

the tooth. Direct determinations of the reaction of the saliva, and, *in vitro* experiments such as we have reported would not give any information as to the reaction in such localized areas.

¹ Starr, H. E., *J. Biol. Chem.*, 1922, liv, 43, 55.

² Bunzell, H. H. Bulletin No. 1, Colgate & Co., 1923.

³ Bunting, R. W., *J. Am. Dent. Assn.*, 1924, xi, 64.

3265

Occurrence of Schick Negative Reactions in Absence of Free Antitoxin in Blood Stream.

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The object of this communication is to present some observations concerning the relationship of antitoxic immunity to the Schick test.

The Schick test, consisting of the intra-dermal injection of 1/50 M. L. D. of diphtheria toxin, shows under proper conditions, a reaction at the site of injection in the non-immune (positive), and a complete absence of reaction in those who are immune (negative). The generally accepted explanation of a negative Schick test is that antitoxin is present in the blood serum, the circulating antitoxin reaching and neutralizing the toxin before tissue damage results.

This explanation is of course plausible, especially since we know of no product of the tissues capable of neutralizing toxin, except antitoxin. There was no ground for dispute of this hypothesis, so long as the presence of antitoxin in the blood was predicated, but it now develops as a result of a series of comparative observations with the Schick and the Kellogg¹ tests that there are individuals who give absolutely conflicting results, in that a negative Schick is accompanied by a lack of antitoxin in the blood as shown by the Kellogg test. These persons have all, with one exception, been found in the group of those originally Schick positive and who have become Schick negative by the administration of toxin-antitoxin. This may have a bearing on the explanation of the phenomenon, and points the way toward a line of investigation.

Attention was first directed to this matter, when some children in the California School for the Deaf and Blind, who had been immunized and later found to be Schick negative, were inadvertently included in a group that was having blood samples taken for the Kel-

logg test. These were positive, a result that was so surprising that a retest of 14 children who had been immunized five months before, was made by both methods. Two were found to be Schick positive, one was doubtful and the rest negative. All were Kellogg positive.

The tests that furnish the basis of the present report were made at the Sonoma State Home for the feeble minded, through the courtesy of Dr. F. O. Butler, the medical superintendent.

As a result of a fairly large series of comparative tests, it was noted that more than 20 per cent of those who were Schick negative following toxin antitoxin immunization were Kellogg positive, that is, they either had no antitoxin in the blood, or the amount present was too small to account for a negative Schick reaction. Some of these persons have been followed up with subsequent tests for confirmation and to observe whether the condition was temporary or permanent.

The following records are given as representative for the group studied:

<i>Case J. F.</i> —Schick positive,	April, 1923.
Toxin-antitoxin given (3 doses),	August, 1923.
Schick test positive,	March, 1924.
Second series toxin-antitoxin given,	April, 1924.
Schick test negative,	March, 1925.
Schick negative and Kellogg positive	May, 1925.
Again Schick negative and Kellogg positive,	March, 1926.
Again Kellogg positive,	May, 1, 1926.
<i>Case R. M.</i> —Schick positive,	April, 1923.
Toxin-antitoxin given (3 doses),	August, 1923.
Schick test negative,	March, 1924.
Schick negative and Kellogg positive,	May, 1925.
Schick negative and Kellogg positive,	March, 1926.
Again Kellogg positive,	May 1, 1926.

The Kellogg test, while adjusted to detect the presence or absence of 1/30 unit of antitoxin per cc., shows the presence of antitoxin in amounts as small as 1/100 unit, without readjustment of the toxin dosage. It may be, however, that even smaller amounts may possibly, in exceptional individuals, still give a negative Schick reaction, although the explanation of such behavior is not clear. Perhaps there is some difference in tissue permeability that permits larger amounts of lower grade antitoxin to come into contact with the test dose. If this were true, one would expect to find the same thing in persons originally Schick negative, thus giving rise to conflicting

results in the primary application of these tests. No such conflict has been observed in a large series of comparative tests.

The question of the exact immune status of these individuals presents itself, with the problem of the explanation of the mechanism involved in the suppression of the necrosing action of toxin in the absence of demonstrable antitoxin. This will involve the almost impossible task of following a large number of persons under conditions of natural exposure to infection.

Closely related to this problem is the question of the origin of antitoxin, latent immunity, local tissue immunity, etc.

¹ Kellogg, W. H., *J. Am. Med. Assn.*, 1922, lxxviii, 1782; *Ibid.*, 1923, lxxx, 748.

3266

Physiological Phenomena at the Time of Flowering.

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In order to study the growth curve of wheat, and especially the physiological phenomena at the time of flowering, Hard Federation wheat was grown in sand cultures under constant conditions. The illumination was continuous (Mazda C lamps), the temperature varied 1 to 2° C., the relative humidity of the air varied about 10 per cent, the water and salt content in the sand was kept as constant as possible. Every two days 6 plants were harvested and the fresh-weight and dry-weight of every leaf, stem and ear was determined in every plant separately. Each plant had 5 leaves and 1 stem with ear at maturity (all the tillers were removed as soon as they started to grow). These experiments quite confirmed the results which Kreuzler¹ obtained with corn some fifty years ago. He found that the gain in dry-weight was minimum at the time of fertilization of the ears or the first development of the kernels. However, recalculation of his results and of the data of several other investigators shows a close correlation between the time when this minimum occurred and the time when 100 per cent female inflorescences were present, *i. e.*, the week during which the maximum number of female inflorescences flower. In our experiment with wheat the minimum occurred exactly at the time of stamination.

This recalculation shows, furthermore, that coinciding with the