

there is present, besides the products of digestion, the ferment or the active agent in the transformation. In the case of bacteria growing in an artificial medium outside the body or developing in the body, there is—in addition to what digestive products may be formed—a living bacterial cell, and any secretion which it may produce; and it will be seen that the body of the bacterium, as well as its secretion—whether this be of the nature of a ferment or not—are both of the highest importance in the consideration of diseased conditions and processes.

In bringing these aspects of bacterial action to your notice, it will be seen to what extent the products of their digestion of albuminous substances or the mere secretion of poisonous substances act in disease.

The study of putrefaction, which is produced by many different micro-organisms, has shown that—besides the production of albumoses as the early products of digestion—numerous chemical substances, or final products, are formed, some of which are not toxic, although many are highly poisonous.

It is not necessary to dwell on this part of the subject, except to say that the effect of these toxic bodies of putrefaction is (1) that of intense local irritation, whether they are injected under the skin or introduced into the digestive tract; and (2) an action on the central nervous system whereby, besides the production of muscular twitchings and clonic and tonic spasms, there is with many of them a tendency to the production of stupor and coma, ending in death. These chemical products of putrefaction, with, perhaps, one exception—that of mydaineine—do not cause a rise of body temperature, so that the fever which is observed in cases of poisoning by putrefactive products, such as those occurring in some cases of food poisoning, are due to other products of the bacteria. At one time similar chemical products or

animal alkaloids, as they are called, were supposed to play a large part in the processes of specific infective diseases. Thus, Briege isolated two bodies, tetanin and tetano-toxin, which were supposed to be the active agents in the production of the convulsive spasm of tetanus. He also isolated typho-toxin, a chemical body which was supposed to be an active poisonous agent in typhoid fever. The existence of these bodies has, however, not been confirmed by subsequent research. It does not follow, of course, that in all diseases such final products may not play a part in the production of the symptoms. As I have shown in anthrax, such a product is formed, and is one of the active poisons in the disease. Of later years, especially as the result of the study of the chemical pathology of diphtheria and of tetanus, the most active poison which is produced by the micro-organism is not of the nature of an animal alkaloid, but a substance which cannot be defined chemically, but only by the investigation of its physiological action.

SEPARATION OF BACTERIAL POISONS.

The three kinds of poisons which have been indicated must be borne in mind, namely: (1) The poisons secreted by the bacterium itself; (2) the products of the digestive action of the bacterium, that is, the albumoses; and (3) the final non-proteid products, which may be provisionally called an animal alkaloid. The first two poisons are precipitated from solution by means of alcohol; generally speaking, the last class of poisons is soluble in alcohol. In the separation of the first two classes of poisons by means of alcohol great care has to be taken that they are not exposed for too long a time to the action of the reagent, so that their toxic properties may not be diminished. The prolonged action of alcohol, for example, on pepsin, will diminish its activity;