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Typing of Typhoid Bacilli in Nine Western States by Bacteriophage Method of Craigie and Yen.

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The method of typing various strains of *Bacterium typhosum*, as reported by Craigie and Yen,¹ has received neither the recognition nor the widespread application that its useful possibilities seem to justify. The survey herein reported was undertaken in an effort to bring the advantages of this method to the attention of those most likely to benefit by its use.

The typing method is based on certain peculiarities of a strain of bacteriophage which is specific for the Vi form of *B. typhosum*. In addition this bacteriophage exhibits a selective affinity for the strain on which it is propagated and for epidemiologically related strains. By selective propagation of this bacteriophage on various strains of *B. typhosum*, Craigie and Yen¹ have shown that it is possible to divide freshly isolated cultures into a limited number of readily distinguished types, which have been designated by the letter system A to J inclusive, with the exception of type I. Later reports by Craigie^{2, 3} and by Yen⁴ have added subtypes of B, D, E, and F and additional studies have brought to light types L and M, which are rarely encountered.⁵ Among the typed cultures herein reported, 97.1% fell into the 6 main groups, A, B, C, D, E, and F.

TABLE I.
Distribution of Cultures by States.

	A	B ₁	B ₂	C	D ₁	E ₁	F ₁	J	L	M	Imp. V	W	Totals
California	15	1	4	7	—	22	40	2	1	1	13	2	108
Colorado	—	3	1	2	—	4	1	—	—	—	—	1	12
Idaho	—	—	—	1	—	—	1	—	—	—	—	—	2
Montana	—	1	4	—	—	2	—	—	—	—	—	4	11
Nevada	—	—	—	1	—	—	—	—	—	—	—	—	1
New Mexico	5	6	24	2	7	32	16	—	—	—	12	1	105
Oregon	24	1	4	7	5	14	10	4	—	—	6	1	76
Utah	1	—	2	10	1	—	—	—	—	—	—	2	16
Washington	7	1	1	—	2	7	—	1	—	—	—	9	28
Totals	52	13	40	30	15	81	68	7	1	1	32	19	359

¹ Craigie, J., and Yen, C. H., *Canad. Public Health J.*, 1938, **29**, 448.² Craigie, J., *Canad. Pub. Health J.*, 1939, **30**, 37.³ Craigie, J., *Canad. Pub. Health J.*, 1940, **31**, 18.⁴ Yen, C. H., *PROC. SOC. EXP. BIOL. AND MED.*, 1939, **41**, 162.⁵ Craigie, J., personal communication.

Cultures for this study were obtained through the coöperation of the directors and technical staffs of the 9 state laboratories concerned, and were typed by the method described in detail in the original report by Craigie and Yen.¹ Table I shows the distribution of the various types by states.

Table II is included to show the distribution of individual patients by states, since in many cases multiple cultures were received from single individuals. It will be noted that types B₃, B₄, D₂, D₃, E₂, F₂, G and H have not as yet been encountered in the area being studied.

TABLE II.
Distribution of Individuals by States.

	A	B ₁	B ₂	C	D ₁	E ₁	F ₁	J	L	M	Imp.	V	W	Totals	% typed
California	12	1	4	6	—	16	37	2	1	1	7	2	89	90	
Colorado	—	3	1	1	—	4	1	—	—	—	1	—	11	91	
Idaho	—	—	—	1	—	—	1	—	—	—	—	—	2	100	
Montana	—	1	3	—	—	1	—	—	—	—	—	—	2	71	
Nevada	—	—	—	1	—	—	—	—	—	—	—	—	—	1	100
New Mexico	5	5	17	2	5	23	11	—	—	—	3	1	72	94	
Oregon	16	1	3	6	3	9	8	3	—	—	5	1	55	89	
Utah	1	—	1	10	1	—	—	—	—	—	—	—	2	15	87
Washington	7	1	1	—	2	7	—	1	—	—	—	9	28	68	
Totals	41	12	30	27	11	60	58	6	1	1	16	17	280	88.2	

Table III demonstrates the number of cultures isolated from each of the 280 individuals concerned.

TABLE III.
Number of Isolations per Individual.

No. of times isolated per individual	A	B ₁	B ₂	C	D ₁	E ₁	F ₁	J	L	M	Imp.	V	W	Totals	
1	34	11	23	24	8	48	51	5	1	1	11	15	232		
2	6	1	6	3	2	6	4	1	—	—	1	2	32		
3	—	—	—	—	1	4	3	—	—	—	3	—	11		
4	—	—	—	—	—	1	—	—	—	—	—	—	—	1	
5	—	—	1	—	—	1	—	—	—	—	—	—	—	2	
6	1	—	—	—	—	—	—	—	—	—	—	—	—	1	
10	—	—	—	—	—	—	—	—	—	—	1	—	—	1	
No. of individuals	41	12	30	27	11	60	58	6	1	1	16	17	280		
No. of cultures	52	13	40	30	15	81	68	7	1	1	32	19	359		

It is to be noted that no evidence of instability of type has as yet been encountered, either in the cultures of human origin herein tabulated or in supplementary animal experiments now under way.

The 359 cultures were isolated from various sources, the majority having been obtained from blood and fecal specimens. Cultures isolated from gall bladder, chest abscess, urine, abdominal wound and

river water have likewise been examined. In all cases, the value of the typing method of Craigie and Yen has been evident. Epidemiological studies have repeatedly verified the original investigations of Craigie and Yen regarding the stability of types and the separation of epidemic and endemic cases. Application of the typing results to epidemiological studies is being made as often as is possible and the results show that the typhoid typing method is a valuable and sensitive tool in the control of typhoid fever. Properly applied, the procedure is a useful adjunct to epidemiological studies. Future possibilities in applying the method are dependent on the aid and co-operation of all concerned.

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Carrion's Disease. I. Some Growth Factors Necessary for Cultivation of *Bartonella bacilliformis*.

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The medium of preference for the isolation of *Bartonella bacilliformis* from the blood of Oroya fever cases and for the routine of stock cultivation is still the one originally used for these purposes by Noguchi: namely, his semi-solid serum agar for leptospira.^{1, 2} This medium however, is not suitable for the production of vaccines. In attempts to grow the organism on solid media it soon became apparent that the addition of blood was necessary.^{3, 4} It seemed of

¹ Noguchi, H., and Battistini, T., *J. Exp. Med.*, 1926, **43**, 851.

² Noguchi, H., *J. Exp. Med.*, 1926, **44**, 553.

³ Aldana, L., *Bacteriología de la Enfermedad de Carrion Tesis*, Lima, Peru, 1930.

⁴ Lawkowic, W., *Trans. Roy. Soc. Med. Hyg.*, 1939, **32**, 601.