homogenized fresh muscle, and that potassium is necessary for the phosphorylation of creatine to accompany pyruvate oxidation by animal tissues. Thus the paralysis may be due to a breakdown in the enzyme system responsible for muscular contraction.

Potassium therapy has been of some value in clinical investigations of certain types of paralysis. Aycock[11] has recently reported a case of familial paralysis in which the administration of potassium brought about a prompt recovery from the paralysis. Likewise, potassium chloride has been found to have a mild effect on the symptoms of myasthenia gravis. Several dog breeders and veterinarians have called our attention to the frequent existence of a paralysis in animals maintained on commercial dog foods. The possibility of a potassium deficiency existing in these rations is being studied at the present time.

Summary. In order to study the paralysis described in dogs by Smith, a ration similar to that described in her work was prepared and fed to growing dogs. When placed on this ration, our animals failed to grow and developed a paralysis which was curable with potassium. Even though Smith has obtained cures with the administration of biotin, one of our animals receiving biotin became paralyzed and responded to potassium therapy.

[11] Aycock, W. L., and Foley, G. E., *Am. J. Med. Sc.*, 1945, **210**, 397.

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Antigenic Relationship of *Shigella dispar*, Types I and II, to *Shigella paradysenteriae*, Boyd Type P143.

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Attempts to classify certain paradysentery-like bacteria have indicated a possible antigenic relationship between *Shigella dispar* and *Shigella paradysenteriae*, type P143.[1] In particular, a culture (No. 2-193) isolated by Major William H. Ewing, Sanitary Corps, United States Army, has been classified on various grounds as *Sh. paradysenteriae*, type P143,[2] *Sh. alkalescens*,[3,4] and *Sh. dispar*.[2] The present investigation was undertaken to attempt to clarify the relationship between *Sh. dispar* and type P143.

Four serotypes and several subtypes of *Sh. dispar* were previously reported.[5] Representative strains of these were employed. Type P143 was secured through the courtesy of Dr. K. M. Wheeler of the Connecticut Public Health Laboratories as his culture No. 573.[6] Antiserums were prepared by immunizing rabbits with living vaccines of this and of the type and subtype strains of *Sh. dispar*.

Cross agglutination tests indicated the existence of antigens common to type P143 and *Sh. dispar*, types I and II. This was confirmed by reciprocal adsorption of the cross-reacting serums, as shown in Table I. From these data were derived the partial antigenic formulae listed in Table II. The relationship between *Sh. dispar*, types I and II, and *Sh. paradysenteriae*, type P143, is apparent. While antigens *B*, *C* and *D* are apparently minor factors in P143, nevertheless, they appear to account for the strong agglutination (to titers of 1280 or 2560) of types I and II in antiserum P143.

Culture 2-193 is biochemically like *Sh.*

[1] Boyd, J. S. K., *J. Hyg.*, 1938, **38**, 477.

[2] Ewing, W. H., personal communication.

[3] Neter, E., PROC. SOC. EXP. BIOL. AND MED., 1944, **57**, 200.

[4] Neter, E., *J. Imm.*, 1945, **51**, 151.

[5] Carpenter, P. L., *J. Bact.*, 1944, **47**, 419.

[6] Wheeler, K. M., *J. Imm.*, 1944, **48**, 87.

TABLE I.
Cross-agglutination and Reciprocal Adsorption of *Sh. dispar*, Types I and II, and *Sh. paradysenteriae*, Type P143.

Serum	Adsorbed with strain	Agglutinative titer with *Sh. dispar* serotype I (171)	IIa (167)	IIb (205)	IIc (231)	*Sh. para.* P143
171	Unads.	5120*	640	1280	1280	80
	167	5120	0†	0	0	80
	205	5120	0	0	0	80
	231	5120	0	0	0	40
	P143	2560	640	640	1280	0
167	Unads.	640	81920	40960	40960	640
	171	0	20480	5120	10240	160
	205	0	2560	0	2560	320
	231	0	0	0	0	0
	P143	320	20480	20480	20480	0
205	Unads.	320	10240	10240	10240	20
	171	0	10240	5120	10240	20
	167	0	0	0	0	0
	231	0	0	0	0	0
	P143	160	10240	5120	5120	0
231	Unads.	1280	10240	10240	10240	320
	171	0	10240	10240	5120	160
	167	0	0	0	160	0
	205	0	80	0	2560	40
	P143	1280	10240	10240	10240	0
P143	Unads.	1280	2560	2560	2560	10240
	171	0	320	1280	640	2560
	167	320	0	0	0	2560
	205	80	160	0	20	2560
	231	160	0	0	0	2560

* Titers are expressed as reciprocals of the highest dilutions giving any agglutination after 15-18 hours incubation at 55°C.
† *0* indicates no agglutination in 1:40 dilution.

TABLE II.
Antigens of *Sh. dispar*, Types I and II, and *Sh. paradysenteriae*, Type P143.

Culture No.	Type	Antigens
171	*Sh. dispar* I	A.C.
167	*Sh. dispar* IIa	AB.D.
205	*Sh. dispar* IIb	AB.
231	*Sh. dispar* IIc	AB.DE.
P143	*Sh. paradysenteriae* P143	BCD.F.
2-193		AB.

alkalescens. Neter[3,4] has recently so classified this strain. However, he stated that it does not share any major antigens with *Sh. alkalescens* types I, II or IV, and established a separate serotype (III) for it. He noted that this strain is strongly agglutinated by antiserum P143. Wheeler *et al.*[7] reported strong cross reactions between culture 2-193 (Wheeler's No. 2372) and type P143, and postulated a common antigen distinct from the specific P143 antigen. They also noted very close relationship between 2-193 and *Sh. dispar*, type II.

In the present investigation, strain 2-193 agglutinated in 1:2560 dilution of antiserum P143 (homologous titer 1:10,240). Conversely, P143 agglutinated to a titer of 1:320 in an antiserum for 2-193 (supplied by Dr. Wheeler) whose homologous titer was 1:20,480. By use of monovalent serums prepared by suitable adsorption (Table II), major antigens *A* and *B* were found in strain 2-193. It is therefore antigenically a typical *Sh. dispar*, type IIb. It is to be noted that fraction *B* is the antigen common to 2-193 and P143. Furthermore, culture 2-193 agglutinated to titer in antiserum 205 (type IIb) and almost completely adsorbed the latter (titer reduced from 20,480 to 160).

[7] Wheeler, K. M., Stuart, C. A., and Ewing, W. H., *J. Bact.*, 1946, in press.

Likewise, antiserum 2-193 agglutinated strain 205 to titer, and when adsorbed with 205 had a residual homologous titer of only 40.

It thus appears that antiserum P143 may be rendered more nearly monovalent by adsorption with *Sh. dispar*, type I and IIa or IIc. This procedure would prevent confusion in classification of cultures such as 2-193.

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Immunity Following Para-Aminobenzoic Acid Therapy in Experimental Tsutsugamushi Disease (Scrub Typhus).

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(Introduced by S. Bayne-Jones.)
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Two recent communications[1,2] from this laboratory have dealt with the therapeutic effectiveness of para-aminobenzoic acid (PABA) in the treatment of experimental tsutsugamushi disease. The beneficial effect of PABA and especially that of the sodium salt of the acid (NaPAB) was demonstrated against the Ceylon, Calcutta, and Karp strains of *R. orientalis*[1,2] and later against an Imphal strain.[3] The animals used in these experiments were 2 species of desert rodents, *Gerbillus pyramidum* and *Gerbillus gerbillus*, which are abundant in Egypt.[4] The susceptibility of gerbilles to these strains of *R. orientalis* and the manifestations of the disease in them have been detailed elsewhere.[5]

Para-aminobenzoic acid has also been shown experimentally to have a beneficial therapeutic effect on murine[6-9] and epidemic typhus,[7] and on Rocky Mountain spotted fever.[10,11] Clinical trial of PABA has demonstrated it to be of value in the treatment of louse-borne typhus fever.[12] There has also been recently reported a case of Rocky Mountain spotted fever which received PABA with apparent benefit.[13]

Thus, it has been shown by several investigators that PABA has an effect on several rickettsial agents. The mode of action of PABA on these organisms is of great interest since they are obligate intracellular parasites. Various studies carried out in developing chick embryos indicate that PABA is rickettsiostatic rather than rickettsiocidal.[7-10] Furthermore, in PABA treated human cases of epidemic typhus fever and the case of Rocky Mountain spotted fever there was no apparent disturbance of the antibody dynamics as judged from findings in Weil-Felix and complement-fixation

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2 Murray, E. S., Zarafonetis, C. J. D., and Snyder, J. C., PROC. SOC. EXP. BIOL. AND MED., 1945, **60**, 80.

3 Unpublished observations of the authors.

4 Snyder, J. C., Zarafonetis, C. J. D., and Lui, W. T., PROC. SOC. EXP. BIOL. AND MED., 1945, **59**, 110.

5 Zarafonetis, C. J. D., PROC. SOC. EXP. BIOL. AND MED., 1945, **59**, 113.

6 Snyder, J. C., Maier, J., and Anderson, C. R., Report to the Division of Medical Sciences, National Research Council, Washington, D. C., December 26, 1942.

7 Hamilton, H. L., Plotz, H., and Smadel, J. E., PROC. SOC. EXP. BIOL. AND MED., 1945, **58**, 255.

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9 Greiff, D., and Pinkerton, H., *J. Exp. Med.*, 1945, **82**, 193.

10 Hamilton, H. L., PROC. SOC. EXP. BIOL. AND MED., 1945, **59**, 220.

11 Anigstein, L., and Bader, M. N., *Science*, 1945, **101**, 591.

12 Yeomans, A., Snyder, J. C., Murray, E. S., Zarafonetis, C. J. D., Ecke, R. S., *J. A. M. A.*, 1944, **126**, 349.

13 Rose, H. M., Duane, R. B., and Fischel, E. E., *J. A. M. A.*, 1945, **129**, 1160.