leadership and confidential councils have been substituted. These are nothing but new social instruments for old ends, namely, the destruction of democracy.

The author frankly admits that the principle of leadership means that "all power to make decisions resides in the leader of the enterprise—the employer." In forest enterprises "the leader will be either the forest owner or the forest officer" (pp. 226 and 227). He also claims that the social interests of the worker have always been fairly well safeguarded in German sustained-yield forest enterprise, omitting to mention that the women and children are forced to work in the forests because the head of the family is unable to earn a living wage. He further fails to mention that since the advent of the NSDAP the rural and forest workers have been deprived of almost all freedom of movement, and have been subjected to the competition of unemployed from the cities. The "bounden duty" of such workers, riveted to the land, is to do whatever their self-appointed "leaders" tell them to do. The bucolic paradise which Dr. Heske holds out as the ideal for us to emulate is thus nothing more than chattel slavery and feudal serfdom.

How well the "leader principle" has worked out may be gained from the fact that in the woods industry, for instance, the average hourly rate of wages for skilled labor, male and female, has dropped from 111.2 Reichspfennigs in 1931 to 79.3 Reichspfennigs in 1936. For unskilled labor, it has been reduced from 91.3 Reichspfennigs in 1931 to 62.0 Reichspfennigs in 1936. (These figures are quoted from the National Industrial Conference Board's report "Economic Development of Germany under National Socialism." Study No. 236, pp. 33–60. New York, N. Y.). Truly, "the concept of the new labor law finds a ready soil in German forest enterprises" (p. 230). It is, therefore, somewhat understandable why American forest owners would be interested in having this interpretation of German forest conditions made available to American foresters. Why foresters, some of them high in the public service, should be active participants in helping to indoctrinate our forestry profession with this new ideology is much more difficult to understand or to explain.

There is one peculiar deviation from the general spirit of the book. This is the discussion of the "freedom of science," almost passionate in tone, which leaves much to the imagination and conjecture of the reader. "An important, yes, an almost sacred fundamental characteristic of science, including forestry science," says Dr. Heske, "is freedom. Without freedom, science becomes a farce." And again, "The discovery of truth requires that science be absolutely free from compulsion and tutelage, for the ways of science are determined only by the search for truth, and must be neither anticipated nor influenced from without." And so on for two and one-half pages (pp. 205–207), without a single reference to the status of science in Germany.

This discussion is sandwiched in between a rather glowing account of the status and scope of forestry science and one of forest research in Germany. It is followed by a chapter on forest education, in which the author points out Germany's advantages as a center for forest education for foreign students.

A few pages later, he states, "Thus far, the fear that the forestry authorities would cramp the professors engaged in directing research with troublesome instructions and thereby encroach upon the freedom of research has proved groundless." The implication, therefore, is that science in Germany is free and that the admonition to be "on guard to keep the endeavors of science free from partisan influences" is really meant only for us. Or may it not be a spontaneous outcry of a tortured scientist's soul (shade of Freud) protesting against making all science in Germany the handmaiden of inspired truth!

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SPECIAL ARTICLES

THE CAPSULAR POLYSACCHARIDE OF THE TYPE XIV PNEUMOCOCCUS AND ITS RELATIONSHIP TO THE SPECIFIC SUBSTANCES OF HUMAN BLOOD

RECENTLY in this journal, Finland and Curnen[1] have called attention to a number of untoward clinical reactions manifested by hemoglobinuria, and even death, following the intravenous administration of Type XIV antipneumococcal horse serum. Examination of 19 different specimens of horse sera of this type revealed in every instance agglutinins for human erythrocytes in high titer, whereas only two of 41 specimens of sera of other types agglutinated human red blood cells in dilution of 1:20 or higher. This distinction is not shared by Type XIV rabbit serum.

Since the phenomenon of erythrocyte agglutination is peculiar to Type XIV antipneumococcal horse serum it was thought that an investigation of the properties of the capsular polysaccharide of the Type XIV pneumococcus might reveal points of similarity with the blood group specific substances, and at the same time shed light upon the mechanism, whereby antipneumococcal horse serum of this particular type agglutinates human erythrocytes.

Two possible explanations for the observed effects

[1] M. Finland and E. C. Curnen, SCIENCE, 87: 417, 1938.

on human red blood cells suggest themselves: (*a*) That the Type XIV Pneumococcus, owing to some peculiarity in structural makeup, might adsorb selectively from the culture media sufficient blood group substance to act antigenetically in the horse to produce agglutinins against human erythrocytes, since it has been shown that the blood group A specific substance is present in commercial peptone and broth media;[2, 3] (*b*) that the chemical constitution of the Type XIV polysaccharide is sufficiently akin to the blood group substances to produce agglutinins against human erythrocytes, simultaneously with the production of type specific pneumococcal antibodies. The latter hypothesis seemed more tenable, since it is somewhat gratuitous to assume that adsorbed blood group A substance would thus be rendered antigenic. Furthermore, if this were the case, the hemagglutinins engendered would be specifically directed toward the erythrocytes of blood group A.

With this concept in mind, the authors have prepared the specific capsular polysaccharide from Type XIV pneumococci in the following manner: A human strain of Type XIV pneumococcus, recently isolated, was passed consecutively until 0.1 cc of an eight-hour culture was consistently lethal for mice in from 8 to 12 hours. Meat infusion broth, containing 0.1 per cent. dextrose and 1.0 per cent. Witte's peptone, was seeded with a culture of this organism and, after six hours, the living bacteria were collected in a Sharples centrifuge. The organisms from 50 liters of culture were resuspended in saline and allowed to autolyze at 37.5° C. for 72 hours. The gram-negative bacterial detritus was removed by centrifugation and the clear supernatant liquid concentrated to 500 cc *in vacuo*. Protein was removed by adjusting the pH of the solution to 3.78 followed by centrifugation. The specific polysaccharide was then precipitated by the addition of 1.5 volumes of alcohol. Solution and reprecipitation were repeated several times. The protein-free product was finally isolated as a white amorphous substance which showed the following properties:

The substance was soluble in water to approximately 1 per cent. Tests for uronic acids were negative, as were protein tests with picric and trichloroacetic acids. Copper acetate, mercuric chloride and uranium nitrate caused no precipitation. Partial precipitation occurred upon the addition of basic lead acetate and barium hydroxide solutions, and a heavy precipitation was obtained with tannic acid. The material gave negative biuret, ninhydrin, sulfosalicylic acid, Hopkins-Cole, Millon's and xanthoproteic reactions. The Molisch test was extremely strong, as were tests for amino sugars.[4] Analysis of a dried sample of one preparation showed: C 44.4 per cent., H 6.8 per cent., N 5 per cent., acetyl 9.0 per cent., reducing sugars (calculated as glucose) 74 per cent., amino sugar 62 per cent., and specific rotation $[\alpha]_D = +12.5$. Serologically, the material reacted with Type XIV antipneumococcal horse and rabbit sera in dilutions as high as 1:4,000,000. That the type specific polysaccharide is neither identical nor contaminated with the blood group A substance is evidenced by the fact that the bacterial polysaccharide does not appreciably inhibit the lysis of sheep cells when the latter are added to anti A serum in the presence of complement.

The group A substance is the only specific substance of the human blood cells which has been carefully investigated chemically, although recent studies of the remaining blood group substances reveal points of similarity.[5, 6] A comparison of the properties of the Type XIV pneumococcus capsular polysaccharide with those of the blood group A specific substance isolated by Landsteiner from horse saliva[7] and commercial pepsin[8] shows many points in common. Save for the biuret reaction, the group A substance gives almost identical qualitative tests and approaches closely in elementary analysis, acetyl content and specific rotation the capsular polysaccharide of Type XIV pneumococcus. It would seem from the properties already described that the capsular polysaccharide of Type XIV pneumococcus in its natural state, as a part of the intact bacterial cell, may well possess sufficient chemical and immunological relationship to the blood group specific substances to incite in the horse the formation of agglutinins for human erythrocytes, simultaneously with the production of other type specific antibodies. An analogous situation exists in the common immunological properties of the Forssman substance and the polysaccharide derived from the Shiga bacillus, both of which in their antigenic forms incite the production of hemolysins for sheep erythrocytes and, as happens, act interchangeably in inhibiting the hemolysis of sheep cells.[9]

In the case of the Type XIV pneumococcus these concepts are strongly supported by observations made in this laboratory, that the blood group A specific substance gives a vigorous precipitin reaction in the cold with Type XIV antipneumococcus horse serum, the reaction still being detectable in dilutions of 1 part in a million. In Type XIV antipneumococcus rabbit serum,

[2] F. Schiff, *Zeits. für Bakt.*, Ref. 98, Abt. 1, 94, 1930.
[3] Walther F. Goebel, *Jour. Exp. Med.* (in press).
[4] L. A. Elson and W. T. J. Morgan, *Biochem. Jour.*, 27: 1824, 1933.
[5] C. Hallauer, *Zeits. Immunforsch.*, 83: 114, 1934.
[6] J. R. Marrack, "The Chemistry of Antigens and Antibodies," p. 105, Medical Research Council Special Report, Series No. 230, London, 1938.
[7] K. Landsteiner, *Jour. Exp. Med.*, 63: 185, 1936.
[8] K. Landsteiner, *ibid.*, 63: 813, 1936.
[9] K. Meyer and W. T. J. Morgan, *Brit. Jour. Exp. Path.*, 16: 476, 1935.

however, no cross reaction with the specific blood group A substance occurs, even in the cold. This is further evidence of the greater specificity of the antibodies produced by the rabbit, as compared with those formed by the horse, and would seem to offer an explanation for the observation made by Finland and Curnen that Type XIV antipneumococcus horse sera agglutinate human erythrocytes in high titre, whereas Type XIV antipneumococcus rabbit sera do not.

The relationship of the pneumococcus Type XIV specific polysaccharide to the blood group specific substances is further substantiated by the fact that absorption of Type XIV antipneumococcal horse serum with homologous polysaccharide removes the hemagglutinins for all blood groups.

Further studies on the chemical nature of the Type XIV pneumococcus polysaccharide and its chemo-immunological relationship to the blood group substances are in progress.

In conclusion the authors wish to express their thanks to Dr. Karl Landsteiner for his generous counsel.

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ULTRA-VIOLET ABSORPTION SPECTRUM OF CATALASE

THE absorption spectrum of catalase obtained from horse liver shows maxima at 4090, 5050, 5400 and 6220 Å.[1] The preparation in the air-driven quantity-ultracentrifuge[2] of solutions of catalase which appear to be homogeneous both upon ultracentrifugal[2] and electrophoretic[3] analysis has made possible the measurement of the absorption spectrum of the enzyme in the ultra-violet region.

The curve shown in Fig. 1 was obtained with a small Hilger quartz spectrograph and a Spekker spectrophotometer. The light source was a tungsten steel spark. The curve shows maxima at about 2,750 and 4,050 Å. The peak at 2,750 Å is due to the protein carrier of the enzyme, while the maximum at 4,050 Å is caused primarily by the hemin residue. A maximum in the ultra-violet region has previously been found in less highly purified catalase preparations.[4]

The values of the extinction coefficients at the two maxima, as calculated by the formula $\varepsilon_{c=1 \text{ mM Fe per liter}} = \frac{D}{d.c}$,[5] where D represents the observed optical density (see Fig. 1), d the thickness of the absorption cell (1 cm) and c the concentration of the enzyme in terms of mM Fe per liter, are $\varepsilon_{2,750\text{Å}} = 185$ and $\varepsilon_{4,050\text{Å}} = 80.5$.[6]

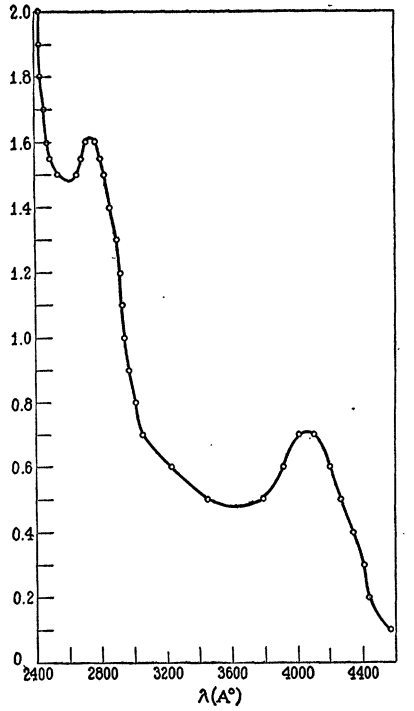

FIG. 1. Ultra-violet absorption curve of horse liver catalase. Solvent, 4.10-3 M. Phosphate, pH 8. Concentration of enzyme, 0.6 mg. per cc; of porphyrin-bound iron, 8.7 · 10-6 M. Abscissa, wavelength in Ångström units; ordinate, optical density $D = \log I_o/I$).

In contrast to other hemin-containing proteins, such as hemoglobin, chlorocruorin and the respiratory ferment, the value of the extinction coefficient at 2,750 Å, which is due to the protein component, is greater than that at 4,050 Å. This reversal in magnitude is probably due to the fact that in hemoglobin the mass ratio of hemin to protein is 2,600/68,000, while in catalase it is 2,600/250,000,[2] thus diminishing the quantitative contribution to the light absorption made by the four porphyrin groups present in these molecules. The underlying assumption is that the total content in aromatic amino acids in these conjugated proteins is of the same order of magnitude.

The visual examination of photographic plates obtained with the aid of a hydrogen discharge tube and a small Hilger quartz spectrograph reveals a band structure[7] typical for a globulin. There appear to be present bands due to tryptophane, tyrosine and phenyl-

[1] K. G. Stern, *Jour. Biol. Chem.*, 121: 561, 1937.
[2] K. G. Stern and R. W. G. Wyckoff, SCIENCE, 87: 18, 1938, *Jour. Biol. Chem.*, 124: 573, 1938.
[3] Unpublished.
[4] K. G. Stern, *Zeits. physiol. Chem.*, 212: 207, 1932.
[5] D. L. Drabkin and J. H. Austin, *Jour. Biol. Chem.*, 112: 51, 1935–36.
[6] This value is lower than that previously reported on the basis of photo-electric spectrophotometric records obtained from other enzyme preparations (see note 1).
[7] G. I. Lavin and J. H. Northrop, *Jour. Am. Chem. Soc.*, 57: 874, 1935; see also C. B. Coulter, F. M. Stone and E. A. Kabat, *Jour. Gen. Physiol.*, 19: 739, 1936.