have been used preceding the employment of either or both dioxane and tertiary butyl alcohol and many surprising results have been noted. Much of the obloquy heaped upon certain killing and fixing fluids appears to be wholly gratuitous and should be laid instead against absolute ethyl alcohol, xylol, chloroform, benzene and similar fluids employed for "clearing" purposes.

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IMMUNOLOGICAL REACTIONS AND VISCOSITY

IN 1923, while at the Rockefeller Institute in New York, we devised a microviscosimeter of high sensitivity[1] which enabled us to follow continuously the changes of viscosity occurring in a sample of solution, as a function of time, temperature or as a consequence of a reaction. It occurred to us that this instrument was well adapted to the study of immunological reactions—immune serum plus antigen—and that it might be interesting to find out whether flocculation and precipitation were not preceded or accompanied by some variations in the viscosity of the mixture. We found that such was the case, and that the addition of one drop of specific antigen to 1 cc of immune serum determined a considerable but *momentary* increase in the viscosity of the mixture. The amplitude of the phenomenon reached, in certain cases, 300 per cent. of the original viscosity. In a few minutes, the viscosity comes back almost to its former value. This reaction is strictly specific. Although we did not publish it at the time, we described the phenomenon at the Pasteur Exhibition in Strasbourg, 1923. In 1933 we reported it before the Congress of Immunology (Rome, Convegno Volta) and in 1934 in the Ergebnisse der Hygiene.[2]

Late in 1934, we took it up again with Miss V. Hamon and applied it to the study of the diphtheria toxin-antitoxin reaction which had been shown by Ramon[3] to yield quantitative results, making it possible to titrate the antitoxic activity of a serum *in vitro*. We found that, under the conditions specified by Ramon, who kindly supplied us with toxin and antitoxin, the same increase in viscosity could be observed, and that, for a given ratio of concentrations of the two substances, a quicker and more important phenomenon took place. It was thus possible to titrate the antitoxin content of a serum by a new and entirely different method, which may prove to be more accurate than the flocculation method.

The same method was then applied to precipitins by our associate, Dr. M. Coppo,[4] in our laboratory. It was found that the increase in viscosity in this case was proportional to the concentration in precipitins of the serum (rabbits injected with horse serum). The reaction is extremely sharp. A few interesting results were obtained: The higher the titer in antibodies of the serum, the smaller the quantity of antigen required to obtain the maximal viscosity. For instance, if 1.5 cc of immune serum precipitating at 1/1000 is mixed with antigen, the maximum of viscosity will be attained when .7 cc of antigen is added. If the serum precipitates at a dilution of 1/15,000 it will only be necessary to add .01 cc of antigen to 1.5 cc of serum in order to obtain the maximal viscosity. And in that case the absolute value of the maximum will be much higher than in the first case. In addition, it was observed that the rapidity at which the viscosity increases, then decreases, is a function of the concentration in antibody of the serum. It was also found that, for a certain and different ratio antigen antibody, corresponding to an excess of antigen, a minimum of viscosity occurred, the amplitude of which was much smaller than that of the maximum.

Similar maxima and minima, when the serum is mixed with tannin in definite proportions, were observed in our laboratory by another of our associates, Dr. F. Seelich. A detailed account of the experiments will appear shortly.

This new reaction seems, therefore, to raise questions of interest, not only from the practical, but also from the theoretical standpoint.

LECOMTE DU NOÜY

INSTITUT PASTEUR, PARIS

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF THE PHOTOELECTRIC CELL IN PHYSIOLOGICAL EXPERIMENTS

THE photoelectric cell, as ordinarily used, measures the density of light to which its total active surface is exposed.

In searching for a method of conveniently obtaining a record of the motion of a beam of light, it occurred to us that the photoelectric cell could be made to record a continuous curve of the arc traversed by the beam, rather than simply the fact that it impinged or did not upon the surface of the cell. It was found that this could be done by interposing between the

[1] Lecomte du Noüy, *Jour. Gen. Physiol.*, 5: 329, 1923.
[2] Lecomte du Noüy, *Ergebn. Hygiene, Bakter., Immunit., u. Exp. Therap.*, 15: 304–334, 1934.
[3] G. Ramon, *C. R. Soc. Biol.*, 86: 661 and 711, 1922.
[4] M. Coppo, *C. R. Soc. Biol.*, 118: 1307, 1935; 119: 165, 1935.