DERMATOGLYPHIC METHOD OF MEDICAL GENETICS

SUBJECT:- MEDICAL BIOLOGY.

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The Development of the Study of Dermatoglyphics

Towards the end of the nineteenth century, the recognition of the importance of fingerprint patterns was gaining ground in many quarters, notably in India, Japan, Argentina and the UK.

A British Commissioner in India, Sir William Herschel, noticed the use of fingerprints as a form of signature amongst illiterate Indians and put this to good use to for his employees to authenticate their identity when collecting their wage packets. Successfully using this over a twenty year period clearly established the fact that fingerprints did not change their form over time and that therefore they could be used as a reliable form of personal identification.

Around the same time in Japan, a Scottish medical missionary by the name of Henry Faulds noticed the use of fingerprints as a form of signature on pieces of pottery and in 1880 he wrote a piece for *'Nature Magazine'* suggesting that the individuality and uniqueness of fingerprints gave them a potential usefulness in criminal identification.

In Argentina, the Croatian Juan Vucetich had developed his own system of identification through the use of fingerprinting and by 1891 this was being successfully employed by the Argentinian authorities. Although it was first suggested to the Home Office in 1887, it wasn't until 1901 that fingerprinting became an established procedure in criminological investigation in England. This came about largely through the efforts of Faulds and Herschel, in conjunction with Francis Galton.

Francis Galton

Francis Galton (1822-1911), the cousin of Sir Charles Darwin, was a scientist with a wide range of interests covering anthropology, geology, biology, heredity and eugenics, publishing some 240 written works, including some fifteen books. He conducted extensive research into the significance of skin ridge patterns not only to demonstrate their permanence and consequently their use as a means of identification, but also to demonstrate the hereditary significance of fingerprints and to show the biological variations of different fingerprint patterns amongst different racial groups. He collected vast numbers of fingerprints from all types of people, noting the variations of pattern types amongst different races and established the relative frequency

with which each pattern type occurred amongst different peoples. His classification of fingerprint patterns was considerably more simple than that proposed by Purkinje, delineating only three main types of pattern. He identified the triradius as being the significant indicator of a fingerprint pattern type and hence based his classification on the number of triradii to be found within each pattern.

For Galton there are therefore only three main types of pattern, the simple arch (with no triradius), the loop (with one triradius) and the whorl (with two triradii). Although he recognises the other main patterns that can be found in the hand, he subsumes them into this primary threefold classification. Consequently, tented arches become a type of loop whilst double loops become a type of whorl. Whilst his system of classification may suffice for the purposes of criminal identification, it is clear that it leaves much to be desired in terms of discriminating the different psychological qualities associated with each type. Alas, it is this system of classification rather than that of Purkinje which has been adopted by both the police and dermatoglyphicists, and this must be borne in mind when considering fingerprint statistics from either of these sources.

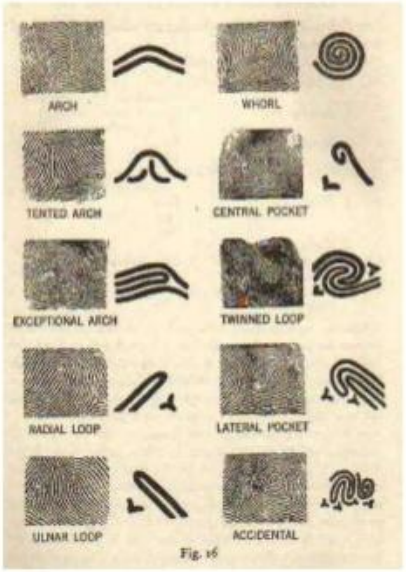


Fig. 16

However, Galton is perhaps the single most influential figure in the whole study of the skin ridge patterns of the hands and many of his methods for analysing fingerprints have carried through into the work of later genetic dermatoglyphic researches. His interest in heredity focused on the possibility of raising the standards of physical and mental health amongst the population as a whole and he saw in the study of fingerprints a means to initiate investigations into human genetics with this aim in mind. To this end, in 1895 he established the Galton Laboratory for Eugenics (a term he himself coined in 1883), at the University of London, which was later to conduct extensive investigations into the genetic significance of the hand as well as investigating correlations between dermatoglyphic patterns and known chromosomal abnormalities. His two works *'Fingerprints'* (1892) and *'Fingerprint Directories'* (1895) are rightly considered as classics in the field of early dermatoglyphic research and stimulated the interest of all sorts of scientific

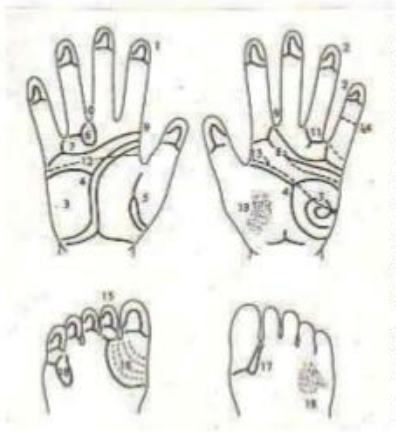
investigators,such as anthropologists and zoologists as well as geneticists and criminologists.

The Genetics of Dermal Ridges

After Galton's initial pioneering work, many further investigations were undertaken to develop this fledgling science of dermatoglyphics. Anthropologists concentrated on researching dermatoglyphic distributions of different peoples from around the world, and work was done on clarifying both the methodology and morphology of dermatoglyphic analysis. Meanwhile, the scientific world pioneered studies to investigate the embryogenesis of dermatoglyphic patterns and the first studies investigating the genetic significance of dermatoglyphic patterns were conducted. In America, HH Wilder inaugerated investigations into comparative dermatoglyphics, producing work on both the methodology and morphology of both palmar and plantar (feet) dermatoglyphics. H Poll and J Dankmeijer instigated research into dermatoglyphic distributions amongst different races and K Bonnevie investigated the embryology of dermatoglyphics as well as conducting studies on the genetic inheritance of dermatoglyphic patterns. The scientific investigation of the hand was beginning to prove without doubt that the hand was indeed a study worthy of the finest minds and could reveal not only vital genetic and medical information about an individual but also something of the psychological uniqueness of each person. With the discovery of the significance of dermatoglyphics, the study of the hand was truly beginning to come of age.

Fingerprints, Palms and Soles

From the mid 1930's onwards, the hand was coming to be recognised as an important diagnostic aid in the diagnosis of congenital syndromes such as mongolism. LS Penrose had studied the hands of people with Down's Syndrome and other conditions of congenital mental defect for many years and had discovered that the hand revealed particular malformations peculiar to these conditions. In 1931, he penned an article for *The Lancet*correlating the absence of the medial digital crease on the little finger with congenital mental retardation, research that proved to be but the start of a long and detailed investigation into the relevance of the hand in the clinical diagnosis of congenital conditions. However, the main breakthrough in establishing the significance of the dermatoglyphic analysis of the hand came with the publication of the results of the research of Harold Cummins and Charles Midlo in their seminal work *'Fingerprints Palms and Soles'* in 1943.



Cummins and Midlo were professors of Microscopic Anatomy at Tulane University in the United States, and it was they who in fact coined the term 'dermatoglyphics' in 1926 (derma = skin, glyph = carving). The main thrust of their research was into Down's Syndrome and the characteristic hand formations it produces. They showed that the hand contained significant dermatoglyphic configurations that would assist the identification of mongolism in the new-born child and thus they set the stage for much of the later dermatoglyphic research work. They also researched the embryo-genesis of skin ridge patterns and established that the fingerprint patterns actually develop in the womb and are fully formed by the fourth foetal month.

When it was later discovered that Down's Syndrome was in fact caused by chromosomal abnormality, research was begun to see how far the hand could be used as a guide to diagnosing other chromosomal defects and dermatoglyphic analysis soon became referred to as 'the poor man's karyotype'. The researches of Cummins and Midlo had proved that the hand could be of particular significance in the study of diseases with a genetic origin and, given the expense involved in conducting analyses of the chromosomes themselves, dermatoglyphic analysis was now beginning to prove itself as an extremely useful tool for preliminary investigations into conditions with a suspected genetic basis.

Genetic and Chromosomal Research

It was reading Cummins and Midlo's work that inspired LS Penrose to conduct his own dermatoglyphic investigations as a further aspect of his research into Down's Syndrome and other congenital medical disorders. In 1945, he was appointed to the Galton Chair of Eugenics at London University. Although the post had existed for some fifty years up to this point, very little research had actually been done into the genetic significance of fingerprints. Penrose was about to change all of that. Whilst he held the post, he conducted extensive investigations into chromosomal disorders and their dermatoglyphic manifestations, considering not only the more common trisomies such as Down's Syndrome, Edwards Syndrome and Patau's Syndrome, but also initiating investigations into other more rare chromosomal disorders such as 'Cri du Chat' Syndrome, and the sex chromosome disorders, Turner's Syndrome and Kleinefelter's Syndrome.

Characteristic Palmar Features in Down's Syndrome

Cheiromorphognomy:
- short, broad palms with short fingers
- short Air fingers (55% cases) (normally only found in 5% hands)
- clinodactyly of Air finger (55% of cases) (normally only found in 6% of hands)
- single interphalangeal crease on Air finger (26%) (virtually never seen normally)
- hyperflexive lower thumb joint (77%) (normally only found in 28% of hands)
- Simian lines commonly present (53%) (normally only found in 1-2% of hands)

The dermatoglyphic features commonly seen in the hands of those with Down's Syndrome include:
- increased incidence of ulna loops (83%) (normally 63%)
- ulna loops very high and L shaped
- often have 10 ulna loops (35%) (normally only 5%)
- reduced incidence of whorls (12%) and arches (3%)
- decreased incidence of radial loops but increased incidence of radial loops on fingers other than Water finger (Fire/Air fingers normally virtually never have radial loops)
- displaced axial triradius to t2 position, occuring on 85% DS hands (4% in controls)
- large dermatoglyphic patterns in hypothenar area of the hand in 80% of DS hands
- Interdigital Loop I3 very common occuring on 90% DS hands (only 40% normally)
- transverse alignment of skin ridges in Interdigital area
- low a-b ridge count
- increased incidence of skin ridge dissociation

The Kennedy-Galton Centre

In 1965, the Galton Laboratory became the Kennedy-Galton Centre for Clinical Genetics and Mental Deficiency Research under the chairmanship of Penrose. A new centre was set up in Hertfordshire as a research facility especially dedicated to chromosomal and dermatoglyphic research as well as a facility for offering genetic counselling for prospective parents. Penrose also contributed to the development of dermatoglyphics in that he established several important methodological procedures

and practices. It was he that formulated the measurement to establish the position of the displaced axial triradius in terms of the ATD angle, as well as establishing the inheritance of its position in the palm. In 1967, he chaired an International Symposium convened to standardise dermatoglyphic nomenclature and terminology.

One of Penrose's assistants at the Kennedy-Galton centre was Sarah Holt, whose own work *'The Genetics of Dermal Ridges'* published in 1968, summarises much of both her findings and the research of the centre itself. Much research was done on establishing the statistical distributions of dermatoglyphic patterns of both the fingers and the palm in various peoples, both normal and congenitally afflicted. In addition to giving further confirmation of the genetic and chromosomal basis of dermatoglyphic patterns and investigating the manifestations of these in Down's Syndrome and other chromosomal disorders, other investigations focused on which dermatoglyphic features are in fact inherited and how inheritance might be detected. This research focused particularly on the identification of those features of the palm which would indicate the genetic likelihood of a mother giving birth to a Down's Syndrome child, but also concentrated on the study of twins and especially identical twins, given their genetic identity. Through these researches it has now been established that it is possible to ascertain whether a pair of same-sex twins are monozygotic or dizygotic (ie fraternal or identical twins) from an examination of their fingerprints alone!

Dermatoglyphics Today

Although many important discoveries regarding the psychological significance of fingerprint patterns have been made, the main thrust of scientific dermatoglyphic research in the latter half of the twentieth century has been directed into genetic research and the diagnosis of chromosomal defects. Over the last thirty years or so, more than *four thousand* papers have been written on the significance of skin-ridge patterns! Whilst many of these have been restricted to the study of genetic or congenital disorders, not all of them have been concerned solely with chromosomal disorders. Significant investigations have also been carried out into the dermatoglyphic indicators of congenital heart disease, leukaemia, cancer, coeliac disease, intestinal disorders, rubella embryopathy, Alzheimer's disease, schizophrenia as well as other forms of mental illness. Most of this research has only been published in the pages of medical journals, but a good summary of these findings can be found in Schaumann and Alter's *'Dermatoglyphics in Medical Disorders'* published in 1976.

The current state of medical dermatoglyphics is such that the diagnosis of some illnesses can now be done on the basis of dermatoglyphic analysis alone and currently, several dermatoglyphic researchers claim a very high degree of accuracy in their prognostic ability from the hand's features. Dr Stowens, Chief of Pathology at St

Luke's hospital in New York, claims to be able to diagnose schizophrenia and leukaemia with up to a 90% accuracy from the patterns of the hands alone and in Germany, Dr Alexander Rodewald reports he can pinpoint many congenital abnormalities with a 90% accuracy from a consideration of the features of the hands alone.

In fact, in Germany dermatoglyphic assessment has been taken very seriously indeed, to the extent that computer programmes have now been designed to perform rapid multi-variate assessments of hand imprints which can predict with up to an 80% accuracy the chances of a new-born child developing heart disease, cancer, leukaemia, diabetes or mental illness. Such is the status of dermatoglyphic analysis in Germany, that it has become an integral part of the medical syllabus in many German universities and it would seem that before too long, the diagnosis of disease from the patterns of the hand will become a quite ordinary and commonplace activity.

The modern study of the hand is thus far removed from the popular image of the soothsaying hand reader uttering mysterious incantations in an arcane language. Rather, through decades of scientific research, the hand has come to be recognised as a powerful tool in the diagnosis of psychological, medical and genetic conditions. For dermatoglyphic research and the discoveries of medical science have corroborated many of the traditional claims of hand analysts and has provided a firm empirical basis for the modern study of chirology.

QUESTION AND ANSWER

1. WHAT DO YOU MEAN BY DERMATOGLYPHIC METHOD OF MEDICAL GENETICS?
2. HOW WE CAN IMPLEMENT IN OUR LIFE?

THANK YOU MAM