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GEOGRAPHY OF HUMAN BLOOD GROUPS (A, B, O SYSTEM)

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The distribution of the alleles of the AB blood group is of great importance in physical anthropology since it is the only human racial character whose genetics is fully clear,¹ and which has been studied intensively and with exact methods. As far as is known, the gene is not linked with any other gene, nor do the blood group genes control any other physiological characters. This means that so far as is known they have no selective significance. The mutation frequencies are evidently very low. This is shown, in the huge body of genetical material collected all over the world, by the great similarity in the frequencies of the alleles between related ethnic groups which have been separated from each other for centuries and have not mingled with other groups for centuries. Thus, unmixed gypsies have nearly the same ratios as the present natives of their ancestral home in India; German colonists in south Hungary have the same frequencies as do the present population on the middle Rhine area, although the colonists left the Rhineland hundreds of years ago (Hirszfeld, 1928).

The frequencies of blood alleles, "the serological pattern," are thus a first-rate indication of origin. However, the rule of the variability of the allele ratios within a human group is subjected to the law of chance. Hence the above-mentioned fact of the invariability of the pattern is true only of large-sized populations. Within areas of limited population, e.g., a rural parish, new relations between the alleles may develop, especially after wars,

¹ In the following study we use only the allele frequencies (p , q , r), not the frequencies of phenotypes (A, B, O, AB).

plagues, etc., when the population has been further reduced.

THE DISTRIBUTION OF THE DIFFERENT ALLELES

The allele p is distributed in variable frequencies all over the world (map 1) with the exception of America, where it is fairly rare. It is also sparse in east Africa and in the interior of Arabia. Very high frequencies are found in the following four regions: (1) The whole of Europe with a great part of the Near East excepting Arabia, but including Egypt and the northern half of the Somali Peninsula. (2) The Australian continent but not New Guinea. (3) The outer (eastern) part of Polynesia. (4) Japan, and also a great part of China. Further, p is common in Tibet and most of the Himalayan countries, and also among many primitive tribes. Besides the above-mentioned Australian aborigines, it is common among Bushmen in South Africa, Congo pygmies, negritos in the Philippine Islands, and some "hill tribes" of south India; it is also frequent among many Eskimos and some Indians of the north-western part of the United States.

The allele q (maps 2 and 3) has its greatest frequency in central Asia and in northern and central India—in both regions, curiously enough, with about the same mean percentage, i.e., 27 per cent; but it has lower ratios in most of the intervening Himalayan countries; q is also very frequent in Egypt and among the Congo pygmies. In relation to p , q is rather frequent in the whole of central and western Africa, but sparse in the south and east. In the latter regions, it is more

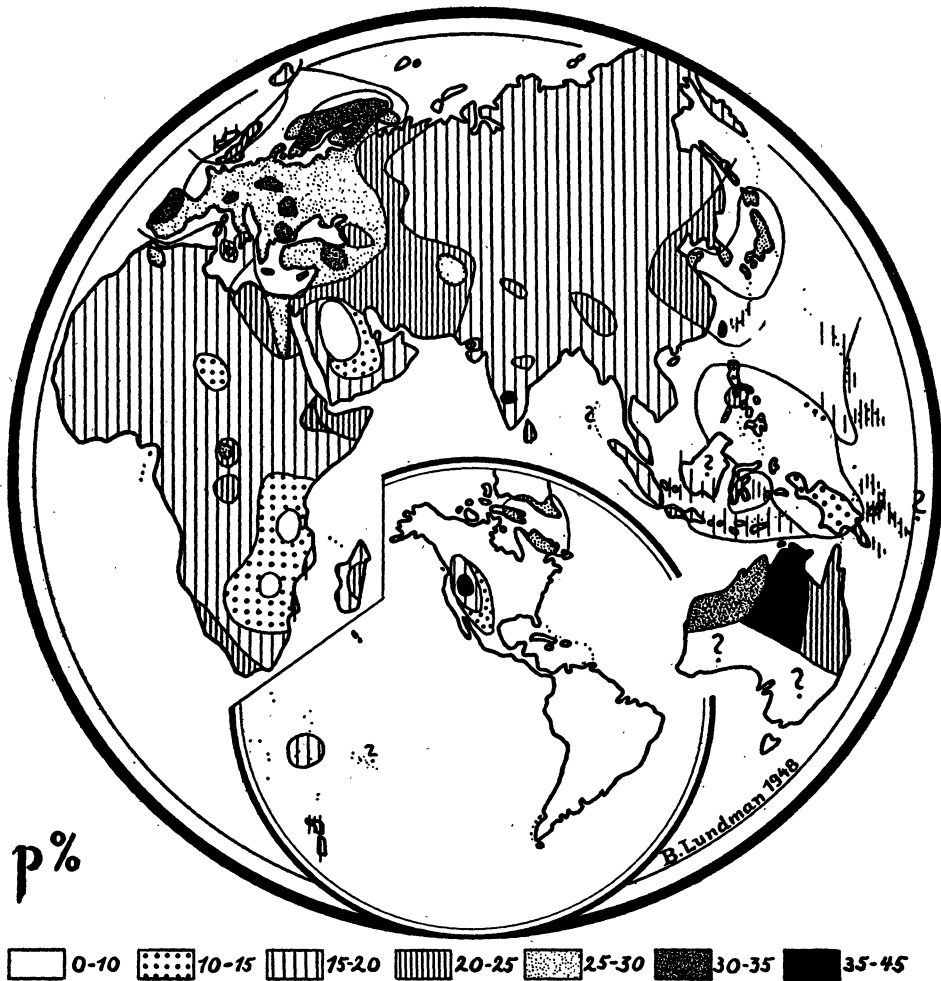


FIG. 1. Map of frequencies of blood allele p .

abundant only among the Hottentots and Somalis. In America q is extremely rare among the indigenous races. Some tribes in the southern part of South America may have a little more of that allele, but the material from there is extremely small and possibly not always reliable. q is also found in very low percentages on the Australian continent, in great parts (especially the outer ones) of Polynesia and in central Arabia. In Europe q is most frequent in the east among the Finns; the east and west Slavs, and in the north-eastern parts of the Balkan Peninsula. In the west of Europe it is rather rare.

Northern and eastern Germany (of 1919–1938), east of the Elbe, has an intermediate position, yet nearer to the west than to the east. Curiously enough, q is again fairly common in westernmost Europe in many Celtic districts of Great Britain.

The allele r (map 4) is the most common of all the alleles throughout the world although it is possible that its frequency is no greater than that of p among some hill tribes in South Deccan and among the Blackfeet and the Blood Indians in the northwestern part of the United States. The frequency of r is not only greater

than that of either of the other alleles, but in most countries it is greater than that of both of the other alleles combined. Only relative dominance (and then at frequencies only very little below 50 per cent) is known, in addition to the mentioned small tribes of India and the United States, in parts of Egypt, among some Mongolian tribes in central Asia, and among some of the Congo pygmies. In nearly all Indians r prevails almost to the exclusion of the other alleles (90–100 per cent) and the small amount of the two other alleles is usually but not always (cf. the above-named U. S. A. Indians) the

result of post-Columbian minglings. Still, it cannot be assumed that p and q originated in the Old World after the departure of the Indians to America, for these alleles are found even among the apes.

GEOGRAPHIC SYNTHESIS

In spite of all irregularities, the world may be divided into a rather restricted number of tolerably homogenous "serological provinces" (map 5). Between them we often must insert transitional belts and here and there isolated aberrant islets. Furthermore, data from the Tibetan-Himalayan region are nearly un-

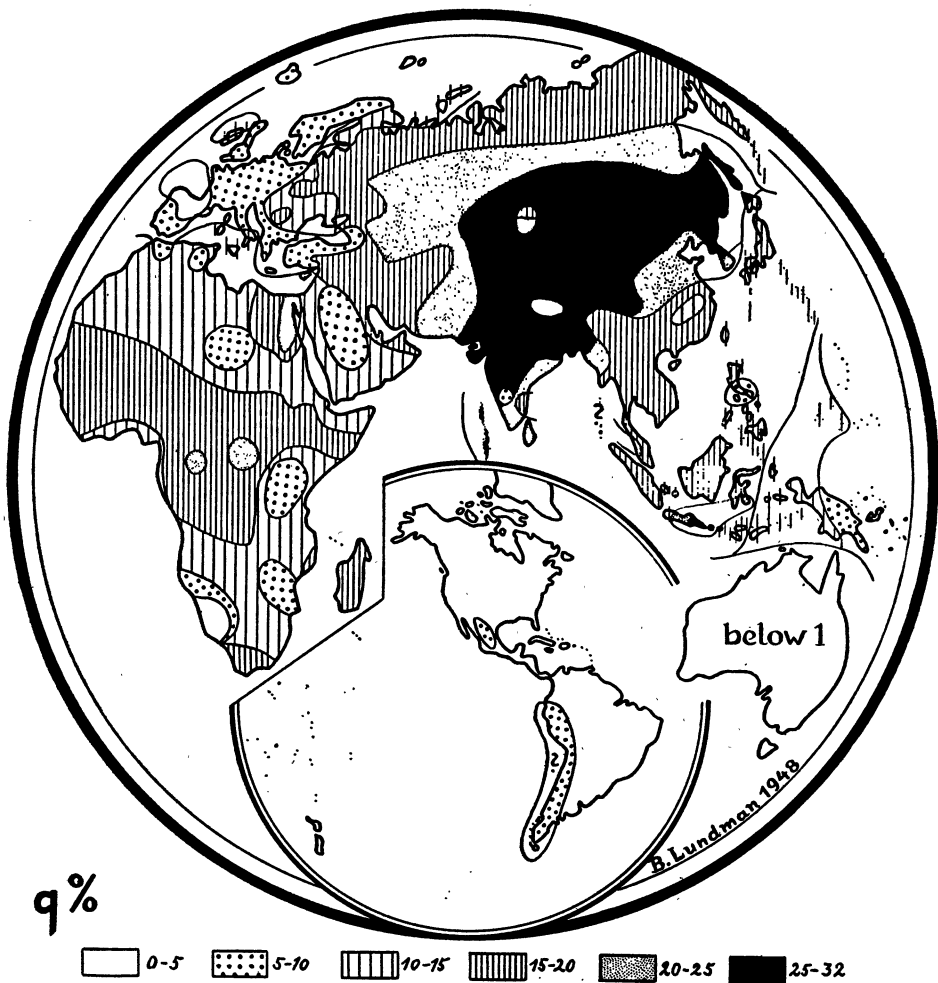


FIG. 2. Map of frequencies of blood allele q .

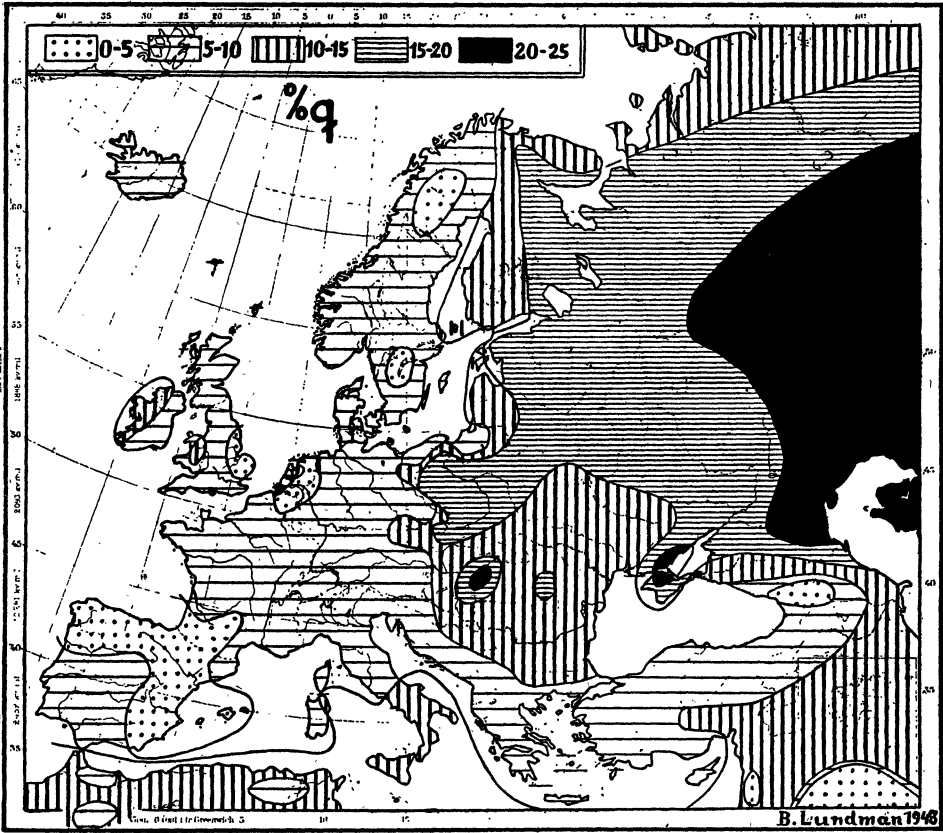


FIG. 3. Map of frequencies in Europe of blood allele q .

known and that area is marked with a question mark on the map. Western Europe and the Near East (except Arabia) form a special province (A on the map) which is especially rich in p and poor in q . Central Asia (B 1), rich in q , forms another serological province. The above mentioned little known Himalayan tribes indicate different, more "European" conditions, but north and central India (B 2 on the map) have again about the same allele frequencies as B 1. Region C on the map fills out the arid regions which border the Indian Ocean from Arabia through eastern to South Africa, with interruptions for some coastal belts (Somalia) and the shores of the great river Zambezi. In C r is abundant while p is rare, and q even rarer. The central African forests and Upper Guinea (D) have a

greater frequency of q and to some extent also of p .

Between these main regions in the western half of the Old World lie several broad transitional zones² and also small aberrant districts, especially among British Celts, Egyptians, Congo pygmies, and Bushmen. Curiously enough, the ratio $p:q$ is the same in nearly all Africa except among Bushmen, the steppe tribes in Tanganyika, and in the whole northwestern part, even though the r frequencies of the Egyptians and Kaffirs are very different.

Such serological regions are a little more difficult to construct in the whole

² The eastern European belt between A and B has independence, having a p rate nearer A and an r rate nearer B, but being rather intermediate in the q rate.

eastern half of the Old World and in Oceania. Partly, as in Indo-China and parts of Polynesia, the material is scanty; partly (especially in Java) great contrasts are encountered in neighboring populations. Yet, we find the Japanese region (E) with much p and q , a rather indistinctly marked region in central and south China, Indo-China and Indonesia (F), a Melanesian region with much more r (G), and a central Australian region (H) that is extremely rich in p . The native races of America constitute a great region (J) with the exception of the aberrant Eskimos and the above-mentioned strange

tribes in the northwestern part of the United States. This completes the delimitation of all the serological regions.

DISCUSSION

As has been implied above, the correlation between racial relationship and serological similarity is not very close. Central Mongols and Hindus, physically so utterly unlike, exhibit practically the same serological pattern. The Egyptians and the central Arabians differ extremely in this respect from each other, but are racially rather closely related to Mediterranean peoples.

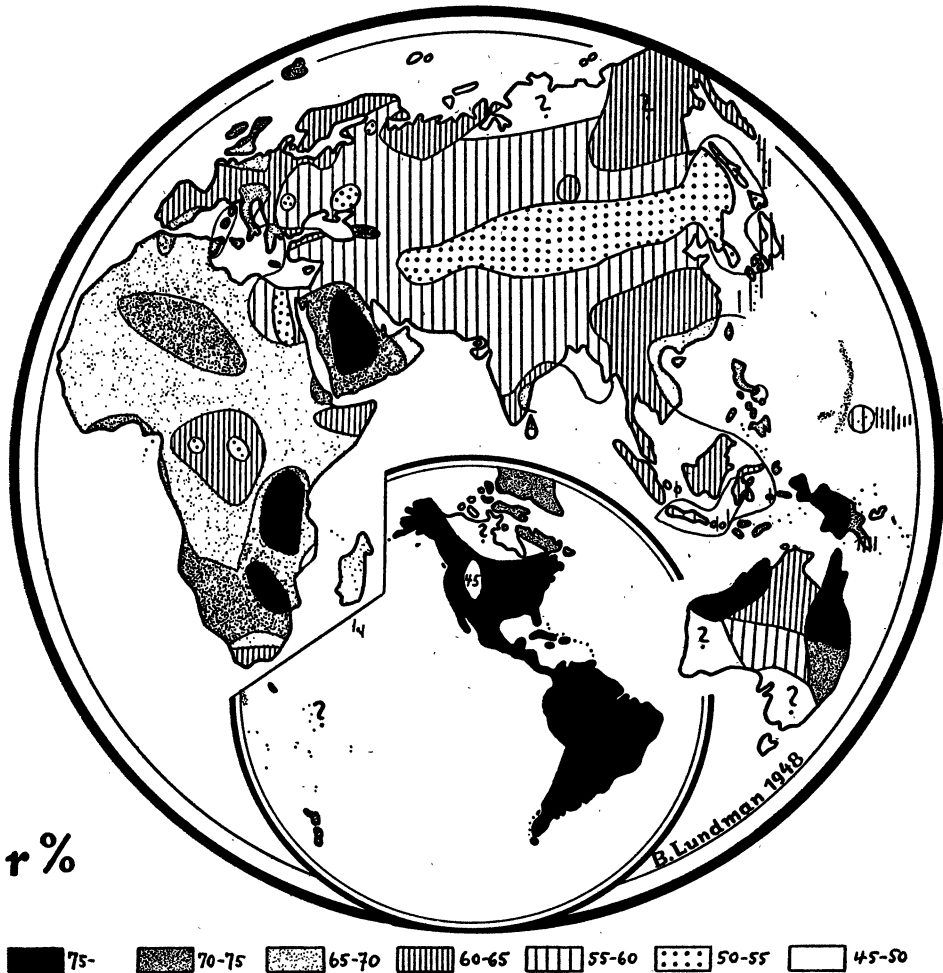


FIG. 4. Map of frequencies of blood allele r .



FIG. 5. Map of serological regions.

Single letters (also B 1 and B 2) see text. Double letters = mixed regions. Small aberrant districts are marked black on the map.

Evidently the explanation is that the parentage here goes back to times when the nowadays-serologically differing, but undoubtedly racially related, groups were so small that chance (in combination with time) was able to displace the ratios of the alleles to a great extent. More difficult to explain is the astonishingly great similarity in serological pattern between the central Mongols and the Hindus, but here mere chance is a probable explanation. Strange is also the serological likeness between the Scandinavians and most of the Greenland Eskimos. It is too great and the races are too distantly

related to permit explaining the whole matter as a consequence of the slight amount of comparatively recent intermarriage between the Eskimos and Danes (and possibly Norsemen in the Middle Ages). The very close serological resemblances between Scandinavians and Scandinavian Lapps, and between Japanese and Ainus, are similar situations. It is not clear how one should explain the origin of a few Indian tribes extremely rich in p in the midst of the large American Indian population almost devoid of p . Should one apply the elimination theory here of the r allele in the very small origi-

nal group, or postulate mutations in old times? The first seems more probable to the present author. On the whole, the elimination theory explains many irregularities of the blood alleles. It makes the scientist less inclined to construct great world-embracing wanderings of peoples in prehistoric times, only on the basis of modern serological values. But, it cannot be denied that the theory of the relative intactness of the Columbian races of America from relatively late, but pre-Columbian invasions from the Old World is strongly supported by the A-B-O serology.

The distribution of the blood alleles is of considerable value in helping to determine the parentage of those ethnical groups which, after their comparatively recent separation, have not been subject to the modifying effects of small population size; also in cases of mass emigration in historical times. An analysis of the blood alleles of mixed population groups sometimes permits the calculation of the numerical contribution of the two components of the mixture, but it is outside the scope of this short paper to substantiate this statement with concrete examples.

On the other hand, the significance of the serological pattern is small or nil as an indicator of ancient racial connections or for the identification of small family groups in our time. In spite of these shortcomings the maps of the distribution of the blood alleles are of great general biological interest as genetic maps based on extensive material derived from all parts of the world.

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EXPLANATION OF THE MAPS

These are the only fairly detailed and accurate maps of the world distribution of the blood alleles that are available. They are based on published material known to the author. Unpublished series have hardly been used. Almost all of the material is found in Boyd's works and, in addition, in Gates. [The latest data from Madagascar are not accessible to the author.] For Sweden I arrived at the following values: $p = 30.9 (\pm 0.20)$, $q = 7.6 (\pm 0.15)$ and $r = 61.5 (\pm 0.25)$, by pooling the hitherto published Swedish results (about 34,000 Swedes in Sweden who were blood givers in the Army [not serologically selected]). Statistics for populations that have emigrated to their modern homesteads in post-Columbian times are not included in the maps. Naturally it was necessary to make many generalizations in drawing up the maps on such a small scale.

TABLE 1. *Approximate values typical for focal areas of the respective regions*

Region	Per cent		
	<i>p</i>	<i>q</i>	<i>r</i>
A	30	7	63
B (= B 1 and B 2)	18	27	55
C	12	10	78
D	16	16	68
E	28	17	55
F	15	18	67
G	14	12	74
H	40	0	60
J	7	2	90+
C. African Pygmies	25	21	54
Egyptians	27	22	51
E. Java	13	27	60
W. Java	22	19	59
Korea	25	22	53