IDENTIFICATION NEWS

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HEREDITY IN FINGERPRINTS

by Gaye Shahan

Heredity may be defined as the transmission of characteristics from the parents to the offspring. Such traits as body size, hair color, skin color, eye color, etc. are known to be inherited.

The cell is the unit of structures and the unit of heredity.

Chromosomes in all of the body cells of a single individual are alike. Thus, the individual functions as a single unit —alike in every cell yet different from all other people.

Under extremely high magnification, crossbands on the chromosomes are visible. These sections are considered to be groups of genes, the determiners of heredity.

Human body cells have 23 pairs, or 46 chromosomes.

Genes are also present in pairs. .4 gene is that portion of a DNA molecule that is genetically active and produces a trait. It is a unit of heredity information. Genes determine hereditary traits. Every cell in our bodies normally contains all of our genes. (Many thousands of them).

The genetic makeup was established at the beginning of our lives when an egg and sperm combined their haploid chromosome numbers to produce a diploid zygote, our first somatic cell.

From that moment on, every gene has replicated prior to a mitatic cell division. Thus, every cell in our bodies contains our complete genetic code.

The original egg contained 23 chromosomes and a full set of genes. The sperm, which fertilized the egg, also had 23 chromosomes and a full set of genes.

Therefore, the genes of one person are functionally different from all other people. No other person who is living, has ever lived, or may ever live, has the same DNA makeup as any other person.

The DNA molecules are of infinite variety in molecular structure. It has been estimated that purines and pyrimidines may be joined in more than 10,000 billion billion different combinations in DNA molecules.

The hereditary makeup of the individual is determined the instant the egg and sperm unite.

The same parents produce offspring with quite different characteristics. The variation in the eggs or sperm formed by a single individual is due to the chance distribution of genes m the chromosomes in the germ cells.

When we consider that man has 46 chromosomes and that each chromosome has numerous genes, the possbiilities of gene combinations in eggs and sperm following reduction division are almost without limit.

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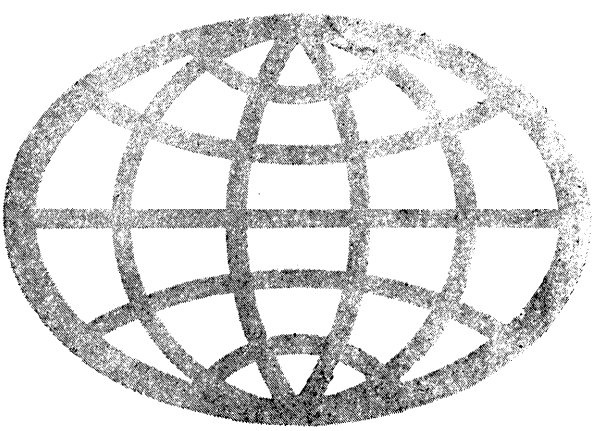

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The chance distribution of genes during reduction and the resulting variation in characters of offspring makes one person different from another. The particular combination of genes in one person will never occur again, and has not occurred before.

Genes can be carried without indicating their presence for several generations, and may then appear at a later time in some member of the family.

Each gene has a specific function to perform in the development and maintenance of a living organism. There are regularly two of each kind of gene in each cell. These two genes are found on two different chromosomes within the cell and the two chromosomes will always be similar to one another.

The chances of a couple having two children with the same assortment of chromosomes are so minute as to be considered impossible.

Even though people lived for thousands of years and had children by the thousands, the possible number of combinations is still so great that we would not find two children with the same chromosomes. Calculated by the laws of probability, the chance that you will have the same assortment of chromosomes possessed by your brother or sister is one in 281 trillion. This fails to allow for the exchange of parts of chromosomes which is known to occur. This process would greatly multiply the before described number of variations.

The study of human heredity is complicated by the fact that human beings cannot be mated as are animals; also about twenty years elapse between generations, and a relatively small number of offspring are produced.

PATTERNS SUBJECT OF STUDY

History has recorded that man discovered the appearance of papillary ridges on the friction skin surfaces of the hands and feet, and it has been known since the stone ages that these ridges or corrugations formed patterns of swirls or whorls and loops especially on the terminal digital joints.

These patterns have been the subject of studies by the anthropologist, the geneticist and, of course, those who are interested in personal identification through this media. The history of these studies will not be repeated here, but a cry of alarm has been heard from identification experts when those m other scientific fields have suggested that their studies indicated hereditary influence on the appearance of the fingerprint patterns.

Many researchers on the subject of fingerprint identification have prepared sets of calculations with regard to the percentage of chance involved in duplicating a fingerprint. One such formula establishes an estimate of the chance occurrence of each of the fingerprint details separately in the form of a fraction, such as, one to two. These fractions are then multiplied together to obtain the chance of occurrence. Using only nine details of identification points, this formula would project one to the ninth power of fifty or one to one quadrillion, nine hundred and fifty-three trillion, one hundred twenty-five billion. An early pioneer in these studies, Sir Francis Galton, determined that the chance occurrence was one to sixty-four thousand millions.

These may be very conservative figures however based on knowledge gained through research in the field of genetics. No attempt will be made in this writing to explain any theory or the laws of genetics, but our text books in the field of human biology state that the chances of a couple having two children with the same assortment of chromosomes are so minute as to be considered impossible. Even though people lived for thousands of years and had children by the thousands, the possible number of combinations, genetic combinations, is so great that we would not find two children with the same chromosomes. The genes of one eperson who is living, has ever lived, or may ever live has the same DNA (deoxyrilionucleic acid) make up as any other person. The DNA molecules are of infinite variety m molecular structure. It is estimated that the structure (the joining of purines and pyrimidines) may occur in more than ten thousand billion billion different combinations in the DNA molecules.

It would seem, therefore, that the best scientific argument would be to admit that genetics may play a part in the fingerprint characteristics, if it can be established that this is so, because the chance probability that any two fingers would be the same is incomprehensibly remote if we were to assume full genetic influence.

FAMILY SELECTED

In order to determine the effect, if any, of genetic influence on fingerprint patterns and friction ridge detail, a study has been conducted of a selected family group.

The particular family was selected for varous considerations. The first and an important factor was to obtain a family with a sizeable number of oil-spring so as to obtain a representative study. A second factor was to choose a husband and wife pair whose friction ridge patterns contained a number of like characters. If possible, one would also have been chosen wherein all ten fingers of each would have been of the same pattern type. Another factor was to choose a family group with a number of marriages with issue into a third and fourth generation. With a large family in which a number have married, it was contemplated one or more partners brought into the family group would have patterns similar to those of the family group. Some will certainly have different types of patterns and this, it was hoped, would afford an opportunity for comparisons of the results in children of the third generations. These third generation offspring would in some cases issue from parents with pattern types similar to the first generation, and some would be from parents, one member of whom would be different.

This line of comparison would then continue into the fourth and eventually succeeding generations.

The family group chosen afforded an opportunity to conduct a number of interesting comparisons. In the first generation both man and wife have the same pattern types in certain finger combinations. They both have ulnar loops in the little fingers,

numbers five and ten. They both have whorl type patterns in the ring fingers, numbers four and nine. They have a combinations of whorls and ulnar loops in the thumbs, numbers one and six, and in the middle fingers, numbers three and eight. Their index fingers, numbers two and seven, contain a combination of whorl and radial loops.

It is well known among fingerprint analysts that certain pattern types appear more often in certain finger positions. The ulnar loop, for example, may appear more frequently in little fingers than other type patterns in these digits. Likewise, the whorl types are observed to appear more frequently in the thumbs and ring fingers than elsewhere. This is true in the pattern types in the first generation couple in this study. Also of interest is the fact that the ring and little fingers contain the same type of patterns. The thumbs are different but are alike as to each partner. There are differences in index and middle fingers but of interest in these digits is the appearance of the radial loops, two in the husband and one in the wife.

To follow this study experiment, the following system was adopted: The initial husband and wife group are considered as the first generation. Following generations are then numbered consecutively. In the second generation there are a total of thirteen members, and whether or not their fingerprints became a part of this study, they are numbered one through thirteen according to birthdate. Members of subsequent generations are also assigned numbers according to the generation number and order of date of birth. The numbering system will retain the second generation and all following generation number designations. For example, the first born of the elder child of number one in the second generation will be assigned one-one-one. Each numeral indicating the first born from each generation from second through fourth.

Illustrations will designate finger locations by numbers one through ten. The right thumbs will be number one and right little finger number five. The left thumb will be number six and the left little finger number ten.

The fingerprint pattern types used herein are the plain arch, tented arch, radial loop, ulnar loop, and whorl. The types will be designated as A, T, R, U, and W.

For the purpose of the general survey and study, all whorl types are grouped into one. All questionable patterns are grouped under the preferred pattern type. The grouping of questionable patterns became a difficult task. Although it was not done in this experiment, it is believed that when this type of survey is being conducted, the strict rules governing fingerprint pattern type designation should be relaxed.

As fingerprint technicians have observed, the loop type patterns with a number of converging ridges opposite the looping ends of the ridges frequently have the casual appearance of whorl types. There are also the tented arch types of patterns which on casual examination bear the general appearance of the loops.

Some of the initial observations made are depicted in the following charts or examples:

Example number A shows the pattern types in the first generation:

Example number B is the pattern types of available members of the second generation.

It is interesting to note here that the ulnar loops in fingers number five and ten, the little fingers, continued through the second generation. The whorl type in numbers four and nine, the ring fingers, continued through all of the second generation except number nine finger in the thirteenth member. This pattern is a loop with converging ridges previously mentioned.

Some additional observations are noted. The W. P. combination in numbers one and six continued with variations except in number two. The radial loop in this case is of a type with ridges simulating the whorl type.

The radial loop in numbers two and seven fingers failed to carry through although the majority did have radial loops in the right hand digits and a representative number in the left.

Digits three and eight, the middle fingers, were three W. and one U. in the first generation. The U. in the right middle finger of the father appeared to dominate, however, the U. appears also in the left hand digits of the second generation whereas both parents have W. in these digits.

Additional observations of interest may be seen in third and fourth generations.

FIRST GENERATION

FINGER NUMBER

	1	2	3	4	5	6	7	8	9	10
Husband	W	R	U	W	U	W	R	W	W	U
Wife	U	R	W	W	U	U	W	W	W	U

EXAMPLE — A

SECOND GENERATION

1. Son	W	R	W	W	U	W	W	W	W	U
2. Son	R	A	U	W	U	R	T	U	W	U
4. Daughter	W	R	W	W	U	U	U	W	W	U
5. Daughter	U	U	U	W	U	U	R	W	W	U
6. Son	W	R	U	W	U	W	W	W	W	U
7. Son	W	R	U	W	U	U	R	U	W	U
9. Son	W	U	U	W	U	U	U	R	W	U
11. Son	U	T	A	W	U	W	R	U	W	U
13. Son	W	R	U	W	U	W	R	U	U	U

In example 1. the spouse brings additional ulnar loop type patterns into being. The percentage is seven and three, U. to W., out of ten. The W. and U. in ring and little fingers, however, remained constant. In the two offspring only I -2 carried the W. in four and nine, whereas I -2 picked up the U. in these two digits. The U. in five and ten remained constant in this third generation group.

(please turn page)

1 'he one married member here, 1-1, added additional U. patterns, seven out of ten. The spouse in this mating is the first example of a W. in a little finger, number five. It is very interesting to note that a whorl also appears in number five in one of the two members, 1-1-1, of this fourth generation.

Also of interest is the appearance of radial loops in ring fingers, four and nine of 1-1-1, and four of 1-1-2. This pattern had not previously been seen in these digits and if we are to attribute its appearance to heredity it may be assumed that it originated in the father's background. The radial loops in the index fingers here is consistent with percentages up to this point.

THIRD GENERATION

Example 1

Husband	W	R	W	W	U	W	W	W	W	U
Wife	U	W	U	W	U	U	U	U	W	u

THIRD GENERATION

Daughter 1-1	W	A	U	U	U	W	R	U	U	U
Daughter 1-2	W	W	W	W	U	W	W	W	W	U

THIRD GENERATION

Example 1-1

Husband	U	U	U	U	W	U	W	U	W	u
Wife 1-1	W	A	U	U	U	W	R	U	U	U

FOURTH GENERATION

Daughter 1-1-1	W	R	U	R	W	U	R	U	R	U
Daughter 1-1-2	U	R	U	R	U	W	U	U	U	U

As we examine example 2. of the third generation, it is observed that the spouse has only loop types, U. in all except index fingers and R. in those digits. The firstborn of four in this group, 2-1, brings only ulnar loops except one, the T. in number two. Number 2-3 also has loops except the W. in number six and the T. in number seven. The W. in six is a double loop type whorl and is the first appearance of this type. The T. in number seven has the casual appearance of an R.

Additional members of this third generation, numbers 2-2 and 2-4, continue whorls in ring and ulnar loops in little fingers except number nine of 2-4 which is the coverging ridge type of loop with the casual appearance of the whorl.

The spouse of the married member, 2-1, of this third generation group returns whorls in the ring fingers.

THIRD GENERATION

Example 2

Husband 2	R	A	U	W	U	R	T	U	W	U
Wife	U	R	U	U	U	U	R	U	U	U

THIRD GENERATION

Son 2-1	U	T	U	U	U	U	U	U	U	U
Son 2-2	W	U	U	W	U	W	U	U	W	u
Son 2-3	U	U	U	U	U	W	T	U	U	U
Son 2-4	W	T	U	W	U	W	T	U	U	U

THIRD GENERATION

Example 4

Husband	U	U	U	U	U	U	U	U	U	U
Wife 4	W	R	W	W	U	U	U	W	U	

THIRD GENERATION

Daughter 4-1	U	U	T	U	U	U	U	U	U	U
Son 4-2	U	U	R	U	U	U	U	R	U	U
Son 4-3	W	U	U	W	U	U	U	W	W	u

Example 5

Wife 5	U	U	U	W	U	U	R	W	W	U
Husband	W	W	U	W	U	W	W		W	W W

THIRD GENERATION

Son 5-1	U	R	W	W	U	U	W	U	W	U
Daughter 5-2	W	U	U	U	U	U		U	U	U U
Daughter 5-3	U	W	U	W	U	W	W	U	W	W

FOURTH GENERATION

Example 2-1

Husband 2-1	U	T	U	U	U	U	U	U	U	U
Wife	U	W	U	W	U	U	W	U	W	u

FOURTH GENERATION

Son 2-1-1	W	U	U	U	U	U	U	U	U	U
Son 2-1-2	W	A	U	U	U	W	U	A	U	U

In example 4 of the third generation, the spouse is the first example of a group member with ten ulnar loops. The second generation member, number 4, of this couple has whorls in digits one, three, four, eight, and nine. The effect of the additional ulnar loops by the father of the offspring here is interesting. There are no whorl type patters in 4-1 and 4-2. 4-3 repeated the whorl of the mother and in the same digits. It did not repeat the R of the mother in number two finger.

Example 5-1

Husband 5-1	U	R	W	W	U	U	W	U	W	U
Wife	U	R	U	U	U	U	U	U	U	U

Second generation members six and seven are twins, believed to be identical twins. The two spouse are sisters. In both examples the spouse have only U and T types.

In example 6 the second generation member's patterns are made up of six W types including the constant W in ring fingers. The U constant also appears in the little fingers.

This example is interesting because the W type does not appear in one digit of any of the five third generation offspring. Radial loops in index fingers may have been carried forward but the only constant is the U in little fingers and it may be reasoned that the ulnar loop is most frequently found in these digits.

The number seven second generation member has the same pattern types and in the same order as its twin in the right hand but bears a striking difference in the left hand.

The two off-spring here do not continue the W types and only one, 7-2. has whorls in right thumb and ring fingers.

Here it may be observed that the pattern types of twins may be different and, although the two wives are sisters, no substantial influence is noted unless it is a tendency toward influence of a predominance by the ulnar loop types.

THIRD GENERATION

Example 6

Husband 6	W	R	U	W	U	W	W	W	W	U
Wife	U	U	U	T	U	U	U	U	U	U
Daughter 6- I	U	R	U	U	U	U	R	R	U	L"
Son 6-2	U	T	U	T	U	U	R	U	U	U
Son 6-3	U	U	T	U	U	U	T	U	U	U
Daughter 6-4	U	U	U	U	U	U	U	R	U	U
Son 6-4	U	U	U	U	U	U	U	U	U	U

THIRD Generation

Example 7

Husband 7	W	R	U	W	U	U	R	U	W	U
Wife	U	T	U	U	U	U	T	U	U	U

THIRD GENERATION

Son 7- I	U	T	U	U	U	U	R	U	U	U
Daughter 7-2	W	R	U	W	U	U	U	U	U	U

Early studies established that the occurance frequency of certain pattern types is greater than others. Researchers have not been in complete agreement but the variance between their findings has been slight. An average of the research results has established about 65 percent of all patterns are ulnar 100ps. About 30 percent are whorls and about 5 percent arches.

A study conducted by Scotland Yard consisted of the examination of the pattern of 5,000 individuals and percentages of pattern appearance established for the 50.000 fingers. The results, less amputated or otherwise missing or scarred fingers is depicted in example D.

It is noted here that the percentages are: A, 4 percent; T, I percent or a total of 5 percent for arches. The loops were 6 percent for radial and 64 percent for ulnar, or 70 percent for all loops. The total for all whorl types was 25 percent.

When this type of comparison is applied to the group being studied in this experiment there appears to be an influential trend toward the predominance of ulnar 100p type patterns.

The original couple presented fifty percent whorls, thirty-five percent ulnar loops and fifteen percent radial loops, or fifty percent whorls to fifty percent loops and no arches.

The second generation members reduced the whorl percentage to thirty-nine. The 100p percentage increased to fifty-seven and four percent arches including tented arches was added.

The second generation was then combined with marriage partners, and this reduced the whorl percentages to thirty-one. The 100p percentage increased to sixty-four, and arches increased to four percent.

It is noted at this point that the percentages have closely approached the established average levels. This may, in part, be the influence of 100p type patterns added to the study group by marriage partners.

EXAMPLE D

FIRST GENERATION

Pattern	1	2	3	4	5	6	7	8	9	10	Tot.	%
Arch	.	.	.	.	.	.	.	.	.	.	.	0 0
T. Arch	.	.	.	.	.	.	.	.	.	.	.	0 0
R. Loop	.	2	.	.	.	.	1	.	.	.	3	.150
U. Loop	I	.	I	.	2	I	.				2 7	.350
Whorl	I	.	I	2	.	1	I		22		. 10	.500

EXAMPLE D-1

SECOND GENERATION

Pattern	1	2	3	4	5	6	7	8	9	10	Tot.	%
Arch	0	1	1	0	0	0	0	0	0	0	2	. 0 2 2
T. Arch	0	1	0	0	0	0	1	0	0	0	2	. 0 2 2
R. Loop	1	5	0	0	0	1	4	1	0	0	1 2	. 1 3 3
U. Loop	2	2	6	0	9	4	2	4	1	9	3 9	. 4 3 3
Whorl	6	0	2	9	0	4	2	4	8	0	3 5	. 3 8 8

EXAMPLE D-2

SECOND GENERATION AND SPOUSE

Pattern	1	2	3	4	5	6	7	8	9	10	Tot.	%
Arch	.	1	.	.	.	.	.	.	.	.	1	.008
T. Arch	.	I	.	.	1	.	.	2	.	.	4	.033
R. Loop	.	1	5	.	.	.	1	3	.	.	.	1 0 . 0 8 3
U. Loop	6	3	1	0	3	1	2	8	4	7	4 1	1 6 8 . 5 6 7
Whorl	5	2	2	8	0	3	3	5	8	1	3 7	. 3 0 8

Twenty members of the third generation, as reflected in chart D-4, possess patterns in approximate proportion to the established standard. The whorl percentage has dropped about five percent under the standard and the loop percentage about five percent over. They may be accounted for by an indication of a tendency of the radical loops to carry through. The percentage of radial loops is slightly higher than a standard expectation.

Chart D-4 combines the third generation and their marriage partners. The percentage of appearance of pattern types has remained very comparable to the standard.

Members of the fourth generation have not been completely examined, but those available for comparison reflect fifteen percent whorls, fifty-eight percent ulnar loops, and thirty percent radial loops. This is an extra-ordinary large radcial loop percentage and one half of these appear in ring fingers. This pattern has not previously appeared in those digits.

It will be necessary to explore the paternal family line of this fourth generation to determine the possibility of a genetic origin of these developments.

Another very interesting development is noted in third generation example 5. The spouse in this case returned whorls to the group, eight of ten fingers. This includes the W in the little finger, number 10, which is noted in the same digit of 5-3.

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THIRD GENERATION

Pattern	1	2	3	4	5	6	7	8	9	10	Tot.	%
Arch	.	1	.	.	.	.	.	.	.	.	1	.005
T. Arch	.	3	3	1	.	.	2	1	.	.10		.050
R. Loop		4	1				6	3			14	.070
U. Loop	3"	9	14	11"	20"	14"	8	14	15"	19"	37	.685
Whorl	7	3	2	8	0	6	4	2	5	1	3	8 . 1 9 0

EXAMPLE D-4

THIRD GENERATION AND SPOUSE

Pattern	1	2	3	4	5	6	7	8	9	10	Tot.	%
Arch	.	1	.	.	.	.	.	.	.	.	1	.025
T. Arch	.	1	.	.	.	.	.	.	.	.	1	.025
R. Loop	.	.	.	.	.	.	1	.	.	.	1	.025
U. Loop	3	1	4	3	3	3	1	4	2	4	2 8	. 7 0 0
Whorl	1	1	.	1	1	1	2	.	2	.	9 . 2 2 5	

EXAMPLE D-5

SUMMARY

DRIFT TO ULNAR LOOP

Pattern Type	A	T	R	U	W
Yard Survey	.04	.006	.06	.64	.25
1st Generation	.00	.00	.15	.35	.50
2nd Generation	**.02**	**.02**	.13	.43	.39
2nd and Spouse	.01	.03	.08	.56	.32
3rd Generation	.01	.05	.07	.69	.19
3rd and Spouse	.03	.03	.03	.70	.23
4th Generation	.05	.00	.15	.65	.15

These studies of friction ridge finger-tip pattern type has provided an abundance of detail indicating that the laws of heredity and genetics may control these human body characteristics just as surely as it has been proven that they control other characteristics. There is also to be found unlikenesses and dissimilarities which can be used to argue that genetic influence is not present in this area. These instances of failure to correspond with the study family pattern type appearance may well be explained by recessive genes in the study group or may have been influenced by the marriage partners' families.

The most important quesiton, however, is whether or not the details of fingerprints upon which identification are based, may be influenced by genetics.

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Fingerprints are not alike or different because they are of the same or different pattern types. Identity is established or denied by the minutia of smaller detail. The ending ridges, bifurcations, or forking of ridges, the islands or enclosures, the short ridges and dots that make up the patterns, and the surrounding friction skin area determine whether or not fingerprint was made by the same finger. It is not only the appearance of these details in the fingerprint, but their relative position to each other is also a major factor in the identification procedural process.

In this study experiment each digit from the first through the fourth generation was examined to discover instances in which these minutia may have been repeated. There were no similarities between any two fingers or any one member of this group or between any finger of one member to a finger of another member.

The close examination of this minute detail disclosed that the fingerprints may as well have been taken from persons at random so far as any detail likeness is concerned.

In summary, those points of most interest were the carrying through or whorl type patterns in the ring fingers seemed to be influenced by the first generation couple. This could also be said of the ulnar loop in the little fingers.

The most interesting development was the appearance of the whorl in the left little finger of the husband of member number five of the second generation and the re-appearance of a whorl in this digit in 5-3.

This occurred again in the right little finger of the husband of 1-1 in the third generation and re-appeared in the same digit of 1-1-1 of the fourth generation.

Another very interesting and possibly a very significant development was the trend toward the established basic percentage of pattern types in this study group. There may be a formula factor which can be applied to this tendency if additional studies establish that there is such a drift pattern.

PATTERN DRIFT TO LOOP

SCOTLAND YARD SURVEY

Pattern	1	2	3	4	5	6	7	8	9	10	Tot.	%
Arch	122	425	273	91	27	225	418	354	133	57	2125	.042
T. Arch	1	114	30	1	0	0	97	43	4	1	291	.006
R. Loop	11	1291	126	73	10	10	1161	125	25	1	2833	.056
U. Loop	2786	1602	3719	2769	4254	3287	1893	3647	3429	4466	31852	.637
Whorl	2065	1537	823	2045	687	1466	1399	805	1384	449	12660	.253

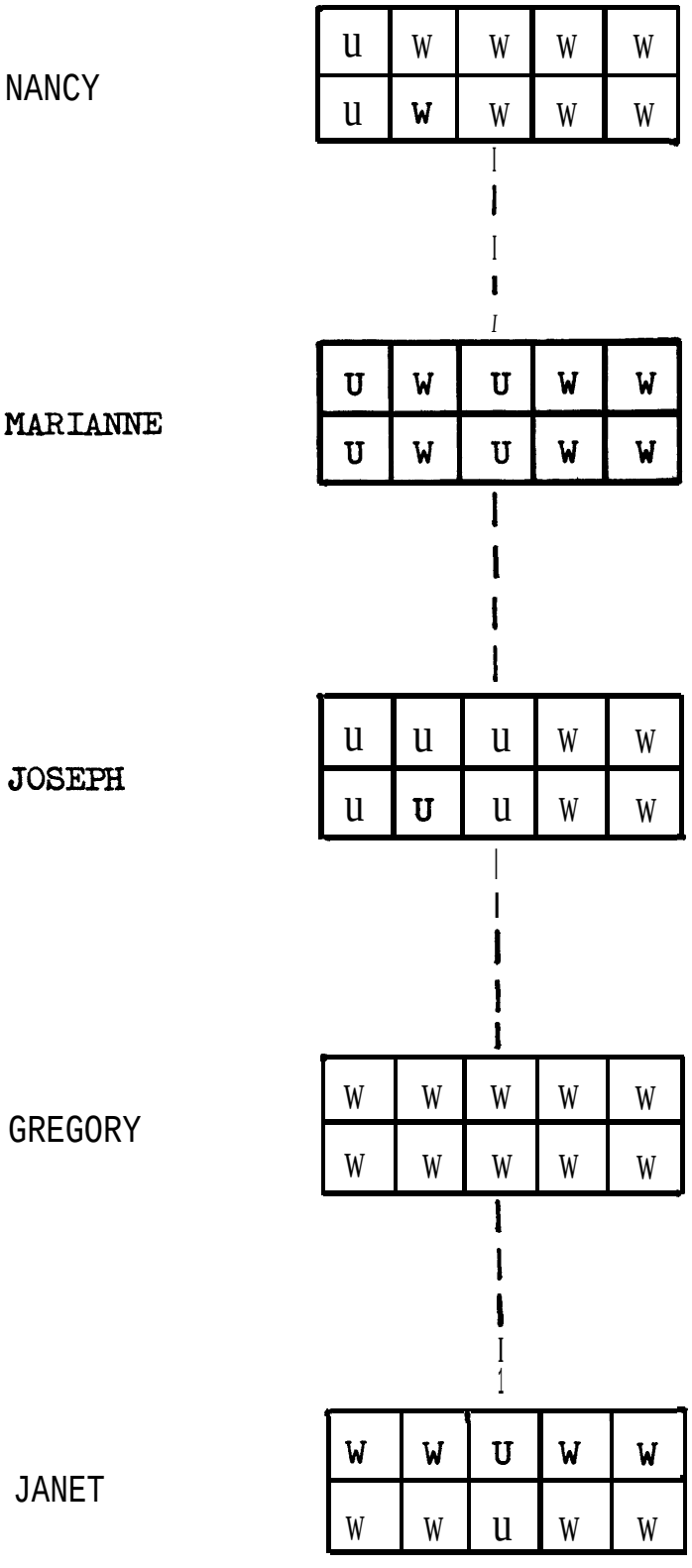

FIGURE 5.

If any reader knows of similar "whole hand mirroring" within a family involving five or more persons, I would appreciate hearing about it.

Conclusion:

We arrived at several conclusions as a result of our family fingerprint project. For one thing, we found out in a hurry that attempting to take the prints of youngsters under two years of age can be likened only to trying to bait two hooks at once with a couple of hyper-active worms. Any legislator, state or federal, who ever introduces a bill requiring that all 10 prints of newborn babies must be taken immediately after birth should definitely be recommended for psychiatric treatment!

Another conclusion that we agreed upon was that family fingerprinting can be fun. There is a real challenge in it for the fingerprint technician, whether it is in looking for unusual prints, similarities within the family, or pattern distribution that might just possibly give some hints regarding inherited trends. There are also some pitfalls. Inked fingers can cause unbelievable problems when they are attached to wiggly grandchildren.

I sincerely hope that this article, which does not pretend to be a scientific research endeavor, will prompt many other I. A. 1. members to start a family fingerprint chart. The results could be interesting, and I'm sure that Chairman William Freele of our Subcommittee on Fingerprints would be anxious to hear about any unusual charts that were compiled. A collection of such charts just might prove to be a most interesting exhibit at a future 1. A. 1. meeting.

Rather than sign my name at the end of this article, I have included the print of my left index finger. If you look real carefully at Figure 6, you just might find my middle initial at the core.

FIGURE 6.