surgical anesthesia and asepsis and stones from human bladders, too large to pass through the canine ducts, were inserted. The stones chosen were of the compact variety made up of bile pigments, calcium, iron, and, in some, cholesterol. The experimental animals were confined in laboratory cages and were given a regular mixed diet. After an average duration of 60 days in these 8 dogs, the stones had diminished in size in 3 and had disappeared in 5.

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## Effect of Bacteriophage Upon the Agglutination of Hemolytic Streptococci.

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There exists a definite effect of the bacteriophage upon the phenomenon of agglutination in the coli-typhoid-dysentery group, as is seen from papers by d'Herelle,[1] Bordet,[2] Gratia[3] and others. Since the studies on this problem were confined exclusively to the coli-typhoid-dysentery group, it was thought desirable to extend them to hemolytic streptococci in which the phenomenon of bacteriophage was shown to exist, Dutton,[4] Shwartzman.[5]

The effect of two lytic principles upon various strains of pathogenic streptococci which differed in their antigenic structure and their susceptibility to these principles, was investigated. The results may be grouped as follows:

1. The first group of changes of a whole culture was observed with a strain of scarlet fever streptococci grown in broth containing lytic principle. The changes consisted of complete inagglutinability by the normal culture serum; considerable loss of agglutinin absorbing power, and partial loss of agglutinogenic power. Two rabbits persistently immunized with this antigen responded with agglutinins of a low titer (1:400). The same method of immunization with the normal culture gave sera of titer 1:12,800.

2. When a strain highly susceptible to phage was made resistant to this principle it underwent changes which were still more marked than those described above. These changes manifested themselves in complete inagglutinability, complete loss of agglutinin absorbing and agglutinogenic properties. Five animals failed to respond to immunization with lysed cultures or with the resistant type of this

strain. Further attempts to obtain anti-sera should be made before complete loss of agglutinogenic properties can be safely accepted.

3. Examples of changes of a different character were afforded by representatives of scarlet fever streptococci and a strain of rabbit hemolytic streptococcus. These streptococci when treated by the phage became inagglutinable by homologous normal culture sera. However, the specific antigens were completely preserved, since the phage cultures were able to absorb agglutinins from normal culture sera, and incited the production of agglutinins for the normal cultures. Moreover additional components became prominent in the phage cultures. The phage cultures sera agglutinated the homologous as well as the normal cultures to a high titer. This was in contrast to the effect of the normal culture sera which were not able to agglutinate the phage cultures, or did it in a very low titer. The added components were related to the specific antigens of the normal cultures, from which they were derived. In one instance (rabbit streptococcus) the additional component was not related to the specific antigen of this strain.

The relation of the additional components to other strains was studied by cross absorptions and cross agglutinations with various strains on hand. It was found that these components were of the "group" variety and thus considerable cross agglutinations occurred with heterologous strains.

4. Two strains of streptococci (one green producing strain and one pyogenes hemolytic streptococcus) underwent a complete modification. The changes consisted of complete transformation of the normal cultures into antigens of entirely new specificity.

It appears that the bacteriophage phenomenon may play an intricate rôle in the serological grouping of various strains of pathogenic streptococci.

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[1] d'Herelle, The Bacteriophage, English edition, 1926.

[2] Bordet-Cinca, *Compt. rend. Soc. Biol.*, 1921, lxxxiv, 280.

[3] Gratia, A., *J. Exp. Med.*, 1922, xxxv, 287.

[4] Dutton, L. O., *J. Inf. Dis.*, 1926, xxxix, 48.

[5] Shwartzman, Gregory, *J. Exp. Med.*, 1927, xlvi, 917.