A NEW SEROLOGICAL TYPE OF SALMONELLA.

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The culture representing the new type to be described was obtained by one of us (S. H. W.) under rather unusual circumstances. Three fatalities occurred at intervals of 4 and 6 months among the children of one family living in Ashington, Northumberland, a coal-mining town of 30,000 population; in each case death was due to acute gastro-enteritis and supervened within 24 hours of their falling ill. On the death of the third child a bacteriological examination was made *post-mortem* and *S. aertrycke* found in abundance in the organs. The suggestion was made at the inquest that a carrier must exist in the stricken family and specimens of faeces from the surviving members were examined by S. H. W. From the mother's specimen a Salmonella was isolated agglutinating with the sera not only of *S. paratyphi* B, but also of *S. enteritidis* (Gaertner). This Salmonella, which we propose to call *S. newcastle*, was obviously different from the strain of *S. aertrycke* obtained from the fatal case, and the suggestion that the mother had been a carrier infecting her family should almost certainly be dropped; she had had no suspicious illness at any time. The probability is rather that conditions in the house and habits of the inmates were responsible for the succession of cases, though no evidence could be obtained as to possible infection of food by rodents, or consumption of food likely to be specifically infected; the sanitation was of poor quality (privy midden).

A second specimen of faeces from the mother obtained some 10 days later yielded the same Salmonella but in almost vanishing numbers, one colony only developing from a large amount of faecal material.

The further examination of the two strains, Newcastle 1 and 2, was performed by Scott: they behaved in identical fashion and do not require separate description.

The cultural characters are those of the Salmonella group. Differential features from certain members of the group are: (1) very feeble production of H_2S so that blackening of lead acetate in broth cultures is slow and slight; (2) absence of fermentation of inosite; (3) rapid fermentation of dulcite, rhamnose and arabinose: (1) distinguishes the strain from *S. enteritidis*, (2) from *S. derby*, and (3) from *S. dublin* and from *S. suipestifer* (Group II).

As might be expected from the cultural differences, serological investigation shows that the Newcastle strain is also antigenically different from the types mentioned. In Tables I and II the results of agglutination tests and

tests for absorption of agglutinin are summarised. The salient points are: (1) that *S. newcastle*, though possessing a good deal of labile antigen (H-antigen) in common with *S. enteritidis* and *S. moscow*, has a labile component peculiar to itself in preponderating amount; (2) the labile components shared by *S. newcastle* with *S. dublin* and *S. derby* are smaller in amount, identical in

Table I. *Newcastle serum.*

Titre of Newcastle serum—2 hours at 50° C.

		Absorbed with *S. newcastle* (phenol-agar culture steamed for 2½ hours) to remove O-agglutinin				
			Absorbed by			
	Unabsorbed	Not further absorbed	*S. enteritidis*	*S. derby*	*S. moscow*	*S. dublin*
S. newcastle	20,000 f*	20,000	20,000	20,000	20,000	20,000
heated	3,000 g*	<100	—	—	—	—
S. enteritidis	1,600 f	1,000	<100	1,000	200	800
heated	50 g	<100	—	—	—	—
S. derby	500 f	400	<100	<100	100	<100
heated	<50†	<100	—	—	—	—
S. moscow	1,600 f	1,000	<100	1,000	<100	400
heated	50 g	<100	—	—	—	—
S. dublin	800 f	500	<100	<100	100	<100
heated	<50	<100	—	—	—	—
S. paratyphi B	800 g	<100	—	—	—	—
heated	800 g	<100	—	—	—	—
S. typhi	50 g	<100	—	—	—	—

* f = loose flocculation; g = dense granules.
† < = no agglutination at this dilution, the lowest tested.

Table II. *Enteritidis serum.*

Titre of Enteritidis serum—2 hours at 50° C.

		Absorbed with *S. enteritidis* (phenol-agar culture steamed for 2½ hours) to remove O-agglutinin				
			Absorbed by			
	Unabsorbed	Not further absorbed	*S. newcastle*	*S. moscow*	*S. dublin*	*S. derby*
S. enteritidis (Gaertner)	50,000 f	50,000	50,000	50,000	50,000	50,000
heated	1,000 g	<100	—	—	—	—
S. newcastle	6,000 f	3,000	<100	3,000	3,000	3,000
heated	1,000 g	<100	—	—	—	—
S. moscow	25,000 f	25,000	30,000	<100	30,000	30,000
heated	800 g	<100	—	—	—	—
S. dublin	12,000 f	12,000	10,000	10,000	<100	10,000
heated	1,000 g	<100	—	—	—	—
S. derby	2,000 f	800	<100	300	800	<100
heated	100 g	<100	—	—	—	—

composition and included in the labile complex of *S. enteritidis*; (3) the heat-stable components of *S. newcastle* (O-antigen) are for the most part peculiar to it but it possesses small factors in common with *S. enteritidis*, *S. moscow*, *S. paratyphi* B and *S. typhi*; it contains practically no O-antigen in common with *S. dublin* and *S. derby*; (4) the cross-agglutination between strains and sera of *S. newcastle* and *S. paratyphi* B is entirely due to heat-stable antigen and its corresponding agglutinin.

There is no evidence of group and specific phase differentiation in *S. newcastle*; it is monophasic like nearly all the types which contain the specific antigen of *S. enteritidis* (Gaertner) in greater or less amount. [The diphasic *S. tokyo* (White, 1929) is an exception.]

These nearly related types form a curious set and we have thought it right to put on record, in *S. newcastle*, still another member. The relationship to each other which they display is almost without parallel among the other Salmonellas, for among the latter the specific antigen of one type is not discoverable as a minor admixture in the antigenic complex of other types. Relationships among the Salmonellas in general are shown only by the possession in common of a subsidiary antigenic complex, the "group antigens."

Some speculation is justified as to the manner of origin of the set of allies of *enteritidis* of which *S. newcastle* is the latest adherent. Among the other Salmonellas, as Andrewes first discovered, the "group" antigenic complex shows sharp fluctuations in the degree of its development in the same strain, the fluctuations constituting the phenomenon of diphasic differentiation. This behaviour may be supposed to act as a defensive device. The primitive Salmonella, represented by the group phase, meets in the living animal with antibodies either "natural" or acquired as the result of other Salmonella infections. The growth conditions so imposed make the elaboration of the group antigen a disadvantage; the consequence is its almost complete suppression and the development, instead, of the specific antigen against which antibodies are not possessed by animals in general; the process can be imitated *in vitro*, cf. Scott (1926). The monophasic types such as *S. typhi* and *S. enteritidis* represent specific phases which have lost the habit and the power of reverting to the more primitive group phase; their primitive states are represented respectively by *S. stanley* and *S. tokyo*. When antigenic variation is forced upon them—perhaps in very exceptional circumstances—the change can only involve their monophasic antigen. Thus *S. moscow*, *S. dublin*, *S. derby* and *S. newcastle* would represent derivatives of *S. enteritidis* (Gaertner). No such associated types have yet been described in relation to *S. typhi* though they probably exist.

On the other hand, it must be admitted that the types which look like satellites of *S. enteritidis* may have evolved independently from primitive Salmonellas in virtue of the same conditions as have given rise to *S. enteritidis* itself, though it seems improbable that independent evolution could produce such closely related types.

REFERENCES.

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