REPORT OF THE COMMITTEE ON CAUSE AND PREVENTION OF INFECTIOUS DISEASES.

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MR. PRESIDENT AND GENTLEMEN—Your committee has found it difficult to gather such data of a new character regarding the microorganisms which cause one or more of the infectious diseases as would authorize them to devote any considerable length of time to this portion of the subject. The chairman had hoped, by selecting gentlemen of the committee specially qualified to deal with some particular disease, to have been able to have the last word up to date spoken by your committee on each. It was hoped that Surgeon General Sternberg would have spoken concerning yellow fever, but other pressing duties have prevented. Dr. Jésus Monjarás has, as will be seen, written regarding typhus fever, and said, I think, the last word up to date, while Dr. Suiter has, in a valuable report, made a resumé of the principal features of scarlatina. Dr. Hewitt, as will be seen from the appended report, dealt very fully with diphtheria. I had hoped for much from my other coadjutors, but they, too, have been prevented from reporting on the subjects assigned. In view, however, of the supreme importance of the subject assigned to the committee, its chairman has thought it proper to bring before the Association, not only what has been said by his coadjutors who have reported, but also to touch upon some points which have practical bearings on our work as sanitarians.

In making a survey of the subject, it is apparent that we must realize, as in classifying plants, that the infectious diseases fall into several divisions, both as regards their mode of causation and their growth and development.

Dr. Clifford Allbutt classifies them as follows:

1. Infectious diseases of chronic course: as tuberculosis, leprosy, actinomycosis.
2. Diseases of uncertain bacteriology, (a) not endemic: as measles, rubeola, scarlatina, smallpox, chickenpox, whooping cough, mumps; (b) topical or endemic: as typhus, dengue, yellow fever, dysentery.
3. Infective diseases communicable from animal to man, (a) of certain bacteriology: as glanders, anthrax; (b) of uncertain bacteriology: as vacuma, foot and mouth disease, rabies, glandular fever.
4. Diseases due to protozoa: as malaria, amœbic dysentery.
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In order to get information bearing upon the several diseases, with a hope that I might present the results in tabular form, I asked that the relations of the several diseases to soil, climate, etc., be touched upon; but the information supplied has not been sufficient for the purpose.

From the practical standpoint, too, the composition of this committee supplied the means of getting information from statistical and general officers, as State officers, as to the results of any disease, from municipal officers, with full knowledge of details, as to modes of causation, and of those from the laboratory, who would have dealt with the same ab initio; but, as stated, our efforts have been but partially successful.

It will be apparent, however, to even a superficial observer, that the subjects which this Association deals with to-day are not, in a large degree, those which troubled us greatly fourteen or twenty years ago. Excepting, perhaps, about the mere germ itself, we seem to have learnt pretty much all about smallpox, for instance; vaccination and compulsory isolation with effective cleansing, ends the matter, and we set down six weeks of isolation as a finality and move on. The same may largely be said for scarlatina, except that in practice the adage of the celebrated Sydenham, quoted by Dr. Suiter, regarding the mildness of the disease when first differentiated, "vix nomen morbi merebatur," may to-day be so often repeated regarding it that the working physician and municipal health officer find it very difficult to accept the still accepted rule of English hospital practice of isolation for a minimum of forty days.

In the diseases, measles and whooping cough, in both of which the germs have still eluded research, we find health officers still struggling with the difficult problem which health officers everywhere meet with, that of the practical control of two diseases, which, through their common mildness in the families of the well-to-do, still cause amongst the children of the poor, in crowded centers, at least, more mortality than from either of the other two pests referred to. It may be stated as a general conclusion that until regular medical supervision of the public schools becomes a recognized part of municipal health work, no great advance over the present laissez faire methods is to be expected.

As regards diphtheria, regarding which, owing to the notable advances made, both in its diagnosis and treatment, a complete resumé of the work of the past four years should properly have been submitted, the member having the matter in hand has reported very fully. Regarding the disease, it may suffice to say, that the past year has still more clearly demonstrated, from the biological standpoint, the dis-
tinctive differences marking true diphtheria from the allied pseudo forms. Perhaps the most interesting facts in the extended investigations go to show that in all communities where the disease has existed or become in some degree endemic, a notable proportion of all throats examined of children showing no symptoms of the disease, shows the existence of the bacillus, present as a saprophyte, at times virulent in experimental inoculation of animals. The experiments of Professor Wesbrook, presented in a paper read in Montreal last year, illustrated the fact in a case where the disease had become endemic in an orphanage, while results in investigations by Mr. J. J. MacKenzie, Bacteriologist of the Provincial Board of Health of Ontario, upon children, inmates of the Children's Hospital, Toronto, add further corroboration of the fact.

As regards the methods for suppressing outbreaks of diphtheria in a community, further experience in Ontario during the past year has shown that the following seems the most effective and prompt means of stamping out an outbreak. In a number of municipalities where the disease appeared, as it always does, principally amongst school children, the practice was introduced of a morning visitation by the sanitary inspector to all the public schools to obtain a list of the day's absentees. The homes of these were promptly visited, and where any evidence of malaise or sore throat was present, the parents were at once required to send for the family physician and have a swab taken and forwarded to the medical officer by the afternoon. Where neglect occurred the medical officer was notified, who then visited the family and took a swab. These were sent at once by mail to the Provincial Laboratory and the patient isolated until an answer by telegraph of the result of the examination was received. Where the cases proved to be diphtheria the patient was isolated until further examination proved the freedom of the throat from bacilli. The children of the household were kept from school and the public, and the house subsequently disinfected with formaldehyde, where the child had not been removed to the hospital. It may be mentioned that the greater safety of the family and the more assured recovery of the child, not to mention the convenience to family and the economy of the procedure, have so commended themselves to the people that cottage hospitals are yearly growing in favor. It need hardly be said that the most progressive physicians and municipal authorities report yearly the increasing use and efficacy of antitoxin as a curative agent in diphtheria.

Typhoid fever and those allied diseases, typhus, cholera, yellow fever and dysentery, or those zymotic diseases in which the digestive tract is the principal seat of their pathological manifestations, are a
group which, in spite of all the work that has been done towards their elucidation, still stand prominent as a "will o' the wisp," leading bacteriologists onward to a seeming certainty of conclusions, only to elude their grasp at the moment of looked-for success.

The Cuban campaign, as well as the epidemic in the Southern States in 1897, has lent a new interest to yellow fever for members of the Association, who ordinarily are beyond the sphere of its influence. In the absence of a report from Surgeon General Sternberg, that member of the committee who could have told us so much, it does not seem desirable to refer to those investigations into the cause of the disease which may still be said to be incomplete.

As regards typhus fever, it is with pleasure that we are able to produce here some of the very practical and scientific remarks of Dr. J. E. Monjarás, of San Luis Potosí, dealing both with the causation and the prevention of the disease. After referring to the statistical studies of the disease in that city from 1892 to 1898, during which time he had charge of the health department of that city, and studied an epidemic causing eight hundred and fifty-one deaths, Dr. Monjarás makes the statement that the tables published show that there is no period of the year, and even no day of the year, when we can say that no person in the city is suffering from typhus. Meteorological circumstances, such as cold, heat, atmospheric humidity and pressure do not, taken by themselves, show any clear, precise and constant connection with the number of deaths. "Of the telluric influences, that of the rainfall, which plays so great a part in epidemics of typhoid fever and cholera, does not exercise any great influence in the development of typhus; and there is no clear evidence that sewage emanations play a very important role in its development." "Neither can we trace its existence, in an indisputable manner, to the drinking water that is used in the city, and no evidence exists that any occupation exercises any special influence on the disease." "The same cannot be said as regards the social position of the persons attacked; and the exact data that I have been able to collect during the last three years clearly show that the poorer classes are those which furnish the greatest number of victims, amounting to seventy-two per cent. of the total cases. The disease, though attacking well-to-do persons, has always made its first appearance in the huts of the poor quarter of the city. During the prolonged epidemic lasting from October, 1892, to December, 1893, the years of the great drought, charitable persons opened soup kitchens in different parts of the city, where they fed the poor twice a day. "The persons employed in this service were amongst the first victims of typhus, which later invaded the entire city." Based upon these studies, Dr. Monjarás concludes: "I be-
lieve pauperism constitutes one of the principal etiological causes of typhus, and that the extinction of pauperism is the best prophylactic measure against typhus.” While it is true that the disease has increased in winter, Dr. Monjarás believes this not due to the cold directly, but to the crowding, especially of the poor, into badly ventilated rooms, and the want of an open-air life, such as they have during other seasons.

These remarks are most interesting, as indicating an essential distinction between this disease and typhoid, cholera and yellow fever; those diseases which, with malaria, lead us back to that oldest of problems, the relation between them and the organic matter of soils and of ground water.

They are further important, confirming, as they do, for the western world, in large measure, the conclusions held regarding typhus, by health officials and physicians, both in Europe and in the crowded cities of India and China.

In an association formed of representatives of a whole continent situated in the temperate zone, where typhoid tends to prevail, it is most natural that any progress made in an exact knowledge of typhoid fever should be referred to. In this, as also in the mode of dissemination of malaria through the agency of mosquitos, the past year has seemed to have added somewhat to our positive knowledge.

Sir Joseph Fayrer, writing regarding malaria in India, speaks frequently of the degrees of virulence in its manifestations; in other words, of variations in the virulence of the germ. He states that, in different localities, and under different circumstances, malaria varies greatly in intensity. Often mild, it may assume, with the failure of food-supply and favoring meteorological conditions, the character of a dominant and destructive epidemic; and he suggests that simple ague, cachexia and neuralgia, and the severe remittents, according to varying localities, are but variations in the source of the micro-organism; and that further, differences in age, race and personal susceptibility, under varying sanitary surroundings, account for the different types the disease assumes.

Similar variations in the virulence of the type of bacilli are, as we now know, the common experience in the cultivation in both the germ for the production of diphtheria toxin, and in the results of inoculation experiments with different samples of toxins on animals.

From the experimental studies of Dr. Sydney Martin, of London, England, recently published, and from his views of the results of other workers, we are now able to say that the bacillus typhosus is subject to at least equally great variations of virulence, and that it, as well as its allied forms, bacillus coli and bacillus enteriditis of Gärtner, may
by successive bacterial passages through animals, when inoculated with other forms, as a streptococcus or bacillus prodigiosus, increase the virulence in the toxic products produced by their subsequent culture in broth.

He seems to have added still further proofs that these three bacilli, though allied, are absolutely distinct from each other; but, on the other hand, has given us experimental proof of how readily bacillus coli may take on a pathogenic virulence. This would seem a point of prime importance, since we have constantly arising a problem, hitherto wholly unexplained, of why, whether in the new mining camps of Western Australia, in the Transvaal, the mountains of Idaho, or in the Klondike, within the sub-arctics, the prospector has only to locate his claim and settle upon it, disturb the virgin soil and allow, through neglect, excretal pollution of such soils near the camp, when within a few weeks, enteric fevers with typhoid characteristics, will develop. Or still more interesting is the fact that the lumber camp need only be located on the shores of some lakelet in the Northern Laurentides of Canada, in the late autumn, with its drainage flowing towards the lake, and in spite of the intense cold, excretal pollution reaching, beneath the ice, the waters, rich in vegetable organic matter, will, before the springtime, produce an outbreak of enteritis, with typhoid symptoms.

Hitherto we have been forced to explain such outbreaks by supposing always that some vigorous young man has gone to the mining or lumber camp as an ambulant case of typhoid, or if this supposition seemed too ridiculous, we have recently had to assume that the bacillus typhosus is a hemi-saprophyte (or facultative parasite), practically always present in the intestine of man, benign and non-virulent, but differing from bacillus coli in playing no part in digestion.

Sydney Martin points out that bacillus coli differs from the other two in that it causes decomposition of proteids, that it is found in foul water and in soil, and after death penetrates the different abdominal organs, and is one of the causes of putrefaction in the body. He further tells us, "there are, no doubt, many different forms of the bacillus coli," which vary greatly in virulence. Martin states that he found it much easier to increase the virulence of bacillus coli than of either of the other bacilli, and that with fourteen days' culture, 4 c. c. of a broth culture caused death in a large guinea pig in twenty-four hours. With such a ready increase in virulence on the part of this normal saprophyte of the intestine, and in the absence of Widal's test, it does seem that we now have a reasonable explanation of the occurrence of outbreaks of fevers with the enteric symptoms; since Martin's experiments with cultures of high virulence show that inoculations
of the poison, while producing no peritonitis, did produce petechias, both beneath the peritoneum and on the mucous membrane of the ileo-cæcal region and cæcum with profuse diarrhœa.

The results of these experiments have seemed of so much practical importance, as directing our efforts for the prevention of typhoidal diseases, as to excuse this lengthened reference, since your committee is convinced that any doctrine which teaches the general existence of bacillus typhosus as normally present in the intestine, and that the typhoid germ may, therefore, develop in virulence at any moment, and so produce disease, would be dangerous and subversive of the belief of the past twenty years, which has increasingly been taught as a truth, that "maintain the drinking water of a city, or, indeed, of any place, free from the excretal pollution of man and animals, and typhoid fever will not occur; while, on the other hand, allow excretal animal matters to find their way into drinking water, and typhoidal diseases will sooner or later break out."

This report would not be deemed in any degree complete did it not refer briefly to the progress in our knowledge, both with regard to the inoculation and dissemination of, and to the prevention of tuberculosis.

Regarding inoculation with the bacillus tuberculosis, Dr. Hugh Walsham, of London, England, in a remarkable paper giving the results of his pathological investigations, quotes Dr. Sims Woodhead, who says: "I am driven to the conclusion that this method of infection of the glands of the neck through the tonsils must be of a comparatively frequent occurrence, especially in children living under insanitary conditions and subjected to various devitalizing influences," and proceeds to cite the experiments of M. Dieulafoy, before the Academy of Medicine, Paris, who obtained a number of portions of tonsils and adenoid vegetations, removed on account of hypertrophy. With material taken from twenty-one cases of hypertrophied tonsils and inoculated into guinea pigs, eight became tuberculized; and of adenoid vegetations from thirty-five cases, seven guinea pigs became tuberculized. As objections were made that the bacillus might be in mucus and not in the tonsil, Dr. Walsham made sections of tonsils from persons who had died in the hospital, in most cases from tuberculosis, but who had not apparently suffered from tonsillar tuberculosis. Microscopic examinations showed that twenty out of thirty-four cases had tubercular tonsils. While not finding tubercles in portions of hypertrophied tonsils removed from living patients, he quotes Dr. M. Lennoyez to show that tubercular adenoids and tonsils do exist, and that general infection has at times resulted, owing to the wound made by their removal. He concludes:

First. That the tonsils are very frequently affected.
Second. That tubercle may be primary in the tonsil.

Third. That they are frequently infected secondarily in pulmonary cases.

Fourth. That the cervical lymphatics are frequently affected from them.

Fifth. That the tonsils may be affected from without or through the blood stream alone.

Other experimenters seem to have obtained positive results as regards the mucous tissues of the nose, and it would indeed be strange were it not so, where we find the following results from Pflugge's experiments regarding the dissemination of dust and germs of disease by air movements in houses. He pointed out:

First. That, owing to technical errors, the older observations upon the rate of air movement necessary for the lifting of bacterial parasites into the air gave too high a figure as a unit. He places it at about four metres per second.

Second. That once particles have been thrown into the air, they remain floating for hours (six hours), and may be carried from one part of a room to another by currents of very slight intensity, less than two millimetres per second.

Third. That bacteria-holding droplets of fluid are always thrown into the air by a fit of coughing, by sneezing or by loud talking, and these droplets are so small that they may be found floating in the air for at least five hours and are carried about by currents of exceedingly low intensity.

Fourth. That slides supported in front of coughing consumptives are frequently found to be covered with tubercle bacilli, either isolated or in small groups, and that they must have been associated with the small particles which he found would float for such a time in the air.

Fifth. That particles may be thrown a distance of thirty feet by an ordinary fit of coughing.

Sixth. That experiments with the dust of dried sputum on animals have practically always shown that it is not possible to produce inhalation tuberculosis in that way.

Seventh. That, in those cases where inhalation infection has been successful, sprayed moist sputum has always been used.

He concludes that in diphtheria, scarlet fever, consumption, influenza, etc., there is more danger from the infecting agent thrown into the air by the act of coughing than from dust derived from the same material.

Still more recently, Neisser, of Breslau, in a recent paper, points out that the air currents which obtain in an ordinary room, i.e., current of ten centimetres per second, and twenty feet per minute, seem unable to
carry certain bacteria in a living condition. That is, that air currents of such slight character can only carry the driest dust, in which many bacteria have previously been destroyed.

From a long series of experiments he concludes that the following bacteria are not carried by such currents:

- B. Diphtheriae.
- Vibrio Cholerae.
- B. Typho-abdominalis.
- Pneumococcus.
- B. Coli communis.
- Streptococcus pyogenes.

The following are carried:

- Strept. pyo. aureus.
- B. Anthracis.
- S. Pyocyaneus.
- B. Tuberculosis.

German observation seems to controvert this in regard to the diphtheria bacillus and the pneumococcus, which resist drying for a long period.

Such experiments give point to the results of statistical studies of deaths from tuberculosis. It has long appeared evident that the disease has, so to speak, attached itself to certain houses, and by Dr. Gerhardt, of the New York City Health Department, it has been found:

First. That in a single ward of the city (No. 4), where there are six hundred and sixty-three houses, with 18,223 population, or 27.6 to a house, two hundred and forty-eight houses, or 37.3 per cent. of the whole, had, during some one of the years 1894, '95, '96, cases of consumption, or the total cases were five hundred and forty-one, or 0.81 per cent for every house in the ward.

Second. That, for the infected houses, there was an average of 2.81 cases.

Third. That the three years showed no great increase of infected houses.

Fourth. That some houses seem so permanently infected and should be either torn down or renovated from top to bottom.

Many similar results might be related from recent statistical studies in many countries and states, but it is of much importance that we should have laboratory experiments completing the proofs of the extreme danger attaching to inmates of the same house where cases of consumption in advanced stages are resident.

The year has shown notable advances in the practical adoption of the principle of sanatoria or hospitals for consumptives, as in Germany, from France and England, as well as on our own continent, a number of new sanatoria based on the "air cure" idea have been erected. Interesting in this connection is the series of resolutions adopted by the International Conference of State and Provincial
Boards of Health at Detroit, in August last, and which have been generally distributed:

Whereas, it has been the unanimous voice of the International Conference of State and Provincial Boards of Health of North America, that, since tuberculosis, which causes on this continent more deaths than all other contagious diseases together, is now recognized by all scientific and medical authorities as both curable and preventable; and

Whereas, since the onset of the disease depends especially upon hereditary weakness, and on mal-nutrition induced by over-crowding, bad ventilation and over-pressure in school, social and commercial life; and

Whereas, since the continued presence in the homes of the poor and others of so many cases of this chronic disease means almost certain death to the patient, and probable infection to other members of the family, be it therefore,

Resolved, that this Conference does publish, and instruct the Secretary to forward copies of these resolutions to the legislatures, departments of education and municipal authorities of the several States and Provinces represented in the Conference, urging upon them the imperative need of,

1. Having all schools and colleges placed under proper medical supervision with regard to ventilation, over-crowding and over-pressure in studies;

2. Having all hotels, boarding houses and work shops where consumptives may be employed, placed under municipal supervision and inspection;

3. Urging all State and Provincial legislatures to devote public funds, and to encourage private philanthropy, in the establishment of homes or sanatoria in one or more counties or districts of the several states and provinces, to which tuberculized patients may be sent early, either at their own or municipal expense, and under proper regulations be encouraged to remain therein until recovery shall have taken place; while at the same time they shall have prevented the continuance of centres of infection in their homes.

Dr. C. A. Lindsley, Connecticut:—I believe that this resolution should be in some way published at once. I do not think it should be held until published in the regular proceedings. I move that the Secretary prepare copies of this resolution at his early convenience and send them to every State and Provincial board of health that they may have opportunity to bring the matter before their legislatures. Motion was seconded and carried.

Your committee feels that it has only touched upon much that might with profit be dealt with at length by it, but it hopes that the resumé of some of the lines of progress in different fields of sanitary work may not be wholly devoid of interest and instruction.