

New Thoughts on Fingerprints— Practical Applications

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Until about 10 years ago, I had little knowledge of scientific writings on fingerprints. I had one bible—Henry's "*Classification and Uses of Fingerprints*," and, indeed, this is to-day the basis of my working life.

However, on the 6th September, 1952, a turning point came into my life—Bertram Mills' Circus came to Wakefield, and, because exhibits of monkeys were scarce in our Department, I decided to 'print the chimps'.

To say that I found the task interesting is an understatement, so eventually I went to Belle Vue, Manchester, where I was able to add further to my collection.

A comparison of Plates 1 and 2 taken respectively from a Macaque and a Gibbon, two of the animals I 'printed'. shows considerable differences. The Macaque has circular patterns at the base of the fingers and on the hypothenar area, whilst the Gibbon is virtually patternless.

T. G. Mairs, the American expert, suggested that the whorl was the original pattern and that through the ages this had progressed to the loop and eventually to the arch or patternless area.

If we now compare the Gibbon with Plate 3, taken from a chimpanzee, and a human, it may appear that the Gibbon broke away from the evolutionary tree at a much earlier stage than man himself.

However, very little work has been done, in this country at least, in the field of comparative dermatoglyphics.

Dermatoglyphics and Twinning

My next venture was into the realms of twinning and in conjunction with our County Dental Officer I collected upwards of 200 sets, some of identical twins and some not. My own interpretations of these were not always in keeping with the official descriptions of the pairs, given at the birth by doctors and midwives.

It was at this stage that I made some outstanding discoveries. One was the word "Dermatoglyphics" and from what appeared to me to be somewhat obscure Journals, "*Anatomical Record*", "*Journal of Genetics*" and "*Biological Bulletin*", I realised that my discoveries had been somewhat belatedly made. Before going into any details, perhaps it would be better to start all over again and look at the enlarged section of a piece of skin shown in Plate 4.

Ridge Characteristics

You will notice the places where the lines end and divide, termed "ridge characteristics", and in comparing two sections of skin, whether it be from finger or palm or sole, if a number of these characteristics agree in 'coincident sequence' say 8 or 10, the number that can be seen in this plate, a fingerprint expert would have no hesitation in saying that these were made by the same person. If this evidence was to be given in Court, of course the number would have to be 16 (*Great Britain, Ed.*).

In one recorded case an officer was giving evidence on a bare foot impression found at the scene of crime. The defence counsel was at great pains to point out to the Court that whilst this officer was an undoubted expert on fingerprints, this was, in fact, his first case on footprints, so, how could he possibly be regarded as a 'footprints expert'?

It is also reported that the judge commented that "Whilst it may be true that everybody's fingerprints were different and that there had been a recent case in which it had been stated that everyone's palmprints were different,



Plate 1 Right Palm and Foot Prints of Macaque

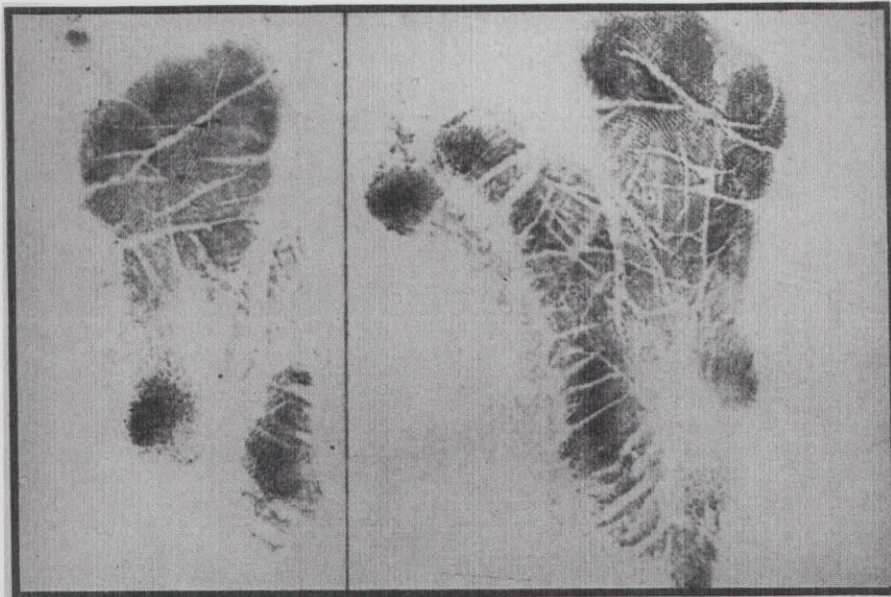


Plate 2 Palm and Foot Print of Gibbon

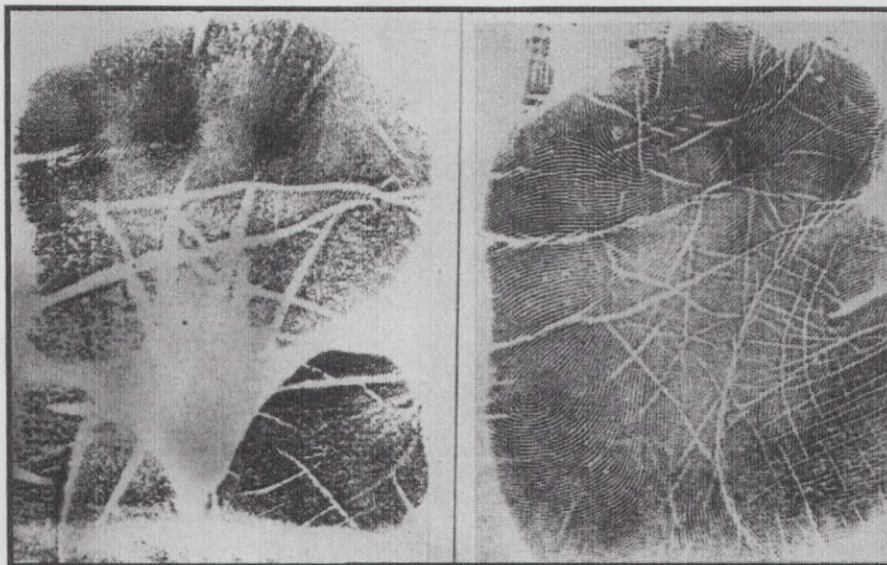


Plate 3 Left Palm of Chimpanzee (left) and Human Child (right)

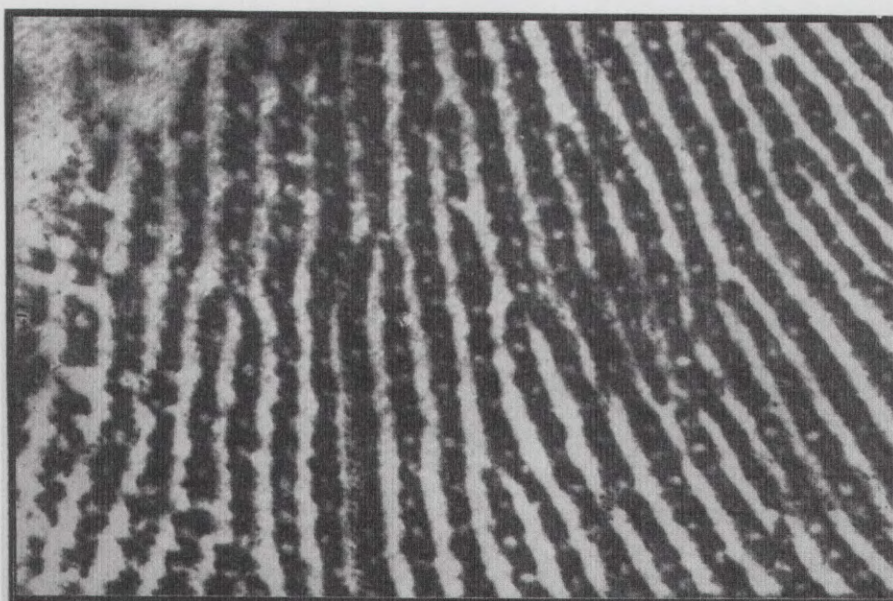


Plate 4 Surface Detail of Human Skin—Much Enlarged

perhaps we had not reached the stage in this country when we could say with certainty that everyone's footprints were different". What red herrings are fed to our unsuspecting juries.

Basically, the fingerprint expert is pointing out that in his two exhibits there are at least 16 ridge characteristics which agree in coincident sequence, and that the probability of this being another person is so remote that it can be excluded.

Whether these characteristics occur on a finger, a palm, a sole or a toe is, evidentially, immaterial.

As the majority of you are aware, the skin is in two basic layers, the outer or epidermal skin and the inner or dermal skin. Perhaps one of the most interesting of the earliest cases of dermal identification in this country was that in the case of Dr. Buck Ruxton, when Lieutenant Hamilton, of the Glasgow Bureau, did such a wonderful job with the bits and pieces found in Scotland, matching them with the marks found on bottles from Dr. Ruxton's house in Lancaster. Unfortunately, much of this evidence was never given in Court. The Director of Public Prosecutions advised against using it and despite strong protests, was adamant. To-day, however, this is regarded as quite a normal identification method, the majority of experts having given evidence of dermal impressions to Coroners' Courts.

These ridges, which cover the whole of the palm and the foot, form themselves into quite distinctive patterns, particularly on the last joint of the finger, as can be seen in Plate 5, and which were named by Galton 'Arches, Loops and Whorls'.

It will be noted that in the case of whorls there are two deltas and a core, in the case of loops—one delta and a core, and in the case of the true arch—neither delta nor core.

Basic Similarities

To return to the twins, in making comparisons of fingerprints or footprints for the purpose of discovering, say inherited factors, one must forget about 'coincident sequence of ridge characteristics' and examine fingerprints by established methods to find basic similarities.

The following table is extracted from the work of J. W. MacArthur (1938).

TABLE 1

FINGERPRINT AND TWIN DIAGNOSIS

AVERAGE NUMBER OF DIFFERENCES OBSERVED

Hand Comparison	Ridge Counts	Pattern Type
Homolateral (L. compared with L., and R. with R.)		
50 pairs Identical Twins	5.88	1.88
50 pairs Fraternal Twins	22.94	4.38
62 pairs Siblings	22.52	4.77
150 Random pairs	28.61	5.60
Bilateral (L. compared with own R.)		
100 Identical Twins	7.16	2.58
100 Fraternal Twins	8.14	2.61
100 Single born persons	8.00	3.49
Heterolateral (L. compared with other's R.)		
50 pairs Identical Twins	6.86	2.51
50 pairs Fraternal Twins	22.98	4.40
62 pairs Siblings	22.59	5.15

It can be seen that the homolateral differences increase as genetic relationship of the pair decreases. Can this be of any practical value? To me it certainly has been.

In January, 1960, I was able to be of some assistance to the Children's Department, Royal Victoria Hospital, Newcastle-upon-Tyne.

Case Histories

Leslie Y. was suffering from a curious stomach disease which was known to have genetic origins. The question as to whether his twin brother was an identical twin was vital, because remedial treatment was contemplated. Because of the difference in stature and physique associated with the disease in Leslie, the usual morphological resemblances in identical twins were not very evident in this pair, and, because of the character of their blood groups, it was technically difficult to provide conclusive evidence from that source.

I made a study of these twins, using the methods outlined in MacArthur's study. All the evidence pointed to these boys being monozygotic, and that was my conclusion.

I thought that this was something that could only happen once during my service, but only last week, I have had a similar request, also from the Royal Victoria Hospital, Newcastle-upon-Tyne, but this time from the Department of Dermatology.

In this case, two married ladies are involved. One is suffering from a skin complaint, and a grafting operation is contemplated.

Obviously, a diagnosis of identical twins is very important.

The comparison of the fingerprints are reproduced below :—

TABLE 2

		NEWCASTLE TWINS					
		Pattern Types and Ridge Counts					
A.	Right	\18	\15	\15	W21	\16	—85
	Left	/16	W16	W16	W21	/17	—86
B.	Right	\17	\15	\15	W22	\17	—86
	Left	/12	W14	/17	W20	/17	—80

The comparisons for these twins are as follows :

Homolateral	Right	A.—85	} Diff. 1
		B.—86	
	Left	A.—86	} Diff. 6
		B.—80	
Bilateral	A.	Right—85	} Diff. 1
		Left —86	
	B.	Right—86	} Diff. 6
		Left —80	
Heterolateral	A.	Right—85	} Diff. 5
	B.	Left —80	
	A.	Left —86	} Diff. 0
	B.	Right—86	

Generally speaking, in the examination of any fingerprints, one expects to find bilateral similarities and, in the examination of the fingerprints of twins, if the difference in the homolateral and heterolateral comparisons are not more than the differences in the bilateral comparisons, this must be regarded as evidence of monozygosity.

The comparison of the palmprints offers almost conclusive evidence in this pair.

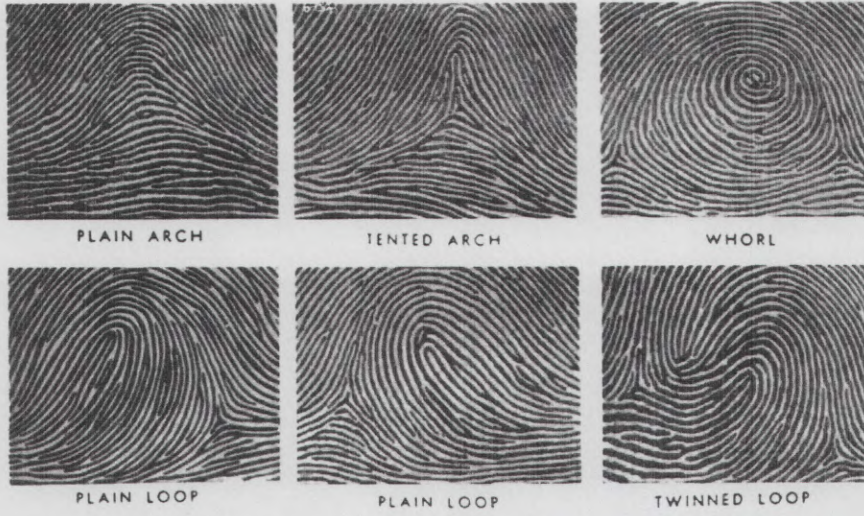


Plate 5. Finger Pattern Types

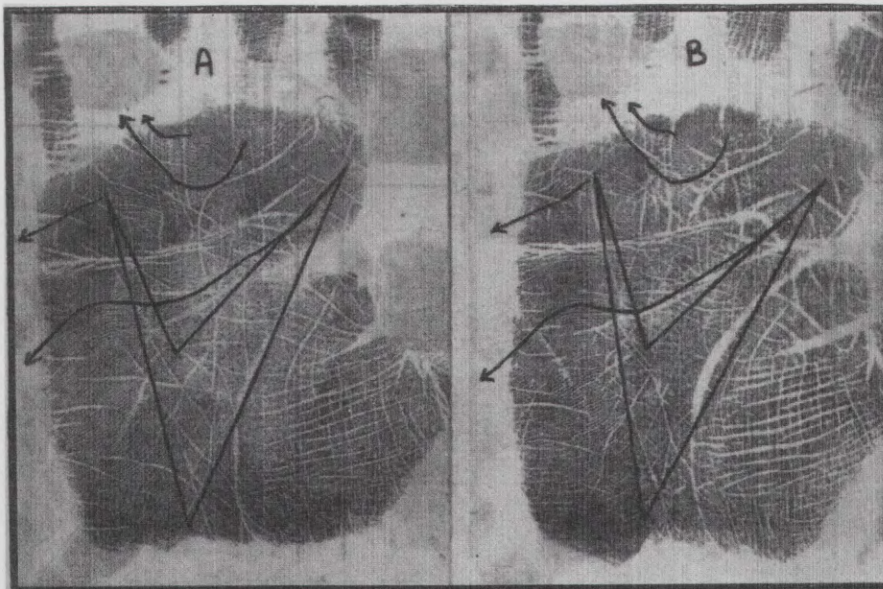


Plate 6 Left Palms of Newcastle Twins

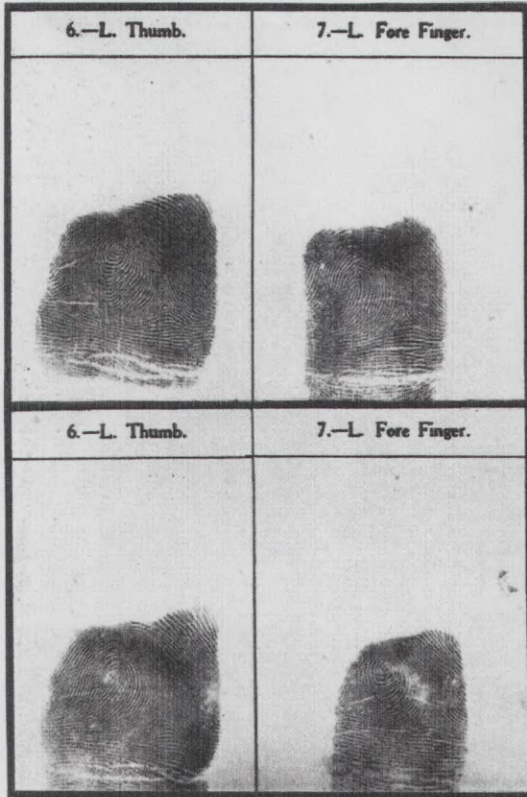


Plate 7 Asymmetrical Reversal of Patterns on Fingers



Plate 8 Right Middle (left) and Ring Finger (right) Patterns of a Pair of Identical Twins

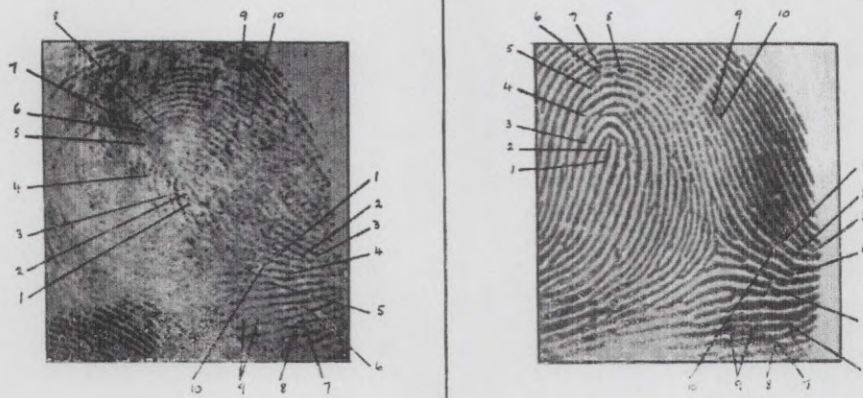


Plate 9 An Almost Perfect Superimposition

Plate 6 shows the comparisons of the left palms. The right palms are equally similar. It will be noted that the tracings of the main lines, the angles of the deltas and the patterning on the hypothenar are remarkably alike.

Obviously, on this pair, I reported that in my opinion, these were identical twins.

Practical Fingerprint Work

Fingerprint officers, that is to say, officers engaged in the work of personal identification, are extremely sceptical of these experiments. In many Fingerprint Bureaux, one sees enlargements of, say two right thumbs, of different pattern, taken from a pair of identical twins. Perhaps this is intended as a morale booster and to show to the world that even in twins, the prints are different.

Plate 7 shows such a comparison but, of course, it does not take a lot of imagination to realise that here is a factor which is indicative of twinning—Asymmetrical reversal of patterns.

Much of the time of fingerprint experts is spent in Court. Usually the cases are straight forward, but, from time to time, and perhaps when all else fails, an attack is made on the system.

About 18 months ago, I was giving evidence at the local quarter sessions. My exhibit was a fairly difficult one to interpret and the Defending Counsel took one look at it, and turned it face downwards. A fairly extensive cross-examination followed which terminated with this question:—

"It would be true to say, would it not, Inspector, that all you can say about fingerprints is that of the two million or so on record in this country, no two have been found to be alike?"

It was obvious that a 'yes' was expected to this question, but I said 'No'.

Even from our discussions to-day, it is obvious that we know far more than this. We know that pattern types, examine quantitatively and qualitatively are genetically influenced. The patterns on our hands and feet have not appeared by chance, but as a direct result of inheritance. Thus we can appreciate why the dermatoglyphic features of identical twins are so much alike.

But why are they different? There is, of course, another influence at work—that of environment.

Genesis of Ridge Detail

Here we are indebted to the work of embryologists like Bonnevie, who was able to demonstrate that the all important period of differentiation was between the 12th and 20th weeks of foetal life. About the 12th week the main prominences of the fingers, palms and feet are bulbous and during the next few weeks gradually recede. At the same time the ridges begin to appear, until, when the pads have completely receded, so the ridges are fully formed.

I imagine a blown-up balloon; as the air is let out so the rubber begins to wrinkle, but in the case of the ridges, these are wrinkling in a pre-determined shape, along the openings of the pores.

In his book, "Genetic Principles in Medicine and Social Science," Professor Hogben discusses intra uterine environment by studying the incidence of still births in twins.

After a table of percentages he says:—

"While these figures are consonant with the prevailing hypothesis of the genesis of twins in so far as they show that the probability of one twin surviving if the other dies is smaller in the case of monozygotic than in that of dizygotic twins, they show still more clearly that the uterine environment of one member of a pair of twins is not precisely identical with that of another.

Again, I have my own simple explanation.

Heredity and Environment

It would seem to me, that, if one starts off with two things which are genetically identical and subject them to precisely the same environment, logically, the end products must be identical. If we start off with two things which are

genetically identical and the end product is different—THEY MUST have developed in a different environment.

In Plate 8 are the right middle and ring fingers of a pair of identical twins. These, in my view, are remarkable in that they show, not only the result of inheritance in the similarities of unusual ridge formations but also demonstrate the work of the environment in pushing the characteristics into different positions so that no expert in his right mind could be deceived. It naturally follows that to achieve two identical fingerprints, one must have not only identical inheritance, but these must develop in an identical environment.

As this latter point is not possible even with identical twins, it must follow that all fingerprints, palmprints and footprints must be different, and not merely from people who are living now, but by the wonderful laws of nature, from any person who has ever lived, or for that matter, who ever will live.

Fingerprints and Paternity

This takes us, of course, to the final stage. If we know with some certainty the influences at work, and above all, the manner in which they work, we should be able to interpret material to express an opinion on the vexed question of paternity.

At this stage I should like to make perfectly clear that I could not pick out one man and say "you are the father of this child", but, if the indisputable evidence was such that two or three men were the only possible fathers, then, in conjunction with other known methods, I am satisfied that the comparison of fingerprints, palmprints and footprints could become not only a valuable aid, but even point out the true father.

Unfortunately, I have not yet had a real life case in which my services have been requested; I feel that such a request would be the height of my ambition, but at least, I have experimented.

The details below are of one such study I have made.

TABLE 3

		FAMILY STUDY					
		Pattern Type and Ridge Counts					
		Thumb	Fore	Middle	Ring	Little	
MOTHER:	Right	\10	\4	\5	\17	\5	41
	Left	A	\5	A	/7	/7	19
							=60
CHILDREN:	Right	\15	/20	W7	\20	\7	69
	Left	/12	\21	/12	/20	/6	71
							=140
2. Male	Right	\13	/5	\7	\5	\7	37
	Left	/9	\6	T.A.	/8	/10	33
							=70
3. Female	Right	\15	W12	\21	W21	\16	85
	Left	/15	T.L. 15	/20	W21	/16	87
							=172
PROBABLE FATHERS;							
A.	Right	\20	/10	\15	W9	\13	67
	Left	/16	\12	/9	W15	/13	65
							=132
B.	Right	\25	\20	\18	\21	\18	102
	Left	/19	W9	/20	/24	/17	89
							=191
C.	Right	W14	/19	/22	W19	\15	89
	Left	/17	W18	W17	W27	/16	95
							=184

The children fall into two groups as far as the ridge counts are concerned. The two females have high ridge counts whilst the counts of the male child are low.

Thus it might appear that the male has 'taken after' the mother and the females after the father.

Thus, on Dr. Holt's work all the three males are probables but female child No. 3 puts Males B and C as the most likely.

Children 1 and 2 each have radial loops on the forefingers and there is only one whorl pattern.

Child No. 3 has four whorl patterns.

Male A has radial loops and two whorl patterns.

Male B has no radial loops and one whorl pattern.

Male C has two radial loops and four whorl patterns, and one of the whorls has a radial slope.

Examining the pattern types of the probable fathers it would appear to indicate A and C as likely fathers, with C as the most likely.

The palmprints of the family study are as follows :—

Mother and all three children—no patterns on thenar or hypothenar.

Male A—Bilateral patterning (distal loops).

Male B—Unilateral patterning (distal loops).

Male C—patternless.

Thus it would appear that Male C is the common denominator, and on these features I selected C as the probable father.

Incidentally—Male C turned out to be the husband, for which I was truly thankful. As far as I am aware, this type of evidence has never been given in this country, but I know that it has been presented in courts on the Continent on a number of occasions.

Practical Difficulties

During the past year or so a not inconsiderable part of my time has been spent on perfecting methods of obtaining fingerprints from badly burned and mutilated bodies. I have been doing this in conjunction with Dr. Price, whom, I might add, has supplied me with some outrageous material and often at the most inconvenient times. We are hoping that, in the near future, when the final touches are made to the script, this may be published.

The work of a fingerprint officer is always exacting and usually tedious. Plate 9 shows on the left hand side a mark which kept our noses to the grindstone for many an anxious hour before we finally decided that it was not a loop to the right, but a loop to the left. The superimposition was almost complete.

In conclusion, however, although I have said that the work is tedious and exacting, for me it has often had its moments of intense satisfaction, even momentary glory, and sometimes I sit back and marvel at these wonderful ridges, unique and unchanging, that nature has so conveniently placed on the tips of our fingers.

References

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MACARTHUR, J. W., 1938, *Reliability of Dermatoglyphics in Twin Diagnosis*, *Human Biology*, 10, 12.
MAIRS, G. T., 1933, *Finger Print and Identification Magazine*, 15. Nos. 4 and 5.