TABLE I.
Results of Treatment.

Treatment	No. of rats	No. dead in shock	Mortality (%)	Time of survival (hr) range	mean
Sulfadiazine	15	15	100	2-8	4
Penicillin	18	17	94	1-9	3¾
Gas gangrene antitoxin	18	17	94	2-9	4
None (controls)	20	19	95	2-13	4¾

in the hind limb just prior to tourniquet release, the organism was readily recovered after death by anaerobic culture of muscle.

II. Treatment with sulfadiazine, penicillin, or gas gangrene antitoxin had no appreciable effect on mortality or time of survival (Table I). The blood sulfadiazine levels of 7 rats at death ranged from 4 to 56.8 mg per 100 cc.

Discussion. The experiments of Aub and associates[1] involved open operative procedures in which bacterial contamination was possible, although organisms already present in the muscle may have been the source of infection. Shock was not produced in their donor animals but rather a state bordering on it. In the studies of Prinzmetal *et al.*[2] shock did not develop until 24 hours after replacement of muscle and death occurred after 2 or 3 days. This slowly developing form of shock due to bacteria is distinct from the acute form produced by tourniquet. In the latter, shock and death occur so rapidly as to make it unlikely that bacterial toxins are contributory.

Conclusion. In the experiments described in this article infection with *Cl. welchii* or other organisms did not prove to be a significant factor in the production of tourniquet shock in rats since:

(1) Anaerobic and aerobic cultures of muscle from the hind limb after death were usually sterile.

(2) Pre-treatment with sulfadiazine, penicillin, or gas gangrene antitoxin did not influence the development of shock, mortality or time of survival.

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Three New Salmonella Types: *S. richmond, S. daytona* and *S. tallahassee.**

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A. *S. richmond.* The sole representative of this type was isolated from the feces of a child affected with mild gastroenteritis. The isolation and preliminary examination of the culture was carried out by Mr. Forrest Spindle in the laboratories of the Virginia State Department of Health. Mr. Spindle later examined stool specimens of the remaining members of the child's family and investigated possible sources of infection. No carriers were found and the source of the infection was not determined.

The organism possessed the usual cultural and biochemical attributes of the Salmonella group. Glucose, arabinose, xylose, rhamnose, trehalose, mannitol, dulcitol, sorbitol and inositol were fermented with the production of acid and gas within 24 hours, while cel-

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TABLE I.
Flagellar Relationships of *S. tallahassee*.

	Serums									
	S. tallahassee				*S. cerro*			*S. düsseldorf*		
		Absorbed by				Absorbed by			Absorbed by	
Antigens	Unabsorbed	*S. cerro*	*S. düsseldorf*	*S. düsseldorf* and *S. cerro*	Unabsorbed	*S. düsseldorf*	*S. tallahassee*	Unabsorbed	*S. cerro*	*S. tallahassee*
S. cerro	10000	<100	500	<100	5000	2000	500	200	<100	<100
S. düsseldorf	10000	200	<100	<100	500	<100	<100	10000	2000	2000
S. tallahassee	20000	200	1000	200	1000	500	<100	1000	1000	<100

Figures indicate highest dilution at which agglutination occurred.

lobiose was fermented after 6 days incubation. Lactose, sucrose, raffinose and salicin were not attacked. H_2S was produced but indol was not formed nor was gelatin liquefied. Dextro-tartrate, levo-tartrate, mucate and citrate were utilized but meso-tartrate was not fermented.

Upon serological examination it was found that the culture was agglutinated to titre by *S. mikawashima* O serum (VI, VII) and in absorption tests removed all agglutinins from the serum. The organism was diphasic and phase 1 was agglutinated actively by, and removed all agglutinins from, serum derived from phase 1 of *S. mikawashima* (y). Phase 2 was agglutinated by serums prepared from all the non-specific phases of the genus. When tested with absorbed serums for factors 2, 3, 5, 6, 7, 10 and 11, it was agglutinated only by serums for factors 2 and 3. In absorption tests the culture removed all agglutinins from serum for phase 2 of *S. newport* (1,2,3...). Therefore, the antigenic formula of *S. richmond* is VI, VII: y—1,2,3. . . .

B. *S. daytona*. This type is represented by only one culture isolated from a stool specimen by Mrs. Mildred M. Galton in the laboratories of the Florida State Department of Health. The clinical condition of the individual from whom it was isolated is unknown. The biochemical characteristics of *S. daytona* differed from those given for *S. richmond* only in that rhamnose was not fermented during a 30-day period of observation and inositol and cellobiose were fermented respectively after 3 and 5 days incubation.

The culture was agglutinated to the titre of VI, VII serum and in absorption tests removed all agglutinins from that serum. *S. daytona* was diphasic and phase 1 was agglutinated by, and removed all agglutinins from, *S. thompson* (k) serum. Phase 2 was agglutinated by all non-specific serums. When tested with absorbed single factor serums, it was agglutinated only by serum for factor 6. In absorption tests with *S. anatum* (1,6...) serum it left a slight residue of agglutinins for the homologous strain but removed all agglutinins for phase 2 of *S. inverness* (1,6...) and phase 2 of *S. norwich* (1,6...). In regard to these results, it may be stated that the 1,6... phases of the genus, like the 1,5... phases[1,2] and the 1,7... phases[3] are not identical. The antigenic formula for *S. daytona* is VI, VII:k—1,6. . . .

C. *S. tallahassee*. This type is represented by 5 cultures, 3 of which were received from Mrs. Galton, while 2 were forwarded by Cmdr. L. A. Barnes of the National Naval Medical Center. One of the cultures from Florida was recovered from the feces of a case of gastro-enteritis, the remainder were

[1] Salmonella Subcommittee, *J. Hyg.*, 1934, **34**, 333.

[2] Edwards, P. R., Cherry, W. B., and Bruner, D. W., PROC. SOC. EXP. BIOL. AND MED., 1943, **54**, 263.

[3] Hormaeche, E., Peluffo, C. A., and Ricaud de Pereya, V., *J. Bact.*, 1944, **47**, 323.

isolated from the stools of normal human carriers. All of the cultures fermented glucose, arabinose, xylose, rhamnose, trehalose, dulcitol, mannitol, and sorbitol with the production of acid and gas within 24 hours. Four cultures fermented cellobiose after 7 to 12 days incubation. One culture fermented inositol promptly; the other 4 cultures did not attack this substance. Lactose, sucrose, salicin and raffinose were not fermented by any of the cultures. Three strains utilized *d*-tartrate; 2 did not. All the cultures utilized *l*-tartrate, *i*-tartrate, mucate and citrate. H_2S was produced but indol was not formed nor was gelatin liquefied.

The cultures were agglutinated to titre by O serum derived from *S. newport* (VI, VIII) and removed all agglutinins from the serum. They were monophasic and their H antigens were related to those of *S. cerro* (XVIII:z_4, z_{23}...) of Hormaeche and Peluffo[4] and *S. duesseldorf* (VI, VIII:z_4, z_{24}...) of Hohn.[5] The relationships of the H antigens of the 3 types are set forth in Table I. From the results it is evident that the 3 types have distinct antigens. It is further evident that factors z_{23} (*S. cerro* serum absorbed by *S. duesseldorf*) and z_{24} (*S. duesseldorf* serum absorbed by *S. cerro*) of Kauffmann[6] must now be redefined, since *S. tallahassee* is agglutinated by both. It is also necessary to assign a symbol (z_{32}) to the specific fraction of *S. tallahassee*. Therefore, z_{23} must now be prepared by the absorption of *S. cerro* serum with *S. tallahassee*, z_{24} by the absorption of *S. duesseldorf* serum with *S. tallahassee* and z_{32} by the absorption of *S. tallahassee* serum with *S. cerro* and *S. duesseldorf*. The diagnostic formula of *S. tallahassee* is VI, VIII:z_4, z_{32}. . . .

Summary. Three new Salmonella types were described: *S. richmond* (VI, VII: y—1,2,3...), *S. daytona* (VI, VII:k—1,6...) and *S. tallahassee* (VI, VIII:z_4, z_{32}...). Attention was directed to the necessity of redefining factors z_{23} and z_{24} since *S. tallahassee* was agglutinated by both serums as they previously were prepared.

[4] Hormaeche, E., and Peluffo, C. A., *Arch. Urug. de Med., Cir. y Espec.*, 1941, **19**, 125.

[5] Hohn, J., *Z. f. Hyg.*, 1936, **117**, 722.

[6] Kauffmann, F., *Die Bakteriologie der Salmonellagruppe*, Copenhagen, 1941.

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Flagella and Flagellar Antigens in "Non-Motile" *Salmonella* Cultures.*

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During the 25 years that antigenic analysis has been applied to the classification of *Salmonella*, it gradually has become an accepted view that flocculating, heat-labile (H) antigens were associated with flagella and motility. Conversely, nonmotile microorganisms are generally considered to be devoid of flagella and H antigens. However, occasional references to the presence of H antigens in nonmotile strains can be found. Kauffmann[1] described a nonmotile culture of *S. aberdeen* which flocculated well in i serum and which was used to prepare the diagnostic i serum distributed by the International Salmonella Center. Such findings naturally raise a question as to whether H antigens are

* The work reported here was in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the Director. It was supported in part by a research grant from the U. S. Public Health Service.

[1] Kauffmann, F., *Acta Path. et Microbiol. Scand.*, 1939, **16**, 278.