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Adsorption Isotherms of Some Bacterial Polysaccharides.

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The study of one of us[1] on the adsorption of bacterial polysaccharides on colloids as antigens suggested further study of the adsorption isotherms of some of these substances, to see if they follow the type of curve usually obtained in adsorption experiments. In the previous work[1] collodion particles, aluminium hydroxide, casein and bacterial cells were used as adsorbents, but in all of these substances with the exception of aluminium hydroxide the adsorption is so slight as to be hardly detectable.

The adsorptive power of charcoal exceeds that of other adsorbents and with this fact in mind as well as the successful immunizing effect which Landsteiner and Jacobs[2] found using this substance as adsorbent with the polysaccharide from *V. cholera,* we used charcoal ("Norit" obtained from A. H. Thomas and Co.) as our adsorbent and as polysaccharides we used that of anthrax, pneumococcus types I and III.

The amounts adsorbed were determined by the precipitin-test with a specific immune serum, titrating the mixed washings from the adsorbent, using as control the same polysaccharide in known concentrations. By comparing the highest dilution of the unknown which gave a definite precipitate with the highest dilution of the control polysaccharide giving the same amount of precipitate, the amount of polysaccharide in the unknown was determined. This method permits a much more accurate determination of the amount of polysaccharide adsorbed than the present chemical method at our disposal (determination of reducing sugars after hydrolysis).

The formula used for the making of the curves is the one given by Freundlich[3]: $a = \alpha c\ 1/n$, where a is the amount adsorbed by 1 gm. of adsorbent, c is the residue in solution of adsorbed substance and α and $1/n$ are constants. This formula is valid at some distance from saturation and can only be applied to the bent rise of the curve. The amounts of carbon used varied from 4.0 to 0.25 gm.

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1 Zozaya, J., *J. Exp. Med.,* 1932, **55**, 325.

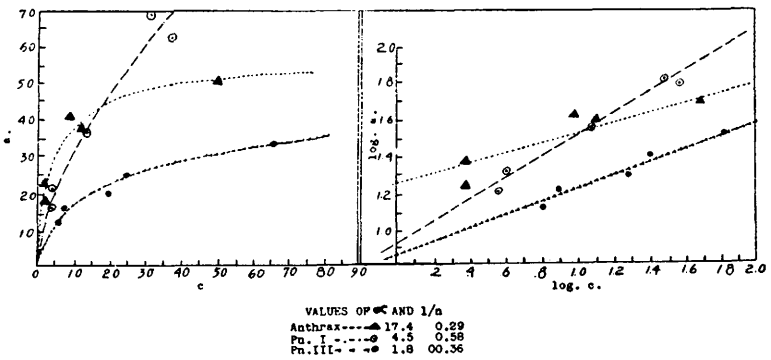
2 Landsteiner, K., and Jacobs, J., PROC. SOC. EXP. BIOL. AND MED., 1932, **29**, 570.

3 Freundlich, H., Colloid and Capillary Chemistry, E. P. Dutton and Co., 1922.

and the polysaccharide from 100 to 10 mg. The volume was kept at 10 cc. We washed the adsorbent with distilled water 6 times. The temperature was that of the room, and the time allowed for adsorption was 30 minutes, keeping the container constantly shaken.

The results of our experiments are given in the graph, in one case plotting the actual values of a against c, and in the other the logarithms of the same. The values which we found for α and $1/n$ of the different polysaccharides are given at the bottom of the graph.

FIG. 1.



Plotted values and curves of a and c values of anthrax, pneumococcus types I and III, polysaccharides adsorbed on charcoal (norit).

The logarithmic curves were all straight lines as was expected and the values of the adsorption exponent $1/n$ are all within normal adsorptions. In all these cases the adsorption was of the non-reversible type and since all of the polysaccharides here studied have been successfully tested for antigenicity, it suggests an interesting speculation as to the mechanism of antibody formation with these antigens which will be further discussed in another paper.

Of practical importance is the fact that once the adsorption isotherm is determined and the values of the constants obtained, one can use the equation for calculating the amounts adsorbed from a solution of a given concentration of these substances.