SPECIAL ARTICLES

THE MNSs BLOOD GROUP SYSTEM *

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As has been the case with many of the other blood group systems, the first steps in the elucidation of the MN system seemed to point towards a simple monomeric character with only two alleles, both of which could be detected directly by suitable antibodies. The genotype could thus be inferred from the phenotype in all cases. It should be mentioned that, in contrast to the way in which the ABO system was discovered, this second important step in serology was the result of many years of systematic search. A variety of animals, preferably rabbits, were injected with human red cells from different individuals. The antibodies formed were tested against a battery of human erythrocytes, and, in 1927, some interesting results were obtained which led to the establishment of two new blood group systems, the MN and the P systems. This work was carried out by Landsteiner in cooperation with an American serologist, Levine. After testing some families with the newly detected antibodies, they were able to establish the genetic hypothesis which is still valid, although it has undergone some later extensions and additions.

The notation used for the ABO system was adopted for the MNSs system. The same letters symbolize the genes and the antigens : thus, the two available genes are called M and N, and they provoke the formation of the antigens M and N, respectively. We do not know which of the chromosomes is the seat of the MN locus. We know only that all other blood group loci investigated so far are some distance from the MN locus, or on different chromosomes entirely. This also applies to loci determining a great variety of rare inherited diseases, the linkage relations of which have been studied.

About twenty years later a new antibody was detected which seemed to define an antigen related to the MN system. The new antigen was called S. This letter had previously been used in con-

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nection with the (ABH—) Secretor character but this was changed to Se, and S and s for the allele are now used only in connection with the MNSs system. The first suggestion was that S and s were alleles at a locus closely linked to the MN locus, and this theory is supported by some recent observations which point to a crossing over between these two loci. Until this is confirmed, however, the other possible explanation must be kept in mind. This alternate theory implies the existence of four alleles, MS, Ms, NS. and Ns, all at the disposal of one and the same locus. Thus, the presence of one gene should lead to the production of two detectable antigens. The discovery of an antibody reacting specifically with the antigen s has helped considerably in the study of these basic problems.

During the last ten years, many complicating observations have been made. One of these was the discovery of individuals who did not react with either anti-S or anti-s. It has not yet been shown whether this is due to a third allele causing a new, undetectable antigen, or whether modifying genes are at work. Furthermore, a stream (about 20 so far) of new antibodies have been found which seem to define antigens with some relation to the MNSs system. As many of these antigens seem to be rare and the antibodies are in the majority of cases limited in amount, extensive family studies have not yet been possible. Such studies would be the only means of deciding the genetic relationship between these characters.