawn with a dotted outline, but not with *c*1, which rests upon the third wire, counting from the axis. As the wires have to sustain the weight of all or nearly all the cards, frequent narrow bridges must be interposed between the main bridges to sustain the wires from point to point. The cards should be divided into batches by partitions corresponding to these interposed bridges, else they may press sideways with enough friction to interfere with their free independent action. Neither these interposed bridges nor the partitions are drawn in the figure. The method of adjusting the wires there shown,

is simply by sliding the rings to which they are attached at either end along the rod which passes through them. It is easy to arrange a more delicate method of effecting the adjustment if desired. Hitherto I have snipped out the notches in the cards with a cutter made on the same principle as that used by railway guards in marking the tickets of travellers. The width of the notch is greater than the width of the wire by an amount proportionate to the allowance intended to be made for error of measurement, and also for that

Fig. 7.



Reduced plan of complete apparatus.

Explanation.—A, the common axis; c_1, c_2, the cards; T, tilting-frame, turning on A (the cards rest by their front ends on F, which is the front cross-bar of T, at the time when the heavy hinder end of T rests on the base-board S); K is the key-board; R R are the rods between which the wires are stretched; B B are the bridges at either end of the key-board, over which the wires pass. (The explanation refers to the other figs., as well as to this.)

due to mechanical misfit. There seems to be room for 500 cards or metal strips, and ample room for 300 of them, to be arranged in sufficiently loose order within the width of 30 inches, and a key of that effective length would test all these by a single movement. It could also be applied in quick succession to any number of other collections.

Measurement of Profiles.—The sharp outline of a photographed profile admits of more easy and precise measurement than the yielding

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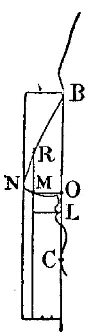
outline of the face itself. The measurable distances between the profiles of different persons are small, but the available measures are much more numerous than might have been expected, and their variations are more independent of one another than those of the limbs. I suspect that measures of the profile may be nearly as trustworthy as those of the limbs for approximate identification, that is, for excluding a very large proportion of persons from the possibility of being mistaken for the one whose measurements are given. The measurement of a profile enables us to use a mechanical selector for finding those in a large standard collection to which they nearly correspond. From the selection thus made, the eye could easily make a further selection of those that suited best in other respects. A mechanical selector also enables us to quickly build up a standard collection step by step, by telling us whether or no each fresh set of measures falls within the limits of any of those already collected. If it does, we know that it is already provided for; if not, a new card must be added to the collection. There will be no fear of duplications, as every freshly-added standard will differ from all its predecessors by more than the specified range of permitted differences.

As regards the most convenient measurements to be applied to a profile for use with the selector, I am unable as yet to speak decidedly.

FIG. 8.



If we are dealing merely with a black silhouette, such as the shadow cast on a wall by a small and brilliant light, the best line from which to measure seems to be B C in Fig. 8; namely, that which touches both the concavity of the notch between the brow and nose, and the convexity of the chin. It is not difficult to frame illustrated instructions to explain what should be done in the cases where no line can be drawn that strictly fulfils these conditions. I have taken a considerable number of measures from the line that touches the brow and chin, but am now inclined to prefer that which I have just described. A sharp unit of measurement is given by the distance between this line and another drawn parallel to it just touching the nose, as at N in the figure. A small uncertainty in the direction of B C has but a very trifling effect on this distance. By dividing the interval between these parallel lines into four parts, and drawing a line through the third of the divisions, parallel to B C, we obtain the two important points of reference, M and R. M is a particularly well-defined point, from which O is determined by dropping a perpendicular from M upon B C. O seems the best of all points from which to measure. It is excellently placed for defining the shape and position of the notch between the nose and the upper lip, which is perhaps the most distinctive feature in the profile. O L can be determined with some precision; O B and O C are but coarse measurements.

In addition to these and other obvious measures, such as one or more to define the projection of the lips, it would be well to measure

the radius of the circle of curvature of the depression at B, also of that between the nose and the lip, for they are both very variable and very distinctive. So is the general slope of the base of the nose. The difficulty lies not in selecting a few measures that will go far towards negatively identifying a face, but in selecting the best—namely, those that can be most precisely determined, are most independent of each other, most variable, and most expressive of the general form of the profile. I have tried many different sets, and found all to be more or less efficient, but have not yet decided to my own satisfaction which to adopt.

We will now suppose that either by the above method or by any other, a standard collection of doubly outlined portraits such as that in Fig. 3, has been made and come into use, so that a profile can be approximately described by referring it to number so-and-so in the catalogue. If the number it contained was less than 1000, three figures would suffice to define any one of them. We will now consider how a yet closer description of the profile may be given by using a few additional figures. One way of doing so is to have short cross-lines drawn at critical positions between the two outlines of the standard, and to suppose each of them to be divided into eight equal parts. The intersection of the cross-lines with the outer border would count as 0; that with the inner border as 8, and the intermediate divisions from 1 to 7. As the cross-lines would be very short, a single numeral would thus define the position of a point in any one of them, with perhaps as much precision as the naked eye could utilise. By employing as many figures as there are cross-lines in the standard, each successive figure for each successive cross-line, a corresponding number of points in the profile would be fixed with great accuracy. Suppose a total of nine figures to be allowed, then the first three figures would specify the catalogue number of the portrait to be referred to, and the remaining six figures would determine six points in the outline of the portrait with greatly increased precision.

I may say that after numerous trials of different methods for comparing portraits successively by the eye, I have found none so handy and generally efficient as a double-image prism, which I largely used in my earlier attempts in making composite portraits.

I have not succeeded in contriving an instrument that shall directly compare a given profile with those in a standard collection, and which shall at the same time act with anything like the simplicity of the mechanical selector, and with the same quick decision in acceptance or rejection. Still, I recognise some waste of opportunity in not utilising the power of varying the depths of the notches in the cards, independently of their longitudinal position.

Personal characteristics exist in much more minute particulars than those just described. Leaving aside microscopic peculiarities, which are of unknown multitudes, such as might be studied in the 800,000,000

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specimens cut by a microtome, say of one two-thousandth part of an inch in thickness, and one-tenth of an inch each way in area, out of the 4000 cubic inches or so of the flesh, fat, and bone of a single average human body, there are many that are visible with or without the aid of a lens.

The markings in the iris of the eye are of the above kind. They have been never adequately studied except by the makers of artificial eyes, who recognise thousands of varieties of them. These markings well deserve being photographed from life on an enlarged scale. I shall not dwell now upon these, nor on such peculiarities as those of handwriting, nor on the bifurcations and interlacements of the superficial veins, nor on the shape and convolutions of the external ear. These all admit of brief approximate description by the method just explained—namely, by reference to the number in a standard collection of the specimen that shall not differ from it by more than a specified number of units of unlikeness. I have already explained what is meant by a unit of unlikeness, and the mechanical means by which a given set of measures can be compared with great ease and by a single movement with every set simultaneously, in a large standard collection of sets of measures.

Perhaps the most beautiful and characteristic of all superficial marks are the small furrows, with the intervening ridges and their pores, that are disposed in a singularly complex yet regular order on the under surfaces of the hands and the feet. I do not now speak of the large wrinkles in which chiromantists delight, and which may be compared to the creases in an old coat, or to the deep folds in the hide of a rhinoceros, but of those fine lines of which the buttered fingers of children are apt to stamp impressions on the margins of the books they handle, that leave little to be desired on the score of distinctness. These lines are found to take their origin from various centres, one of which lies in the under surface of each finger-tip. They proceed from their several centres in spirals and whorls, and distribute themselves in beautiful patterns over the whole palmar surface. A corresponding system covers the soles of the feet. The same lines appear with little modification in the hands and feet of monkeys. They appear to have been carefully studied for the first time by Purkinje in 1822, and since then they have attracted the notice of many writers and physiologists, the fullest and latest of whom is Kollman, who has published a pamphlet, 'Tastapparat der Hand' (Leipzig, 1883), in which their physiological significance is fully discussed. Into that part of the subject I am not going to enter here. It has occurred independently to many persons to propose finger-marks as a means of identification. In the last century, Bewick, in one of the vignettes in the 'History of Birds,' gave a woodcut of his own thumb-mark, which is the first clear impression I know of, and afterwards one of his finger-marks. Some of the latest specimens that I have seen are by Mr. Gilbert Thomson, an officer of the American Geological Survey, who, being in Arizona, and having to make his orders for payment on a camp

suttler, hit upon the expedient of using his own thumb-mark to serve the same purpose as the elaborate scroll engraved on blank cheques—namely, to make the alteration of figures written on it impossible without detection. I possess copies of two of his cheques. A San Francisco photographer, Mr. Tabor, made enlarged photographs of the finger-marks of Chinese, and his proposal to employ them as a means of identifying Chinese immigrants, seems to have been seriously considered. I may say that I can obtain no verification of a common statement that the method is in actual use in the prisons of China. The thumb-mark has been used there as elsewhere in attestation of deeds, such as a man might make an impression with a common seal, not his own, and say, "This is my act and deed"; but I cannot hear of any elaborate system of finger-marks having ever been employed in China for the identification of prisoners. It was, however, largely used in India, by Sir William Herschel, many years ago, when he was an officer of the Bengal Civil Service. He found it to be most successful in preventing personation, and in putting an end to disputes about the authenticity of deeds. He described his method fully in 'Nature,' in 1880 (vol. xxiii. p. 76), which should be referred to; also a paper by Mr. Faulds in the next volume. I may also allude to articles in the American journal 'Science,' 1886 (vol. viii. pp. 166 and 212).

The question arises whether these finger-marks remain unaltered throughout the life of the same person. In reply to this I am enabled to submit a most interesting piece of evidence, which thus far is

Fig. 9.

Enlarged impressions of the fore and middle finger tips of the right hand of Sir William Herschel, made in the year 1860.

unique, through the kindness of Sir Wm. Herschel. It consists of the imprints of the two first fingers of his own hand, made in 1860 and in 1888 respectively, that is, at periods separated by an interval of twenty-eight years. I have also two intermediate imprints, made by him in 1874 and in 1883 respectively. Figs. 9 and 11 are cut from photographs on an enlarged scale of the imprints of 1860 and 1888, which were made direct upon the engraver's block; these woodcuts may therefore be relied on as very correct representations of the originals in my present possession. Fig. 10 refers to the portion of Fig. 9 to which I am about to draw attention. On first examining these and other finger-marks, the eye wanders and becomes confused, not knowing where to fix itself; the points shown in Fig. 10 are

FIG. 10.

Positions of furrow-heads and bifurcations of furrows, in Fig. 9.

FIG. 11.

Enlarged impressions of the fore and middle finger tips of the right hand of Sir William Herschel, made in the year 1888.

those it should select. They are the places at which each new furrow makes its first appearance. The furrows may originate in two principal ways, which are not always clearly distinguishable: (1) the new furrow may arise in the middle of a ridge; (2) a single furrow may bifurcate and form a letter Y. The distinction between (1) and (2) is not greatly to be trusted, because one of the sides of the ridge in case (1) may become worn, or be narrow and low, and not always leave an imprint, thus converting it into case (2); conversely case (2) may be converted into case (1). The position of the origin of the new furrow is, however, none the less defined. I have noted the furrow-heads and bifurcations of furrows in Fig. 9, and shown them separately in Fig. 10. The reader will be able to identify these positions with the aid of a pair of compasses, and he will find that they persist unchanged in Fig. 11, though there is occasionally uncertainty between cases (1) and (2). Also there is a little confusion in the middle of the small triangular space that separates two distinct systems of furrows, much as eddies separate the stream lines of adjacent currents converging from opposite directions. A careful comparison of Figs. 9 and 11 is a most instructive study of the effects of age. There is an obvious amount of wearing and of coarseness in the latter, but the main features in both are the same.

I happen to possess a very convenient little apparatus for examining finger-marks and for recording the positions of furrow-heads. It is a slight and small, but well-made wooden pentagraph, multiplying five-fold, in which a very low-power microscope, with *coarse* cross-wires, forms the axis of the short limb, and a pencil-holder forms the axis of the long limb. I contrived it for quite another use, namely, the measurement of the length of wings of moths in some rather extensive experiments that are now being made for me in pedigree moth-breeding. It has proved very serviceable in this inquiry also, and was much used in measuring the profiles spoken of in the last article. Without some moderate magnifying power the finger-marks cannot be properly studied. It is a convenient plan, in default of better methods, to prick holes with a needle through the furrow-heads into a separate piece of paper, where they can be studied without risk of confusing the eye. There are peculiarities often found in furrows that do not appear in these particular specimens, and to which I will not further refer. In Fig. 10 the form of the origin of the spirals is just indicated. These forms are various; they may be in single or in multiple lines, and the earlier turns may form long loops or be nearly circular. My own ten fingers show at least four distinct varieties.

Notwithstanding the experience of others to the contrary, I find it not easy to make clear and perfect impressions of the fingers. The proper plan seems to be to cover a flat surface, like that of a piece of glass or zinc, with a thin and even coat of paint, whether it be printers' ink or Indian ink rubbed into a thick paste, and to press the finger lightly upon it so that the ridges only shall become inked, then the

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inked fingers are pressed on smooth and slightly damped paper. If a plate of glass be smoked over a paraffin lamp, a beautiful negative impression may be made on it by the finger, suitable for a lantern transparency. The blackened finger may afterwards be made to leave a positive impression on a piece of paper, that requires to be varnished if it is to be rendered permanent. All this is rather dirty work, but people do not seem to object to it; rivalry and the hope of making continually better impressions carry them on. It is troublesome to make plaster casts; modelling-clay has been proposed; hard wax, such as dentists use, acts fairly well; sealing-wax is excellent if the heat can be tolerated; I have some good impressions in it. For the mere study of the marks, no plan is better than that of rubbing a little thick paste of chalk ("prepared chalk") and water or sized water upon the finger. The chalk lies in the furrows, and defines them. They might then be excellently photographed on an enlarged scale. My own photographic apparatus is not at hand, or I should have experimented in this. When notes of the furrow-heads and of the initial shape of the spiral have been made, the measurements would admit of comparison with those in catalogued sets by means of a numerical arrangement, or even by the mechanical selector described in the last article. If a cleanly and simple way could be discovered of taking durable impressions of the finger tips, there would be little doubt of their being serviceable in more than one way.

In concluding my remarks, I should say that one of the inducements to making these inquiries into personal identification has been to discover independent features suitable for hereditary investigation. It has long been my hope, though utterly without direct experimental corroboration thus far, that if a considerable number of variable and independent features could be catalogued, it might be possible to trace kinship with considerable certainty. It does not at all follow because a man inherits his main features from some one ancestor, that he may not also inherit a large number of minor and commonly overlooked features from many ancestors. Therefore it is not improbable, and worth taking pains to inquire whether each person may not carry visibly about his body undeniable evidence of his parentage and near kinships.

[F. G.]

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