BLOOD GROUPS AND TYPES*

BY

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What They Are

MICROSCOPICALLY blood is seen to consist of (*i*) a watery colourless fluid, the *plasma*, and (*ii*) structures with definite shapes, the *blood cells and platelets*. Most of the structures are biconcave discs coloured yellow, the *red blood cells*, hereafter called *r.b.c.* In the r.b.c. there may exist one, both or neither of two group-specific substances, A and B. In the plasma there may exist one, both or neither of two anti-substances, a and b. A substance and its anti-substance cannot exist side by side in the same subject, because the r.b.c. containing the substance get stuck together, *agglutinated*, or even broken up, *lysed*, in the presence of the anti-substances in the plasma.

The only four combinations compatible with life are the four groups. They are:—

Substance in r.b.c.	Anti-substance in plasma	Designation of blood group in New Nomenclature	Designation of blood group in Old Nomenclature	
			Jansky	Moss
O (= nothing, capital letter)	ab	O	I	IV
A	b	A	II	II
B	a	B	III	III
AB	o (= nothing, small letter)	AB	IV	I

In the New Nomenclature the group is named after the substance. In a *'defective group'* an anti-substance which can exist is absent. The Old Nomenclature should now be forgotten.

How they are Determined

When the blood is shed it clots. From the clot is squeezed out a straw-coloured watery fluid, the *serum*. In the serum are contained the anti-substances of the plasma. Only the serum containing a, serum a, and the serum containing b, serum b, are required. They will determine the four groups, thus:—

If only serum a agglutinates the unknown r.b.c., the group is A.

If only serum b agglutinates the unknown r.b.c., the group is B.

If both sera agglutinate the unknown r.b.c., the group is AB.

If neither serum agglutinates the unknown r.b.c., the group is O.

Sub-Groups

Group A is further divisible into A_1, A_2 and A_3 (Wiener, 1939), *sub-groups*, depending upon a full or a partial affinity only for serum a. A blood may thus be: O; A_1, A_2, and A_3; B; and A_1B, A_2B and A_3B (eight serological divisions instead of four).

Types

In addition but unrelated to the substances A and B there exist in the r.b.c. substances M and N. They differentiate three *types* within each group or sub-group, thus: OM, ON, OMN; A_1M, A_1N, A_1MN; A_2M, A_2N, A_2MN; A_3M, A_3N, A_3MN; BM, BN, BMN; A_1BM, A_1BN, A_1BMN; A_2BM, A_2BN, A_2BMN; and A_3BM, A_3BN, A_3BMN (24 serological divisions instead of 4 or 8).

In the M-N system there is nothing corresponding to O in the A-B system.

How Types are Determined

The substances M and N belong to a class quite different from that of substances A and B. Normally there are no naturally occurring anti-substances corresponding to them in human blood. They are prepared in animals artificially. The principle involved is simple. From OM r.b.c. is prepared *anti OM serum*. The antiserum is absorbed with ON r.b.c. The residue left after absorption is *anti M fluid*. Similarly *anti N fluid* is prepared. The preparation in practice is rather wasteful and tedious (Greval, Chandra and Woodhead, 1939).

Knowing all about the groups, sub-groups and types it is possible to obtain one's own grouping sera and prepare one's own typing antifluids without any extraneous aid. It is

* In this communication technical terms needing explanation have been italicised close to the explanation.

much more convenient, however, to procure the material from laboratories stocking it, to begin with.

Blood Groups, Sub-Groups and Types in Transfusion of Blood and Skin Grafting

In transfusion the ideal arrangement is (*i*) that the recipient and the donor should belong to the same group and (*ii*) that the compatibility of bloods should be established *in vitro* by direct matching. In emergency all recipients can be transfused from a donor of group O, '*Universal Donor*'. Recipients AB, '*Universal Recipients*' can at all times be transfused from donors of all groups. Attention has recently been redrawn to dangerous 'Universal Donors' (De Bakey & Honold, 1938). The same danger also exists in transfusing 'Universal Recipients'. The writer eliminates the danger (Greval and Chandra, 1939). The stored blood needed after air raids should come from safe universal donors. Very recently use of plasma has been recommended. The plasma can also be made safe.

The sub-groups have no significance in transfusion apart from the fact that they lead to error in grouping at times.

The types may have some significance in transfusion and may be responsible for incompatibility within the group as determined by direct matching (Greval and Chandra, *loc. cit.*).

In skin grafting and allied operations the consideration detailed above should also hold.

Blood Groups, Sub-Groups and Types in Genetics

O, A and B are all allelomorphs (contrasting characters). A and B are dominant while O is recessive. Mass statistics have shown that their inheritance follows the Mendelian Law. Further, A_1 is dominant over A_2 which is dominant over A_3.

M and N are both dominant.

Biological subtleties and speculations in genetics have found scope for operation when unexpected groups have turned up. The number of such unexpected occurrences has, however, steadily decreased with improvement in technique.

Blood Groups and Types in Forensic Medicine

From the groups of the parents all the possible groups of the offspring can be determined. It is possible to say that Master Tom *cannot* be the son of Mr. Smith. It is not possible to say that Master Tom *is* the son of Mr. Brown. All that an affirmative evidence can say is that Master Tom *can be* the son of Mr. Brown. The same remarks apply to Mrs. Smith and Mrs. Brown regarding motherhood.

Most workers in forensic medicine do not make use of sub-groups in determining parentage, because of difficulties of technique and consequent uncertainty of results.

M and N are easily determinable and may aid when groups have failed.

The writer has dealt with the question of inheritance of groups and types more fully elsewhere (Greval, 1939, 1940). The following tables give possible and impossible children.

Table I

Blood groups in parents and children

	Parents	Children possible	Children impossible
1	O × O	O	A, B, AB
2	O × A	O, A	B, AB
3	O × B	O, B	A, AB
4	A × A	O, A	B, AB
5	A × B	O, A, B, AB	..
6	B × B	O, B	A, AB
7	O × AB	A, B	O, AB
8	A × AB	A, B, AB	O
9	B × AB	A, B, AB	O
10	AB × AB	A, B, AB	O

Table II

Blood types in parents and children

	Parents	Children possible	Children impossible
1	M × M	M	.. MN N
2	M × MN	M MN ..	.. .. N
3	M × N	.. MN ..	M .. N
4	MN × MN	M MN N	.. .. ..
5	MN × N	.. MN N	M .. ..
6	N × N	.. .. N	M MN ..

The group of a stain of blood can also be determined. It is possible to say whether

a stain can or cannot be derived from the blood of a certain person. Even the saliva may indicate the group.

Blood Groups and Types in Anthropology

The relative distribution of O, A and B, and M and N varies in different countries and communities. A predominates in European and B in Indian population. M and N show similar differences (Greval, Chandra and Woodhead, *loc. cit.*).

A view has been advanced that the original group in man is O, that A and B mutations have arisen in two different and distant foci, and that the present distribution has resulted from mingling of masses of humanity.

Immunologically, indications exist that A_2 and A_3 are nearer O than is A_1. Presumably they are nearer genetically too.

In a comparatively very small survey undertaken so far M and N have also shown marked differences in distribution. They too will indicate movements of masses of humanity when more is known about their distribution.

Blood Groups in Animals

Blood groups in animals also exist though they have not been yet worked out (Snyder, 1929). Interest in monkey gland having waned during the last decade, it can only be mentioned in a whisper that an exponent of rejuvenation passed through Calcutta a few years ago in search of monkeys, elsewhere, whose blood group corresponds as closely as possible to human group O. A graft from O is more likely to take and live than a graft from an unknown group which is likely to be different from the group of the subject rejuvenated.

Blood group distribution in the live-stock will presumably have a co-relation with biological qualities. Breeders may improve their stock by selection of blood groups in addition to or in place of selection of specimens.

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EDUCATION DEPARTMENT, OFFICE OF THE HIGH COMMISSIONER FOR INDIA, LONDON

DR. THOMAS QUAYLE'S Report on the activities of the Education Department of the Office of the High Commissioner for India (1938–39) is an impressive document and in the forwarding note we obtain glimpses of the tender solicitude with which the Department was looking after the welfare of Indian students in Great Britain when the international tension culminated in open hostilities in the final month of the year under review. At the beginning of the period there were about 1,514 students, including 131 women, pursuing full-time courses at Universities and Colleges throughout Great Britain, while there were also 118 students taking part-time courses in various branches. In Appendix V to the Report is given a long list of successes achieved by these students, and it is very gratifying to note that a fairly large number of academic honours have come to the share of women. Miss K. N. Bhagvat (Bombay) obtained the PH.D. (Cambridge) in Biochemistry, Miss D. H. Shahaney (United Provinces) was awarded the PH.D. (London) in Bacteriology as a student of the Imperial College of Science and Technology, Miss C. J. Dastur (Central Provinces) gained the B.LITT. degree in English at Oxford, Miss K. E. Bruen (a Government of Burma scholar) got the M.A. degree in Geography of London. In Surgery Miss V. Sankarambal (Mysore) passed the examination for the Fellowship of the Royal College of Surgeons, England. In Section III of this Report, particulars are furnished of the work done by the Department in collaboration with the Indian Stores Department, to find practical training in various branches of industry for the large number of students who each year seek these facilities. It is pointed out that the main difficulty in procuring these facilities arises, not from any racial discrimination, but is due, under pressure of intense trade competition, to the instinct of self-preservation. These trainees ought not to be looked upon as potential competitors, but as collaborators in the development of the Empire of which India is an equal partner.