white cells, but only very exceptionally were they actually found within them. In preparations made from tubes containing red blood-cells treated with tannin and suspended in dextrose solution, or red blood-cells not treated with tannin and suspended in saline solution, neither agglutination nor attachment of red blood-cells to more than a very few leucocytes was found. Furthermore, in hanging drops from these tubes we could observe that moving red blood-cells would come into contact with leucocytes, slide on their periphery and then move away.

On completing this work I was of the opinion that the attachment of the red blood-cells to the leucocytes marked the beginning of phagocytosis, and that phagocytosis could be studied in the action of tannin upon erythrocytes. After the above paragraphs were written, a paper by Reiner and Kopp[5] appeared describing similar experiments (with guinea pig leucocytes) and arriving at similar conclusions, which they carried a step further. By using a longer period of incubation they observed complete phagocytosis of practically all the red blood-cells. This observation I have since confirmed.

4569

Correlation of Ultra-Violet Absorption to the Development of Immunity.

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It has been observed that the absorption spectrum for blood serum in the ultra-violet has a characteristic absorption band at 2800 Ä. Judd Lewis[1] was the first to observe variations from the normal in the absorption curve of various pathological sera. In a second publication Lewis[2] shows that the protein content of serum is the absorbing constituent and gives curves for the absorption of the 3 protein fractions, pscudoglobulin, euglobulin, and albumin. Stenström and Reinhard[3] showed that a synthesis of the amino acids in the proportion in which they occur in blood serum gave a similar

[5] Reiner, L., and Kopp, H., *Z. f. Immunitatsf.*, 1929, lxi, 397.

[1] Lewis, S. Judd, *Proc. Royal Soc. London*, 1915, lxxxix, 327.

[2] Lewis, S. Judd, *Proc. Royal Soc. London*, 1922, xciii, 178.

[3] Stenström, W., and Reinhard, M. C., *J. Biol. Chem.*, 1925, lxvi, 819.

absorption curve to that of serum. They attribute the band chiefly to the effect of the tyrosine and tryptophane content of the serum. Studies have already been made of the protein content of pathological sera and the relation of globulin to albumin. Wells,[4] and Hurwitz and Meyer[5] found a variation of the globulin albumin ratio during the course of artificially stimulated immunity. They found that a temporary decrease of albumin with an increase of globulin took place during the development of immunity. Other investigators noted similar changes. The investigation of Lewis, Stenström, and others would seem to indicate that the ultra-violet spectroscope has the possibility of becoming a good instrument for determining whether immunity has or has not been acquired against certain infectious diseases.

We propose a study of the absorption spectra of the blood serum in various contagious diseases common to childhood, covering the phases of normality, incubation period, height of the exanthem, period of convalescence and expected return to normal. By the correlation of data from a large number of cases, we hope to find some constant factor characteristic of immunity development.

Our investigations were carried out with a Hilger Type E-3 spectrograph and a Judd Lewis sector-photometer using an underwater tungsten spark.

So far we have collected data on 6 diphtheria immunization procedures with toxin antitoxin, the curve of the normal blood serum taken before immunization serving as control; 8 scarlet fever cases and 12 measles cases in various stages of the disease. In some cases it was possible to obtain the normal serum before onset of the disease to serve as a control. In most of the cases this was not possible. We do not feel that definite conclusions can be drawn from the data so far obtained, but a number of interesting changes have been observed.

A shift in wavelength of the absorption head and foot occurs which may prove to be of significance.

A somewhat constant increase of total proteins during the period in which immunity presumably develops, and the beginnings of a return to the normal after that period have been found.

In some of the cases, there is an indication of globulin albumin ratio increase.

From more spectrographic data, together with quantitative analysis, and fractionation of the sera, we can hope to show some con-

[4] Wells, H. G., *J. Immunol.*, 1924, ix, 291.

[5] Hurwitz, S. H., and Meyer, K. F., *J. Exp. Med.*, 1916, xxiv, 515.

sistent change in the proteins during the course of various diseases.

We hope to correlate the spectrographic measurements of total protein changes and relative ratio changes of the protein fractions with the development of immune reactions in the course of disease.

4570

Decreased Resistance of Purified Bacteriophages to Disinfectants.

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The surprising resistance of the bacteriophage to action of disinfectants has been commented upon by many observers. Thus d'Herelle[1] states that bacteriophage corpuscles survive 3 days' exposure to 0.5% mercuric chloride in physiological saline. Prausnitz and Firle[2] claim that resistance is above that of anthrax spores. Watanabe[3] noted well defined racial variations in the resistance of 'phages to phenol, 1% for 24 hours being sufficient to destroy some races, while 4% was necessary to inactivate others.

In order to determine whether the organic matter in the lysates exerts any protective action, 3 races of bacteriophage were purified according to the technique of Arnold and Weiss.[4] These purified 'phages gave negative Biuret, Xanthoproteic acid, Millon, Hopkins, Cole and Molisch tests. Non-purified 'phages were adjusted to the same lytic titer and the lysol resistance of both the purified and non-purified suspensions was compared. Tests of each 'phage were made in triplicate at various lysol concentrations. The results of these tests are summarized in the following protocol.

As is seen, the resistance of the 'phage to lysol was in every case markedly decreased. That the lysol solutions did not decrease greatly in activity is evidenced by the fact that after the 24 hour period a 3% concentration killed *B. subtilis* spores in 24 hours.

A decided decrease in the resistance to mercuric chloride was also noted, although accurate quantitative determinations have thus far not yet been made.

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[1] d'Herelle, F., "The Bacteriophage and Its Behavior."

[2] Prausnitz, C., and Frile, E., *Centralbl. f. Bakt.*, Orig., 1924, xciii, 148.

[3] Watanabe, T., *Arch. f. Hyg.*, 1923, xcii, 1.

[4] Arnold, L., and Weiss, E., *J. Infect. Dis.*, 1925, xxxvii, 411.