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Distribution of blood groups among 21 Dhangar castes of Maharashtra

Introduction

A review of the published material in Maharashtra (and for that matter all over India) shows that an important segment of our society, the mobile population—nomadic and semi—nomadic—has been completely ignored. One such caste—cluster, comprising 23 Dhangar Shepherd castes, numbering over three million in Maharashtra, has only received lip service so far; Karve and Dandekar (1951) having included two groups in their study.

The dearth of biological and socio—cultural data on nomads prompted late professor Karve to undertake a detailed multidisciplinary bio-social project among the Dhangars of Maharashtra. During the period 1969 to 1973 a variety of data were gathered on the Dhangars. Results of proteins and enzymes have been reported earlier (Das et al. 1974; Mukherjee et al. 1976, 1976a; Undevia et al. 1973).

The aim of this paper is to report results of analysis of six serological systems A_1 A_2 B, MN, Rh (-C, -c, D_1-E), Le^a Le^b and P- among the Dhangars of Maharashtra.

The Dhangar caste-cluster

The Dhangar caste—cluster numbering over three million consists of 23 endogamous touchable castes and are found in all the 26 districts of Maharashtra. These semi—nomads are in different stages of sedenterzation; Zende and Shegars are settled, parts of Hatkars and Thellaris are true nomads, while the rest are semi-nomads. The castes very considerably in numerical strength ; some number in a couple of thousands, while many are over hundred thousand. Although most of the castes are highly localized, some of them, in particular, Hatkars and Khutekars are found scattered over several districts. The Dhangar caste-cluster includes castes with varied tradi-

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tional occupation ; sheep rearing, sheep rearing and wollen blanket wearing, only woollen blanket weaving, buffalo rearing, meat selling, etc. The groups markedly differ in several other cultural details. For further details see Malhotra (1976, 1976a).

Methods and materials

A total of 3, 560 males between the ages 10--60 years, belonging to 21 endogamous Dhangar castes, drawn from 210 villages, spread over 82 talukas (counties) of all the 26 districts of Maharashtra were finger pricked for blood samples. The random sampling design was prepared bp Dr. T. V. Hanurav and Dr. R. Chakraborti of Indian Statistical Institute, Calcutta.

Blood samples were collected in tubes containing 1--2 drops of 3. 8 percent sodium citrate solution. Usually about 2 c. c. of blood were collected and immediately stored in thermos--flasks containing ice. These were air flown to eitheer Anthropometric and Human Genetics Laboratory of the Indian Statistical Institute, Calcutta, or Cancer Research Center, Bombay; within 48 hrs. of collection.

In spite of our best efforts 158 samples got haemolysed during transhipment. Thus, 3,402 samples were available for final analysis.

A castewise breakdown of the number of samples tested for each system are shown in respective tables. It will be observed from tables 1-6 that the numbers tested for various systems vary considerably. This happened because of several reasons : some times the reagents were not readily available, or an occasional blood sample was received in the laboratory in a condition unsuitable for reliable testing, and in a number of cases the quantity of blood was insufficient. Then another difficulty came. After testing about 1, 500 samples, the Indian Statistical Institute could not undertake further work. Dr. J. V. Undevia came to our rescue and readily accepted our offer to collaborate with us. But Dr. Undevia had limited stock of Chemicals and anti—sera; he could do Hb, G—6—PD, A_1 A_2 BO, MN, and Rh (anti—D) systems only. This will explain the differences in sample size for various systems.

The blood typing reagents with which the tests were performed included anti—A, —B, —(A+B); anti—M, anti—N; anti—Le^a, —Le^b; anti—P (from U. S. S. R.); anti—A_1 (from Molter company, Germany); and anti—C_1-c_1--D and--E from Dade Reagents, U. S. A.

Gene frequencies have been calculated by maximum--likelihood procedures using ALLTYPE computer programme of the Population Genetic Laboratory of the University of Hawaii, USA.

Results and analysis

The results of analysis of six serological markers are presented in tables 1 through 13. Before attempting at a detailed analysis, as is customary, Chi-square values for testing agreement with Hardy-Weinberg expectations, were calculated separately for each system and for each caste group. In general the values obtained are nonsignificant ruling

out errors of testing, only in MN system two groups Gadhari Dhengar and Khutekars showed significant values at 5 per cent level, and shegars for OA_1A_2B system.

OA_1A_2B System: A total of 3, 402 subjects representing 21 Dhangar castes were typed for this marker. The phenotype and gene frequencies are given in tables 1 and 7. In general, all the groups are characterised by high frequency of the r gene in all the groups, except Thellaris and shegars, this gene accouns for over 50 per cent with a series average of 56. 53 per cent. The gene p_2 is present in all the groups and varies from 0. 76 per cent to 6. 35 per cent with a series average of 2. 99 per cent. The series average incidence of p and q genes are O. 2054 and 0. 2293 respectively. Eight groups have higher frequencies of the p gene, of which six are from south and south—western districts of Maharashtra, and two groups Kannade and Kurmars are from the eastern Maharashtra. Although the gene q does not present any definite spatial pattern ing, the p gene shows a clear cut cline-it increases from north to south (see figure 1).

MN System: This Marker could be studied only on 2, 158 subjects, representing 19 groups. The results are given in table 2. The gene m predominates over the gene n; the series average frequencies of these genes are 0. 5783 and 0. 4217, respectively. Interestingly enough among two groups, Kannade and Unnikan Kans. the gene n exceeds over m. No geographical patterning is discernible with respect to this system.

RH System: For this marker a total of 2, 840 subjects were typed. 1470 subjects belonging to 14 groups (table 3) and were typed by using 4 anti-sera (-C, -c, -D, -E), and 1,370 covering 12 groups were typed with anti-D (table 4). Gene frequency data are presented in table 8. All the groups are characterized by high frequency of gene R_1 (CDe); it varies from 0.4876 to 0.6770, with a series average of 0.5728. Genes r (cde) and Ro (cDe) are fairely common; the series averages are 0.1365 and 0.1139, respectively. The most notable feature of the data are the detection of three rare Rh-genes, namely R_2 (CDE), R " (CdE) and R_Y (CdE): their frequencies are 0.0223, 0.0081, and 0.0029, respectively. It was desirable to have these rare types re-confirmed by repeating the tests. But under the circumstances it was not possible. We, however, hope to type the families of these probands in future.

Phenotype Rh (—) occurs in low frequency; upto 7.84 per cent with a series average of 4.54. (table 4). No geographical patterning is discernible.

Le^a and Le^b systems: Both these systems were studied on 1942 persons belonging to 17 Dhangar castes. With respect to Le^a system phenotype Le^a (-) is preponderant; it varies from 63.24 per cent to 94.29 per cent with a series average of 75.28 percent (table 5), and the frequency of gene Le^a (-) for the entire series is 0.8677 (table 9). Compared to Le^a, system Le^b shown more variation; in 14 groups Le^b (-) is present in over 5o per cent of the individuals

with a series average of 56.69 per cent Le^b (—) gene = 0.6581). The distribution of these alleles do not depict any geographical pattern.

P system: This marker was studied on 1939 persons belonging to 17 Dhangar castes table 6 and 9. The phenotype P (+) predominates in all the groups except Telangis; it varies from 42.22 per cent to 80.88 per cent, with a series average of 66.22 percent. The average series gene frequency of alleles P (+) and P (—) are 0.4188 and 0.5812, respectively.

Analysis of inter-caste differences

In the previous section we have described the variation in phenotypes and gene frequencies pertaining to six serological systems among the Dhangar castes. In order to understand the magnitude of such phenotypic differences, we firstly calculated chi-squares using 2x n contingency tables for each system separately. In all the six systems the chi-square values were highly significant; A_1A_2 BO (2998.58, d. f. 100); MN (2210.72, d. f. 36); Rh (tested with only —D: 1233.6, d. f. 11); Le^a (2613.58, d. f. 16), Le^b (2185.12, d. f. 16), and P (2435.19, d. f. 16). Owing to small cell frequencies in the case of samples tested with 4 anti-Rh sera, this analysis was not attempted. Having thus confirmed that considerable heterogeneity exists among the Dhangar Castes, We further calculated 2.2 contingency table chi—squares separately for each system and the results, incorporated in tables 10-13.

It is evident from these tables that the maximum inter—caste differences, as could be judged from number of caste—pair statistical significant differences, exist for the A_1A_2 BO system; 94 caste—pairs comparisons out of the 231 (40.69 per cent) showed significant differences at 5 percent and below level. Rh system (tested with anti—D) showed least inter—caste differences; only castes Danger x Ahir differ with respect to this marker. The per cent differences with respect to MN, Le (a), Le (b) and P are 23.68, 23.53, 22.22, 33.99 per cent, respectively.

A further scrutiny of these results suggests that castes Telangi, Unnikankan, Shegars, Kannade, Hattikankan, and Thellaris consistently show differences with the rest of the groups. On the other hand castes Hande, Mendhe, Kurmar, Zende, Hatkar, and Khutekar show least differences among themselves.

Discussion

The results of analysis of six serological markers can be summarised as below:

(1) The Dhangar castes show considerable differentiation.

(2) Except for the allele 'P' the other alleles do not confirm to any clear cut micro-geographical patterning and.

(3) Some castes like Shegars and Telangis stand out separately while a few castes show considerable similarity.

These observations suggest that, in spite of the fact that the Dhangar castes are found widely scattered in different ecological regions of Maharashtra (figure 1) except for, allele P, none of the other allels studied produced discernible clinal tendencies. It could also be that the systems under study are not subject to rapid changes due to different ecological pressures. The other factor which can disturb clinal configuration is migration in terms of population movement, and lastly if castes originate from one breeding population through the process of fission and if the split occured in recent times and the groups got scattered in different areas then that will also mark clinal tendencies.

Let us now examine the above factors in the light of known ethno-history of the Dhangar caste-cluster, and see which one explains the situation better. The ethnographic details suggest beyond doubt that castes Hatkars, Zende, Thellari and Danage were earlier one caste. The similarity in clan names, deity worshipped, and the dialect spoken suggests beyond doubt that the Thellaris and Zende separated from the Hatkars in recent times compared to the Danges. It is also well documented that both the Gadhari castes are immigrants from western Uttar Pradesh; they still speak a dialect of Hindi language. The linguistic evidence suggests that Kurmars, who are now found in eastern Maharashtra, migrated from Karnataka; they continued speaking Kannada language. Likewise the Thellaris whose present habitat is in north Western Maharashtra, have migrated from southern-Maharashtra; this is evidenced by the Marathi dialect they speak.

Also, till 1950 the Thellaris were true nomads, and part of Hatkars particularly in Western Maharashtra, continue to be true nomads. Several other groups are semi-nomads. This all suggests considerable spatial movement of these castes.

These two aspects-fission and spatial migration-will obviously hinder the process of clinal configuration. Further, the archaeological evidence, which is indeed very scanty, and in the form of occurence of sheed bones in neolithic, chalcolithic and mesolithic sites suggests that the antiquity of Dhangars in Maharashtra is between 5000—10,000 years from present. That they are recent arrivals in this region is also supported by the fact that none of Dhangars examined showed presence of Hbs. Instead, low freqnency of Hb variants D and J and G-6-PD deficiency have been encountered; populations with established long antiquity in this region show high incidence of Hbs and G-6-PD deficiency.

To sum-up, the three aspects of Dhangar ethnography, namely their recent arrival in this area, considerable migration of the castes coupled with nomadism, and origin of some of the castes through fission, explains the observed distribution of six serological markers.

Before we conclude, we wish to touch upon two more points. Firstly, as noticed earlier, the allele 'p', in spite of the limiting

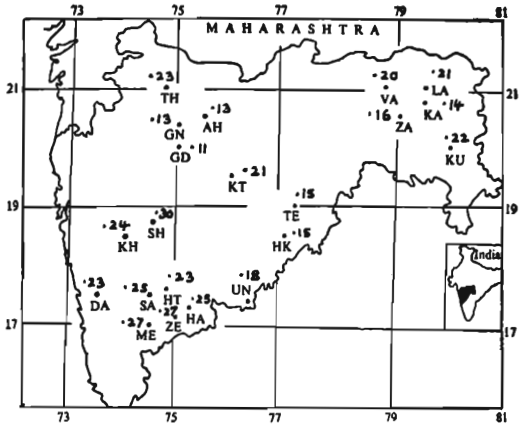

Fig. 1 Distribution of gene 'p' among Dhangars

factors as detailed above in terms of clinial configurations, shows a decreasing north-south trend. It appears that ABO locus, compared to other loci, is more susceptible to differential ecological pressures. Studies carried out among the American Indian natives suggest complete absence of allele 'q' which took about 20,000 years.

Secondly in this article we have purposely avoided discussion on the affinities between the Dhangar Castes, as we are aware of the limitations of such analysis in arriving at dependable conclusions. The next article in this series will deal with this aspect using a more appropriate statistical method the distance statistics.

TABLE 1

Distribution of A_1 A_2 BO blood groups

Dhangar Caste	Abbrev.	N	O		A_1		A_2		B		A_1B		A_2B	
			n	%	n	%	n	%	n	%	n	%	n	%
Ahir	A. H.	317	129	40.69	50	15.77	10	3.15	113	35.65	13	4.10	2	0.64
Dange	D. H.	184	77	41.85	50	27.17	14	7.61	32	17.39	9	4.89	2	1.09
Gadhari-Dhengar	G. D.	108	30	27.78	9	8.33	3	2.78	56	51.85	9	8.33	1	0.93
Gadhari-Nikhar	G. N.	108	42	38.89	19	17.59	1	0.95	39	36.11	7	6.48	0	0.00
Hande	H. A.	98	33	33.67	29	29.59	4	4.08	21	21.43	11	11.22	0	0.00
Hatkar	H. T.	665	193	29.02	195	29.32	19	2.86	201	30.22	50	7.52	7	1.05
Hattikankan	H. K.	35	14	40.00	5	14.29	1	2 85	11	31.43	4	11.43	0	0.00
Kannade	K. A.	90	50	55.55	19	21.11	2	2.22	16	17.78	2	2.22	1	1.11
Khatik	K. H.	139	48	34.53	43	30.93	8	5.76	30	21.58	10	7.19	0	0.00
Khutekar	K. T.	511	162	31.70	125	24.46	18	3.52	154	30.14	46	9.01	6	1.74
Kumar	K. U.	95	30	31.58	24	25.26	5	5.26	28	29.47	8	8.42	0	0.00
Ladabe	L. A.	121	34	28.10	29	23.97	2	1.65	42	34.71	13	10.74	1	0.83
Mendbe	M. E.	170	47	27.65	52	30.59	7	4.12	44	25.88	17	10.00	3	1.75
Sangar	S. A.	88	27	30.68	11	12.50	4	4.54	37	20.05	7	7.95	2	2.27
Shegar	S. H.	105	15	14.29	26	24.76	1	0.95	35	33.33	23	21.90	5	4.76
Telangi	T. E.	90	27	30.00	11	12.22	9	10.00	39	43.33	4	4.44	0	0.00
Thellari	T. H.	109	21	19.27	22	20.18	8	7.34	43	39.45	12	11.01	3	2.75
Unnikankan	U. N.	64	16	25.00	16	25.00	1	1.56	28	43.75	2	3.12	1	1.56
Varhade	V. A.	74	21	28.39	14	18.92	1	1.35	26	35.13	10	13.51	2	2.70
Zende	Z. E.	153	40	26.14	42	27.45	6	3.92	41	26.80	20	13.07	4	2.61
Zade	Z. A.	78	31	39.74	17	21.79	1	1.28	24	30.77	5	6.41	0	0.00
		3,402	1087	31.95	808	23.75	125	3.67	1060	31.15	282	8.28	40	1.75

TABLE 2

Distribution of M N blood groups

Dhangar Caste	N	M n	M %	N n	N %	MN n	MN %	Gene frequencies M	Gene frequencies N	Chi-square d.f. 1
A. H.	12	4	33.33	2	16.67	6	50.00	.5833	.4167	.01
D. A.	68	30	17.86	9	5.36	29	17.28	.6544	.3456	.22
G. D.	60	13	21.67	9	15.00	38	63.33	.5333	.4667	4.52
G. N.	84	27	32.15	16	19.05	41	48.00	.5655	.4345	.35
H. A.	98	30	30.61	17	17.35	51	52.04	.5663	.4337	.00
H. T.	454	144	31.72	87	19.16	223	49 12	.5628	.4372	.25
H. K.	35	18	51.43	2	5.71	15	42.86	.7286	.2714	.04
K. A.	90	22	24.44	24	26.67	44	48.89	.4889	.5111	1.08
K. H.	109	38	34.86	14	12.84	57	52.29	.6101	.3899	1.54
K. T.	250	89	35.60	33	13.20	128	51.20	.6120	.3880	4.02
K. U.	95	22	23.16	16	16.84	57	60.00	.5316	.4584	1.14
L. A.	88	32	36.36	18	20.45	38	43.19	.5795	.4205	2.98
M. E.	170	54	31.76	23	13.53	93	54.71	.5912	.4088	.46
S. A.	60	20	33.33	13	21.67	27	45.00	.5583	.4417	1.22
S. H.	100	50	50.00	12	12.00	38	38.00	.6900	.3100	.77
T. E.	90	23	25.56	18	20.00	49	54.44	.5278	.4722	1.87
U. N.	64	10	15.62	17	26.56	37	57.81	.4453	.5547	2.16
Z. E.	153	49	32.03	37	24.18	67	43.79	.5302	.4608	.11
Z. A.	78	38	48.72	8	10.26	32	41.02	.6923	.3077	.00
	2158	718	33.04	375	17.38	1070	49.58	.5783	.4217	.59

TABLE 3

Distribution of Rh phenotypes (tested with –C, –c, –D, –E)

Dhangar Caste	N	ccDee	CCDee	CCDEe	ccdee	CCdee	ccdEe	CCdEe	CcDee	CcDEe	ccDEe	Ccdee
D. A.	68	5	19	0	2	1	1	0	23	13	4	0
H. A.	98	2	38	4	4	1	1	0	27	14	4	3
H. T.	286	13	119	7	8	0	0	2	87	38	9	3
H. K.	35	1	17	0	0	0	0	0	9	5	3	0
K. A.	59	5	38	2	2	3	0	0	5	3	1	0
K. T.	118	5	51	3	1	0	1	0	33	12	11	1
K. U.	95	4	42	4	3	0	0	0	26	8	6	2
L. A.	88	6	39	8	3	5	0	0	13	6	7	1
M. E.	170	6	71	7	9	2	1	0	44	17	10	3
S. A.	60	5	16	4	1	0	1	0	22	6	4	1
S. H.	100	5	32	2	1	0	0	0	34	14	11	1
T. E.	13	1	5	0	0	0	0	0	5	0	1	1
U. N.	64	0	15	1	4	0	0	0	21	11	10	2
Z. E.	153	8	63	4	5	1	1	0	45	13	12	1
Z. A.	63	5	44	1	2	2	0	0	3	2	3	1
Total	1470	71	609	47	45	15	6	2	397	162	96	20
	%	4.83	41.43	3.20	3.6	1.02	0.41	0.13	27.01	11.02	6.53	1.36

TABLE 4

Distribution of Rh (+)and Rh (−) Phenotypes (tested with anti −D).

Dhangar Castes		Rh (+)		Rh (−)		Gene frequency	
		n	%	n	%	D	d
A. H.	314	294	93.63	20	6.37	.74760	.25240
D. A.	116	114	98.28	2	1.72	.86870	.13130
G. D.	48	47	97.92	1	2.08	.98570	.14430
G. N.	24	24	100.00	0	0.00	1.000000	.00000
H. T.	270	259	95.93	11	4.07	.79816	.20184
K. H.	51	47	92.16	4	7.84	.71994	.28006
K. T.	298	284	95.30	14	4.70	.78325	.21675
L. A.	33	31	93.94	2	6.06	.75381	.24619
S. A.	28	27	96.43	1	3.57	.81102	.18898
T. H.	109	103	94.49	6	5.51	.76538	.23462
V. A.	74	73	98.65	1	1.35	.88375	.11625
	1965	1903	95.46	62	4.54	.78386	.21614

TABLE 5

Distribution of Le(a) and Le(b) blood groups

Dhangar Castes	N	Le^a System				Le^b System			
		Le(a+)		Le(a−)		Le(b+)		Le(b−)	
		n	%	n	%	n	%	n	%
D. A.	68	25	36.76	43	63.24	34	50.00	34	50.00
G. N.	84	30	35.71	54	64.29	46	54.76	38	45.24
H. A.	98	16	16.33	82	83.67	60	61.22	38	38.78
H. T.	393	102	25.95	291	74.05	222	56.49	171	43.51
H. K.	35	2	5.71	33	94.29	21	60.00	14	40.00
K. A.	90	26	28.89	64	71.11	54	60.00	36	40.00

(Contd.)

(Contd.)

K. H.	88	29	32.96	59	67.04	49	55.68	39	44.32
K. T.	188	46	24.47	142	75.53	123	55.42	65	34.58
K. U.	95	18	18.95	77	81.05	50	52.63	45	47.37
L. A.	88	21	23.86	67	76.14	36	40.91	52	59.09
M. E.	170	38	22.35	132	77.65	94	52.29	76	44.71
S. A.	60	12	20.00	48	80.00	31	51.67	29	48.33
S. H.	100	19	19.00	81	81.00	45	45.00	55	55.00
T. E.	90	17	18.89	73	81.11	64	71.11	26	28.89
U. N.	64	12	18.75	52	81.25	44	68.75	20	31.25
Z. E.	153	40	26.14	113	73.86	93	60.78	60	39.22
Z. A.	78	27	34.61	51	65.39	35	44.87	43	55.13
	1942	480	24.72	1462	75.28	1101	56.69	841	43.31

TABLE 6

Distribution of P blood group

Dhangar Castes	N	P (+)		P(−)	
		n	%	n	%
D. A.	68	55	80.88	13	19.12
G. N.	84	43	51.19	41	48.81
H. A.	98	68	69.39	30	30.61
H. T.	393	257	65.39	136	34.61
H. K.	35	25	71.43	10	28.57
K. A.	90	48	53.33	42	46.67
K. H.	88	51	57.95	37	42.05
K. T.	188	122	64.89	66	35.11
K. U.	95	74	77.89	21	22.11
L. A.	88	71	80.68	17	19.32
M. E.	167	122	73.05	45	26.95
S. A.	60	41	68.33	19	31.67
S. H.	100	61	61.00	39	39.00

(Contd.)

(*Contd.*)

T. E.	90	38	42.22	52	57.78
U. N.	64	42	65.62	22	34.38
Z. E.	153	117	76.47	36	23.53
Z. A.	78	49	62.82	29	37.18
	1939	1284	66.22	655	33.78

TABLE 7

Gene frequencies O, A_1 A_2, B

Caste Group	Gene frequencies				Chi square (d. f. 2)
	O	A_1	A_2	B	
A. H.	.6446	.1052	.0215	.2287	1.16
D. A.	.6456	.1755	.0544	.1245	.26
G. D.	.5191	.0864	.0202	.3743	1.40
G. N.	.6238	.1285	.0053	.2424	3.63
H. A.	.5680	.2279	.0264	.1777	2.97
H. T.	.5489	.2066	.0254	.2191	2.34
H. K.	.6081	.1356	.0161	.2402	.95
K. A.	.7443	.1246	.0193	.1118	3.75
K. H.	.5930	.2130	.0375	.1565	.51
K. T.	.5601	.1838	.0292	.2269	3.18
K. U.	.5690	.1853	.0330	.2127	.06
L. A.	.5266	.1915	.0154	.1665	.08
M. E.	.5223	.2288	.0389	.2010	.38
S. A.	.5463	.1075	.0387	.3075	4.65
S. H.	.3387	.2756	.0381	.3576	7.41
T. E.	.5735	.0873	.0576	.2816	.82
T. H.	.4483	.1704	.0636	.3177	4.95
U. N.	.5357	.1561	.0196	.2886	2.51
V. A.	.5034	.1757	.0241	.2968	1.71
Z. E.	.4924	.2266	.0425	.2385	.57
Z. A.	.6322	.1528	.0076	.2076	.67
Total	.5653	.1755	.0299	.2293	1.67

TABLE 8

Rh—gene frequencies

Dhangar Castes	CDe R_1	CDE R_2	Cde R'	cDE R_0	cDe Ro	cde r	cdE R''	CdE Ry	Chi-square d. f. 4
D. A.	.5008	.0464	.0329	.0633	.1470	.1767	.0329	—	.34
H. A.	.5448	.0427	.0780	.0650	.0444	.2075	.0175	—	.64
H. T.	.5970	.0352	.0289	.0529	.1037	.1672	.0000	.0171	.00
H. K.	.6770	.0000	.0000	.1245	.1985	.0090	.0000	—	.48
K. A.	.4963	.0284	.1070	.0238	.1603	.1841	.0000	—	.00
K. T.	.5923	.0000	.0295	.1005	.1456	.1083	.0240	—	2.09
K. U.	.5778	.0000	.0519	.0996	.0935	.1772	.0000	—	.00
L. A.	.4176	.0208	.1352	.1066	.1352	.1846	.0000	—	.00
M. E.	.5377	.0166	.0547	.0821	.0665	.2322	.0101	—	.42
S. A.	.5031	.0270	.0422	.0650	.1812	.1393	.0422	—	.53
S. H.	.5547	.0000	.0303	.1472	.1531	.1057	.0000	—	.36
U. N.	.4876	.0000	.0520	.1925	.0000	.2679	.0000	—	.34
Z. E.	.5625	.0000	.0300	.0911	.1140	.1892	.0131	—	.77
Z. A.	.5059	.0000	.1005	.0492	.1603	.1840	.0000	—	.40
Total	.5728	.0223	.0563	.0872	.1139	.1365	.0081	.0029	7.26

TABLE 9

Gene frequencies of Le(a), Le(b) and P systems

Castes	Le(a)		Gene frequencies Le(b)		P	
	Le(a+)	Le(a−)	Le(b+)	Le(b−)	P(+)	P(−)
D. A.	.2048	.7952	.2929	.7071	.5628	.4372
G. N.	.1982	.8018	.3274	.6726	.3014	.6986
H. A.	.0853	.9147	.3773	.6227	.4467	.5533
H. T.	.1395	.8605	.3404	.6596	.4117	.5883
H. K.	.0290	.9710	.3675	.6325	.4655	.5345
K. A.	.1567	.8433	.3675	.6325	.3168	.6831
K. H.	.1812	.8188	.3343	.6657	.3516	.6484
K. T.	.1309	.8691	.4120	.5880	.4075	.5925
K. U.	.0997	.0003	.3117	.6883	.5298	.4702
L. A.	.1274	.8726	.2313	.7687	.5605	.4395
M. E.	.1188	.8812	.3314	.6686	.4809	.5191
S. A.	.1056	.8944	.3048	.6952	.4373	.5627
S. H.	.1000	.9000	.2584	.7416	.3755	.6245
T. E.	.0994	.9000	.4625	.5375	.2399	.7601
U. N.	.0986	.9014	.4410	.5590	.4137	.5863
Z. E.	.1406	.8594	.3738	.6262	.5149	.4851
Z. A.	.1914	.8086	.2575	.7425	.3902	.6098
Total	.1323	.8677	.3419	.6581	.4188	.5812

TABLE 10

Inter-group χ^2 values for A_1 A_2 BO system (D. F. 5)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
A. H.	26.31	15.05	3.43	20.52	31.08	3.94	12.86	22.30	20.60	10.22	14.29	7.38	28.01	58.67	11.41	24.90	8.19	14.98	30.92	3.
D. A.		46.50	20.00	7.71	26.14	8.39	7.41	4.83	20.46	8.88	21.56	24.28	13.65	50.34	25.42	29.50	20.61	21.13	18.85	10.
G. D.			10.86	27.50	28.73	5.20	34.09	34.22	23.79	16.95	13.01	2.96	28.14	27.86	7.75	12.44	10.43	9.00	25.06	13.
G. N.				10.79	11.24	1.89	12.82	13.15	8.11	6.31	5.45	7.28	14.48	27.59	11.07	17.17	6.68	6 77	15.30	.
H. A.					5.82	3.83	13.82	1.42	4.78	2.15	6.50	15.51	3.10	21.23	18.98	15.02	13.13	9.11	4.69	5.
H. T.						5.03	26.84	8.61	4.42	3.29	3.66	13.26	3.33	37.30	25.71	17.45	6.18	8.07	8.20	5.
H. K.							8.86	5.27	2.82	2.52	3.01	2,74	5.39	13.56	5.27	7.45	7.80	2.71	5.16	1.
K. A.								13.67	21.63	14.61	20.75	21.08	21.54	46.78	24.74	34.66	17.49	19.61	24.59	7.
K. H.									8.28	2.33	10.91	18.93	5.34	33.33	19.03	19.50	14.47	14.57	9.41	6.
K. T.										1.82	2.58	9.08	3.92	30.58	19.40	12.90	7.25	5.01	5.70	4.
K. U.											3.92	8.15	3.23	20.33	9.14	8.41	7.36	6.68	4.71	5.
L. A.												6.98	4.86	12.88	15.01	8.08	4.28	1.91	4.49	3.
M. E.													13.14	19.84	4.77	5.54	6.26	4.18	11.49	7.
S. A.														17.73	21.06	10.19	9.05	6.14	1.30	7.
S. H.															33.54	11.48	14.40	7.18	10.94	22.
T. E.																9.95	9.49	13.25	21.05	10.
T. H.																	7.16	5.29	7.46	14.
U. N.																		5.86	9.60	6.
V. A.																			3.82	5.
Z. E.																				9.
Z. A.																				—

TABLE 11

Inter-caste χ^2 values for M N system (D. F. 2)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A. H.	.49	.89	.04	.04	.05	1.99	.75	.14	.12	.63	.21	.13	.17	1.20	.34	2.22	.37	1.11
D. A.		7.46	2.52	3.19	4.37	1.49	8.23	1.74	1.83	8.06	1.74	3.48	2.31	.56	6.11	13.32	4.65	.46
G. D.			3.06	2.06	4.35	9.31	3.72	3.20	4.30	.18	5.94	2.20	4.07	12.97	1.22	2.74	6.61	10.66
G. N.				.20	.01	5.52	2.01	1.39	1.75	2.45	.56	1.49	.24	6.21	.94	5.44	.94	5.42
H. A.					.31	5.98	2.61	.98	1.36	1.55	1.46	.71	.83	7.74	.65	5.33	2.20	6.34
H. T.						7.30	3.38	2.40	4.24	3.95	1.09	2.99	.40	12.52	1.38	7.26	2.09	9.49
H. K.							11.25	3.55	3.88	10.29	4.74	5.42	5.39	1.15	9.02	16.34	7.70	.62
K. A.								6.82	9.75	3.14	3.12	7.07	1.50	14.84	1.15	1.97	1.57	13.37
K. H.									.04	3.45	2.60	.29	2.33	5.21	3.01	9.84	5.33	3.62
K. T.										4.95	3.13	.68	3.78	6.43	4.20	12.59	8.02	4.32
K. U.											5.51	2.33	3.39	15.14	.61	2.85	6.17	12.40
L. A.												3.63	.14	4.40	2.84	7.97	.66	4.29
M. E.													2.71	9.17	2.33	9.13	6.86	6.59
S. A.														5.07	1.44	5.31	.51	4.94
S. H.															12.08	20.63	10.11	.23
T. E.																2 51	2.59	10.30
U. N.																	6.42	18.74
Z. E.																		9.06
Z. A.																		—

TABLE 12

χ^2—Values for inter-caste differences with respect to systems Le(a), above the diagonal and Le(b) below the diagonal (d. f. 1)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Castes
	.02	9.02	3.39	11.52	1.10	.25	3.77	6.48	3.07	5.18	4.96	6.61	6.34	5.20	2.56	.07	D. A.
.34		9.01	3.29	11.31	.93	.14	3.65	6.39	2.89	5.12	4.18	6.53	6.24	5.14	2.39	.02	G. N.
2.06	.78		3.98	2.48	4.27	7.00	2.51	.23	1.65	1.40	.34	.24	.21	.16	3.32	7.87	H. A.
0.99	.08	.72		7.16	0.52	1.78	.15	2.03	.16	.82	.98	2.08	1.97	1.52	.01	2.45	H. T.
0.93	.27	.02	.16		7.79	9.86	6.14	3.44	5.42	5.12	3.59	3.48	3.39	3.17	6.85	10.58	H. K.
1.57	.49	.03	.39	.00		.34	.62	2.52	.58	1.35	1.50	2.56	2.47	2.07	.22	.63	K. A.
.50	.01	.59	.02	.10	.34		2.18	4.70	1.79	3.39	2.99	4.79	4.59	3.79	1.27	.05	K. H.
5.01	2.81	.49	4.21	.38	.77	2.42		1.10	.01	.22	.51	1.12	1.08	.88	.13	2.85	K. T.
.11	.08	1.45	.46	.56	1.02	.17	4.35		.66	.42	.03	.00	.00	.00	1.69	5.46	K. U.
1.28	3.51	7.66	7.02	3.67	6.49	3.84	14.75	2.52		.07	.31	.06	.65	.57	.15	2.32	L. A.
.55	.01	.89	.07	.26	.53	.01	3.83	.17	4.80		.14	.42	.42	.96	.63	4.16	M. E.
.03	.13	1.39	.49	.62	1.02	.23	3.66	.01	1.67	.23		.02	.03	.03	.83	3.57	S. A.
.41	1.74	5.23	4.24	2.33	4.27	2.14	11.20	1.13	.32	2.67	.67		.00	.00	1.72	5.56	S. H.
7.33	4.99	2.04	6.48	1.43	2.46	4.57	.89	6.67	16.49	6.17	5.86	13.21		.00	1.66	5.35	T. E.
4.79	2.98	.95	3.40	.77	1.24	2.66	.24	4.11	11.52	3.48	3.78	8.87	.10		1.35	4.44	U. N.
2.34	.81	.01	.83	.01	.01	.60	.78	1.59	8.87	1.00	1.47	6.08	2.64	1.23		1.80	Z. E.
.58	1.58	4.67	3.54	2.21	3.84	1.93	9.66	1.03	.26	2.33	.63	.01	11.89	8.12	5.29	—	Z. A.

TABLE 13

Inter-caste X^2 values for P system (d. f. 1)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
D. A.	14.46	2.76	6.36	1.19	12.95	9.26	5.98	.21	.01	1.59	2.68	7.49	23.91	3.94	.53	5.78
G. N.		6.29	5.98	4.13	.08	.79	4.57	14.04	16.72	11.86	4.23	1.79	1.40	3.10	15.80	2.23
H. A.			.56	.05	5.12	2.63	.58	1.79	5.13	.41	.02	1.53	14.08	.25	1.55	.84
H. T.				.52	4.58	1.73	.01	5.48	7.75	5.14	.20	.67	16.54	.01	6.26	.20
H. K.					3.40	1.92	.56	.59	1.25	.04	.10	1.22	8.60	.35	.39	.79
K. A.						.38	3.42	12.41	15.02	10.16	3.36	1.14	2.23	2.33	13.92	1.54
K. H.							1.23	8.39	10.69	6.02	1.63	.18	4.40	.92	9.07	.41
K. T.								5.01	7.01	2.74	.24	.43	12.81	.01	5.39	.10
K. U.									.26	.75	1.76	6.53	24.62	2.92	.07	4.74
L. A.										1.82	2.95	8.67	27.72	4.40	.58	.58
M. E.											.49	4.21	23.66	1.24	.49	2.64
S. A.												.87	9.85	.10	1.49	.45
S. H.													6 69	.36	6.94	.06
T. E.														8.21	28.77	7.11
U. N.															2.71	.12
Z. E.																4.76
Z. A.																—

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