

hypothesis, and, if it should be correct, then eliminating the central factor would leave only the peripheral (hormone?) mechanism which may become more amenable to drug therapy.

Some physiological effects of anterior chordotomy have been discussed.<sup>9</sup> The result of chordotomy on motor function in some 90 cases will be published in the near future.

### 11440 P

#### Occurrence of Strains of Pneumococci Which React With More Than One Type-Specific Antipneumococcal Serum.

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Pneumococci are commonly classed among the best examples of bacterial type-specificity. While cross-reactions frequently occur involving types 3 and 8 and less frequently other types, they have usually been considered from the standpoint of the cross-reacting antibodies that sometimes develop during immunization rather than from the standpoint of the antigenic type-multiplicity which causes them.<sup>1, 2</sup>

Several strains of pneumococci that conspicuously violate the prevailing conception of type-specificity have been isolated recently in this laboratory. Neufeld tests with sera of 3 different manufacturers show that each of these strains reacts with at least 3 type-specific sera.

Table I summarizes the reactions of 6 such strains. It will be noted that each strain shows somewhat greater capsular swelling with one serum (either type 29 or type 24) than with others. However, reaction is only slightly less with a second, and in some strains with a third, serum.

With the exception of the Hoge strain all 6 were isolated from 488 routine specimens submitted to this laboratory for typing between February 16 and April 3, 1940. Fifty-nine of these specimens were reported as containing more than one type of pneumococci, and 18 of them examined for the possible presence of multiple-react-

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<sup>9</sup> Hyndman, O., and Van Epps, C., *Arch. Surg.*, 1939, **38**, 1036.

<sup>1</sup> Lyall, H. W., and Odell, H. R., *Am. J. Hyg.*, 1939, **29** (Sect. B), 103.

<sup>2</sup> Noble, A., and Cameron, B. C., *J. Lab. and Clin. Med.*, 1939, **24**, 1.

TABLE I.

Pneumococcal strain	Reactions with type-specific sera		
	Maximal capsular swelling and massive agglutination	Slightly sub-maximal swelling and moderate to massive agglutination	Little or no capsular swelling and moderate agglutination
Hoge*	29	10	20
Weingart	29, 29	20, 31	—
Thorpe	29	10, 20	—
Hinman	24	7	20
Brown	24	7	20
Walker	29	10, 20	—

\* Englewood Hospital Laboratory, Chicago, kindly furnished the specimen from which this strain was obtained.

ing strains. From these the last 5 listed in Table I were recovered. There is reason for believing that such strains were present in 2 other specimens but escaped isolation.

To ascertain that a mixture of types was not responsible for the multiple-type reactions, each of the 6 strains was plated from young blood-broth cultures. From each plate well-segregated colonies were picked, each colony to a fresh tube of blood broth. This procedure was repeated not less than four times with each strain. No change in the reactions of any of the strains was produced by this treatment.

Table II shows the reactions of 4 strains with the sera of 3 principal producers of typing sera. For purposes of comparison and control one strain each of types 10, 20, 29, and 31 also was tested. These were obtained from one of the producers whose sera were included in the study (Manufacturer C). Young cultures in Felton broth, formalinized (1.0% commercial formalin) to inhibit autolysis, or saline suspensions prepared therefrom, were employed in the tests. The saline suspensions were prepared by centrifugalizing the cultures and resuspending the sediment in formalinized (1.0%) physiological saline, the final turbidity approximating that of tube number 8 of a Macfarland nephelometer. One 2 mm loopful of bacterial suspension, one 2 mm loopful of Loeffler's methylene blue and one 4 mm loopful of serum were mixed in each preparation examined under the microscope.

It is apparent from the second table that although the sera from the 3 sources differ somewhat in the scope and degree of their cross-reactions they severally substantiate the fact of multiple-type antigenicity in the strains tested. Even the control strains, types 10 and 20, do not appear to be perfectly specific. However, the reactions of

TABLE II.  
Reactions Between Sera of 3 Manufacturers and 4 Multiple-reacting Strains of Pneumococci.

Cultures	Type-Specific Sera											
	Manufacturer A				Manufacturer B				Manufacturer C			
	10	20	29	31	10	20	29	31	10	20	29	31
Multiple-reacting strains												
Hoge	+++	++	++	SL.Ag.	++	Ag.	++	++	++	++	++	++
Weingart	±	+++	+++	+++	-	+++	+++	±	-	++	+++	++
Walker	+++	+++	+++	-	++	+++	+++	-	++	++	+++	-
Thorpe	+++	+++	+++	-	+	+	+	-	+	+	+	-
Control strains												
Type 10	+++	±	-	-	+++	Ag.	-	-	+++	SL.Ag.	-	-
" 20	+++	+++	-	-	Ag.	+++	-	-	SL.Ag.	+++	-	-
" 29	-	-	+++	-	-	-	+++	-	-	-	+++	-
" 31	-	-	-	+++	-	-	-	+++	-	-	-	+++

+++ = maximal capsular swelling.

++ = slightly submaximal swelling.

+ = definite swelling.

± = doubtful swelling, moderate to heavy agglutination.

Ag. = moderate to heavy agglutination, no swelling.

SL.Ag. = slight agglutination, no swelling.

- = no agglutination, no swelling.

this group of cultures with the 3 sets of sera are close enough to strict specificity to furnish further evidence of the multiple-antigenicity of the test-strains. The somewhat discrepant results obtained with the sera of the 3 manufacturers may have either of two explanations: (1) cross-reacting antibodies may have been more completely removed from one set of sera (by absorption) than from another, or (2) more strictly specific cultures may have been used as antigens in the production of one set of sera than in another.

While measurement by loops, as in the Neufeld test, is not a perfectly quantitative method, the results here cited have been obtained so repeatedly and consistently that they leave no room for doubt as to their reproducibility.

From the figures cited above it seems likely that the occurrence of these broadly non-specific strains is fairly frequent. Their significance for the prevailing conception of type-specificity is obvious. Recognition of their existence creates a number of problems in the diagnosis and treatment of pneumonia, some of which are being studied further.