

RECENT STUDIES ON DIPHTHERIA.

IT is an acknowledged fact that as regards diphtheria, personal predisposition on the part of its victims plays a most important part.

We find this well illustrated by statistics which show that it is in early childhood that the majority of cases occur, and the heaviest diphtheria death-rate is recorded. Thus Feer in Basel found that the most susceptible age to diphtheria lies between the years 2 and 5 and 5 and 10; but that whilst the mortality amongst children attacked in the *earlier* period was 25·4 per cent., in the *later* period, with practically no diminution in the number of cases, the diphtheria death-rate fell to 7·6 per cent. After this period there is not only a great decline in the number of cases of diphtheria, but also a marked decrease in the percentage of deaths, suggesting that with increasing age the human system is enabled gradually to develop means of protection from this terrible disease.

That some such protective power must also be possessed to a large extent by children, follows from the fact that a disease practically endemic in some of our large cities, so many children succeed in escaping from its ravages, for it is impossible to conceive that all those who have remained unscathed have never been exposed to infection from diphtheria.

Thus Flügge has worked out an interesting diphtheria-table for the city of Breslau during the years 1886-1890, in which he not only confirms Feer's observations upon the connection between age and the diphtheria death-rate, but he also shows very clearly that even in the most susceptible period of child-life, the number of cases of diphtheria is relatively small when compared with the number of children of the same age who are not attacked.

In what does this protective power against diphtheria infection possessed by many children and a large number of adults consist? This interesting and important question Dr. Wassermann has recently endeavoured to answer by making a very extensive examination of the properties possessed by the blood serum derived from patients not suffering from diphtheria, but admitted on other grounds to the Berlin Institute for Infectious Diseases. Careful inquiries were, moreover, in every case made as to the patient's previous history as regards diphtheria, and only those were included in the investigation who had never had diphtheria.

The serum which was obtained from these strangers to diphtheria was in every case tested for its immunising or protective power by inoculating it along with a recognised lethal dose of diphtheria toxin into guinea-pigs, the latter by itself having been proved capable of killing these animals without exception in from 30 to 48 hours.

The results obtained were extremely interesting. Out of seventeen children varying in age from 1½ to 11 years, eleven yielded serum with highly protective properties as regards diphtheria, for all the animals treated with their serum and virulent diphtheria toxin experienced no ill-effects whatever. Two out of the seventeen children yielded serum possessed of slightly protective power, it being found capable of delaying the death of the infected animals, whilst the serum derived from the four remaining children had no protective properties whatever.

Amongst the adults the number of those yielding an anti-toxic serum was much greater, for out of thirty-four individuals the serum of as many as twenty-eight was found to be endowed with protective properties against diphtheria infection; and, as far as the investigation went, it appeared that the possession of such serum, as well as its strength or degree of efficiency, was more marked with increasing age.

That people who have gone through the ordeal of diphtheria possess such antitoxic serum in their system has been shown by various investigators, but, so far as we

know, Wassermann is the first who has proved that anti-diphtheritic serum may also be possessed by individuals who have had no previous experience of diphtheria.

This discovery serves to explain how virulent diphtheria bacilli may be present in the throat of perfectly healthy people, without producing any bad results at all. That such may be the case has been proved by most careful and trustworthy observers, and that their presence does not engender diphtheria, we must now regard as probably due to the possession of anti-diphtheritic serum by the individual who so unconsciously has harboured them. Such may also be, and probably is, the explanation of the harmless presence of virulent diphtheria bacilli in the throats of patients convalescent from diphtheria long after the disappearance of all the typical symptoms.

It does not follow, however, that because at some given time a particular individual has been found the happy possessor of anti-toxic serum he may, therefore, rashly assume that he is for ever after proof against diphtheria infection.

It must be remembered that such serum is possessed in very different degrees of strength by different individuals, and may vary also, in one and the same individual, in its protective character at different times.

Research has shown that people possessing only feebly antitoxic serum can contract diphtheria, but in the majority of such cases it is satisfactory to learn that the symptoms are light, and the disease is mastered without much difficulty.

So far as our present knowledge goes, it would appear reasonable to admit that although the possession or non-possession of antitoxic serum of varying degrees of strength may not be the only circumstance which regulates the fluctuating personal disposition towards diphtheria infection, that yet it may be regarded as an important factor, and Wassermann considers principal cause, in determining the apparent idiosyncracies of diphtheria infection. What the mechanism may be whereby this anti-toxic serum is produced in the system is still a mystery; that it should be possessed by infants only eighteen months old, would incline to the belief that it is natural or inborn, and not subject to later processes of evolution.

On the other hand, however, we have the well-established fact that the serum of animals which have a natural or race immunity to a particular disease, is wholly devoid of power to confer protection from this disease on other classes of animals.

This remarkable circumstance has been once more very clearly demonstrated by Wassermann in the case of diphtheria, to which disease white rats are absolutely immune. In order to test the character of white-rat-serum as regards diphtheria infection, fatal doses of diphtheria toxin were administered to guinea-pigs along with such serum, but in no single case did the latter survive, showing that this serum possessed no anti-diphtheritic properties whatever, and was incapable of protecting animals from diphtheria infection.

Thus, on the one hand, we find that natural or race immunity to a particular disease does not provide protective serum against infection from that disease in other animals, and, on the other hand, that the serum of individuals who have never had diphtheria, does provide in many cases such protective serum.

Now Wassermann argues from these facts that the possession of protective human serum is not natural or born with the individual; for otherwise, as in the case of white-rat-serum, it would be incapable of conferring immunity, that it must therefore rather be regarded as a later acquisition, and subject to evolution processes.

In pursuing this line of reasoning, Wassermann assumes that race immunity found to be characteristic of a particular description of animal is necessarily of the same character as exceptional immunity confined to particular

individuals of a race. In the one case it belongs to the whole race, whilst in the other it is possessed by only particularly fortunate individuals of a race.

Does not this point rather to the operation of exceptional circumstances, in which, possibly, heredity may play a part? How is it that whereas some families appear to have a faculty for contracting every zymotic disease, others exposed to similar conditions, have an equally characteristic faculty for escaping such diseases?

The impression is irresistible that such a faculty is born with or natural to the individual.

It may be argued that the white-rat-race-immunity may also be ascribed to the operation of heredity. This is quite possible, but in the one case the immunity is perfected or heredity has accomplished its work, whilst in the other it is incomplete and is still in an evolutionary stage. The race immunity to diphtheria, or immunity in its perfected condition, is evidently of a different order, and may also very possibly have been developed on quite different lines, from that which we have been discussing in the human subject. In what this difference consists is at present unknown, and until we have a more intimate understanding of the actual condition in the system upon which immunity depends, or a closer insight into the particular agents responsible for its production we cannot hope to arrive at any definite conclusion.

There is, however, another obstacle to a logical acceptance of Wassermann's arguments as to the origin of protective diphtheritic serum in the human system, that is to say, in the light of our present knowledge, for it entails the supposition that such individuals have been subjected to the action of diphtheria bacilli. This supposition is the logical outcome of the bacteriological evidence which is at our present command on this subject. Thus it has been found, over and over again, that the serum of animals artificially rendered immune to a particular disease, is only efficacious in affording protection to other animals infected with *identically the same microbial disease*. This has quite recently been carefully worked out by Pfeiffer, who has shown that the serum of horses rendered immune to cholera is only efficacious in cases of infection from the cholera vibrio, and that it is absolutely inoperative in protecting from an infection due to any other vibrio, however nearly the latter may resemble that of the cholera vibrio.

But we have seen that protective serum may be possessed by individuals who have never had diphtheria, on whom, moreover, careful investigation has not been able to reveal the invariable presence of true diphtheria bacilli. So far it must be acknowledged, then, that we have no working hypothesis which enables us to comprehend aright the circumstances which determine the presence of or control the generation of anti-diphtheritic serum in the human system, and we are therefore powerless to either stimulate or diminish its production; but we are, however, in a position to regulate, to a great extent, the dissemination of diphtheria virus from one individual to another.

It has recently been shown that children taken from diphtheria surroundings, and not themselves suffering from the disease, in a large number of cases carry about with them in their nasal and throat passages typical virulent diphtheria bacilli, and that although they do not necessarily themselves develop the disease, they thus become the dangerous carriers of infection.

It is considered essential, therefore, that no member of a family where diphtheria has occurred, should be allowed to mix with others until a bacteriological examination has shown that diphtheria bacilli are absent from the air passages, neither are those who have recovered from this disease to be permitted to resume their usual occupations until the absence of diphtheria bacilli has been conclusively proved.

In Germany such systematic examinations are rapidly

gaining ground, and already in some of the hygienic institutes the practice is regularly carried out. Indeed, in Königsberg, von Esmarch has suggested that to facilitate the universal adoption of such precautions, the throat of the patient or suspect should be wiped with a sterile sponge, and the latter forwarded for bacteriological examination.

The causes at present at work contributing to the generation of diphtheria in London have yet to be found.

If the contraction of diphtheria primarily depends upon the presence or absence of anti-toxic serum in the human system, then it would appear that some causes are at work tending to deprive the individual of the capacity to generate this means of protection.

It is difficult to conceive, and hard to realise, that the advance in sanitary science and improved hygienic conditions of the present day have but resulted in London in increased facilities for generating and distributing the virus of diphtheria, and that so far we have proved ourselves hopelessly unable to fathom this problem, or to stay the progress of this terrible malady.

REPORT OF THE COMMITTEE APPOINTED BY THE SMITHSONIAN INSTITUTION TO AWARD THE HODGKINS FUND PRIZES.¹

THE Committee of Award for the Hodgkins prizes of the Smithsonian Institution has completed its examination of the two hundred and eighteen papers submitted in competition by contestants.

The Committee is composed of the following members: Dr. S. P. Langley, Chairman, *ex-officio*; Dr. G. Brown Goode, appointed by the Secretary of the Smithsonian Institution; Assistant Surgeon-General John S. Billings, by the President of the National Academy of Sciences; Prof. M. W. Harrington, by the President of the American Association for the Advancement of Science. The Foreign Advisory Committee, as first constituted, was represented by M. J. Janssen, Prof. T. H. Huxley, and Prof. von Helmholtz; and after the recent loss of the latter, Dr. W. von Bezold was added. After consultation with these eminent men the Committee decided as follows:

First prize, of ten thousand dollars, for a treatise embodying some new and important discoveries in regard to the nature or properties of atmospheric air, to Lord Rayleigh, of London, and Prof. William Ramsay, of the University College, London, for the discovery of argon, a new element of the atmosphere.

The second prize, of two thousand dollars, is not awarded, owing to the failure of any contestant to comply strictly with the terms of the offer.

The third prize, of one thousand dollars, to Dr. Henry de Varigny, of Paris, for the best popular treatise upon atmospheric air, its properties and relationships. Dr. de Varigny's essay is entitled "L'Air et la Vie."

(Signed), S. P. LANGLEY,
G. BROWN GOODE,
JOHN S. BILLINGS,
M. W. HARRINGTON.

August 9, 1895.

SUPPLEMENTARY REPORT OF THE COMMITTEE APPOINTED BY THE SMITHSONIAN INSTITUTION TO AWARD THE HODGKINS FUND PRIZES.

After having performed the function to which the Committee was called, as announced by the circular of the Secretary of the Smithsonian Institution, dated March 31, 1893, which function did not include the award of any medals, there remained several papers to which the

¹ Communicated by Dr. S. P. Langley, Secretary Smithsonian Institution.