is favored by more alkaline pH. Changes in surface tension of the media[4] do not alter the manifestation of agglutination by susceptible bacteria so long as growth is possible.

No correlation has been found between agglutinability of susceptible organisms and their capacity to produce coagulase, to ferment mannitol and to produce rabbit-cell hemolysin. Agglutinable staphylococci have been tested with other materials from the egg, such as albumin, yolk and an emulsion of chick embryo, but none has given the phenomenon as described. A limited number of observations suggest that amniotic fluid probably possesses, in common with the chorio-allantoic fluid, the ability to exhibit the reaction. The effects of normal horse serum as well as peptone have been tested with negative results. Further, there is no apparent relation between the present agglutination reaction and the known property of some staphylococci to show clumping when grown in media containing human red blood cells. Experiments have ruled out the possibility that this reaction is associated with any colony change due to bacterial dissociation. Preliminary observations suggest that bacteriophage[5] does not play a role in this phenomenon, since both the Craig and the Wood 46 strains have been shown to carry bacteriophage.

This property of the egg fluid, whether in normal or virus-infected material, disappears very rapidly (in 1 to 2 min.) at 56° C. If, however, the titer is unusually high, exposure for 5 minutes at this temperature may be required for inactivation. The agglutinating property of the fluid will remain active at ice-box temperature for a month or more.

When this agglutination phenomenon was first observed, it was in association with influenza virus-infected chorio-allantoic fluid. However, some normal fluids were soon found to manifest the same effect with susceptible bacteria. In these early experiments filtrates[6] of mouse lung infected with influenza virus were tested as well as filtrates from normal mouse lungs. Similar results were obtained using these reagents as have been described for the chorio-allantoic fluids. Wood 46 strain showed no agglutination with virus-infected or normal lung filtrates in the tests made, 14 and 12, respectively. The Craig strain was agglutinated by all 14 virus-infected filtrates, but in only 4 of the 12 tests with normal lung material did the reaction take place. This aspect of the work while interesting has not been stressed, for when filtrate-broth mixtures stand for 18 hours at 37° C. or at room temperature, the precipitation of denatured proteins makes reading of the test difficult. While most samples from normal lungs tested against various strains of staphylococci gave negative reactions (27 tests), occasionally positive results were obtained (4 tests). Agglutinins for staphylococci were lacking in the blood serum from these mice.

Just what part, if any, the influenza virus plays in this agglutination is not understood at present. The fact that most normal chorio-allantoic fluids give the reaction would tend to minimize the importance of this infecting agent. Also, recent experiments show that if one adsorbs the influenza virus from infected fluids with chicken red blood cells and elutes the virus in buffer,[7] the fluid which no longer gives the agglutination of red blood cells agglutinates susceptible staphylococci to the same titer as before adsorption. On the other hand, the buffer into which the virus is eluted does not possess the ability to agglutinate susceptible bacteria even though the virus has been concentrated, as shown by the chicken red blood cell agglutination test.

*Summary:* Certain strains of *Staphylococcus aureus* will agglutinate when grown in the presence of normal or influenza virus-infected chorio-allantoic fluid. Fluids are rendered inactive after heating at 56° C. for one or two minutes. Surface tension and temperature are not important factors in the manifestation of the phenomenon so long as they are within the limits compatible with growth. The reaction is favored by an alkaline pH. Bacterial dissociation is not a feature of this phenomenon and the relationship of this reaction to bacteriophagy is probably not significant but is being investigated further. Similar reactions as described for the egg fluids may be seen when Berkefeld filtrates of influenza virus-infected and normal mouse lungs are used. A more detailed account of all the data will appear at a later date.

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## AN ANTIGEN-ANTIBODY REACTION WITH TETRAHYMENA WHICH RESULTS IN DYSTOMY[1]

AN interesting reaction of the free-living, holotrichous ciliate, Tetrahymena[2] (Colpidium-Glaucoma group), has been observed in experiments dealing with several strains of the organism and immune rabbit sera. These ciliates show the agglutinative, paralytic and sheath-formation reactions described by Robertson[3] when they are incubated for an hour or

[4] W. E. Larson, W. F. Cantwell and T. B. Hartzell, *Jour. Infect. Dis.*, 25: 41–46, 1919.

[5] F. d'Herelle, "The Bacteriophage and Its Behavior," p. 73. Baltimore: Williams and Wilkins, 1926.

[6] Mouse lungs, both normal as well as virus-infected, were ground and filtered through a Berkefeld "N" filter before use in the test.

[7] W. M. Stanley, *Jour. Exp. Med.*, 79: 255–65, 1944.

[1] This work was aided by a grant from the Rockefeller Foundation.

[2] We are very grateful to Professor George W. Kidder for the cultures used in this work.

two in mixture with antisera of appropriate dilutions. In still higher dilutions and with further incubation they show a sharp increase in the number of cells in division as compared to the number of young phenomena when grown in the presence of certain selected strains of bacteria. In both of these studies the occurrence of an increased number of dividing pairs of organisms and the development of monsters

TABLE 1

THE REACTIONS OF TETRAHYMENA, STRAIN H, IN SELECTED ANTISERA

| Type | Rabbit Serum Dilution 1–16 | 1–32 | 1–64 | 1–128 | 1–256 | 1–512 | 1–1024 | Reaction |
|---|---|---|---|---|---|---|---|---|
| homologous immune | ++++ | ++++ | ++ | + | – | – | – | Agglutination |
| | ++++ | ++++ | +++ | ++ | + | – | – | Immobilization |
| | 0 | 5 | 15 | 64 | 36 | 10 | 2 | Dividing pairs (1) |
| | 68 | 55 | 38 | 17 | 12 | 57 | 48 | Single individuals (2) |
| | 0 | 0.10 | 0.40 | 3.80 | 3.00 | 0.20 | 0.04 | Ratio (1) to (2) |
| heterologous immune | – | – | – | – | – | – | – | Agglutination |
| | – | – | – | – | – | – | – | Immobilization |
| | 2 | 8 | 1 | 2 | 7 | 4 | 4 | Dividing pairs (1) |
| | 38 | 44 | 62 | 39 | 75 | 75 | 52 | Single individuals (2) |
| | 0.05 | 0.20 | 0.01 | 0.05 | 0.10 | 0.05 | 0.08 | Ratio (1) to (2) |
| normal | – | – | – | – | – | – | – | Agglutination |
| | – | – | – | – | – | – | – | Immobilization |
| | 4 | 4 | 2 | 2 | 3 | 2 | 3 | Dividing pairs (1) |
| | 52 | 60 | 43 | 48 | 30 | 62 | 50 | Single individuals (2) |
| | 0.08 | 0.06 | 0.05 | 0.04 | 0.10 | 0.03 | 0.06 | Ratio (1) to (2) |

Legend: ++++ to +, strong to weak reaction; – no reaction.

and mature cells not in division. In some experiments as many as 80 per cent. of all the cells used in the test have been found in division at one time. With continued incubation, running up to 24 hours, many of the pairs of cells which seem unable to complete the process of division have been seen to undergo further abortive attempts at division and develop into chains of three or four parts or into multinucleated giant cells of very irregular shape.

The reaction seems to be an antigen-antibody affair: it has been observed in all combinations of organisms and antisera in which the reactions described by Robertson occur; it has not been observed in combinations with antisera or normal serum in which those reactions do not occur. Table 1 illustrates the specificity of the reaction and the frequence with which it occurs in populations subjected to antibody.

We have been impressed with the ability of these organisms to continue growth in spite of a sharp delay or failure to complete division when under the influence of antibody. The rate of increase of total sedimentable cell volume, as measured in Goetz phosphorous tubes in several experiments, seemed to be about the same in the presence of dilute but effective antibody as in normal control serum. Moreover, the progressive increase in size of many affected cells has been followed microscopically. Thus the principal involvement of the organisms in the reaction seems to be connected with the cell surface.

It is perhaps especially significant that other cultures of this genus have been reported by Chatton and Chatton[4] and Sonneborn[5] to exhibit somewhat similar was recorded, but there seems to be some difference in the details of events they observed and the reaction recorded here.

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## ORAL ADMINISTRATION OF PENICILLIN IN CORN OIL AND LANOLIN

PREPARATIONS for oral administration of penicillin are undoubtedly increasingly in demand. Since Libby's[1] original demonstration that appreciable concentrations of penicillin can be attained in the animal body following the oral administration of penicillin in cottonseed oil, a number of modifications have been offered by other investigators with varying results.

György *et al.*[2] have given penicillin orally with trisodium citrate as a buffer salt to eliminate the destructive action of the hydrochloric acid in the stomach. Chow and McKee[3] delayed the action of penicillin by combining it with human plasma proteins. Little and Lumb[4] report results with a combination of the stabilizing effect of protein and the buffer action of sodium bicarbonate. Their best results were obtained with using raw egg as the protein. The work of Charney,

[3] M. Robertson, *Jour. Path. and Bact.*, 48: 305, 1939.

[4] E. Chatton and Mme. Chatton, *Rev. Suisse de Zool.*, 32: 99, 1925.

[5] T. M. Sonneborn, *Biol. Bull.*, 43: 187, 1932.

[1] R. L. Libby, SCIENCE, 101: 178, 1945.

[2] P. György, H. N. Vandergrift, Wm. Elias, L. G. Colio, F. M. Barry and J. D. Pilcher, *Jour. Am. Med. Asn.*, 127: 639, 1945.

[3] B. F. Chow and C. M. McKee, SCIENCE, 101: 67, 1945.

[4] C. J. Harwood Little and George Lumb, *Lancet*, 1: 203, 1945.