had developed no immunity as a result of the intraintestinal injection of virus.

The pooled serum of one group of animals bled 23 days after intraintestinal inoculation showed no neutralizing antibodies when tested by the virus neutralization test. However, another group of animals bled 21 days after intraintestinal inoculation showed protective power against 200 lethal doses, which is a strong degree of protection. There were 4 animals in this group whose sera were pooled. It was in this group that one animal survived the subsequent intracerebral inoculation of 100 lethal doses of virus.

Summary. Our studies indicate that it is difficult to secure cerebral infection when the virus of St. Louis encephalitis is introduced into the intestinal tract. Nevertheless one definite infection did occur after intraintestinal inoculation. We feel the experimental procedure ruled out the nasal route of infection. Some degree of humoral immunity was produced in mice both by intragastric and intraintestinal inoculation. Only two animals survived the subsequent intracerebral injection of 100 lethal doses of virus, showing that only rarely is adequate protection against infection provided by intragastric or intraintestinal virus inoculations.

13321 P

Influence of Certain Bacteriophages on the H Antigens of *Salmonella poona* and *E. typhi.*

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There is a large body of evidence indicating that the usual site of action on a bacterial cell by a bacteriophage is the soma. However, reports have appeared which call attention to the fact that in the phenomenon of bacteriophagy some other portion of the bacterial cell may be affected. Sertic and Boulgakov[1] described a phage whose action on *E. typhi* was solely on the flagella. Craigie and his associates[2] have shown that in order for certain typhoid phages to

1 Sertic, V., and Boulgakov, N. A., *Compt. rend. Soc. de Biol.*, 1936, **123**, 887.

2 Craigie, J., *J. Bact.*, 1936, **31**, 56; Craigie, J., and Brandon, K. F., (a) *Canadian Publ. Health J.*, 1936, **27**, 165; (b) *J. Path. and Bact.*, 1936, **43**, 233; (c) *Ibid.*, 1936, **43**, 249.

manifest themselves Vi antigen must be present in these bacterial cultures. Rakieten *et al.*[3] demonstrated that in the case of mucoid strains of bacteria bacteriophagy mainly affects the capsular material, leaving the somatic portion of the cell relatively unchanged.

We wish to record another instance where the action of 3 different bacteriophages on 2 strains of *Salmonella poona* was limited chiefly to the flagella, the somatic portion of the cell being very slightly, if at all, modified. The strains of *S. poona* were from Dr. Schiff's collection (*S. poona* No. 91, Kauffmann, and *S. poona* No. 733). Both strains develop very well in Savita mediums, macroscopic evidence of growth being visible in broth after 3 hours' incubation at 36°C. Both strains are actively motile, are smooth, and give the usual tests for Salmonella in sugar mediums. Their antigenic pattern is XIII, XXII :z :1,6. The three races of bacteriophage were isolated from sewage. On the basis of their activity toward phage resistant strains (secondary cultures) we have regarded these phages as not being identical. In spite of the fact that these phages contain different types, one of their chief characteristics is their ability to remove the flagella from both strains of *S. poona*.

When 0.25 cc of bacteriophage Ent/5 is added to broth containing 0.1 cc of an 18 hour broth culture of *S. poona* No. 91, no visible evidence of lysis is noted, following incubation and continued for as long as 5 days at 36°C. One can, however, by an appropriate plating method demonstrate plaques. These plaques, in contrast to the well punched out areas usually observed with most phages acting on Salmonella strains, appear as slight depressions in the culture surface, each filled with bacterial growth (secondary culture). On examining broth phage culture mixtures from 3 hours after incubation, the resulting secondary growth exhibits intense Brownian movement, in sharp contrast to the very active, true motility of the control growth. The other 2 phages give a similar reaction on this strain as well as on strain No. 733. When a secondary non-motile culture of strain No. 91 and the original culture are subjected to antigenic analysis the following is found to be the antigenic pattern:

Strain No. 91, smooth, XIII, XXII : z : 1,6 (motile)

Strain No. 91, smooth after being in contact with phage Ent/5 XIII, XXII : — : — (non-motile)

The antigenic analysis was carried out by slide agglutination. One may conclude that the action of the bacteriophage was chiefly on the flagella apparatus. Whether the culture used is in the specific, or

[3] Rakieten, M. L., Eggerth, A. H., and Rakieten, T. L., *J. Bact.*, 1940, **40**, 529.

non-specific phase, the action of these phages seems to be most evident on the H antigen.

A motile strain that is made non-motile through the action of a phage remains non-motile so long as that culture carries that phage, because the phage propagates itself as the bacteria proliferate, and attacks any H antigen that may be formed.

One of us (M.L.R.) has also tested out the pathogenicity of these secondary cultures in mice. It may be reported that these non-motile cultures differ in their pathogenicity. One of the cultures is avirulent, while the other 2 are as virulent as the original smooth strain.

Sixteen other Salmonella strains that are susceptible to several of our phages have been tested, but in no instance have non-motile secondary cultures been obtained. One of us (M.L.R.) has succeeded in isolating 2 phages that attack 2 strains of *E. typhi* in much the same manner as that described above for *Salmonella poona*; both of these recently isolated typhoid strains were rendered non-motile after being in contact with these phages. These studies are being continued.

Conclusions. Three races of bacteriophages have been isolated which attack the H antigens of 2 strains of *Salmonella poona*. Two races of phage have been isolated which are able to attack the H antigen of *E. typhi*. This finding is another example of the selective activity of bacteriophages which is directed particularly against the non-somatic portions of the bacterial cell.

13322 P

Sulfonamide Drugs as Protective Agents Against Carbon Tetrachloride Poisoning.*

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During the last few years we have been interested in the mechanism whereby the subcutaneous injection of various substances such as xanthine, sodium ricinoleate, etc., increases a rat's resistance to the poisonous action of carbon tetrachloride or chloroform. Dur-

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