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A. E. Mourant

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The hereditary blood factors of the peoples of New Guinea and the surrounding regions

BY A. E. MOURANT, F.R.S.
Medical Research Council Serological Population Genetics Laboratory,
St Bartholomew's Hospital, London, E.C. 1

Blood specimens were sent from New Guinea to the Serological Population Genetics Laboratory, London, and tested for blood groups, serum groups and red-cell isoenzymes. The tests carried out are listed but the results are described separately in this volume (by Booth). The general distribution of blood groups and other factors in the region as a whole, is described. They can mostly be explained by assuming the very early settlement of human populations in Australia and New Guinea, followed by the more recent migration of peoples from southeast Asia into most of the islands, but only to the coastal areas of New Guinea and hardly at all to Australia.

INTRODUCTION

Ever since the introduction of boats to the western Pacific and southeast Asia, communications by sea have been relatively easy and those by land difficult: this applies with particular force to the island of New Guinea where, as explained by Booth (this volume, p. 257), the interior is occupied by numerous distinct populations differing widely among themselves and speaking a great variety of languages with little relation to any outside the island. The coastal peoples on the other hand show considerable similarities both physically and linguistically to those of neighbouring islands.

The bulk of the blood tests, the results of which we are about to examine, were done in the Medical Research Council Serological Population Genetics Laboratory, London, though considerable numbers in addition were done by Dr P. Booth. It is he, however, who has analysed all the results with reference to the similarities and differences between the peoples of the Territory of New Guinea, and he will deal with this aspect of the work. The full details will be published jointly elsewhere.

I propose to refer briefly to the technical side of the work, and then to discuss the genetical relationships of the peoples of New Guinea, and especially the coastal peoples, to those of neighbouring islands and continents.

THE TESTS

Because of the good organization of collection and transport of blood specimens it was possible to test the latter for an extremely wide range of hereditary factors. The specimens were collected into 'vacutainers' containing sequestrene (EDTA) as an anti-coagulant, and were sent with ice in insulated containers, by air, first to Sydney and then on to London. Considerable numbers of specimens were also tested by Dr Booth in Port Moresby and later in Christchurch.

Red cells were tested for blood-group antigens of the ABO, MNSs, P, Rh, Lutheran, Kell-Sutter, Duffy, Kidd, Diego, Wright, Radin and Gerbich systems (the last almost entirely by Dr Booth). Sera were tested, by electrophoresis and appropriate staining, for haptoglobins and transferrins. Red-cell haemolysates were tested, by electrophoresis and staining, for variants of the enzymes acid phosphatase, 6-phosphogluconate dehydrogenase, glucose-6-phosphate dehydrogenase, lactate dehydrogenase, adenosine deaminase, adenylate kinase, phosphohexose isomerase, and malate dehydrogenase. The last of these tests was added at a late stage at the suggestion of Dr R. L. Kirk, who had found a new variant in samples from New Guinea which he had tested (Blake, Kirk, Symons & Alpers 1970). It was fortunately possible to obtain clear-cut results with nearly all the stored specimens (Leakey, Coward, Warlow & Mourant 1973), and this variant, up to now known only in New Guinea, has proved most useful in distinguishing between certain populations.

We now, perhaps, possess more information on the distribution of the red-cell isoenzymes in New Guinea than in any other territory of equal size anywhere in the world. These factors have therefore been of considerable value in the comparison of one population with another within New Guinea, though as explained by Booth they vary less in frequency from one part of the territory to another than do the blood groups in the narrow sense, and thus the latter have yielded more taxonomic information than they have.

Moreover, despite the many tests recently done by Dr R. L. Kirk and his colleagues, we know relatively little about enzyme distribution in the surrounding region, and it is the blood groups in the classical sense that provide us with most of our comparative information for the region as a whole.

The peoples of southeast Asia and the Pacific islands

There are at present three main sets of criteria for classifying human populations. Two of these are hereditary and physical – the external characters of the body, and the inherited blood characters, which include blood groups, serum groups and red-cell isoenzymes. The third is a cultural one, that of language. It is well known that on many occasions, in various parts of the world, one population has adopted a new language from a neighbouring one, while incorporating relatively few of its genes, but in general, especially when the methods of glottochronology are used, the relationships of populations deduced from language are found to correspond closely with those deduced from physical observations. Since many of the populations which we are considering have originally been classified by language, it is convenient to consider this criterion first of all.

Languages

Nearly all the indigenous peoples of Malaya and the islands of southeast Asia and the Pacific area, with the exception of Australia and much of New Guinea, speak languages of a well-defined group known as Austronesian. These languages are further classified into the Indonesian group (spoken in Malaysia, Indonesia, the Philippine Islands, Taiwan – and incidentally Madagascar), Melanesian (spoken in parts of New Guinea, mainly the coastal areas, and islands to the east up to and including Fiji) and Micronesian and Polynesian (in the groups of islands known by these names). There can be no doubt that the Austronesian languages have spread in the last few thousand years from the mainland of southeast Asia, but it does not follow that the details of their spread correspond exactly to the movements of the peoples who now speak them. The uniqueness of the blood-group picture presented by the Polynesians in particular suggests that some of their genes may have come from elsewhere than southeast Asia, but that is a topic that cannot in this context be considered in detail. There is, on the whole, a greater approximation to uniformity in the blood-group distribution in Indonesia, Melanesia and Micronesia, but there is nevertheless a well-marked heterogeneity in the area of the Indonesian languages.

Alfred Russel Wallace (1869), the co-discoverer of evolution by natural selection, defined a line cutting across the southeast Asian Archipelago, and passing between Bali and Lombok near the eastern end of Java, which is now known as 'Wallace's Line', and which separates the non-human land faunas of Asia and Australasia. In describing it he mentioned that, somewhat to the east of the same line, there was a marked change in the physical type of the human populations. The distribution of the non-human faunas is probably much older than that of the human populations, but both have depended to a large extent on land-bridges developing in the shallow seas of the area whenever sea-level fell in Pleistocene and perhaps in late Tertiary (Neogene) times.

BLOOD GROUPS

However, the observations of Wallace (and of more recent anthropologists) on man in the area are broadly supported by the facts of blood-group distribution. The details set out below are drawn from a very wide range of publications and have recently been tabulated by Mourant, Kopeć & Domaniewska-Sobczak (1974). References to individual papers are therefore not given here. The most striking features are those shown by the MN system. On the mainland of south-east Asia M gene frequencies are mostly above 65 %, in Java about 65 %, but in eastern Indonesia they lie between 40 and 50 %. In Borneo frequencies are mostly near 60 %, but in the Melanau only 47 %: frequencies in the Philippine Islands are slightly over 50 %. Unfortunately we do not know at all precisely the pattern of the change, for we possess few data for the inhabitants of individual islands in the critical area. In the island of New Guinea frequencies of M are everywhere low – nearly all below 10 % inland, rising to 20 % or more in places on the coast. The details of this pattern are discussed in this symposium by Booth, but it is clear that in general the very old populations of the interior, with very low M frequencies, have interbred in the coastal areas with peoples coming, possibly at one or more removes, from southeast Asia and Malaysia. The relatively low M frequencies in eastern Indonesia thus appear to be the result of interbreeding of peoples of the Malay radiation with peoples related to the inland peoples of New Guinea, possibly as a result of a counter radiation, but more probably due to old populations having already existed on the various islands when the Malays arrived.

The islands of Micronesia, to the north of New Guinea, have M gene frequencies from 20 to 40 %; in the rest of Melanesia, east of New Guinea, they also fall to near 30 %. In both these areas we are presumably witnessing the effect of mixing of these two main stocks. In contrast to this the Polynesians, farther east still, have M gene frequencies near 50 % – considerably lower than in south-east Asia but definitely higher than in Melanesia and Micronesia.

In attempting to understand the origins of the peoples of New Guinea and the surrounding islands it is, of course, necessary to take into account the blood groups of all systems, and these are considered in the following paragraphs, but the MN groups have been considered first and separately because they provide such a clear-cut picture.

The S and s genes, closely linked to M and N, add little to the regional picture, as so few data are available. Within New Guinea, there are, however, abundant data for the frequencies of these genes, which add considerably to our understanding of the internal situation. While S has a rather low frequency by European standards, it is present in nearly all the peoples of New

Guinea, but almost solely in the combination *NS*, which is rare in most other parts of the world but relatively common in the Ainu of northern Japan. By contrast the Australian Aborigines, with about 30 % of *M* genes, are almost totally lacking in *S*.

The ABO blood groups are in all parts of the world notoriously variable in their frequencies, even among peoples otherwise known to be closely related (as they are, for instance, in Western Europe). This is probably why, in the region we are considering, they do not contribute much useful information. The frequency of the *B* gene fluctuates without departing far from the range of 15–20 % (it is virtually absent in Australia and Polynesia); *O* is high and *A* low in Malaya, and both genes fluctuate very considerably in frequency within New Guinea.

The gene frequencies of the Rh system show a rather disappointing degree of uniformity throughout the region. Rh(D)-negatives are of course almost totally absent, and $CDe(R_1)$ is everywhere preponderant.

However there is a steady rise from *CDe* frequencies near 80 % on the Asiatic mainland to levels between 80 and 90 % in Indonesia and an average of slightly over 90 % for the very numerous sets of data for the island of New Guinea, where also *CDE* (R_z) is almost totally absent. As one moves northward and eastward from New Guinea, *CDe* falls and *cDE* rises in frequency. Once again the Polynesians differ markedly from the Melanesians and Micronesians, in having (like American Indians) 40 % or more of *cDE*. The Australian Aborigines differ from the peoples of New Guinea in having somewhat less of *CDe* and more of *cDE*, but especially in their almost constant relatively high frequency of *CDE*. Apart from a few Siberian populations, the highest recorded frequencies of *CDE* are found in Australian Aborigines and American Indians.

The *K* and Lu^a genes are almost completely absent throughout the area, as is the Di^a Mongoloid marker gene (present, however, in the Sea Dyaks of Borneo). The Duffy (Fy) system, however, yields some useful data. Throughout most of the area $\mathrm{Fy^a}$-positives predominate, but about 20 % of Fy^b genes are present. However, in the island of New Guinea itself, in the Bismarck Archipelago, and among the Australian Aborigines, many population samples are entirely $\mathrm{Fy^a}$-positive, and in a few cases they have been shown also to be entirely $\mathrm{Fb^b}$-negative, so that even Fy^b heterozygotes are absent.

Tests for the Jk (Kidd) system, though few, are of some interest. In most parts of eastern Asia the frequency of the Jk^a gene is about 40 % – somewhat lower than in Europe. There are unfortunately no data available for Indonesia, but in Melanesia most frequencies are near 60 %. In the Territory of New Guinea, however, there is a markedly bimodal distribution, some populations showing about 60 % and some about 30 %. It is possible that the higher frequencies originate in the sea-based recent immigrant populations, and the lower frequencies in the old-established inland peoples, but the scanty data are inadequate to prove this.

Other blood factors

There are abundant data on the haptoglobins for the Territory of New Guinea and the Bismarck Archipelago, and for Australian Aborigines, and a few data for eastern Asia and the intervening islands. The frequency of the Hp^1 gene in New Guinea and the Bismarck Islands is near 70 % – considerably higher than in the islands and continent to the west. Frequencies in the Solomon Islands are near 60 %. They are variable but lower in Micronesia, but the Hp^1 average frequency for Polynesia is surprisingly high at 64 %. The average for Australian

Aborigines on the other hand is extremely low: 18 %. Glucose-6-phosphate dehydrogenase deficiency is present in most populations tested in southeast Asia, Indonesia and New Guinea. Frequencies of the deficient type of gene vary widely from 1 or 2 % to about 20 %. Variations are, however, almost certainly the result of the varying incidence of *falciparum* malaria, rather than indices of population affinities.

Numerous tests for other isoenzyme systems have been carried out on the peoples of New Guinea itself, but comparative data for the surrounding region are very few indeed. These systems are therefore of value mainly for purposes of internal comparison, and are discussed by Booth in this volume. The fast-migrating variant of malate dehydrogenase already mentioned, and a fast variant of phosphoglycerate kinase (which has sex-linked inheritance) (Chen, Malcolm, Yoshida & Giblett 1971), are of special interest as they appear, so far, to be confined to New Guinea.

The broad picture presented by the distribution of marker genes in southeast Asia and Australasia is consistent with the long-established existence of populations, fairly distinct from one another, in New Guinea and Australia, followed by the much more recent spread from the Asiatic mainland of sea-going peoples who may collectively be called Malays. They may have been heterogeneous when they set out, as they certainly are now, but it is difficult to say how far the heterogeneity now observed is original, how far to subsequent genetic drift and evolution, and how far to mixing (apart from the undoubted cases of New Guinea and the extreme north of Australia) with populations already established on the various islands, or migrating simultaneously from other homelands. Despite the archaeological evidence for a very early arrival of man in Java, no genetical evidence has so far been found of an ancient component in the present population.

The close collaboration, throughout the Pacific area, of physical anthropologists, serologists and archaeologists is throwing a flood of light on the prehistory of the islanders, but there is a serious lack of up-to-date serological data from China, Malaysia, Indonesia and the Philippines. This constitutes a weak link in the chain of evidence, and one which ought to be remedied as soon as conditions in the area become favourable for research.

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