

base in blood plasma. (B⁻) in blood plasma, owing to the adjustability of (HCO₃⁻) among the factors of acid equivalence, controls the total ionic content of this fluid. In gastric juice from the fundus (Cl⁻), other acid factors being nearly negligible and (H⁺) being the result of (Cl⁻)—(B⁻), should determine the total concentration of electrolytes. An approximate equivalence of total ionic content in blood plasma and in gastric juice is thus indicated.

To further illustrate this point and also to indicate clearly the size and, in contrast with the nearly stationary concentration of chloride, the mobility of the fixed base factor in gastric juice, the accompanying diagrams are presented. In them the base factors are superimposed in the left hand, and the acid factors in the right hand columns.

The measurements of fixed base and of chloride were obtained by the methods of Fiske. The procedure of Kramer and Tisdall was used in determining potassium.

3005

Parallelism between serologic and bacteriophagic response in *B. typhosus* and certain avian paratyphoids.

PHILIP HADLEY.

[From the Department of Bacteriology, University of Michigan, Ann Arbor, Michigan.]

Although not commonly recognized, there exist two curious and clearly marked discrepancies in the specific action of typhoid immune serum and typhoid antigen. In 1912 Pfeiler and Rehse¹ isolated from an epidemic of the disease, fowl typhoid, an organism which they regarded as a new species and to which they gave the name, *Bacillus typhi gallinarum alkalifaciens*. They demonstrated the agglutinability of this organism to a high titer in typhoid (human) immune serum; also a slightly reduced agglutinability of *B. typhosus* in B. T. G. A. immune serum. I have shown elsewhere² that the organism discovered by Pfeiler and

¹ Pfeiler and Rehse, *Mitteil. d. Kais. Wilhelm's Inst. f. Landwirtschaft im Bromberg*, 1912-13, v, 306-321.

² Hadley, P., *R. I. Agr. Exp. Sta. Bul.*, 1917, No. 172, pp. 1-40; No. 174, 1918, pp. 1-216.

Rehse was not a new species, but the old *B. gallinarum* of Klein, which has masqueraded under various names. In 1915 Theobald Smith and Tenbroeck³ confirmed the findings of Pfeiler and Rehse, using in this case the *Bact. sanguinarium* of Moore, which also is identical with *B. gallinarum* of Klein. In addition, they showed a similar serologic and antigenic relation between *B. typhosus* and another avian paratyphoid, the *Bact. pullorum* of Rettger, the causative agent in chick septicemia. I² have repeated the experiments of Pfeiler and Rehse, and of Smith and Tenbroeck, and have studied the serologic relationships of these avian types, not only to *B. typhosus*, but also to a number of other cultures coming from avian or mammalian sources. A resumé of the reactions usually observed, so far as they concern the subject of this paper, are presented in the following table.

TABLE I.

Showing the serologic and antigenic relationships between the organisms mentioned. Symbols: (+) positive agglutinative reaction at a high titer; (—) no agglutination; (0) no test.

Serum immune to organisms listed below	Bacterial antigens				
	<i>Bact. pullorum</i>	<i>B. gallinarum</i>	<i>B. typhosus</i>	<i>B. coli</i>	<i>B. dysenteriae</i>
<i>Bact. pullorum</i> (No. 13)	+	+	+	—	—
<i>B. gallinarum</i> (No. 89)	+	+	+	—	—
<i>B. typhosus</i>	+	+	+	—	+
<i>B. coli communis</i>	—	—	—	+	0
<i>B. dysenteriae</i>	—	—	—	—	+

In view of these peculiar and easily observed antigenic relationships between *B. typhosus* and the avian paratyphoids it was a matter of interest to ascertain to what degree, if at all, similar relationships might be present in the lytic principle reactions, active and passive, between the same cultures. If the phenomena of reciprocal agglutination depend on similarities in antigenic groups, it might be assumed that these similar antigenic groups would also determine similar bacteriophagic reactions.

Accordingly I dissociated each of the five cultures concerned into the S- and R-components and worked exclusively with the freshly isolated S-types. For each of these I produced a lytic

³ Smith and Tenbroeck, *J. Med. Res.*, 1915, xxxi, 503-521.

principle having an inhibition titer of about 1×10^{-8} when used against one standard loop of 18-hour broth culture in 10 cc. of beef infusion broth, pH 7.6. In preparing the lytic filtrates, each was carried by dilution sufficiently far from the original stock (city sewage) to insure the disappearance of any "heterologous" bacteriophage that otherwise might have passed from tube to tube in the series. These lytic filtrates were tested against the various cultures (1) by lysis on agar slants, (2) by inhibition of growth in broth. In the former tests one loop of lytic principle was streaked against 3 loops of culture according to the usual methods. In the latter tests one drop (0.04 cc.) of lytic filtrate was brought into action against one drop of 18-hour broth culture in 10 cc. of beef infusion broth. The results were usually sharp at the end of 18 hours, that is, either complete inhibition of growth or marked clouding, similar to that of the controls. After 36 hours a secondary, SR-type culture arose in nearly all the tubes showing inhibition except those containing the specific lytic agent mixed with its homologous substratum. These remained permanently clear. It is to be noted, however, that typhoid lytic principle gave complete and permanent inhibition of *Bact. pullorum*. The outcome of the tests is presented in the following table.

TABLE II.

Showing the bacteriophagic relationships between the cultures mentioned. Symbols: (++) complete and permanent inhibition; (+) complete inhibition for 36 hours; (—) no inhibition; (Cl) tube remains clear; (N) normal growth (culture controls).

Lytic filtrate for organisms listed below	Bacterial substratum					
	<i>Bact. pullorum</i>	<i>B. gallinarum</i>	<i>B. typhosus</i>	<i>B. coli</i>	<i>B. dysenteriae</i>	L. P. control
<i>Bact. pullorum</i> (No. 13)	++	+	+	—	—	CC
<i>B. gallinarum</i> (No. 89)	+	++	+	—	—	CC
<i>B. typhosus</i> (Eberth)	++	+	++	—	+	CC
<i>B. coli</i> (Jordan)	—*	—	—	++	—	CC
<i>B. dysenteriae</i> (Shiga)	—	—	±	—	++	CC
Control on culture	N	N	N	N	N	

*See text.

The results tabulated above indicate that the bacteriophage reactions follow closely the trend of the agglutinative reactions presented in Table I. The only exceptions were that the lytic

principle for *B. coli* occasionally gave a slight inhibition of *Bact. pullorum* in broth; also that the Shiga lytic principle sometimes gave temporary inhibition of *B. typhosus*.

We may conclude from these observations that a bacteriophage, evolved at the expense of an organism common to the intestinal tract of man, but absent from birds, may possess *at once and in full strength* (*i. e.*, without the need of "adaptation"), power to cause complete inhibition and lysis of organisms common to the intestinal tract of birds but, so far as I am aware, never found in the human intestine. Moreover, that there exists a curious parallel between the eccentric serologic and antigenic characteristics of *B. typhosus* and its mode of response in reactions, active and passive, to the bacteriophage. It is obvious that these results are difficult to reconcile with the ultravirus theory of the nature of the bacteriophage as maintained by d'Herelle.

3006

Injections of spermatozoa and testicular substance into male rats.

WM. J. QUICK. (Introduced by A. J. Carlson).

[*From the Hull Zoological Laboratory, University of Chicago, Chicago, Ill.*]

In studying possible modifying effects on spermatogenesis, young adult male rats were injected subcutaneously and intraperitoneally with (1) freshly macerated testis suspensions and (2) with a suspension of rat spermatozoa. Subsequent matings were made with all injected males and the testes were later studied histologically. Agglutination tests were not made.

It was found that one to five relatively heavy injections of these materials produced no specific effect on testicular activity within the limits of the experiment (three days to four months after the last injection). Smears from testes of previously injected males showed sperm motility, and litters obtained from matings proved the spermatozoa physiologically normal.