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On the absence of isoagglutinins in mice.

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The number of units of inheritance, or genes that are known in mice, is already so much in excess of the number of those known in any other mammal that there is offered a strong inducement to make intensive studies in order to increase the number of genes to the point where the deeper study of the genetic mechanism of a mammal may be undertaken. A possible field for the search for new characters was suggested by the claims of Von Dungern and Hirschfeld[1], Learmonth[2], and Ottenberg[3] that blood groups in man depend in their inheritance upon simple Mendelian factors. Besides being of interest from the standpoint of mouse genetics and of the technique of experimental transplantations, the discovery of blood groups in mice would lead to a genetic investigation that could provide an experimental basis for the study of the inheritance of blood groups in man.

The tests made upon rabbits and steer by Ottenberg and Friedman[4] are said to reveal the presence of blood groups in these animals. On the other hand, other investigators (Hektoen[5], Ingebristen[6], Fischbein[7], and Rohdenburg[8]), using a variety of animals (cats, dogs, sheep, swine, cattle, horses, rabbits, guinea-pigs, rats, and frogs), have failed to find any evidence of blood groups. In certain cases agglutinations were found, but these did not appear to be grouped.

Such negative results did not promise well for the discovery of blood groups in mice, but the availability of a greater number

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1 Von Dungern and Hirschfeld, *Zeit. f. Immunitatsforschung*, 1910, vi, 284.

2 Learmonth, J. R., *Jour. Genetics*, 1920, x, 141.

3 Ottenberg, R., *Journ. Immunology*, 1921a, vi, 363; *Journ. Am. Med. Asso.*, 1921, lxxvii, 682, and 1922, lxxviii, 873.

4 Ottenberg and Friedman, *Journ. Exp. Med.*, 1911, xiii, 531.

5 Hektoen, *Journ. Infect. Dis.*, 1907, 297.

6 Ingebristen, *Münchener med. Woch.*, 1912, lix, 1475.

7 Fischbein, *Journ. Infect. Dis.*, 1913, xii, 133.

8 Rohdenburg, G. L., PROC. SOC. EXP. BIOL. AND MED., 1920, xvii, 82.

of different races than had been used in testing the other animals favored the chances of a positive result.

The following races of mice were used in the present experiments: (1) Japanese Waltzers (Lambert strain), which originated from a single pair of mice isolated in 1906 and intensively inbred ever since; (2) ten lines inbred three or four generations from Lathrop stock by Dr. C. C. Little in his experiments with X-rays; (3) Lathrop stock mice untreated with X-rays; (4) Albinos of a vigorous strain inbred since 1912 by Dr. H. J. Bagg of the Memorial Hospital; (5) from Dr. L. C. Dunn of the Agricultural Experiment Station at Storrs, Conn., three selected piebald families, inbred brother by sister for three years, descendants of an old race originally at the Bussey Institution of Harvard University, later in the hands of Dr. J. A. Detlefson, and later in the possession of a fancier; (6) Dilute Browns, a race inbred by Dr. Little since 1909; (7) Storrs-Little, a race of pink-eyed blacks, derived from the preceding race with the introduction of a single unrelated animal and subsequently crossed back to the pure dilute brown for five generations; (8) Black-eyed Whites, inbred brother by sister for a year by Dr. L. C. Strong of St. Stephens College, mice coming from a race kept pure since its introduction from England in 1913 at the Bussey Institution; (9) Cold Spring Harbor wilds, comprising two sets of wild mice taken at two separated places in Cold Spring Harbor, both places being at some distance from the Laboratory; (10) Storrs wilds, raised from wild mice collected at Storrs, Conn.; (11) Waltzers; a stock from a back cross between Japanese Waltzers and Bagg Albinos made by Miss E. M. Vicari. The use of these various races was made possible by the cooperative spirit of the following investigators: Drs. Little, Dunn, and Strong, Mr. Gates and Miss Vicari.

METHODS

In order to secure enough serum it was necessary to kill the mouse. The most successful method proved to be to etherize, suspend it by its tail and cut its throat suddenly with scissors, catching the blood in a centrifuge tube by means of a paraffined funnel. After the blood clotted, the serum was separated in an electric centrifuge and pipetted off into a small test tube. To obtain samples of cells, the tip of a mouse's tail was cut off and

small amounts of blood taken with a pipette and added to about a c.c of a 0.7 per cent. salt solution. Based on the light pink color, cell suspensions of a suitable concentration were obtained. This method was used because the main problem necessitated a procedure that did not require killing the mouse to be tested. Each test was made by microscopic examination of a hanging drop of equal quantities of cell suspension and serum; the observations were made within an hour.

From the various races of mice forty-eight sera were made, and a total of 300 samples were tested; the total number of different combinations of cells and sera was 1,180. Of these combinations only two showed any agglutination. These two cases were combinations of cells from two wild mice and serum from a Storrs-Little pink-eyed black. Repeated tests with cells from the same mice and serum from mice related to the one that gave the first serum failed to give further agglutinations.

Since one mouse yields such a small amount of serum, at best 2 c.c., it was thought that some other serum, obtainable in larger quantities might have advantages in testing for differences in the blood of different strains of mice.

To this end four guinea-pig sera were used in making 180 tests; four sheep sera were used in making 136 tests, and nine white rat sera were used in making 276 tests. In every case the guinea-pig and sheep sera showed unquestionable agglutination, and in no case did the rat sera show any signs of agglutination, although the whole range of mouse races was tested with each of the sera.

These results appear to be conclusively negative from the standpoint of finding blood groups in mice that could be utilized in a genetic study; from the standpoint of the agglutinations between different species, it appears that guinea-pig and sheep differ from rats in the reactions of their sera to mouse cells.