DERMATOGLYPHIC TRAITS OF JEWISH AND NON-JEWISH WHITES

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The systematic study of Dermatoglyphics has advanced through the researches of Wilder (1922), Montgomery (1926), Henry (1934) and Cummins (1926 and 1929). Application of this knowledge to Anthropological studies is on record by Biswas (1936), Cummins, Lane, Leche, Millar, Steggerda (1936), and Abel (1937). A comprehensive review of the methods and biology of Dermatoglyphics is given by Cummins and Midlo (1943). A revised method for plantar formulation developed under the direction of Professor Norma Ford Walker of the University of Toronto is employed in this analysis.

In the present report is presented a statistical analysis of palmar and plantar pattern frequencies of 309 Jewish people of Toronto and Chicago as compared with 124 non-Jewish Whites of the same areas.

Four main sources supplied the prints required: (1) students of the University of Toronto, (2) students of public schools and collegiates of Toronto, (3) members of the Young Men's Hebrew Association of Toronto, (4) students of the University of Chicago and members of Marcy Centre, Chicago. The second and third sources supplied prints of about 250 Jewish people and the fourth supplied prints of an additional 60 Jewish people.

The ancestry of the groups was as follows:

|	Females	Males
Jewish with Polish ancestry	47	54
Jewish with Russian ancestry	41	32
Jewish with Russian-Polish ancestry	12	18
Jewish with Central European ancestry	12	16
Jewish with mixed European ancestry	18	24
Jewish with English ancestry	4	5
Jewish with North American ancestry	4	5
Jewish offspring of cousin marriages	6	11
Jewish total........309:	144	165
Non-Jewish, English, Scottish, Irish	30	32
Non-Jewish, various nationalities	16	46
Non-Jewish total........124:	46	78

REVISED METHOD OF PLANTAR FORMULATION

In this study special attention has been given to the formulation of the plantar configurations, which up to the present have not been described as satisfactorily as have the palmar patterns. All prints were made by the inkless Faurot method which makes possible the printing of the entire ridge skin area of the sole on a single sheet of sensitized paper by one rolling motion. A brief outline of the revised method of formulation is necessary.

Plantar topography and marginal loci numbers are given in figure I A. Main lines, Hal (E), A, B, C, D, are traced from their digital triradii to their marginal terminations. The locus of each termination is recorded. For example, main line B crossing the long axis of the sole obliquely may terminate at 15 (figure I, C.). When a main line becomes involved in the hallucal area it terminates as 15h.
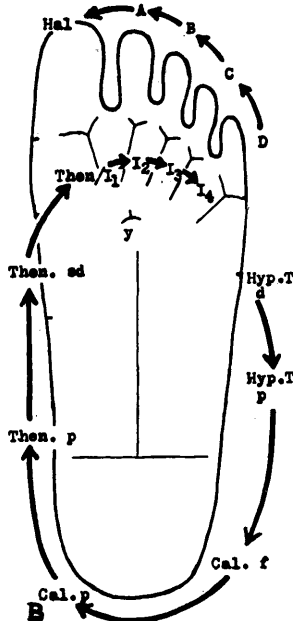
Recurring main lines running into interdigital whorls or loops will not terminate marginally and are therefore formulated as interdigital, e.g., 9i or 11i.

Plantar hallucal configurations are formulated according to the method of Walker (1946) who gives a double formulation, descriptive of both the distal thenar and the first interdigital area (W^s/O, figure 1, C.). Whorls are of three types: concentric (W) spiral (W^s) and seamed whorls (W^{sm}). S-Patterns may occur. Central pockets (CP) are like whorls except that they have no confluent circular ridges. Loops open in three directions: tibial (L^t), fibular (L^f), and distal (L^d).
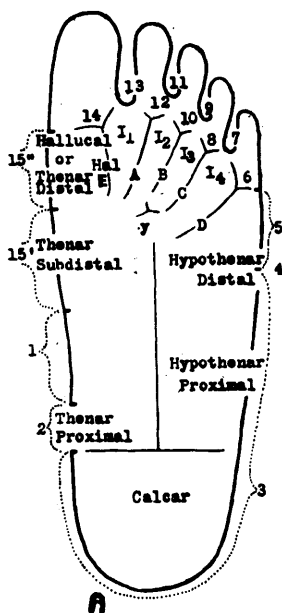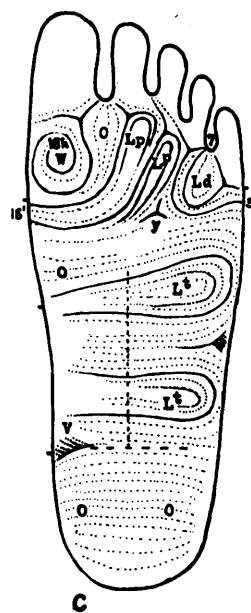

PLANTAR DERMATOGLYPHIC FORMULATION

	MAIN LINE TERMINATIONS				and		PATTERN FORMULA					
A	D	C	B	A	Hal.	Hyp.T	Cal.	Then.	Hallucal.	Interdigital		
B	V	IV	III	II	I	d/p	f/t	p/sd	Th.d/	I_1	I_2	I_3 I_4
C	7 .	5 . 15'	. 15' . 15h.	Lt/Lt	.0/0 .	V/0	.	W^s / 0 .	Lpt . Lpty.Ld			

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FIGURE 1.   Plantar topography and dermatoglyphic formulation.

Arches open proximally (A^p), tibially (A^t), fibularly (A^f), and distally (A^d). Open fields (O) are common as part of the dual formulation.

Second, third and fourth interdigital areas show elongated whorls (W); loops distal (L^d), proximal (L^p), proximal opening fibularly (L^{pf}) and tibially (L^{pt}); loops accompanied by accessory triradii (D and d); vestiges (V), small vestiges (v); open fields (O), and multiplications (M). Proximal triradii are indicated as y, subordinate to a loop or whorl (figure 1 C, in the third interdigital note the pattern, L^{pt}y).

In the hypothenar, calcar and thenar areas dual formulations are the more

convenient. The hypothenar area is divisible into distal and proximal and each area may show a distinct loop usually opening tibially but sometimes fibularly (L^t/L^f). Arches (A), multiplications (M), or vestiges may also be present. The calcar area is formulated in dual fibio-tibial order. Tibial vestiges in the calcar and thenar proximal area are common. True calcar patterns are extremely rare. The calcar and sub-distal thenar are most commonly open fields, that is they have the lowest pattern intensity. Complete hypothenar and thenar formulations are an innovation in the present study. By printing onto the extralimital margins two distinct pattern areas may be discovered in the hypothenar region (figure 1, C. Lt/Lt).

TABLE 1

Plantar formulae for the 16 tracings of actual prints shown in figure 2.

CASE No.	LINEAR FORMULA						PATTERN FORMULA					
	D V	C IV	B III	A II	Hal I	Hyp. T d/p	Cal f/t	Then p/sd	Hallucal Th. d/I₁	Interdigital I₂	I₃	I₄
Left Plantar												
1A	15'	15'	15''	15''	15h	Lt/Lt	Lt/v	V/O	W/O	O	V	O
1B	13	*9i*	*7i*	7	15h	Lt/V	O/O	O/O	W/O	Lpy	W	Lp
1C	*15''*	10	8	*7i*	15h	Lt/O	O/O	O/O	W/O	Lpy	W	Lpt
1D	11i	9	7	*5*	15h	V/Lt	O/O	v/O	W/O	Lpy	Ld	Ldy
2A	15''	15h	13	11	9	O/O	O/O	O/O	Lfd/O	W	O	O
2B	15''	9i	7	0	15h	Ap/Lt	O/O	O/O	W/Oy	O	W	O
2C	11	9	7	5i	5i	Lt/O	O/V	O/O	O/Af	O	Ld	O
2D	15'	0	*7i*	*7i*	7i	Lt/O	O/O	O/O	Ap/O	Lpf	W	O
Right plantar												
3A	15''	13	*0*	*0*	7	Ap/Lft-Lt	O/v	O/O	O/Lf	O	Ld	O
3B	15'	11	9	7	13	Lt/V	O/O	O/O	O/Ldy	O	Ld	M
3C	15'	15h	15h	15h	15h	Lt/V	O/O	V/O	Ld/W	O	Ldy	O
3D	13	13	13	13	5	Ap/v	O/O	v/O	O/Ld	O	M	M
4A	15'	15'	15'	15''	15h	Lt/V	Lt/V	V/O	W/O	O	M	O
4B	15'	15'	*15''*	*15''*	13	Lt/O	O/O	V/O	O/Ld	Lpt	O	O
4C	15'	9	*7*	7	15''	Ap/Lpf	O/O	O/O	CP/Oy	Lp	Ld	O
4D	8	6	9	9	13	Lt/Lf	O/v	O/O	O/Ldy	O	Ldy	Ld

The numbers in Italics indicate the extent of digital derm ridge confluence distal to the digital triradii.

The order of complete plantar formulation is indicated in figure 1 B. It is as follows:
1) Terminations of main lines in the sequence, D, C, B, A, Hal (or E).
2) Hypothenar distal and proximal configurations.
3) Calcar fibular and tibial areas.
4) Thenar proximal and sub-distal areas.
5) Hallucal (distal thenar and first interdigital patterns).
6) Second interdigital (I_2) configurational area.
7) Third interdigital (I_3) configurational area.
8) Fourth interdigital (I_4) configurational area.
9) Ridge confluencies above digital triradii formulated by underscoring linear formula.

Figure 1 with its subscripts illustrates this complete formulation. Sixteen other sole tracings are shown in figure 2, and their formulations are presented in table 1.

TESTS OF SIGNIFICANCE

To determine the statistically significant associations of traits with either the Jews or the non-Jews the chi-square test is applied. Grouping configurations

TABLE 2

Comparison of the frequencies of the terminations of the palmar main lines in Jewish and Non-Jewish people. (Left and right combined. Jewish, 618 palms; Non-Jewish, 248 palms.)

Loci	Line D Jewish	Line D Non-J.	Line C Jewish	Line C Non-J.	Line B Jewish	Line B Non-J.	Line A Jewish	Line A Non-J.
1							2.6	6.1
2					0.2		4.4	2.0
3					0.3		29.6	*36.3*
4					0.6	0.4	15.5	16.9
5'			0.7	0.4	10.0	8.9	*40.5*	33.1
5''			8.7	11.3	31.4	*39.9*	5.2	4.0
6			2.8	3.2	7.6	7.7		
7	9.9	12.9	29.0	27.8	*42.6*	*39.9*		0.4
8	2.8	3.2			3.4	0.4		
9	29.8	*31.9*	*48.7*	*40.7*	3.1	2.4		
10	9.5	8.9	2.6	0.4				
11	*47.7*	*41.1*	0.5	1.2	0.2		2.3	1.2
13	0.3	0.4						
X			3.4	4.8	0.2			
X			1.1	4.0				
O		1.6	2.4	6.0	0.5	0.4		
Accessory Triradii	5.7	7.7	0.5	0.4			1.1	1.2
Chi-square for the entire range		9.949	*16.112*		9.459		*14.652*	
n equals		5	5		5		6	
Critical Significance value	11.070		11.070		11.070		12.592	
Association:	Not Significant		Significant		Not Significant		Significant	

Chi-square for Termination X   *6.128*
for Absence of Line   *7.228* (Where n is 1, p 0.05, Crit. Val. 3.841)
Both Significant

Most frequent Main Line Terminations:
JEWISH: 11 . 9 . 7 . 5' —   NON-JEWISH 11 . 9 . 7 . 3 —
                           or   9 . 7 . 5'' 5'

TABLE 3

Frequencies of positions of axial triradii of Jewish and Non-Jewish people determined by linear measurement and expressed in percent of total palm length. (By the method of Walker and Penrose.) (Left and right palms are combined.)

Position of Triradius*	Jewish (622 palms)	Non-Jewish (300 palms)	Chi-square value
0	1.9	0.0	
t	29.6	45.3	*22.157*
t'	59.6	51.0	*6.191*
t''	8.8	3.7	*7.510*
Two or more Triradii per palm	15.7	7.0	*13.802*

In all Chi-square tests, n is 1, for p 0.05 the Critical Value is 3.841, therefore all four values show Significant Associations.

* 0—absence of triradii; y, triradius within 0 to 14.9% of palm length from distal bracelet crease to proximal crease at base of third digit; t', 15 to 39.9%; t'', 40% and over.

dichotomously either as patterns or as pattern-less, a two by two (2 x 2) table enables us to use the standard formula:

$$X^2 = \frac{(ad - bc)^2 \, N}{(a + c) \, (b + d) \, (c + d) \, (a + b)}$$

Consulting Fisher's (1936) table for n equal to 1, and for the probability 0.05, chi square (X^2) should equal or exceed 3.841 to indicate a significant association between the two variables. In some tests a greater degree of freedom is found necessary, and two by n (2 x n) calculations are applied. Of the many traits involved in these computations only those configurations which show significant differences between Jews and non-Jews are pointed out.
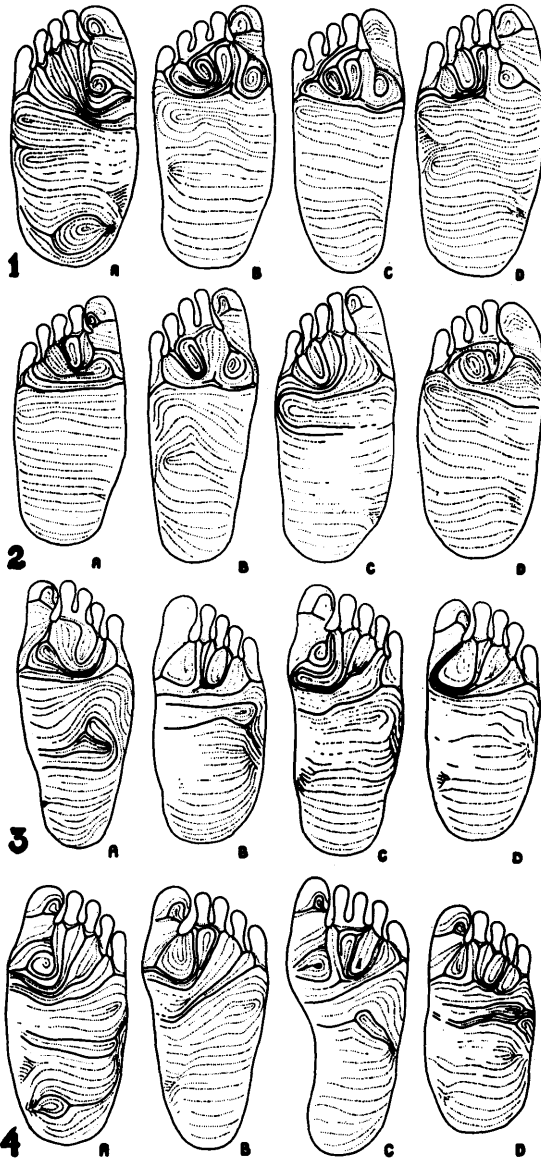

FIGURE 2. Tracings of plantar configurations from 16 rolled prints.

TABLE 4

Comparison of configuration frequencies in all palmar areas of Jews and Non-Jews. (*Expressed in percentages based on 618 Jewish and 248 Non-Jewish palms.**)

PATTERNS	HYPOTHENAR Jews	Non-J.	THENAR Jews	Non-J.	I_1 Jews	Non-J.	I_2 Jews	Non-J.	I_3 Jews	Non-J.	I_4 Jews	Non-J.
O	16.3	13.3	78.9	77.4	90.8	92.3	65.2	56.8	43.2	54.4	31.4	21.8
v & V	15.5	13.7	18.1	21.3	7.9	7.3	16.5	32.6	1.8	2.4	16.2	29.4
M			0.6	0.4	0.2	0.0	12.5	6.4	0.3	1.2	7.8	3.2
l and L	36.4	29.8	1.9	0.8	1.1	0.4	0.5	0.0	53.4	41.9	39.1	41.5
d & D							5.2	4.0	1.5	0.0	14.1	13.3
W	4.2	2.8	0.2		0.2				0.2			
S	2.3	2.8										
T	0.5	0.8										
Au	83.6	87.9										
Ac	41.2	49.6										
Ar	2.1	2.0										
P-th		1.2										

Chi-square tests dichotomously applied, grouping Patterns (T, 1, L, d, D, W. S. P-th) and Patternless (O, v, V, M, A) so that n is 1, and Critical value is 3.841, p 0.05.

X^2	2.505	0.021 for thenar plus I_1	0.955	12.095 Association Significant	0.182

*Percentages exceed 100 in the totals due to dual configurations in some areas, especially the hypothenar.

TABLE 5

Comparison of frequencies of plantar main line terminations in Jews and Non-Jews expressed in percentages. (*Based on 618 Jewish and 248 Non-Jewish soles.*)

Locus	Line D. Jews	Non-J.	Line C. Jews	Non-J.	Line B. Jews	Non-J.	Line A. Jews	Non-J.	Line E, or Hallucal. Jews	Non-J.
5			0.8	0.8	1.3	4.0	1.9	2.4	1.7	2.1
6			0.3		1.1		0.6	0.4	0.2	0.4
7i			0.2		0.3		0.6		0.2	
7	2.7	4.8	2.6	2.4	15.5	20.6	13.3	14.1	4.5	4.4
8	0.3				6.5	4.4	3.1	2.0	0.2	0.4
9i	0.8	1.2	3.6	5.2	7.3	2.0	2.3	1.6	1.0	2.0
9	1.6	2.4	24.7	31.9	14.6	16.1	7.0	4.4	1.0	1.2
10	1.3		5.0	3.6			1.1		0.3	0.4
11i	0.8	0.4	1.0	1.6	0.6	0.4	1.1	0.4		0.4
11	1.1	1.2	4.7	2.8	2.4	1.6	1.0		0.8	1.2
12	0.8		2.6	0.8	1.3				1.1	1.6
13	2.3	2.0	4.9	4.4	2.4	2.4	1.9	4.0	41.9	43.5
15'	42.4	54.0	19.6	22.6	10.7	16.9	12.8	33.9	2.9	8.9
15''	44.3	32.2	23.5	18.5	21.7	16.5	32.7	19.3	10.8	5.6
15h	1.3	0.8	1.3	0.8	2.3	1.2	4.4	2.4	32.2	26.6
X			0.2		0.6				0.2	0.4
O	0.2		3.6	3.2	11.2	12.9	15.4	14.5	0.5	0.4
X^2	14.700		8.129		14.635		63.132		22.091	
n	5		5		6		5		5	
Critical Value:	11.070		11.070		12.592		11.070		11.070	
Association:	Significant		Not Significant		Significant		Significant		Significant	

The most common plantar main line formula:
  Jewish:
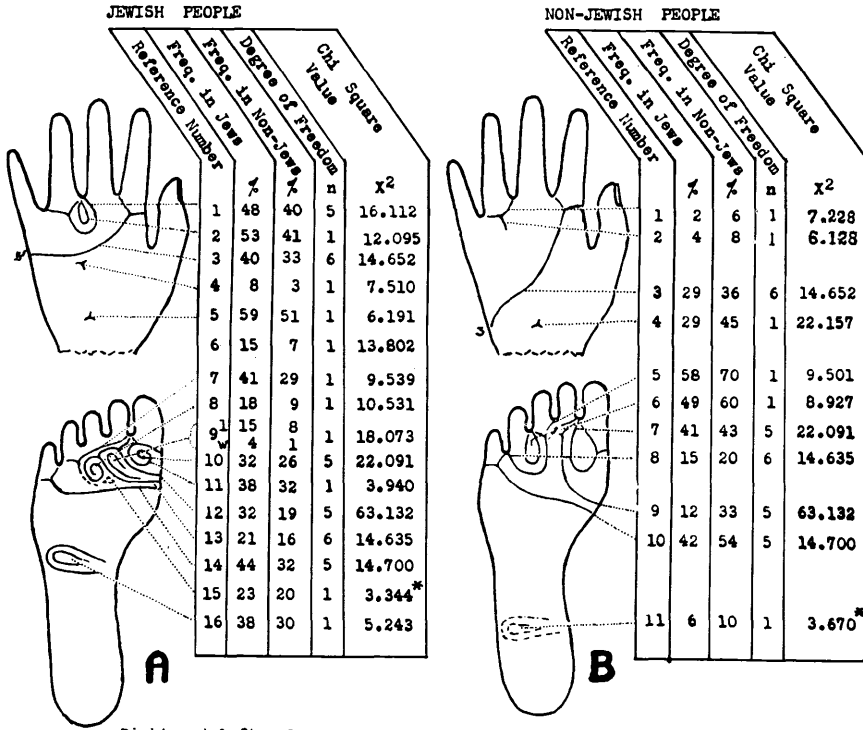   15'' (15') . 9.15'' . 15'' . 13(15h)—
  Non-Jewish:
      15' . 9 . 7(15') . 15' . 13—

PALMAR FORMULAE

Palmar configurations are formulated according to standard methods (Cummins and Midlo, 1943) and the frequencies of similar configurations are calculated for various areas. Right and left palms are combined. The results are presented in tables 2 to 4.

CONFIGURATIONS THAT SHOW STATISTICALLY SIGNIFICANT ASSOCIATIONS WITH

JEWISH PEOPLE

Reference Number	Freq. in Jews	Freq. in Non-Jews	Degree of Freedom (n)	Chi Square Value (x^2)
1	48	40	5	16.112
2	53	41	1	12.095
3	40	33	6	14.652
4	8	3	1	7.510
5	59	51	1	6.191
6	15	7	1	13.802
7	41	29	1	9.539
8	18	9	1	10.531
9	15 / 4	8 / 1	1	18.073
10	32	26	5	22.091
11	38	32	1	3.940
12	32	19	5	63.132
13	21	16	6	14.635
14	44	32	5	14.700
15	23	20	1	3.344*
16	38	30	1	5.243

NON-JEWISH PEOPLE

Reference Number	Freq. in Jews	Freq. in Non-Jews	Degree of Freedom (n)	Chi Square Value (x^2)
1	2	6	1	7.228
2	4	8	1	6.128
3	29	36	6	14.652
4	29	45	1	22.157
5	58	70	1	9.501
6	49	60	1	8.927
7	41	43	5	22.091
8	15	20	6	14.635
9	12	33	5	63.132
10	42	54	5	14.700
11	6	10	1	3.670*

A   B

Right and left palmar and plantar traits are presented in combination on left hand and foot outlines.

Chi Square Values which approach but do not quite attain statistically significant associations for probability 0.05, the critical value for n 1 being 3.841 .

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FIGURE 3. Configurations showing statistically significant associations with Jewish and Non-Jewish people.

The terminations of each of the four palmar main lines show a marked highest frequency at definite loci among the Jewish people. In general the main lines in Jewish people tend to be crowded into the distal region of the palm with a transverse confluence of the ridges. Among non-Jewish people dermal ridges have a greater tendency to run longitudinally so that line A terminates more frequently at locus 3. The third palmar main line, i.e., line C, is absent in 6 percent of the non-Jews printed, in 2.4 percent of Jewish people. The most frequent main line formula among the Jewish people is 11 . 9 . 7 . 5', while among the non-Jewish it is 11 . 9 . 7 . 3 or 9 . 7 . 5″ .5' (table 2).

Palmar axial triradii of Jewish people display two high frequencies; namely, a highest frequency in position t between 10 and 15 percent of the palmar length (from the bracelet crease to the carpophalangeal crease of the third digit) and

TABLE 6

Comparison of frequencies of configurations in the hypothenar, calcar, and thenar areas in Jews and Non-Jews.   (Based on 618 Jewish and 248 Non-Jewish soles.)

PATTERN	HYPOTHENAR AREA				CALCAR AREA				THENAR AREA			
	Distal		Proximal		Fibular		Tibial		Proximal		Subdistal	
	Jews	Non-J	Jews	Non-J	Jews	Non-J	Jews	Non-J	Jews	Non-J	Jews	Non-J
O	29.6	33.5	62.9	71.8	99.0	98.4	63.1	71.0	78.0	77.0	96.8	96.4
v	0.8	0.4	5.5	0.4	0.2	0.0	8.9	2.0	9.2	2.8	1.0	0.4
V	20.9	23.4	25.1	17.3	0.2	1.2	28.0	26.6	12.6	19.8	2.3	2.8
Lt	38.2	30.2	6.3	10.8	0.6				0.2			
Lf	0.3											
Ap	10.2	11.7	0.2									

Chi-square for loops and Non-loops: In the calcar and thenar areas nearly all of the
                                            configurations tend to be open fields or vestiges.

	X²	5.243	3.670
n		1	1

Association:
   Significant   Not Significant

Symbols: O, open fields; V, vestiges; Lt, loops tibial; Lf, loop fibular; Ap, arch proximal.

TABLE 7

Comparison of configurational frequencies in the plantar hallucal area of Jews and Non-Jews. (Percentages based on 618 Jewish and 248 Non-Jewish sole prints.)

PATTERN TYPES	THENAR DISTAL AREA		FIRST INTERDIGITAL AREA	
	Jews	Non-Jews	Jews	Non-Jews
O	46.1	51.2	51.9	49.2
V	1.1	1.3		1.2
Lt	9.6	10.5		
Lf	1.0	0.8		13.3
Ld	0.3		44.5	35.5
Ap	2.7	2.8	0.2	
At	0.5		0.3	
Af	0.5	0.8	2.4	0.4
W	*38.0*	*32.2*	0.6	

Chi-square test for association of patterns (Loops and Whorls) and patternless (Open fields,
   Vestiges and Arches).

	X²	2.135	0.945
	n	1	1
Critical Value		3.841	3.841

Association: Not significant   Not significant

Chi-square test for association of Whorls and No Whorls in Thenar and First Interdigital
   areas combined.

	X²	*3.940*
	n	1
Critical Value		3.841

Association significant

another high frequency in position t', between 30 and 35 percent of palmar length. Two or more triradii per palm are found in 15.7 percent of Jewish palms. Non-Jewish palms show fewer double triradii, and fewer triradii in position t' and t", but 1.5 times as many triradii in the low position of t (tables 3 and figure 1).

In the palmar hypothenar area of Jewish people ulnar and radial loops and also whorls show a higher percentage than in non-Jews. In the thenar and first interditial areas loops and whorls occur in a few Jewish palms as also in non-Jewish. Second and third interdigital areas show a higher percentage of whorls,

A GRAPH SHOWING POSITIONS OF AXIAL TRIRADII ON THE PALMS OF:

JEWS. (622 palms)

NON-JEWS. (300 palms calculated to the proportions of 622)

Positions of Triradii in Percent of Palmar Length.
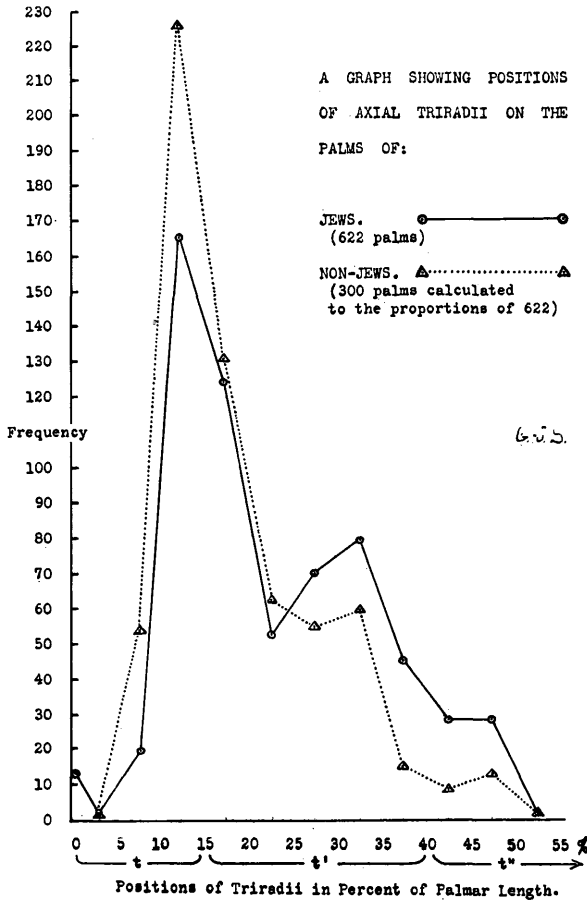
FIGURE 4. Frequency of axial triradii in various positions on the palms of Jews and Non-Jews.

loops, and loops with accessory triradii in Jewish palms. Patterns in the third interdigitial area are significantly associated with Jewish palms. But in the fourth interdigital area the non-Jews have a higher frequency of loops. In all areas of the palm, patterns such as whorls and loops, are more frequent in Jewish palms than in non-Jewish with the exception of loops in the fourth interdigital area.

PLANTAR CONFIGURATIONS

Ridge confluencies distal to digital triradii on the soles of Jewish people show a significantly greater frequency than in non-Jewish (table 9). This means that cutaneous syndactyly is commoner, including fusions of two, three or four toes.

TABLE 8

Comparison of frequencies of plantar configuration in the second, third, and fourth interdigital areas of Jews and Non-Jews. (Percentages based on 618 Jewish and 248 Non-Jewish soles.)

PATTERNS	PLANTAR INTERDIGITAL CONFIGURATIONS					
	Second		Third		Fourth Area	
	Jews	Non-Jews	Jews	Non-Jews	Jews	Non-Jews
O	51.9	68.1	16.5	13.7	66.5	61.7
V	4.4	4.8	3.1	7.7	3.1	13.1
M	2.9	1.2	8.1	3.6	14.2	8.9
A	0.2				0.5	
Lpt	*15.8*	8.9	4.4	4.4	2.9	2.0
Lpf	14.9	11.3	0.2			
Ld	5.5	4.0	49.7	*60.9*	12.1	14.1
W	*4.5*	1.2	*18.1*	9.3	0.5	

Chi-square Test for Association of Patterns (loops and whorls) and Patternless (all other configurations and open fields).

X²	*13.073*	0.440	0.047

Critical Significance Value　　　　　　　　3.841, n = 1　　and p = 0.05
　　　　　　Significant　　　　　　Not Significant　　　　Not Significant

Chi-square Test for Association of Distal Loops and No Loops in the third interdigital area. n = 1.

X²　　　　　　　　　　　　　　　*8.927*
Association:　　　　　　　　　Significant

Chi-square Test for Association of Whorls and No Whorls in the third interdigital area, n = 1.
Critical Value 3.841

X²　　　　　　　　　　　　　　*10.531*
Association:　　　　　　　　　Significant

TABLE 9

Comparison of ridge confluencies above digital triradii on the soles of Jews and Non-Jews. (Expressed in percentages based on 618 soles of Jews and 248 soles of Non-Jews.)

	Jews		Non-Jews	
	Left	Right	Left	Right
Across Four Digits D, C, B, A	2.3	3.2	0.0	0.0
Across Three Digits C, B, A	11.3	8.7	6.4	7.3
Across Two Digits C, B or B, A	28.2	28.5	24.2	21.8
Total	41.8%	40.4%	30.6%	29.1%

No. of Confluences L & R divided by total No of soles　41.4 ± 2.0%　　　29.8 ± 1.6%

Chi-square Test for Association of presence and absence of any Confluences: n 1.

X²　　　　　　　　　　　　　　　　　　9.539
p 0.05, Critical Value 3.841.　　　Association Significant.

TABLE 10

Comparison of frequencies and of positions of proximal plantar triradii in Jews and Non-Jews. (Expressed in percentages based on 618 Jewish and 248 Non-Jewish prints.)

	INTERDIGITAL AREAS							
	I_1		I_2		I_3		I_4	
	Jews	Non-J.	Jews	Non-J.	Jews	Non-J.	Jews	Non-J.
Left	2.6	2.4	21.7	18.9	12.0	12.9	4.4	5.2
Right	3.4	8.1	25.9	21.8	12.6	9.3	4.4	6.9
Added	6.0	10.5	47.6	40.7	24.6	22.2	8.8	12.1
Average	3.0	5.2	23.8	20.3	12.3	11.1	4.4	6.0

Chi-square test applied for association of Triradii and Absence of Triradii.
　　　　n = 1, X² = 2.28　　　　　3.344　　　　　0.56　　　　　1.94
For p = 0.05 Critical Value is 3.841. Therefore no associations are statistically significant.

Proximal plantar triradii show a greater frequency (though not significant) in the second and third interdigital areas of Jewish soles compared to non-Jewish. However, in the first and fourth interdigital areas the reverse is the case and non-Jews show a greater frequency (table 10).

In the hypothenar distal area Jewish soles have about eight percent greater frequency of tibial loops than non-Jewish, which association is significant (table 6). More than ninety-nine percent of calcar and thenar (proximal and subdistal) areas are characterized by open fields and a few vestiges. A few rare loops appear on the heels of the Jewish people (table 6). Whorls are found in the hallucal thenar area of 38 percent of Jewish people and only 32 percent of non-Jewish: a significant association (table 7). In Jewish plantar second interdigital areas loops and whorls are greater in number. In the third interdigital area whorls are twice as frequent as in non-Jews. The latter show a high frequency of distal loops in this area. All these associations are significant (table 8). The fourth interdigital area shows no difference of significance.

A significant association of a configuration in favor of one people or another is not always easily discernible. A pattern occurring in a high percentage of both Jews and non-Jews and showing only a small difference between the two may be statistically significantly associated in favor of one, whereas a pattern occurring in a low percentage of cases in both people must show a much greater difference in frequency before it is said to be significantly associated with one or the other people.

Figure 3 illustrates most of the salient Jewish and non-Jewish traits which these tests have revealed to be significantly associated with one or the other of the two Caucasian sub-groups. Figure 3 A shows sixteen configurations statistically significantly associated in favor of Jewish people. The higher percentage frequencies are evident for every configuration in the second column. The third column shows the lower frequencies in the non-Jews. Figure 3 B shows eleven specific configurations significantly associated with non-Jews. Their higher percentage frequencies are given in the third column. In both figures the fifth column shows that all chi-square values (except the one marked with an asterisk) exceed the critical significance value for probability 0.05. Where n is 1, the critical value is 3.841; where n is 5, it is 11.070; where n is 6, it is 12.592. The two configurations marked with an asterisk approach but do not quite attain statistically significant association for probability 0.05.

SUMMARY

Formulation of plantar dermatoglyphics is extended to cover the entire ridge skin areas and as a result new areas of discrete dermal configurations are discovered in the hypothenar distal and proximal regions of the sole.

The dermatoglyphics of 309 Jewish people are compared with 124 non-Jewish Whites. Chi-square tests reveal that the configurations showing a statistically significant association in favor of the Jews are as follows: (See figure 3 A.)

1. Terminations of palmar line C at 9.
2. Distal loops in palmar third interdigital area.
3. Termination of palmar line A at 5'.
4. Axial triradius on the palm at position t".
5. Axial triradius on the palm at position t'.
6. Double axial triradii on the palm.
7. Ridge confluence across two, three, or four plantar digits.
8. Whorls in the third interdigital area of the sole.
9. Loops and whorls in the second interdigital area of the sole.
10. Terminations of plantar line E at 13 or at 15h.
11. Whorls in the thenar distal area of hallucal patterns.
12. Termination of plantar line A at 15".

13. Termination of plantar line B at 15″.
14. Termination of plantar line D at 15″.
15. Proximal plantar triradii in the second interdigital area approach significance.
16. Tibial loops in the hypothenar distal area.

Configurations showing a statistically significant association in favor of non-Jews, are: (See figure 3 B.)

1. Absence of palmar line C.
2. Short termination of line C.
3. Termination of palmar line A at 3.
4. A single palmar axial triradius at position t.
5. Absence of ridge confluence across plantar digits.
6. Loops in the plantar third interdigital area.
7. Termination of plantar line E at 13.
8. Termination of plantar line A at 15′.
9. Termination of plantar line B at 7.
10. Termination of plantar line D at 15′.
11. Tibial loops in the hypothenar proximal area approach significance.

It is therefore shown that palmar and plantar ridge confluence in the Jewish people here studied tends to be more transverse to the long axis of the palm and sole than in the non-Jewish people, that Jewish people have a greater pattern intensity in almost all ridge skin areas than non-Jewish people, and that these differences are statistically significant. This supports the finding of Cummins and Midlo (1943) and Rife (1948).

The extent of the intra-racial variations, as well as the inter-racial, within and between the Jewish and the non-Jewish Whites, is revealed by the percentage frequencies of the configurations which occur in the two groups studied.

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