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The importance of changes in electrical charge in specific bacterial agglutination.

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We have undertaken studies of the changes in the electrical charge on bacteria that take place in specific bacterial agglutination. Last year,[1] working with pneumococci and paratyphoid bacilli, we were able to show that their immune agglutinating sera possess a specific charge-reducing effect which is quantitatively related to the agglutination titre of the serum, which may be removed by absorption of agglutinin by the homologous or-

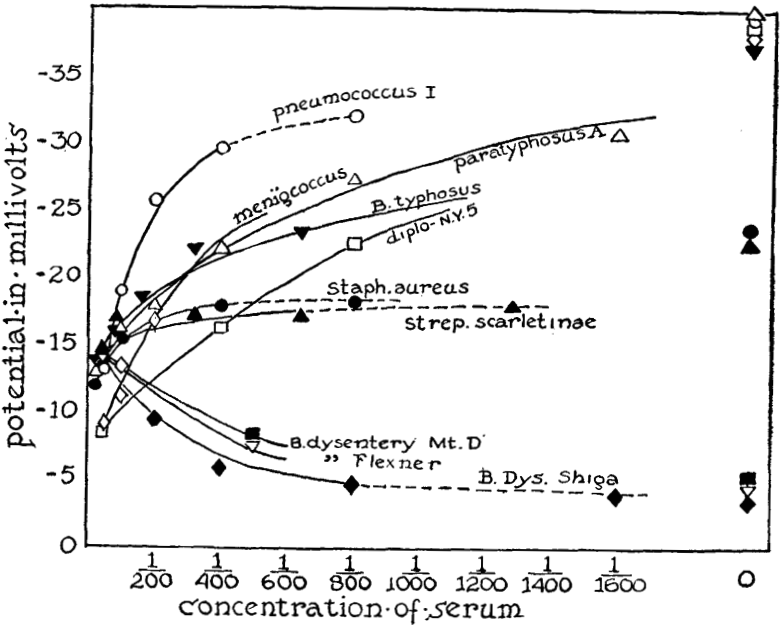

FIG. 1.

Effect of ten immune agglutinating sera upon potential and agglutination of their homologous organisms. Experiments in G. P. A. buffer pH 7.0 (M/200). Solid lines indicate agglutination, broken lines, no agglutination.

[1] Shibley, G. S., *J. Exp. Med.*, 1924, xl, 453.

ganism; this specific effect was not demonstrable in a highly protective, non-agglutinative serum.

This year, these studies have been extended to many other organisms and their sera; and it has been found that the conclusions set forth above may be enlarged by the statement that, where the natural charge on the organism is very low, specific serum *raises* the charge. Determinations were made (Fig. 1) of the changes in charge produced by their specific sera upon Type I pneumococci, meningococci, staphylococci, hemolytic streptococci, a diplococcus variant of streptococci, typhoid, and paratyphoid A bacilli, and three strains of the dysentery bacillus, Flexner, Shiga and Mt. Desert. In the case of the first named seven organisms, where, under the conditions of the experiment, the charges without serum are high or relatively high (23-40 millivolts), the homologous agglutinating sera produce a reduction of charge which is directly proportional to the concentration of

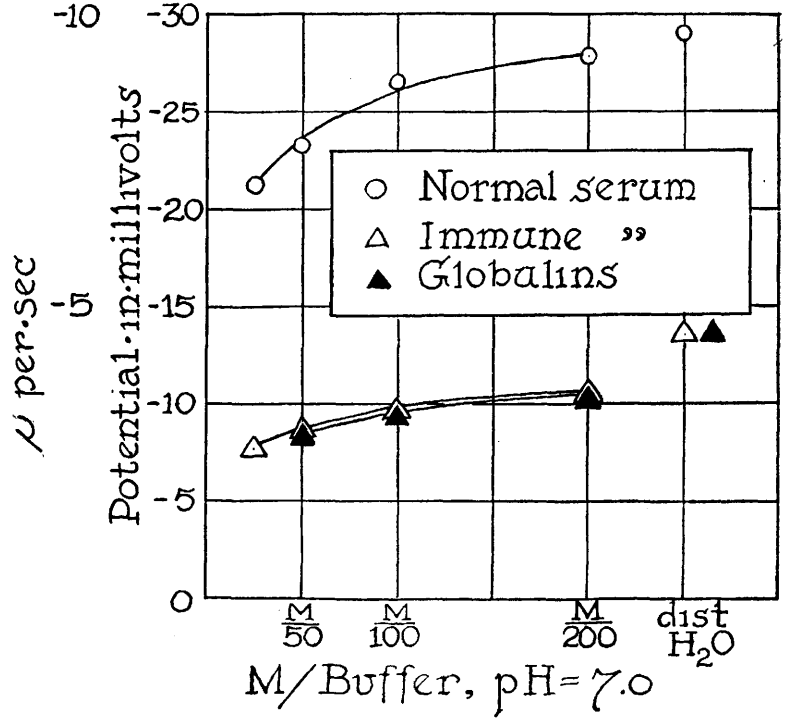

FIG. 2.

Effect of G. P. A. buffer pH 7.0 in varying molar concentration upon potential of Type I pneumococci treated with normal and immune serum 1:20 and of globulins of the immune serum.

the serum. However, with the three dysentery strains, where the natural charge is low (5 mv.) the effect of the specific sera is to raise the charge. In all cases, no matter what the initial charge, the effect of the serum in high concentration is to bring the charges of the bacteria to a *common potential level* (8-14 millivolts). It is known that bacterial agglutinins are included in the globulin fractions of immune sera. Euglobulin particles from human ascitic fluid were tested in electrolyte solutions similar to those used in the preceding experiments, and their charge falls into the potential zone noted above. Also, the globulin particles of a Type I pneumococcus serum were thrown down by the addition of distilled water, and the charges on these particles and on sensitized Type I pneumococci were compared (Fig. 2), and were found to be practically identical, *i. e.,* the sensitized bacteria act essentially like globulin particles, or in other words, the bacteria are coated by the agglutinin.

From these findings it may be concluded that the first step in the specific agglutination of bacteria is a selective coating of the organism by its particular agglutinin, that the changes in electrical charge accompanying the phenomenon are the result alone of this coating, and that the changes in charge, although perhaps contributory, do not, *per se,* have great importance in the mechanism of specific bacterial agglutination.

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Notes on the mechanism of paroxysmal hemoglobinuria.

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The assumption that the Landsteiner[1] phenomenon constitutes the actual mechanism in paroxysmal hemoglobinuria has been questioned on clinical grounds, and has led to several attempts to demonstrate some other factor promoting intravascular hemoly-

[1] Donath, J., and Landsteiner, K., *München. Med. Wchnschr.,* 1904, li, 1590.