

# Ethnic Bearing of the Dermatoglyphic Studies in India

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## Introduction

Dermatoglyphics reveal great variations in their occurrence in different racial groups and provide a useful tool in the evaluation of degrees of relationship.

Racial differences in dermatoglyphics are now almost evident after the publication of data of over 300 groups of peoples from the various parts of the world, on the basis of Galton's threefold division of fingerprints into Whorls, Loops (Radial and Ulnar) and Arches. Nothing systematic so far has been attempted in India. There are a few studies, however, but they are incomplete and isolated in nature.

Cellular antigens provide us best examples of simple inheritance and dermatoglyphics provide excellent examples of genic interaction in the production of traits.

There is always the possibility that genetic drift may result in one or two traits being somewhat similar in frequency in two distantly related populations. It is, therefore, advisable to employ as many different traits as feasible in such comparisons. Polygenic traits such as dermatoglyphics are especially valuable in this respect, as it is less likely that they will be as greatly affected by chance fluctuations as are traits owing their variation to genes at a single locus.

## Dermatoglyphic researches in India

Schlauginhaufen (1906) was the first to study the dermatoglyphics of further Indian and Ceylon populations. Biswas (1936) studied the finger and palm prints of 50 Indians then residing at Berlin. Dermatoglyphic studies on the Oriyas (Biswas and Chowdhury, 1938); Indian Criminals (Biswas, 1945); Oraons (Verma, 1952); Santals (Biswas, 1957); Rajis and Bhotias (Tiwari, 1955) have also been published. Sarkar (1954) published the finger prints of the Paniyans, Adiyans, Vettu Kurumas and the Andamanese. Geipel (1961) published a dermatoglyphic study on some of the Dravidian and Mundari groups.

Very recently Chakravarti and Mukherjee (1961, '62, '63) studied 62 endogamous groups of both sexes from the ten states of India. The preliminary dermatoglyphic studies of the aborigines of Orissa (Sarkar and Banerjee, 1957) and Kadar and Urali of Kerala (Chakravarti, 1959; Chakravarti and Gupta, 1960) have also been published. Das (1959) studied the dermatoglyphics of some Mongoloid groups of Assam.

### **Materials for present study**

The present study comprises dermatoglyphic analysis of Pahiras from the Dalma Hills, Manbhūm, Bihar (Chakravartti, 1959); Mundas of Ranchi, Bihar; Oraons of Bihar and West Bengal; Santals of West Bengal (Chakravartti, 1960), Kadar (Chakravartti, 1959). For comparative purposes, Chakravartti and Mukherjee's (1961, 1962, 1963). All India data and Das's (1959) Assam data have also been utilised.

### **Materials and methods**

All population samples are adult and therefore for the most part represent the actual breeding population.

Size of the population varies considerably for the two sexes. While population size does not appear to be reflected in the samples, at least within the scale of analysis of them, there are two possible effects. In theory, any effect of random genetic drift may be minimized in the large populations, especially if offset by gene flow (Lasker, 1954).

The finger prints were first of all identified under a magnifying lamp (Geipel, 1935) and classified according to Galton's three fold classification of Whorls, Loops (Radial and Ulnar) and Arches. The palm prints were studied after the method proposed by Cummins and Midlo (1943) and Rife (1959). In analysing the gene frequencies, Bonnevie's (1929) method has been followed.

### **Object of the present study**

The object of the present study is to test whether dermatoglyphics can be utilized as an ethnic criteria in this country. The Pahiras (Chakravartti, 1959); Kadar (Chakravartti, 1959); Urali (Chakravartti and Gupta, 1960); Paniyans (Chakravartti, 1958, 1961; Sarkar, 1954); Adiyans (Sarkar, 1954) and Oraons (Chakravartti, unpub.) have been classed under one ethnic group, called Veddids or Australoid on the basis of anthropometric studies. The four groups, Juang (Sarkar et al. 1957, Chakravartti, 1958), Sabara (Sarkar et al. 1957), Santal (Chakravartti, 1960) and Munda (Chakravartti, unpublished) have been classed separately from the above Veddids group into another and because of their common linguistic affinity, they have been classed as Mundari-speakers. The Mongolian peoples form the third group.

### **Analysis of the data**

#### **a) PAPILLARY PATTERNS**

##### **THE AUSTRALOIDS**

As will be evident from table 1 the male sexes of the Pahira, Paniyan, Oraon, Kadar, Urali and Adiyans present more Whorls than Loops. The percentage of Arch is higher among the Adiyans than the other groups, while the male Uralis do not have

any Arches at all. The two sets of Oraon finger prints, one from Ranchi district and the other from West Bengal, from both the sexes, appear to be similar to one another in all dermatoglyphic patterns. They basically possess more Whorls than Loops.

Sarkar (1954) proposed an approximate ratio of 60: 40 (W: L) for the Australoids. This is almost true in the case of the above tribal groups. The Oraons also show strong Australoid affinity from the anthropometric point of view and the above 60 : 40 (W : L) appears to be true with them as well. It appears, therefore, that the Australoids in general have a high predominance of whorls over loops. This is also seen in Cummins and Setzler's (1951) study on the finger prints of the Australian aborigines, who show a very high percentage of whorls (males — 77.6%) over loops (males — 22.1%).

The Australoids also show certain peculiarities in the general Whorl-Loop ratio when the individual fingers are taken into account.

The comparative occurrence of whorls and loops shows that Australoids in general possess more Whorls ( $W > L$ ) in digits I-IV of both the hands than Loops while in the V digit of both the hands the reverse picture ( $L > W$ ) is seen. The comparative occurrence of Arches shows that the Australoids in general have a higher frequency of Arches in the II digit than the other digits of both the hands. It is probable, that 60 : 40 (W : L) ratio combined with a high frequency of radial loops and the whorl-loop ratio for individual fingers, as seen at least among the Paniyans, are probably the characteristic of the Veddids or Australoids.

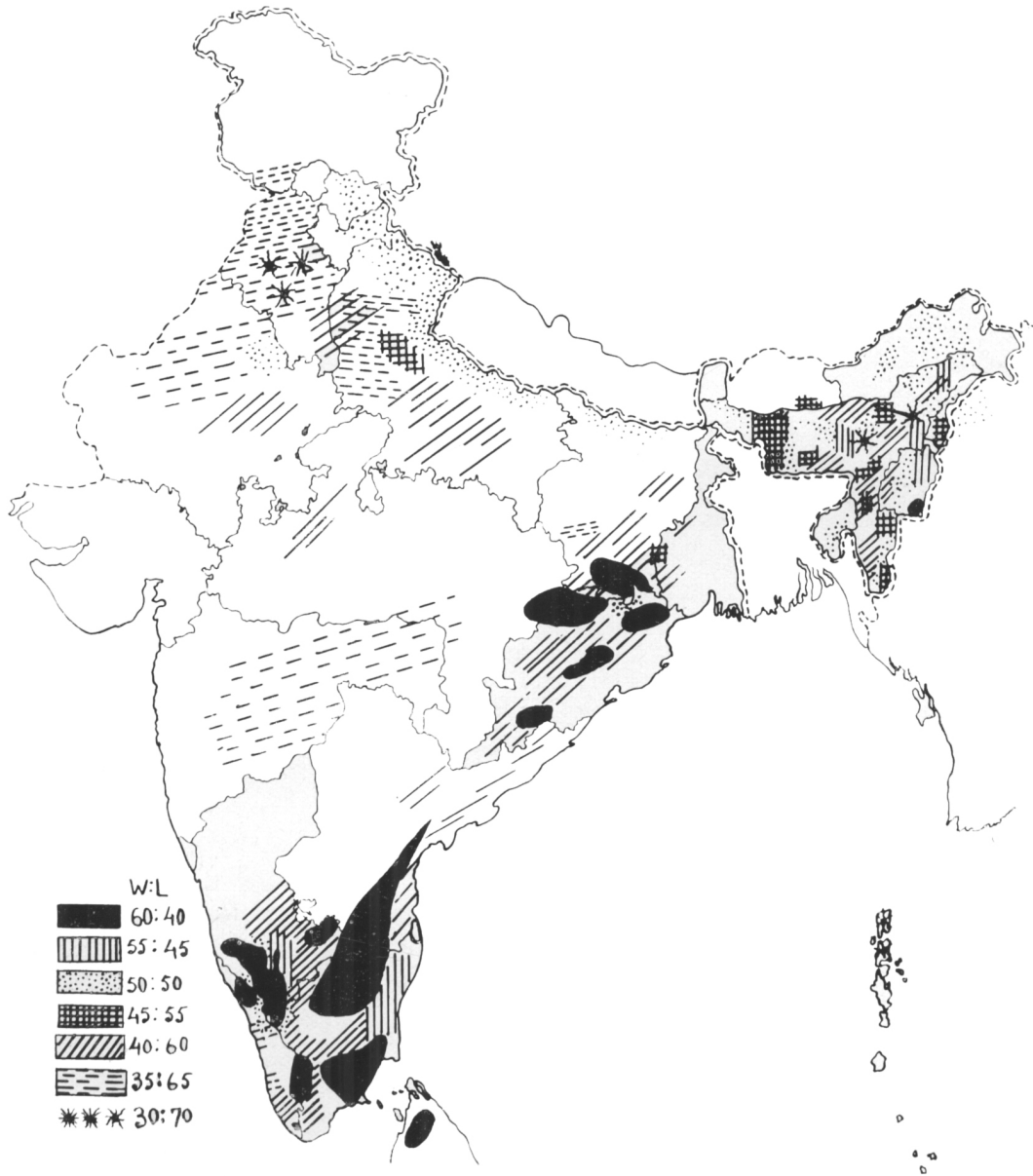
A comparatively high frequency of radial loops appears to be another character of Paniyans and Pahiras, of both the sexes. It may be similar to that of the Veddahs reported by Osman Hill (1941), though the latter data are based on 3 individuals only.

#### THE MUNDARIS

Contrary to the above Australoid dermatoglyphic peculiarities the male sexes of the Juang, the Sabara and the females of the Munda and Pahira show more loops than whorls. The Mundaris show a wider range of variation than the Australoids, as will be discussed later on. The Whorl-Loop ratio, however, appears to be approximately 40 : 60 (W : L) just the reverse of the Australoid ratio. The male Juangs and Sabaras agree closely with one another in having 42.00% and 42.42% of whorls and 56.64% and 55.89% of loops. The female Sabara data are too small for any generalization. The Panos (Sarkar and Banerjee, 1957) of Orissa appear to be similar to the Sabaras.

The frequency of the papillary patterns of the Munda males show a picture different from either of the above two ratios. They show an almost equal percentage of Whorls (49.65%) and Loops (48.38%). The Santal finger prints (Chakravarti, 1960) also appear to be similar to the Mundas in many respects.

The equal Whorl-Loop ratio of the Munda males, is also seen among the Santal females (Whorls — 48.52%; Loops — 47.38%), but the Santal males show a slightly higher percentage of Whorls than Loops (Whorls — 52.57%; Loops — 45.88%).



DERMATOGLYPHIC MAP OF INDIA

The finger print picture of the people are only plotted to avoid complication. The ratio of whorl and loop has been divided into 7 levels and they have been plotted in the map.

The general trend of whorls is to gradually rise towards the South or towards the East and loops in the reverse direction.

The Pahira female type of Whorl-Loop ratio is seen among the Juang and the Sabara males while their females show completely different pictures though the data are too small. The Kurmi Mahato (Chakravartti, 1960) also conform to the Juang and Sabara type.

The Pahira females, the Juangs (males), the Sabara (males), the Mundas of both sexes show more Loops than Whorls, and as such appear at the low Whorl end of the bimanuar.

The comparative occurrence of Whorls and Loops shows that the Mundaris in general possess more Whorls in the I and IV digits of both hands while Loops occur more in II, III and V digits of both hands.

The peculiar position of the Pahira females, who are Australoid ethnically, will be discussed hereafter.

#### THE MONGOLOIDS

The Mongolian samples show nearly equal Whorl-Loop ratio. The Bhotias (Tiwari, 1955) show 50.73% Whorls and 47.01% Loops while the Rajis (Tiwari, 1955) show 46.55% whorls and 57.99% loops. The Chinese (Abel, 1933) show 50.60% Whorls and 47.7% Loops; Koreans show the same in 49.2% and 47.6% respectively. Among the Japanese, whorls occur in 45.20% and Loops in 57.8%.

The Ainus stand in sharp contrast to the Japanese in having 31.8% whorls and 65.2% loops — a ratio which is very well comparable with the Caucasians. The Burmese also show 47.4% whorls against 49.9% loops.

Thus, on the basis of the relative ratio of loops and whorls it is possible to classify three groups:

- W : L
- (1) 60 : 40
  - (2) 40 : 60
  - (3) 50 : 50

It is now worthwhile to find out the ratio of the pattern Arch in respect of the above three ratios. It will be seen from Table I that the percentage of Arches appear to be the highest in Australoids. The next highest percentage of Arches is seen in the Mongoloids, while the lowest is seen in the Mundaris.

The Mongoloids and the Mundaris appear to stand close to one another in respect of papillary patterns than either of them to the Australoids (Chakravartti and Mukherjee, 1963). This evidence is confirmed further by anthropometry.

#### b) SEX - DIFFERENCE IN DERMATOGLYPHICS

The most noteworthy feature is the sex-difference, in the frequency of the papillary patterns. This problem has been raised from time to time. Bonnevie (1924) pointed it out in respect of Kubo's data on the Koreans, in which the male Loop — Whorl ratio conform to the Pahira female type while the Korean female to that of the Pahira

**Tab. 1. Papillary patterns of the Australoids, Mundari-speakers, Mongoloids and Negrito tribes of India**

AUSTRALOID W : L (60 : 40)							
Peoples	Sex	Whorl	Loops			Arch	Pattern intensity index
			Ulnar	Radial	Total		
Pahira	♂	55.95	35.87	4.85	40.42	3.63	15.23
Adiyan	♂	52.26	41.21	1.51	42.72	5.03	14.72
Paniyan	♂	57.99	37.41	3.31	40.72	1.29	15.67
Kadar	♂	59.38	37.53	2.57	40.10	0.52	15.88
Oraon	♂	57.18	40.17	1.28	41.15	1.37	15.55
Urali	♂	53.49	45.49	1.02	46.51	—	15.35
MUNDARI-SPEAKERS W : L (40 : 60)							
Pahira	♀	43.32	51.90	3.34	55.24	1.44	14.18
Juang	♀	42.00	55.00	1.64	56.64	1.36	14.06
Sabaras	♀	42.42	54.95	0.94	55.89	1.69	14.07
Munda	♀	38.60	55.06	2.18	57.24	4.16	13.44
Pano	♀	32.89	58.39	1.34	59.73	7.38	12.55
MONGOLOID W : L (50 : 50)							
Rabha	♂	50.66	46.24	1.55	47.79	1.55	14.91
Rabha	♀	44.98	—	—	50.71	4.31	14.06
Hajong	♂	44.68	51.96	1.73	53.69	1.63	14.30
Hill Garo	♂	50.76	46.55	0.93	47.48	1.74	14.90
Plain Garo	♂	47.96	47.57	1.39	48.96	2.98	14.48
Kachari	♂	54.66	42.86	0.55	43.41	1.84	15.27
Rajbanshi	♂	43.11	51.12	2.02	53.14	3.73	13.93
NEGRITO							
Andamanese	♂	23.33	74.00	2.00	76.00	0.67	12.26

males. Dankmeijer (1938) pointed out that sexual difference in finger prints is similar to that observed in stature. In the present study no sexual difference has been found among the Santals.

Bonnevie did not find any sexual difference in one of her Norwegian sample.

Unfortunately, most of the earlier data on finger prints, have not been collected on sex basis and a thorough enquiry is, therefore, not possible.

It appears, however, from the genetic analysis of finger prints (Table 5) that the sex-difference is genetic in nature though more data are needed for confirmation. Some amount of sexual influence in the occurrence of arches is already well known. It is known to occur in females in a higher frequency than males, as could be seen among Santals (male — 1.61%; female — 4.10%); Oraons (male — 1.12%; female — 3.23%); Juangs (male — 1.36%; female — 3.52); and Mundas (male — 1.97%; female — 4.16%) but not among Pahiras (male — 3.63%; female — 1.44%) and Sabaras (male — 1.69%; female — 1.12%). Some racial factor is not unlikely to be involved in the frequency of arches. An example of it could be seen in the higher frequency of this pattern among the African Negroes than the Oceanic Negroes.

#### c) NEGRITO FINGER PRINTS OF INDIA

The finger prints of 15 Andamanese of Great Andaman were reported by Sarkar (1954). The Andamanese have the predominating frequency of loops while the frequency of arch is almost negligible. The present Andamanese population is highly mixed and the single instance of arch (0.67%) in the II finger of right hand may be extraneous in origin. The Negritos of Eastern Asia possess very little arch as will be apparent from its rarity among the Semang and Aeta (Schebesta, 1952).

#### d) PATTERN INTENSITY INDEX

The Pattern Intensity Index varies between the highest value of 15.88 found for the Kadars and the lowest of 12.59% for Vettukurumas. The females appear to show a lower value of this index. Among the females the highest value of 15.00 has been found for Bihar Oraons while the lowest 11.68 for the Sabaras. The Andamanese show the lowest index of 12.26 and much lower values have been reported for Negritos of Africa (Rife, 1954). Cummins and Setzler (1951) have found this index as 17.73 for the male Australian aborigines and 17.21 for the females of the same. It thus appears that a high value of the Pattern Intensity Index is the characteristic of the Australoids while a low value for the Negritos.

The Pattern Intensity Index varies between 15.23 among the Pahiras and 15.88 for Kadars. The Australian aboriginal index is 17.73. In respect of the Pattern Intensity Index little variation is observed among the different groups. The highest index of 15.27 is seen among the Kacharis followed by 15.08 among the Abors, 14.91 among the Rabhas and 14.90 in the Hill garos; it then falls to 14.48 and 14.30 among the Plain Garos and the Hajongs respectively.

The Mongoloids have a value of 14.64 as the average Pattern Intensity Index.

The Pattern Intensity Index of the Mundaris vary between 13.44 and 14.18 with a mean of 13.94.

## e) MONOMORPHIC HANDS

Monomorphic hands appear to occur more in males than females. It is seen in five out of the eight samples having data on both the sexes. The Australoids are characterized by a higher frequency of Whorls than Loops and the higher frequency of monomorphic whorls than monomorphic loops also bear it out. The Monomorphic

Tab. 2. Comparative occurrence of monomorphic hands (in %)

MALES			
Peoples	Monomorphic Whorl	Monomorphic Loops	Total monomorphic Hands
Pahira	12.12	4.55	16.67
Kadar	17.91	5.22	23.13
Adiyan	20.00	12.50	32.50
Paniyan	15.49	7.74	23.23
Oraon (Bihar)	24.56	7.01	31.57
Oraon (West Bengal)	29.00	9.00	32.00
Vettu Kuruma	4.54	9.09	13.63
Kurmi Mahato	18.86	8.49	27.35
Juang	11.48	18.91	30.40
Sabara	12.96	14.81	27.78
Santal	10.48	4.84	15.32
Munda	10.71	10.71	21.42
Andamanese	3.33	36.37	40.00
FEMALES			
Pahira	14.28	11.90	26.18
Kadar	12.50	7.14	19.64
Oraon (Bihar)	18.86	9.43	28.29
Oraon (West Bengal)	18.75	8.75	27.50
Juang	8.82	20.58	29.41
Sabara	—	16.16	16.16
Santal	15.57	3.28	18.85
Munda	12.37	12.37	24.74

whorl pattern is seen among the Pahira males in 12.12%; among the Paniyans in 15.49%; among the Adiyans in 20.00%; among the Oraons in 26.78% and among the Kadar males in 23.13%; while the females of the respective group have this distribution in 14.28% (Pahira); 18.00% (Oraon) and 19.64% (Kadar). The monomorphic whorls and loops also support our earlier threefold classification on the whorl-loop ratio  $W > L$  :  $L > W$  and  $W = L$ . Each of this type is also supported by monomorphic hands — the first type ( $W > L$ ) is represented by Monomorphic whorls



described above, the second type ( $L > W$ ) by Monomorphic loops as seen in the Junags and the Sabaras while the third type ( $W = L$ ) is very well seen in the Mundas of both sexes.

#### f) SYMMETRY AND ASYMMETRY

It appears that symmetry is always higher than asymmetry. The women (77.16%) appear to be more symmetric than men (74.90%). In males, asymmetry varies between the least percentage of 18.88% among the Oraons of West Bengal and the highest percentage of 40.86 among the Pahira males. The latter appears to be some-

**Tab. 3. Comparative occurrence of symmetry and asymmetry (in %)**

MALES		
Peoples	Symmetry	Asymmetry
Pahira	59.14	40.86
Kadar	78.15	21.85
Adiyan	70.70	29.30
Paniyan	74.41	25.59
Oraon (Bihar)	78.64	21.36
Oraon (West Bengal)	81.12	18.18
Vettu Kuruma	73.59	26.41
Kurmi Mahato	73.46	26.54
Juang	80.05	19.95
Sabara	79.62	20.38
Santal	76.70	23.30
Munda	76.52	23.48
Andamanese	74.67	25.33
FEMALES		
Pahira	80.00	20.00
Kadar	77.70	22.30
Oraon (Bihar)	80.75	19.25
Oraon (West Bengal)	77.61	22.39
Juang	73.00	27.00
Sabara	81.82	18.18
Santal	74.10	25.90
Munda	72.81	27.19

what exceptional; in females, it is seen in only 20.00%. In females, asymmetry varies between the lowest percentage of 10.18 among the Sabaras and the highest of 27.19% among the Mundas.

The ethnic factor in symmetry is difficult to be discerned since excepting the Pahira males all the tribes appear to show overlapping values of symmetry and asymmetry.

g) PAIR GROUP RULE

It is difficult to bring the pair group rule within the purview of ethnic criteria. It has been found to yield contrary results in the two sexes of the same tribe as will be seen in the case of the Pahiras, the Oraons of West Bengal, the Sabaras and the Mundas.

**Tab. 4. Comparative list of populations with indication in each of the validity or lack of the pair group rule**

MALES			
Sl. No.	Peoples	Number	$\Sigma P - \Sigma G = D$
1.	Pahira	33	- 0.69 Void
2.	Adiyan	20	-0.66 Void
3.	Paniyan	71	0 Lacking
4.	Oraon (Bihar)	57	- 0.75 Void
5.	Oraon (West Bengal)	50	0 Lacking
6.	Vettu Kuruma	22	- 1.40 Void
7.	Kurmi Mahato	54	0 Lacking
8.	Juang	74	- 0.80 Void
9.	Sabara	54	- 0.04 Void
10.	Santal	62	6.34 Valid
11.	Munda	112	- 0.28 Void
12.	Andamanese	15	0 Lacking

FEMALES			
Sl. No.	Peoples	Number	$\Sigma P - \Sigma G = D$
1.	Pahira	21	0.15 Valid
2.	Oraon (Bihar)	53	-0.22 Void
3.	Oraon (West Bengal)	40	-0.31 Void
4.	Juang	17	-1.00 Void
5.	Sabara	7	0.02 Valid
6.	Santal	61	2.76 Valid
7.	Munda	101	0.55 Valid

The Paniyans and the Adiyan, who have been found to be similar in many dermatoglyphic characters, also show contrary results — it is lacking in the former and void in the latter.

Similar results were also found by Poll (1938) which he interpreted as “the existence of two contrasting types of dactylographic Asymmetry in human races”.

h) GENE FREQUENCIES

The comparative gene frequencies are given in Table 5 along with the other Indian peoples studied so far.

Abel (1933) showed that racial differences are more apparent in the genetic factor for epidermal thickness (V) than the other two factors R and U.

It will be seen from the Table 5, that sexual difference, is very much clear among the Pahira, Kadar, Oraon and Munda while the Juangs, Sabara and the Santals do not show this sexual difference.

In the male sex of the Pahiras, Kadars and the Oraons, the thin epidermis (vv) show the highest frequency while the females of the above groups are characterized

Tab. 5. Comparative occurrence of the zygotes of V. R. & U.

MALES									
Peoples	vv	Vv	VV	rr	Rr	RR	uu	Uu	UU
Pahira	52.35	43.65	4.00	5.50	64.95	29.55	16.45	70.90	12.65
Oraon (Bihar & West Bengal combined)	47.25	45.42	7.33	3.52	60.42	36.06	14.05	65.86	20.09
Munda	66.75	28.57	4.68	6.29	50.17	43.54	12.98	55.93	31.09
Juang	38.08	50.87	11.05	3.16	49.64	47.20	8.61	50.24	41.15
Santal	53.23	38.71	8.06	11.29	61.29	27.42	8.06	56.45	35.49
Sabara	39.41	47.29	13.30	7.69	40.70	51.61	8.22	54.28	37.50
Kurmi Mahato	61.40	33.26	5.34	5.54	46.34	48.12	5.47	57.69	36.84
Raji	56.66	38.33	5.0	10.0	61.66	28.33	5.0	60.0	35.0
Bhotia	66.23	27.92	5.84	8.11	52.27	39.60	17.02	54.54	27.92
Oraon (Verma)	42.8	46.3	11.90	8.50	57.10	33.90	19.20	55.40	24.90
Kadar	49.35	46.58	4.07	6.50	59.85	33.65	17.00	67.75	15.25

FEMALES									
Pahira	43.53	49.90	6.57	4.26	56.50	39.24	15.10	64.90	20.00
Oraon	40.47	49.86	9.67	7.52	56.63	35.85	11.00	58.07	30.93
Munda	43.45	48.13	8.42	6.79	59.87	33.34	17.01	58.90	25.09
Juang	39.43	54.82	15.75	7.69	40.70	51.61	8.22	54.23	37.50
Santal	57.38	36.06	6.56	9.84	60.66	29.50	9.84	54.10	36.06
Sabara	39.67	44.54	15.79	5.46	39.63	54.81	16.51	55.00	28.49
Kadar	46.85	50.45	2.70	4.45	58.00	33.55	14.00	60.50	25.50

by the highest percentage of the intermediate form (Vv). The intermediate form of epidermis is seen among both the sexes of the Juangs and the Sabaras while both the Santal sexes show the highest percentage of thin epidermis (vv). Thick epidermis (VV) occurs in the highest percentage among the males of both the Juangs and the Sabaras while their females show it in a higher percentage than the males.

From the ethnic point of view Pahiras, Kadars and Oraons can be grouped together — the males having nearly equal high frequency of thin epidermis (vv) and the females almost the same amount of intermediate (Vv) form of epidermis. Similarly, another group can be formed out of the Juangs and Sabaras who show no sexual dif-

ference in their predominant intermediate (Vv) form of epidermis and in their having the highest frequency of thick epidermis (VV).

The Munda males stand aloof in having the highest frequency of thin epidermis (vv — 66.75%) which is nearly approached by the Kurmi Mahato percentage of 61.40. The Munda females approach the Pahira females and the Oraons more than the other three female groups. Both Santal sexes appear to stand in between the above two group — the Mundas on the one hand and the Pahira — Oraon — Kadar group on the other, at least in respect of the two genes vv and Vv. The thick epidermis VV appears to be slightly higher among the Santal males (8.06%). The peculiar position of the Mundas (Sarkar, 1954) in Indian Anthropology is already well known and a co-ordinated study covering all the aspects of anthropology of the Mundas is required to assess properly the racial affiliation of the Mundas.

The genes R and U, according to Abel (1938) appeared to have arisen much earlier than the gene V since racial differences are less observed in respect of the former two genes.

In the case of the gene R, the heterozygote Rr appears to show the highest frequency among the Pahiras and Kadars of both the sexes, male and female Oraons, and Mundas of both the sexes. The Juang females, the Sabaras of both the sexes and the male Kurmi Mahatos show the highest percentage of the homozygote, RR. Heterozygosis appears to be higher in the males than the females but in the Mundas this is reversed — the females showing more heterozygotes than the males. The high frequency of homozygosis (RR) among the Juang females and the Sabaras of both the

Tab. 5a. Quantitative values

Pahira (M) — 11.9	Sabara (F) — 11.4
Pahira (F) — 10.3	Munda (M) — 10.2
Oraon (M) — 10.6	Munda (F) — 9.9
Oraon (F) — 10.3	Santal (M) — 11.2
Juang (M) — 10.8	Santal (F) — 10.6
Juang (F) — 9.9	Kurmi
Sabara (M) — 11.5	Mahato (M) — 10.7

sexes appears to be due to similar reason, they are also similar to one another in respect of the gene for epidermal thickness (V).

The gene U for the Ulnar cushioning appears to show a uniform behaviour. All the tribes show the highest frequency of the heterozygote, Uu and while the males show more heterozygosity among Pahiras, Kadars, Oraons, Santals and the reverse is the case with Mundas, Juangs and Sabaras.

It appears, therefore, that the grouping of the Pahiras, the Kadars and the Oraons into one ethnic strain is borne out by the similar behaviour of three genes V, R and U. The Mundas stand apart in respect of three genes.

The other three tribes, Santal, Juang and Sabara show greater variability than

the Pahira — Oraon — Kadar group though the former three have such other similarities which justify their grouping together.

The sexual differences, as will be obvious from Table 5 is very much striking among the Mundas, who are numerically better represented than the other two tribes showing sexual difference. Sexual differences among these three tribes have been observed in respect of the other character.

Sexual differences in finger prints have also been noted by earlier authorities. Bonnevie (1924) pointed it out in respect of Kubo's data on the Koreans while she herself did not come across any such noteworthy differences in respect of a sample of her own.

Dankmeijer (1938) sought to explain this difference in the same category as stature, where sexual difference is apparent in all races. The present study, however, bears out Dankmeijer so far as sexual differences are seen in the occurrence of the different fingers. It appears that there is probably a fundamental difference in the epidermal thickness between the two sexes. Among Pahiras, Oraons, Mundas and Kadaras, the female sex shows not only the highest percentage of intermediate form of epidermis (Vv) but also a higher percentage of thick epidermis (VV), except in the case of Kadaras. The thin epidermis (vv) is 43.45% among the Munda females in comparison to 66.75% among the males. The Juangs show the highest frequency of the intermediate form (Vv) in both sexes but in the percentage of thin epidermis (vv), the female percentage (29.43%) is much less than that of the male (38.08%); the thick epidermis (VV) being 15.75% in the females and 11.05% in the males. The Sabaras do not show the same variation as the Juangs though the percentage of thick epidermis is 15.79 in females in comparison to 13.30% in males.

The Santal females on the other hand, are an exception to the above generalization. Out of the seven female groups five appear to show a tendency to thicker epidermis in females than the males.

It also appears that differences in body size and surface in males and females may be related to the sexual differences in finger prints. The body size and surface in males is usually larger than females and the terminal digit of the fingers appears to stand also in the same relation. The papillary lines, therefore, should be greater than the females. This is also borne out by the ridge counts and the quantitative values represented by the curves. Symmetry and Asymmetry may, however, affect the papillary lines. The above suggestions are purely tentative and we need more female data for a correct appraisal.

## DISCUSSION

The classification of man on the basis of biological differences is comparatively recent. The two chief methods of study are (1) the morphological method and (2) the genetical method. Although Boyd (1950) made a strong case for the genetical method it is now realised that a combined study with the two methods affords a better understanding of the biological differences between human populations.

Chakravartti (1958-61) had undertaken a study of genetical diversity in some endogamous groups of South, North-East, East and Central India. Finger and palm prints of about 12,000 individuals (both sexes) from 62 endogamous groups were collected. The object of the survey was to test whether dermatoglyphics can be utilised as an ethnic criteria in this country.

### 1. The Australoids of India (Appendix: Table 1: 1-1 - 1-4)

The Australoids of India have undergone some amount of intermixture with one another. The Australoids have, therefore, been divided into two groups; (a) one showing a higher concentration of the original ethnic strain and (b) the other showing the evidences of diverse strains.

As will be evident from the tables above that the male sexes of the Australoid tribes of India present more whorls than loops. Chakravartti (1959) proposed an approximate ratio of 60:40 (W : L) for the Australoids. This is almost true in the case of the above groups and further supports Cummings and Setzler's (1951) study on the Australian aborigines who also show a very high percentage of whorls over loops (Males — 77.6% whorls and 22.1% loops).

Considering the males separately, the Paniya alone of the present series are observed to show a whorl-loop ratio approximating 60 : 40 (W : L) like the Kadar. This has been ascribed to their affinity with Australian aborigines. The Adiyani, Pahira and Urali (Chakravartti and Gupta, 1960) were also loosely grouped together in this category. They have also physical and other affinities. By a closer examination of the data it seems advisable, however, to treat the latter groups separately on account of their marked differences in whorl-loop frequencies from the Paniyan and Kadar. Their ratios are rather more towards 50 : 50 (W : L) than towards 60 : 40. A very small range of variation in this respect among the two Paniyan and two Oraon sets (Chakravartti, unpublished) provides further ground for hesitation in considering 51.00% whorls and 48.00% loops as mere sampling fluctuations of the 60 : 40 trend. Lowering of whorl and raising of loop in the Paniyan, if of any significance, in that case, may reflect some inter-marriages current among these small populations (Sarkar, 1959) as have been postulated also among the Oraons (Chakravartti, unpublished).

Discrimination of this ethnical element from the Australian aborigines will logically follow when actual pattern frequencies of the Australoids (Cummins and Setzler, 1951) are examined.

A geographical continuity of the whorl-loop ratio in fingers, may however, be traced so far as the Bataan Aeta of the Philippines (Schebesta, 1952) through the Shompen of the great Nicobar (Ganguly and Mukherjee, unpublished), the Semang of the Malay Peninsula (Schebesta, 1952); the Papuan of the New Guinea (Kobayashi, 1952) and the Ayom pygmies of the New Guinea (Geipel, 1958) from the Nilgiris and Malabar regions. Further dermatoglyphic researches of the Vedda are expected to provide the missing link in this chain of 60 : 40 (W : L) ratio. The Sholaga and Mullu

Kurumba (Chakravarti and Mukherjee, 1961) are almost similar in their pattern frequencies and are quite comparable with the Urali — the 'Seven Kulla' branch of the Sholaga (Thurston, 1909). The Adiyans, however, remain apart by their conspicuously high Arch proportion, which needs to be explained and might be extraneous in origin. As pointed out by Sarkar (1954) they stand closer to local Vettu Kurumba of Wynaad only in this respect. The amount of loops draw the Adiyans nearer to the Paniya and Kadar on the one hand and that of whorls to the Sholaga, Mullu Kurumba and Urali on the other.

Excepting in Toda, all the ten endogamous groups of the Nilgiri hills are said to be of Middle Eastern origin and certain amount of ethnic convergence with the Kota and other tribes (Chakravarti and Mukherjee, 1961) of probably Australian stock could not be denied. The Kota appears similar to the Gondid type and dermatoglyphically differ from the Australoid tendency of high whorls. Iruulas of Tamil origin are similar. A clear sub-division of the so-called Malide (Eickstedt, 1934) or Australoids could be traced. Eickstedt's (1934) suggestion of a Palae-Mongoloid and Palae-Negrid strain seem to demand serious consideration. If some Kurumbas are regarded to represent a mixture of the Mediterranean and Australoid element dermatoglyphically, only the Mediterranean characters are observed alternatively.

Sexual difference appears to be the greatest of all in the Australoid and the least in the Mongoloid. It appears to be greater than ethnic difference.

The Australoids when compared with "interbreeds" (Hooton, 1958), the change in the average values, in respect of papillary patterns may be noted. Among the Australoid interbreeds sex-difference is further apparent, particularly in the frequency of whorls and arches.

## 2. The Mundari — speakers (Appendix: Tables 2: 2-1 - 2-4)

A clear demarcation could be observed between the Eastern (Santal and Munda) and Western (Juang and Sabara) sections of Mundari speakers. The former seems to have a well founded Mongolian element. An ethnic convergence of the Eastern Mundaris and neighbouring Dravidian speakers could be defended. The Western Mundaris are showing an affiliation with a progressive or finer type, which may betray the North-Western element inherent in either the so-called Gondid or original Mundari type. The similarity of certain section of Dravidian tribes living in towards the central India, proposes the former alternative.

The Mundari speaking tribes are characterized by some dermatoglyphic features in common, and specially low proportion of Arches and highest frequency of the longitudinal mainlines. The Juang and the Sabara display more homogeneity between them and may be distinguished from some Munda and Santal populations, by low pattern Intensity, less radial loops, more loops on II digits, more monomorphic loops than whorls. The Mundas and more so the Santals who speak the Eastern dialect seem to have gradually moved away from the Western Mundaris, namely Juang

and Sabara, and more towards the local Dravidian Australoid stocks. Intermediate stages of such variation of the Eastern Mundaris can be detected in Santals cited by Verma (1952), females of Mundas and other samples.

The possibility of the presence of a Mongolian element either submerged or super imposed amongst the progressive ethnic entity cannot be denied from the study of both finger and palm prints. The Western Mundaris may be considered to retain the original characters of the Mundari and have Pattern Intensity similar to Indonesians and some Middle Eastern people.

### 3. The Mongoloids (Appendix: Tables 3: 3-1 - 3-6)

The Mongolian samples show nearly equal whorl-loop ratio (50 W: 50 L) and track along the Mongolian Map of India, about which there is less diversity of opinion. The interesting point is that some of them have 55 : 45 ratio (W : L) probably verging towards Australoids of South East and some have 45 : 55 (W : L) in the Eastern frontier and they may have tendency towards some North Indian people who show considerable lowering of whorl frequency (about 30 — 35%).

The North Eastern people throw some light on the Mongolian question in India. A high percentage of whorl and longitudinal main lines known to be of Australoid character are very common in the Eastern border the Naga and some Kuki-chin tribe (Chakravartti and Mukherjee, 1961) which is similar to Eickstedt's (1934) Primitive Palae-Mongoloid type. No difference between the long headed and broad headed Mongolians (Guha, 1931) could be traced so far.

Westerly tribes are of a progressive type as far as dermatoglyphics is concerned. The high caste elements of Western ethnic origin could be traced as far as the Lakhimpur and Sibsagar districts of Assam. The disputed difference of the Meitheis and the Bishnupriya — two sets of Manipuri communities — could be clarified by the fact that infiltration of Bengali high castes within the latter is interesting. As a whole the Bishnupriya Manipuris do not seem to have any Mongoloid strain.

As already mentioned, the Mongoloid populations of India present three sets of whorls-loop ratios:

- a) Nearly equal whorl-loop ratio (50 : 50).
- b) Peoples verging towards Australoids of South East (55.45).
- c) Tendency towards North Indian people, who show considerable lowering of whorl frequency (45 : 55).



APPENDIX: TABLES OF PAPILLARY PATTERNS (WHORL, LOOP AND ARCH)

1. AUSTRALOID TRIBES OF INDIA

Tab. 1-1. Australoid showing a higher concentration of the original ethnic strain

MALES

Sl. No.	Groups	No.	Whorl	Loop R	Loop U	Total loops	Arch
1.	Pahira	33	55.95	4.85	35.37	40.42	3.63
2.	Oraon	107	57.18	1.28	40.17	41.45	1.37
3.	Urali	60	53.49	1.02	45.49	46.51	—
4.	Kadar	80	59.38	2.57	37.53	40.10	0.52
5.	Paniyan	33	55.95	4.85	35.57	40.42	3.63
6.	Pania	138	60.65	1.59	36.16	37.75	1.59
7.	Adiyan	20	52.26	1.51	41.21	42.72	5.03
8.	Sholaga	75	51.33	3.33	43.98	47.31	1.33
9.	Mullu Kurumba	134	52.83	2.24	44.77	47.01	0.15
	Average	680	55.45	2.58	40.03	42.61	1.92

Tab. 1-2. Interbreeds, showing evidences of diverse strains

MALES

Sl. No.	Groups	No.	Whorl	Loop R	Loop U	Total loops	Arch
1.	Kurmi Mahato	53	51.33	0.96	45.22	46.18	2.29
2.	Bhil	90	43.20	2.90	50.30	53.20	3.20
3.	Lambadi	51	38.11	3.14	53.04	56.18	5.70
4.	Vettu Kurumba	22	32.41	2.31	58.80	61.11	6.48
5.	- Do -	142	36.84	2.90	57.93	60.91	2.25
6.	Ulladan	162	31.23	4.32	62.96	67.28	1.48
7.	Kota	124	42.90	2.10	52.90	55.00	2.10
8.	Badaga	165	39.57	3.88	54.91	58.79	1.64
9.	Jen Kurumba	100	41.60	3.00	55.40	58.40	—
10.	Toda	100	44.60	3.40	49.00	52.40	3.00
11.	Irula	170	43.29	3.41	52.00	55.41	1.29
	Average	1179	40.46	2.94	53.86	56.80	2.74

Tab. 1-3. Australoid

FEMALES

Sl. No.	Groups	No.	Whorl	Loop R	Loop U	Total loops	Arch
1.	Kadar	65	47.72	1.52	50.25	51.77	0.51
2.	Oraon	93	54.51	1.27	41.00	42.27	3.23
3.	Urali	24	44.30	0.84	53.59	54.43	1.27
4.	Pahira	21	43.32	3.34	51.90	55.24	1.44
5.	Paniya	112	53.57	1.61	43.84	45.45	0.98
6.	Sholaga	88	61.36	0.91	37.73	38.64	—
7.	Mullu Kurumba	154	45.33	1.95	51.69	53.64	1.04
	Average	557	50.01	1.63	47.15	48.78	1.41

**Tab. 1-4. Interbreeds**

## FEMALES

Sl. No.	Groups	No.	Whorl	Loop R	Loop U	Total loops	Arch
1.	Lambadi	54	30.24	1.67	60.48	62.15	7.61
2.	Vettu Kurumba	117	36.41	2.39	60.08	62.47	1.11
3.	Ulladan	120	43.32	3.34	51.90	55.24	1.44
4.	Kota	100	41.20	1.60	53.00	54.60	4.20
5.	Badaga	156	42.95	1.67	53.59	55.26	1.79
6.	Toda	110	48.73	2.18	43.27	45.45	5.82
7.	Jen Kurumba	100	27.00	4.80	66.00	70.80	2.20
8.	Irula	112	45.00	2.14	50.35	52.49	2.50
	Average	869	39.36	2.47	54.83	57.30	3.33

## 2. MUNDARI SPEAKING TRIBES OF INDIA

**Tab. 2-1. Eastern Mundaris**

## MALES

Sl. No.	Groups	No.	Whorl	Loop R	Loop U	Total loops	Arch
1.	Santal	62	52.51	2.10	43.78	45.88	1.61
2.	Munda	112	49.65	2.50	45.88	48.38	1.96
3.	Baiga	30	48.95	1.40	47.22	48.62	2.43
	Average	204	50.37	2.00	45.63	47.63	2.00

**Tab. 2-2. Eastern Mundaris**

## FEMALES

1.	Santal	61	48.52	2.13	45.25	47.38	4.10
2.	Munda	101	38.60	2.18	55.06	57.24	4.16
	Average	161	43.56	2.15	50.16	52.31	4.13

**Tab. 2-3. Western Mundaris**

## MALES

1.	Juang	74	42.00	1.64	55.00	56.64	1.36
2.	Sabara	54	42.42	0.94	54.95	55.89	1.69
	Average	128	42.21	1.29	54.98	56.27	1.53

**Tab. 2-4. Western Mundaris**

## FEMALES

1.	Juang	17	38.82	—	57.66	57.66	3.52
2.	Sabara	9	24.72	1.12	66.30	67.42	7.86
	Average	26	31.77	0.56	61.98	62.54	2.69

## 3. MONGOLOIDS OF INDIA \*

Tab. 3-1. Nearly equal Whorl-Loop ratio (50: 50: W: L)

MALES							
Sl. No.	Groups	No.	Whorl	Loop R	Loop U	Total loops	Arch
1.	Hill Garo	76	50.76	0.93	46.55	47.48	1.74
2.	Plain Garo	94	47.96	1.39	47.57	48.96	2.98
3.	Rabha	295	50.66	1.55	46.24	47.79	1.55
4.	Galong	152	46.00	2.07	49.92	51.99	2.00
5.	Bhotia	36	50.73	2.49	44.52	47.01	2.23
6.	Raji	62	46.55	3.41	48.58	51.99	1.46
7.	Miri	100	49.29	1.61	48.00	49.61	0.90
8.	Meithei Manipuri	118	51.95	2.12	44.07	46.19	1.86
9.	Hmar	100	48.60	3.50	46.80	50.30	1.10
10.	Chothe	84	49.05	0.48	50.00	50.48	0.48
11.	Moyon Monsong	116	48.28	2.76	48.62	51.38	0.34
12.	Gangte	100	46.00	2.00	50.00	52.00	2.00
13.	Lalung	106	51.04	1.70	45.75	47.45	1.51
	Average	1439	49.00	2.00	47.45	49.45	1.55

\* The data on the various Naga groups (Chakravarti and Mukherjee, 1963) have not been utilised.

Tab. 3-2

## FEMALES

1.	Rabha	295	44.98	0.94	49.77	50.71	4.31
2.	Miri	58	44.42	1.37	52.63	54.00	1.56
3.	Meithei Manipuri	128	43.36	1.95	53.20	55.15	1.48
4.	Hmar	148	41.62	2.03	55.95	57.98	0.41
5.	Chothe	68	38.82	2.35	58.92	61.17	—
6.	Moyon Monsong	62	40.00	2.58	56.13	58.71	1.29
7.	Gangte	100	45.00	1.50	52.50	54.00	1.00
8.	Lalung	132	38.94	2.12	55.76	57.88	3.18
	Average	991	42.14	1.85	54.35	56.20	1.66

**Tab. 3-3. Tendency towards North Indian people, who show considerable lowering of whorl frequency (45: 55: W: L)**

MALES							
Sl. No.	Groups	No.	Whorl	Loop R	Loop U	Total loops	Arch
1.	Ahom	112	43.48	2.59	52.50	55.09	1.43
2.	Kalita	113	33.19	2.21	60.71	62.92	3.89
3.	Miri	110	40.28	1.36	57.27	58.63	1.09
4.	Bishnupriya Manipuri	110	44.09	1.36	49.91	51.27	4.64
5.	Mech	72	40.28	1.94	55.28	57.22	2.50
6.	Rabha	132	38.33	1.36	53.64	55.00	6.67
7.	Garó	134	41.94	1.64	53.88	55.52	2.54
8.	Hajong	75	44.68	1.73	51.96	53.69	1.63
9.	Rajbanshi	130	43.11	2.02	51.12	53.14	3.73
10.	Kabui	164	44.27	3.54	52.07	55.61	0.12
11.	Anal	45	34.44	3.33	60.00	63.33	2.22
12.	Zou	84	38.81	3.33	57.86	61.19	—
13.	Veiphei Kuki	148	45.54	2.16	50.68	53.84	1.62
14.	Thado Kuki	100	43.80	1.60	53.60	55.20	1.00
15.	Lushai	134	41.64	3.73	53.28	57.01	1.34
16.	Khasi	260	41.73	2.55	54.31	56.86	1.38
	Average	1923	41.22	2.28	54.25	56.53	2.25

**Tab. 3-4**

FEMALES							
1.	Ahom	110	33.19	2.21	60.71	62.92	3.89
2.	Kalita	120	27.42	2.17	65.91	68.08	4.50
3.	Miri	112	40.09	0.62	56.17	56.79	3.12
4.	B. Manipuri	110	45.55	0.54	49.64	50.18	4.27
5.	Mech	50	38.80	2.40	56.80	59.20	2.00
6.	Rabha	100	46.60	0.60	50.80	51.40	2.00
7.	Garó	104	48.08	2.69	47.50	50.19	1.73
8.	Kabui	118	36.44	3.73	58.98	62.71	0.85
9.	Anal	30	45.00	5.00	50.00	55.00	—
10.	Veiphei	86	46.28	1.40	50.93	52.33	1.40
11.	Thado	124	40.48	0.97	55.65	56.62	2.90
12.	Lushai	124	41.13	3.06	52.58	55.64	3.23
13.	Zou	30	58.33	6.67	35.00	41.67	—
14.	Khasi	256	35.41	2.83	58.18	61.01	3.90
	Average	1474	41.62	2.49	53.49	55.98	2.40

Tab. 3-5. Peoples verging towards Australoids (55: 45: W: L)

MALES							
Sl. No.	Groups	No.	Whorl	Loop R	Loop U	Total loops	Arch
1.	Maonaga	153	55.10	1.96	42.81	44.77	0.13
2.	Tangkhul	270	53.45	2.15	43.00	45.15	1.40
3.	Paite	101	51.39	2.67	44.26	46.93	1.68
4.	Kachari	109	54.66	0.55	42.86	43.41	1.84
5.	Bodo	138	55.22	1.16	42.46	43.62	1.16
6.	Abor	147	53.24	3.03	41.25	44.28	2.48
	Average	918	53.85	1.92	42.78	44.70	1.45

Tab. 3-6

FEMALES							
Sl. No.	Groups	No.	Whorl	Loop R	Loop U	Total loops	Arch
1.	Maonaga	102	51.67	2.06	45.98	48.04	0.29
2.	Tangkhul	172	55.70	1.16	41.63	42.79	1.51
3.	Paite	150	47.20	2.00	50.40	52.40	0.40
4.	Bodo	104	47.88	1.54	47.69	49.23	2.89
5.	Abor	163	45.16	1.49	50.87	52.36	2.48
	Average	691	49.52	1.65	47.32	48.97	1.51

### Palm Prints

Even though the exact relationship between the skin ridges on fingers and palms have not yet been clearly understood it might be worthwhile to examine whether the comparative study of the palmar main lines lead to observations similar to those from finger prints. In order to display the degree of transversality in their coursing, the important palmar main line formulae (Wilder, 1922) only have been grouped and considered.

In the main line formula of the Palm, the Pahira and the Oraon show a very close relationship while the four tribes, the Munda, the Santal, the Juang and the Sabara form another group. The greatest difference between the two groups lies in the presence of the palm formulae 11.0.7-, which have been found only among the former group. On the other hand, Hill's (1941) post mortem study of six Vedda palms shows one individual with the formulae 11.0.7- in both the hands. This formula appears to be rare and is probably Veddid in origin, though more data from the Veddas are necessary to arrive at a definite conclusion. The Pahiras show its highest frequency in 15.15% and 14.28% among the males and females respectively while the Oraons show it in 6.91% and 6.63% among the males and females respectively. This formula is absent

among the Kadars of the two sexes. A variant of the formula 11.0.7. — is seen in 11. x.7- and may be called an abortive type is seen rarely among the Mundari-speaking peoples. Only Mundas show it in, 8.03% in males and in 6.50% in the females. It has not been met with among the Pahiras while it occurs among the Oraon males in 3.81% and females in 7.25%. The Kadars show it in 5.03% in males and in 3.10% in females. The male Paniyans and the Nayadi of both sexes (Chakravartti, 1958) show it in 5.56%; in 4.34% (male Nayadi) and in 8.62% (female Nayadi) respectively. It is a matter of further research whether the abortive type of line C has evolved out of the complete absence of the same since when the abortive and the absent types found among the Oraons, are added together; the Pahira frequency of the absent

Tab. 6. PERCENTILE FREQUENCY OF PALMAR MAIN LINES AND PATTERNS ON HYPOTHENAR, THENAR AND INTERDIGITALS

Tab. 6-1. Australoid

MALES

Sl. No.	Groups	11.9.7	9.7.5	7.5.5	Hypo-thenar	Thenar/1	II	III	IV
1.	Kadar	13.21	19.50	40.25	23.27	24.52	1.20	18.86	57.86
2.	Oraon	18.86	22.64	23.72	30.48	13.48	8.39	28.12	59.59
3.	Urali	20.17	12.61	40.34	32.77	21.03	1.68	21.84	50.42
4.	Paniyan	47.72	5.56	11.11	13.79	13.79	9.77	26.39	33.33
5.	Pahira	24.24	28.78	12.12	28.79	16.67	6.06	28.78	39.39
6.	Nayadi	34.78	15.22	17.39	30.43	21.74	2.17	26.08	26.09
7.	Paniya	39.13	17.03	22.46	17.02	15.93	6.88	39.49	38.41
8.	Sholaga	30.00	20.00	23.33	16.67	13.75	—	33.33	70.00
9.	M. Kurumba	36.03	18.38	28.67	23.88	13.97	—	26.46	35.29
	Average	29.35	17.77	24.36	24.12	16.29	5.16	27.70	45.48

Tab. 6-2

FEMALES

1.	Kadar	10.85	17.83	51.94	26.35	24.80	—	13.88	60.47
2.	Oraon	27.27	12.30	26.53	40.38	14.67	6.63	38.61	52.89
3.	Pahira	16.67	30.95	9.53	45.24	14.29	2.38	16.66	21.43
4.	Paniya	37.94	13.39	25.94	21.88	20.09	2.68	34.82	41.07
5.	Sholaga	22.91	25.00	33.33	24.99	18.75	2.08	18.75	64.58
6.	M. Kurumba	25.32	18.83	30.53	34.40	15.59	0.65	14.93	34.42
7.	Urali	14.58	22.92	47.92	22.91	16.67	—	20.83	56.25
8.	Nayadi	31.03	24.14	20.69	12.07	20.69	1.72	41.38	48.99
	Average	23.32	20.67	30.80	28.53	18.19	2.69	24.98	47.63

Tab. 6-3. Interbreeds

MALES

Sl. No.	Groups	11.9.7	9.7.5	7.5.5	Hypo- thenar	The- nar/I	II	III	IV
1.	Kurmi Mahato	31.42	17.14	19.09	24.76	7.61	7.61	50.00	65.70
2.	Vettu Kurumba	33.09	19.36	15.84	5.04	11.47	2.43	22.90	30.28
3.	Ulladan	16.46	17.99	20.43	37.60	10.70	3.20	32.70	59.00
4.	Kota	54.86	9.67	5.64	45.97	24.20	12.91	50.01	22.60
5.	Badaga	30.30	15.15	24.24	33.31	15.75	0.91	32.42	42.12
6.	Toda	68.00	9.00	2.00	80.00	—	2.00	65.00	4.00
7.	Irula	34.11	14.02	24.76	28.47	27.14	1.89	41.12	43.93
8.	Jen Kurumba	31.00	17.00	31.00	37.00	16.00	1.00	26.00	51.00
	Average	37.41	14.92	17.87	36.12	16.51	3.99	40.06	39.82

Tab. 6-4. Interbreed

FEMALES

1.	Vettu Kurumba	35.47	19.23	21.36	19.21	7.69	0.85	25.63	31.68
2.	Kota	65.00	4.00	3.00	49.00	14.00	18.00	52.00	13.00
3.	Badaga	30.43	16.40	29.89	30.97	7.06	3.26	24.45	35.32
4.	Toda	57.27	1.82	1.82	67.29	—	0.91	56.36	10.01
5.	Jen Kurumba	19.00	18.00	37.00	24.00	3.00	1.00	21.00	50.00
6.	Irula	34.82	16.96	25.94	33.02	8.02	1.78	30.35	38.59
	Average	40.33	12.74	19.83	37.25	7.96	4.30	34.94	29.77

Tab. 6-5. Eastern Mundari tribes of India

MALES

Sl. No.	Groups	11.9.7	9.7.5	7.5.5	Hypo- thenar	The- nar/I	II	III	IV
1.	Santal	24.39	11.38	33.33	24.39	13.01	6.50	26.82	56.10
2.	Munda	25.89	12.94	27.23	25.90	12.49	5.36	30.80	44.64
	Average	25.14	11.66	30.28	25.15	12.75	5.93	28.81	50.37

Tab. 6-6. Eastern Mundari tribes

FEMALES

1.	Santal	25.62	14.05	31.40	23.96	25.62	7.44	31.41	52.89
2.	Munda	24.00	13.50	29.50	31.00	11.00	2.00	32.50	52.00
	Average	24.81	13.78	30.45	27.48	18.31	4.72	31.96	52.45

**Tab. 6-7. Western Mundari tribes of India**

MALES									
Sl. No.	Groups	11.9.7	9.7.5	7.5.5	Hypo-thenar	The-nar/I	II	III	IV
1.	Juang	12.93	28.44	32.00	18.96	11.20	—	25.86	63.80
2.	Sabara	22.12	16.35	27.89	23.08	25.00	8.65	37.50	51.92
	Average	17.53	22.39	29.95	21.02	18.20	4.33	31.68	57.86

**Tab. 6-8. Western Mundari**

FEMALES									
Sl. No.	Groups	11.9.7	9.7.5	7.5.5	Hypo-thenar	The-nar/I	II	III	IV
1.	Juang	13.34	10.00	43.94	33.33	26.67	3.33	33.33	73.33
2.	Sabara	6.25	43.75	43.75	13.45	12.50	12.50	12.50	87.50
	Average	9.80	26.88	43.55	23.39	19.59	7.92	22.92	80.42

type is nearly reached, at least the females (Oraon — 13.88%; Pahira — 14.28%) of the two groups agree very well.

The main line formula 9.7.5 — occurs in the highest percentage of 28.78% among the Pahira males and of 30.95% among the Pahira females. The formula 11.9.7- occurs in the next highest percentage among both the sexes of the Pahiras, the males 24.24% and the females 16.67%. Among the male Oraons the formula 7.5.5. — (26.53%). The Paniyans (male) and the Nayadis (both sexes) show the highest frequency of the formula 11.9.7-. The highest frequency of the Kadars is seen in the formula 7.5.5. — (40.25%). The next highest frequency of the Paniyans (male) and the Nayadis (both sexes) is seen in the formula 7.5.5 — which is followed by 9.7.5-, while the second highest formula of the Kadar (male) is 9.7.5 — which is followed by 11.9.7 — (13.21%). It is worthwhile pointing out that among the Veddas 11.9.7-, 11.7.7. — and 9.7.5, have been found by Osman Hill (1941) of which the first occurs twice and the other two once each.

It thus appears that in the case of the Pahiras, Oraons, Paniyans, and Nayadis the formula 11.9.7- and 9.7.5- have contributed more than the formula 7.5.5. The Kadars show the highest frequency of 7.5.5- (40.25%) while 11.9.7- occurs in 13.21% and 9.7.5- in 19.50%.

The four groups comprising Juang, Sabara, Santal and Munda show a remarkable uniformity in having in all of these the highest percentage of the formula 7.5.5-. It occurs in 29.50% and 27.23% among the Munda males and females respectively; in 32.00% among the Juang males and 43.34% among the Juang females; in 33.33% and 31.40% among Santal males and females respectively and in 27.89% among the Sabara males.



The position of the formula 11.9.7 — which has been called the “white formula” by Wilder (1922) is rather difficult to assess. It is seen in 2 out of the 6 Vedda palms while it occurs in 24.24% among the Pahira males, in 18.89% among the Oraon males; in 47.72% in the Paniyans male, in 34.78% among the Nayadi males and in 13.21% among the Kadar. It has been found in 31.42% among the Kurmi Mahatos (Bihar), in 29.00% among the Oriyas while Biswas (1936) found it in 46.00% in his all India sample comprising 50 individuals. It is found in 30.00% among the Bushmen (Weninger, 1936) in 30.3% among the Eskimos (Abel, 1933). It will be thus apparent that this formula is quite widespread in the various populations of India.

The formula 7.5.5- has been called “Negro formula” by Wilder (1922). It has been found in high percentages among the Chinese (32.0%); Japanese (33.00%) Koreans (32.0%) and such other Mongolian peoples. It has already been shown, that

Tab. 7. PERCENTILE FREQUENCY OF PALMAR MAIN-LINES OF THE MONGOLOID TRIBES OF INDIA

Tab. 7-1. Nearly equal W: L ratio (50: 50)

MALES				
Sl. No.	Groups	11.9.7	9.7.5	7.5.5
1.	Rabha	4.20	21.36	28.30
2.	Bhotia	18.00	20.00	29.00
3.	Raji	28.00	30.00	7.00
4.	Meithei	11.44	32.63	40.25
5.	Hmar	5.50	37.50	49.50
6.	Chothe	19.05	28.57	42.86
7.	Moyon	16.38	41.38	31.03
8.	Gangte	12.00	29.00	60.00
	Average	18.07	30.05	35.99

Tab. 7-2

FEMALES				
Sl. No.	Groups	11.9.7	9.7.5	7.5.5
1.	Rabha	3.90	18.13	32.06
2.	Meithei	20.31	19.53	48.83
3.	Hmar	9.46	20.27	52.70
4.	Chothe	11.76	20.59	64.71
5.	Moyon	4.84	27.42	62.90
6.	Gangte	7.50	25.00	65.00
	Average	9.63	21.82	54.36

**Tab. 7-3. Tendency towards 45: 55 (W: L)**

MALES				
Sl. no.	Groups	11.9.7	9.7.5	7.5.5
1.	Kabui	11.59	37.20	37.80
2.	Anal	16.67	38.89	27.78
3.	Zou	3.57	16.67	59.52
4.	Veiphei	12.16	27.03	53.38
5.	Thado	12.00	22.50	49.00
6.	Lushai	15.67	38.06	29.85
	Average	11.94	30.06	42.89

**Tab. 7-4**

FEMALES				
1.	Kabui	11.86	25.42	45.76
2.	Anal	—	16.67	83.33
3.	Zou	8.33	8.33	75.00
4.	Veiphei	3.49	23.26	62.79
5.	Thado	16.13	21.77	50.00
6.	Lushai	10.48	31.45	49.19
	Average	10.06	21.15	61.01

**Tab. 7-5. Verging towards Australoid (55: 45: W: L)**

MALES				
1.	Maonaga	7.84	19.93	54.58
2.	Tangkhuġ Naga	14.50	29.75	45.25
3.	Paite	9.90	34.65	39.11
	Average	10.75	28.11	46.31

**Tab. 7-6**

FEMALES				
1.	Maonaga	14.71	21.57	45.59
2.	Tangkhuġ Naga	13.37	26.74	44.19
3.	Paite	8.67	21.33	46.67
	Average	12.25	23.21	45.48

the Oraons, Pahiras, Kadars can be ethnically grouped under the Veddiad or the Australoids. They also showed certain common characters in fingers and palm print patterns along the other groups like the Paniyans, the Adiyans and the Nayadis. Besides, their being singled out by the absence and variation of the main line C, which has given rise to the formula 11.0.7- their main constituent palm formula are 11.9.7- and 9.7.5-. The same appears to be true of the very small Vedda sample.

Contrary to the above facts stand out very clearly the four groups, Juang, Sabara, Santal and Munda, who for the sake of convenience, can be called Mundari because of their common linguistic affinity. Contrary to the Veddis they also showed differences in finger prints and this is also very well supported by the Palm Prints.

### Discussion

From tables 6 and 7 it will be apparent that the Australoids (males) showing a higher concentration of the original ethnic strata, present 11.9.7. in highest frequency while the female appear to possess more 7.5.5 main line formula. The two sexes of the Interbreeds have 11.9.7. as the highest formula.

The predominance of the formulae 7.5.5. — among both the sexes of the Mundaris of two types and the Mongoloids of three concentration is noteworthy.

Among the females of the Western Mundari adding together of 11.9.7 and 9.7.5 formulae even do not exceed the formulae 7.5.5. The same holds good for the females of 7.2 and 7.4 series of Mongoloids.

In respect of the main line formulae the three ethnic types appear to differ from one another, but the choice of only three formulae out of the many in each population is not probably a safe procedure.

Rife (1953, '54) has shown very well the ethnic variations in the palmar patterns. Compared with finger prints, palm patterns show much lesser sex variations and this is seen in the II and the III interdigitals, while the Mundaris show much lesser sexual variation in respect of the III and IV interdigitals. The ethnic variation is very well seen in respect of the thenar and I interdigitals. The Mongoloid vary widely in respect of the hypothenar and the IV interdigital patterns from both the Australoid and the Mundari. Between the latter two ethnic types the Australoid males are characterised by a higher frequency of all the palmar patterns than the Mundari males but the two female groups appear to stand close to one another than their male counterparts.

### Summary and Conclusion

1. The male sexes of the Australoids of India present more whorls than Loops. Chakravartti (1959) proposed an approximate ratio of 60 : 40 (W : L) for the Australoids of India. This is almost true in the case of the groups studied so far and further supports Cummins and Setzler's (1951) study on the Australian aborigines who also show a very high percentage of Whorls over Loops.

2. The Australoids of India have undergone some amount of intermixture with one another. The Australoids have, therefore, been divided into two groups: *a*) one showing a higher concentration of the original ethnic strain and *b*) the other showing the evidence of diverse strains.

3. The presence of 60 : 40 (W : L) ratio combined with a high frequency of Radial Loops and the Whorl-Loop ratio for individual finger, as seen at least among the South Indian population of India, are probably the characteristic of the Australoids.

4. A geographical continuity of the Whorl-Loop ratio in fingers, may however, be traced from the Nilgiris and Malabar regions to Malay Peninsula and New Guinea.

5. Sexual difference appears to be the greatest of all in the Australoid and least in the Mongoloid. It appears to be greater than ethnic difference.

The Australoids when compared with "interbreeds" the change in the average values, in respect of papillary patterns, may be noted. Among the Australoid "interbreeds" sex-difference is further apparent, particularly in the frequency of Whorls and Arches.

6. Contrary to the above Australoid dermatoglyphic peculiarities the Mundari speakers of India show more Loops than Whorls. The Mundaris show a wider range of variation than the Australoids.

7. A clear demarcation could be observed between the Eastern and Western sections of Mundari speakers. The former seems to have a well founded Mongolian element. An ethnic convergence of the Eastern Mundaris and neighbouring Dravidian speakers could be defended. The Western Mundaris are showing an affiliation with a progressive or finer type, which may betray the North-Western element inherent in either the so called Gondid or original Mundari type.

8. The Mundari speaking tribes are characterized by some dermatoglyphic features in common, and specially low proportion of Arches and highest frequency of the longitudinal main lines.

9. The Mongolian samples of India show nearly equal Whorl-Loop ratio and track along the Mongolian Map of India, about which there is less diversity of opinion. The interesting point is that some of them have 55 : 45 ratio (W : L) probably verging towards Australoids of South East and some have 45 : 55 (W : L) in the Eastern frontier and they may have tendency towards some North Indian people who show considerable lowering of whorl frequency (about 30 - 35%).

10. The North Eastern people throw some light on the Mongolian questions in India. A high percentage of whorl and longitudinal main lines known to be of Australoid character are very common in the Eastern border, which is similar to Eickstedt's (1934) Primitive Palae - Mongoloid type. No difference between the long headed and broad headed Mongolians (Guha, 1931) could be traced so far.

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#### RIASSUNTO

Da un'indagine sui dermatoglifi presso le diverse tribù dell'India risulta che gli Australoidi di sesso maschile presentano più « vortici » che « occhielli », con un rapporto di 60:40. Questa popolazione è andata soggetta a numerose mescolanze razziali e viene, quindi, divisa in un gruppo omogeneo ed in uno eterogeneo. La differenza fra i due sessi è notevole. I Mundari sono caratterizzati da più occhielli e meno vortici degli Australoidi, da una bassa proporzione di « archi » e da un'altissima frequenza delle principali linee longitudinali. Presso le tribù Mongole il rapporto tra vortici ed occhielli si accosta alla parità, essendo presso alcune di 55:45 e presso altre di 45:55. Nel Nord, specie in prossimità del confine orientale, la popolazione presenta invece un'alta percentuale sia di vortici che delle principali linee longitudinali, che sono delle caratteristiche degli Australoidi.

#### RÉSUMÉ

D'après une recherche sur les dermatoglyphes chez les différentes tribus indiennes, il résulte que les Australoïdes de sexe masculin présentent plus de « tourbillons » que de « anses », avec un rapport de 60:40. Cette population est très mélangée et a été divisé, par conséquent, dans un groupe homogène et un groupe hétérogène. La différence entre les deux sexes est remarquable. Les Mundari ont plus d'anses et moins de tourbillons des Australoïdes et présentent une très baisse fréquence d'« arcs » et une fréquence très élevée des principales lignes longitudinales. Chez les tribus mongoliennes le rapport entre tourbillons et anses approche l'égalité, étant de 55:45 chez certains groupes et de 45:55 chez certains autres. Dans le Nord, et spécialement près de la frontière orientale, la population présente une fréquence élevée soit de tourbillons que des principales lignes longitudinales, qui sont des caractéristiques des Australoïdes.

ZUSAMMENFASSUNG

Eine Untersuchung der Hautleisten bei den verschiedenen Stämmen Indiens hat ergeben, dass bei den Australoiden männlichen Geschlechts die « Wirbel » gegenüber den « Schleifen » im Verhältnis von 60: 40 überwiegen. Diese Bevölkerung hat zahlreiche Rassenvermischungen durchgemacht und lässt sich daher in eine homogene und eine heterogene Gruppe einteilen. Der Unterschied zwischen den beiden Geschlechtern ist erheblich. Die Mundari zeichnen sich durch mehr Schleifen und weniger Wirbel als die Australoiden,

durch einen niedrigen Prozentsatz von « Bögen » und eine sehr hohe Frequenz der wichtigsten Längsleisten aus. Bei den mongolischen Stämmen ist das Verhältnis zwischen Wirbeln und Schleifen fast gleich: bei einigen beträgt es 55: 45 und bei anderen 45:55. Im Norden, besonders in der Nähe der Ostgrenze weist hingegen die Bevölkerung einen hohen Prozentsatz sowohl an Wirbeln als an den wichtigsten Längsleisten auf, welche für die Australoiden charakteristisch sind.