Two terms at once appear and reappear in the literature of the subject which it is necessary to understand, namely antigen and antibody.

If, as a result of the introduction of an infective agent into the body, something is produced which will protect the body against further onslaughts, then the infective agent must in some way, have generated against itself, some antagonistic body—whence come the terms antigen and antibody.

An antigen, then, is any substance which, when introduced into the body, will give rise to the production of substances capable of acting against it, or antibodies.

An antibody is a specific substance produced by the cells of the host in reaction against an antigen.

Among the substances so derived are:—

1. Antitoxins: specific substances capable of neutralising specific toxins, the term specific denoting the fact that a particular antitoxin will combine with and neutralise only the toxin which caused its production.

2. Agglutinins: specific substances capable of causing agglutination or clumping of the agent (antigen) causing their production.

3. Precipitins: specific substances capable of causing precipitation from solution of the substances causing their production.

4. Opsonins: specific substances capable of so acting upon bacteria as to render them more susceptible to destruction by leukocytes (phagocytosis).

5. Lysins: specific substances capable of causing lysis or solution of their antigens.

Numerous theories have been advanced to explain the intricate mechanism involved in the complex process resulting in the production of these substances of which the most prominent and, all in all, the most satisfactory is the Side-chain Theory of Ehrlich.

Originally evolved to explain the nutritive processes of the cell, the theory has been adapted and enlarged to cover what is thought to be the mechanism concerned with antibody formation. It must be emphasised that the entire theory is hypothetical.

Ehrlich visualises the cell as possessing two executive centres, as it were; one presiding over the function of the cell as, in a gland cell, to secrete; and one which controls and superintends the processes of nutrition, waste and repair. It is with the latter that we are particularly concerned.

If the cell is to live it must be nourished; to be nourished it must be able to grasp, absorb, and utilise food molecules in its vicinity. It is easy to visualise, in a purely diagrammatic way, this ability by imagining various outgrowths from the cell capable of combining with certain food elements—these outgrowths being called, by Ehrlich, side-chains.

The picture thus obtained is analgous to and, indeed, derived from the graphic method of presenting chemical formulae. For example, instead of representing the ability of one atom of oxygen to combine with two atoms of hydrogen to form water by the formula $H_2O$, we may indicate it by the graphic formula $O^{H}_{H}$, in which the combining ability of the oxygen (O) is represented by two receptors or side-chains to each of which is attached an atom of hydrogen (H).

In similar fashion we can imagine the combining ability of the cell to be represented by projecting side-chains or receptors each specific and adapted only to a certain substance. Among these would be side-chains for union with a toxin, for example.

However, as a result of the union of toxin and receptor the latter is destroyed, injuring the cell in this respect.

Here we leave Ehrlich, temporarily, and turn our attention to the investigations of Weigert. As a result of his studies on the mechanism of repair after injury, Weigert noted the prodigality of nature in its reaction to injury. He found that, in cells having the ability to repair damage done to them, the reaction was always in excess of the damage. In other words, if one cell only had been destroyed, the body replaced it by an excessive reproduction of cells of that type, and this fact is embodied in what is known as Weigert's Law of Overproduction in Repair.

Applying this law to the formation of antibodies we find that one toxin receptor having been destroyed, the cell, in its efforts to replace the receptor, produces not one, but a large number of similar receptors. There is only place for the attachment of one to the cell—what becomes of the others? They remain free in the blood stream. Each has the same structure as the original; each has, therefore, the power of combining with a toxin molecule and thereby preventing it from acting directly on the cell and causing injury; and each is, therefore, a free antibody, in this case a free antitoxin.

This, in brief, is the nucleus of the side-chain theory of Ehrlich upon which our present explanation of the mechanism of immunity depends.

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