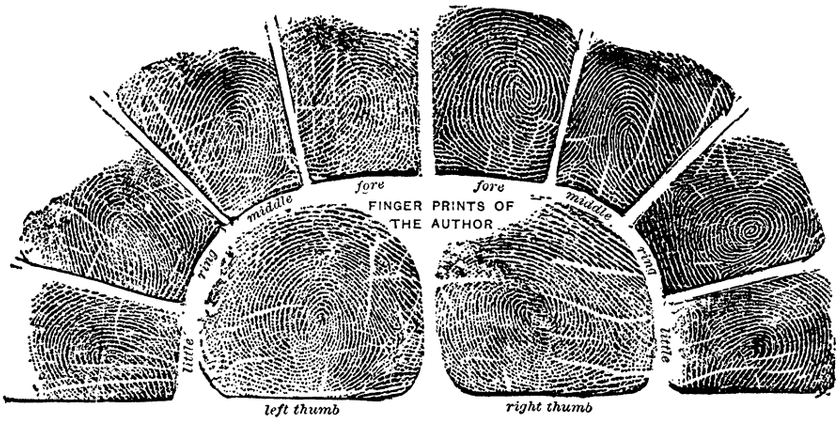
Classics of Science: Finger-Prints



One great advantage of the rude A. L. W. system is that it can be applied, with little risk of error, to impressions that are smudged or imperfect; it is therefore very useful so far as it goes. Thus it can be easily applied to my own finger prints on the title-page, made as they are from digits that are creased and roughened by seventy years of life, and whose impressions have been closely clipped to fit them into a limited space—Galton

Francis Galton was the first to make a thorough study of the pressure-ridges on the fingers as a means of identification, and to devise a complete, yet simple, classification for them. The amateur detective (and who is not?) will enjoy taking his own finger-prints and those of his friends and trying out the classification scheme. An ordinary stamp-pad and news-print paper will give satisfactory impressions.

FINGER PRINTS by Francis Galton, F.R.S., etc. London, 1892.

Ridges of the Hands

The palms of the hands and the soles of the feet are covered with two totally distinct classes of marks. The most conspicuous are the creases or folds of the skin which interest the followers of palmistry, but which are no more significant to others than the creases in old clothes; they show the lines of most frequent flexure, and nothing more. The least conspicuous marks, but the most numerous by far, are the so-called papillary ridges; they form the subject of the present book. If they had been only twice as large as they are, they would have attracted general attention and been commented on from the earliest times. Had Dean Swift known and thought of them, when writing about the Brobdingnags, whom he constructs on a scale twelve times as great as our own, he would certainly have made Gulliver express horror at the ribbed fingers of the giants who handled him. The ridges on their palms would have been as broad as the thongs of our coach-whips.

Let no one despise the ridges on account of their smallness, for they are in some respects the most important of all anthropological data. We shall see that they form patterns, considerable in size and of a curious variety of shapes, whose boundaries can be firmly outlined, and which are little worlds in themselves. They have the unique merit of retaining all their peculiarities unchanged throughout life, and afford in consequence an incomparably surer criterion of identity than any other bodily feature. They may be made to throw welcome light on some of the most interesting biological questions of the day, such as heredity, symmetry, correlation, and the nature of genera and species. A representation of their lineations is easily secured in a self-recorded form, by inking the fingers in the way that will be explained, and pressing them on paper. There is no prejudice to be overcome in procuring these most trustworthy sign-manuals, no vanity to be pacified, no untruths to be guarded against. . . . .

The embryological development of the ridges has been studied by many, but more especially by Dr. A. Kollmann, whose careful investigations and bibliography should be consulted by physiologists interested in the subject. He conceives the ridges to be formed through lateral pressures between nascent structures.

The ridges are said to be first discernible in the fourth month of the fœtal life, and fully formed by the sixth. In babies and children the delicacy of the ridges is proportionate to the smallness of their stature. They grow simultaneously with the general growth of the body, and continue to be sharply defined until old age has set in, when an incipient disintegration of the texture of the skin spoils, and may largely obliterate them, as in the finger prints on the title-page. They develop most in hands that do a moderate amount of work, and they are strongly developed in the foot, which has the hard work of supporting the weight of the body. They are, as already mentioned, but faintly developed in the hands of ladies, rendered delicate by the continual use of gloves, and lack of manual labour, and in idiots of the lowest type who are incapable of labouring at all. When the skin becomes thin, the ridges simultaneously subside in height. . . .

The Patterns

The ridges of the palm of the hand, run athwart the fingers in rudely parallel lines up the last joint, and if it were not for the finger-nail, would apparently continue parallel up to the extreme finger-tip. But the presence of the nail disturbs their parallelism and squeezes them downwards on both sides of the finger. Consequently, the ridges that run close to the tip are greatly arched, those that successively follow are gradually less arched until, in some cases, all signs of the arch disappear at about the level of the first joint. Usually, however, this gradual transition from an arch to a straight line fails to be carried out, causing a break in the orderly sequence, and a consequent interspace. The topmost boundary of the interspace is formed by the lowermost arch, and its lowermost boundary by the topmost straight ridge. But an equally large number of ducts exist within the interspace, as are to be found in adjacent areas of equal size, whose mouths require to be supported and connected. This is effected by the interpolation of an independent system of ridges arranged in loops, or in scrolls, and this interpolate system forms the "pattern." Now the existence of an interspace implies the divergence of two previously adjacent ridges, in order to embrace it. Just in front of the place where the divergence begins, and before the sweep of the pattern is reached, there are usually one or more very short cross-ridges. Their effect is to complete the enclosure of the minute triangular plot in question. Where there is a plot on both sides of the finger, the line that connects them serves as a base line whereby the pattern may be oriented, and the position of any point

(*Just turn the page*)

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roughly charted. Where there is a plot on only one side of the finger, the pattern has almost necessarily an axis, which serves for orientation, and the pattern can still be charted, though on a different principle, by dropping a perpendicular from the plot on to the axis, in the way there shown.

These plots form corner-stones to my system of outlining and subsequent classification; it is therefore extremely important that a sufficient area of the finger should be printed to include them. This can always be done by slightly *rolling* the finger, the result being, in the language of map-makers, a cylindrical projection of the finger. . . .

The words right and left *must be avoided* in speaking of patterns, for the two hands are symmetrically disposed, only in a reversed sense. The right hand does not look like a left hand, but like the reflection of a left hand in a looking-glass, and vice versa. The phrases we shall employ will be the *Inner* and the *Outer;* or thumb-side and little-finger side.

There need be no difficulty in remembering the meaning of these terms, if we bear in mind that the great toes are undoubtedly innermost; that if we walked on all fours as children do, and as our remote ancestors probably did, the thumbs also would be innermost, as is the case when the two hands are impressed side by side on paper. Inner and outer are better than thumb-side and little-finger side, because the latter cannot be applied to the thumbs and little fingers themselves. The anatomical words radial and ulnar referring to the two bones of the fore-arm, are not in popular use, and they might be similarly inappropriate, for it would sound oddly to speak of the radial side of the radius.

The two plots just described will therefore be henceforth designated as the Inner and the Outer plots respectively, and symbolized by the letters I and O.

The Outlines

The next step is to give a clear and definite shape to the pattern by drawing its outline. Take a fine pen, pencil, or paint brush, and follow in succession each of the two diverging ridges that start from either plot. The course of each ridge must be followed with scrupulous conscientiousness, marking it with a clean line as far as it can be traced. If the ridge bifurcates, always follow the branch that trends towards the middle of the pattern. If it stops short, let the outline stop short also, and recommence on a fresh ridge, choosing that which to the best of the judgment prolongs the course of the one that stopped. These outlines have an extraordinary effect in making finger markings intelligible to the untrained eye. What seemed before to be a vague and bewildering maze of lineations over which the glance wandered distractedly, seeking in vain for a point on which to fix itself, now suddenly assumes the shape of a sharply defined figure. Whatever difficulties may arise in classifying these figures, they are as nothing compared to those experienced in attempting to classify unoutlined patterns, the outlines giving a precision to their general features which was wanting before.

After a pattern has been treated in this way, there is no further occasion to pore minutely into the finger print, in order to classify it correctly, for the bold firm curves of the outline are even more distinct than the largest capital letters in the title-page of a book. . . .

The A. L. W. Classification

The classification into Arches, Loops, and Whorls is based on the degree of curvature of the ridges, and enables almost any pattern to be sorted under one or another of those three heads. There are a few ambiguous patterns, and others which are nondescript, but the former are uncommon and the latter rare; as these exceptions give little real inconvenience, the classification works easily and well.

Arches are formed when the ridges run from one side to the other of the bulb of the digit without making any backward turn or twist. Loops, when there is a single backward turn, but no twist. Whorls, when there is a turn through at least one complete circle; they are also considered to include all duplex spirals. . . .

The Arch-Loop-Whorl, or, more briefly, the A. L. W. system of classification, while in some degree artificial, is very serviceable for preliminary statistics, such as are needed to obtain a broad view of the distribution of the various patterns. A minute subdivision under numerous heads would necessitate a proportional and somewhat overwhelming amount of statistical labour. Fifty-four different standard varieties are by no means an extravagant number, but to treat fifty-four as thoroughly as three would require eighteen times as much material and labour. Effort is economised by obtaining broad results from a discussion of the A. L. W. classes, afterwards verifying or extending them by special inquiries into a few of the further subdivisions.

The divergent ridges that bound any simple pattern admit of nine, and only nine, distinct variations in the first part of their course. The bounding ridge that has attained the summit of any such pattern must have arrived either from the Inner plot (I), the Outer plot (O), or from both. Similarly as regards the bounding ridge that lies at the lowest point of the pattern. Any one of the three former events may occur in connection with any of the three latter events, so they afford in all 3x3, or nine possible combinations. It is convenient to distinguish them by easily intelligible symbols. Thus, let *i* signify a bounding line which starts from the point I, whether it proceeds to the summit or to the base of the pattern; let *o* be a line that similarly proceeds from O, and let *u* be a line that unites the two plots I and O, either by summit or by base. Again, let two symbols be used, of which the first shall always refer to the summit, and the second to the base of the pattern. Then the nine possible cases are—*uu, ui, uo; iu, ii, io; ou, oi, oo.* The case of the arches is peculiar, but they may be fairly classed under the symbol *uu*. . . .

It may be asked why ridges are followed and not furrows, the furrow being the real boundary between two systems. The reply is, that the ridges are the easiest to trace; and, as the error through following the ridges cannot exceed one-half of a ridge-interval, I have been content to disregard it. I began by tracing furrows, but preferred the ridges after a trial.

Sir Francis Galton was born in Warwickshire, England, February 16, 1822, and died at Haslemere January 17, 1911. He studied medicine, but decided not to enter the profession, graduated from Cambridge University at 21, and until 1860 devoted himself to travel, especially in Africa, still a generally unexplored continent. His next interest was the weather, and in 1863 he published "Meteorographica" giving the results of his observations. In 1869 his "Hereditary Genius, its Laws and Consequences" opened the field of researches on human heredity. Always interested in anthropology and anthropometry, Galton became enthusiastic about finger prints in 1888 while studying the Bertillon measurements newly introduced into prison records in France. Between the ages of 64 and 73 he was actively engaged on the study and classification of this method of identification. Galton was knighted in 1909, at the age of 86, only two years before his death.