syphilis. The contagium of the one is pus, that of the other the particulate micro-parasites of a specific fever.

Now, Mr. President and Gentlemen, permit me, in conclusion, briefly to recapitulate. We have concerned ourselves this evening almost solely with the more exceptional of the phenomena which occur in connection with primary sores. We have glanced at the topics of incubation-periods; of recurring induration; of the occasional absence of the usual conditions in primary sores; and at the explanation of the differences presented by different sores of venereal origin. I have tried to reconcile the doctrines of the dualist and the unicist by showing that both are in a sense right, with, however, an abiding protest that there is but one syphilis. I have spoken also of the relations of phagedænic action to syphilis, expressing a belief, which I have often expressed before, that syphilis is in truth the parent of almost all phagedæna. By reference to this doctrine, I have tried to explain the origin of hospital-gangrene. Lastly, I have mentioned briefly the sad, but important and final, proof, that clear vaccine-lymph may contain the virus of syphilis. On most of these topics, it has been my pleasant duty to rest my conclusions quite as much on the observations and opinions of others as my own. Although I have not often, under the exigencies of the occasion, found time to mention names, yet I may now say that the excellent works of Henry Lee, Berkeley Hill, Fournier, and Bumstead, have been laid under constant requisition in preparing the statements which I have made this evening. Although I cannot pretend that there are no differences of opinion, it has been a great pleasure to note a very general unanimity of testimony on most points.

A LECTURE

ON

THE EXCITING CAUSES OF DISEASE.

Delivered before the Edinburgh Health Society.

By BYROM BRAMWELL, M.D., F.R.C.P. Edin.,

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(Concluded from page 6.)

In order to understand the measures which should be taken for the prevention and stamping out of these specific infectious and contagious diseases, it is essential to realise that the germs which produce them are not, so far as we know, generated *de novo* (afresh), but that they are always transmitted from some pre-existing case of the same kind. The poison of scarlet fever always comes from a pre-existing case of scarlet fever, that of small-pox from a pre-existing case of small-pox, and so on. If, then, you can destroy all the poison which is given off from every case, for instance, of scarlet fever, and not allow any of it, while still active, to come into contact with any susceptible person, you will ultimately succeed in stamping out the disease. It must, however, be remembered that the poison of some of these diseases is very tenacious of life, that it may lie long dormant; and that, for this and also other reasons (notably, that the poison is invisible), it is not always possible for us to trace the exact source of infection, or to put our finger on the pre-existing case.

The most important means of stamping out the specific infectious and contagious diseases are as follows.

1. *Isolation of the Sick.*—Thorough isolation can seldom be properly carried out in a private house, and is simply impossible in the houses of the poor, where all the members of the family live in one or two rooms. Unless thorough isolation can be carried out, it is generally advisable, in the case of such diseases as scarlet fever and small-pox, which are both very infectious and very fatal, to send the patient to hospital. I am speaking generally; the special nature and circumstances of each case must be taken into account.

To provide the necessary hospital-accommodation, most of our large towns have fever-hospitals. As you are probably all aware, our Edinburgh fever-hospital, which was, until quite recently, connected with the Royal Infirmary, has been—most properly, I think—taken over by the town, and will henceforth be managed by the Public Health Authorities, and supported by the rates. I do most sincerely hope that, whatever additional rate it may be necessary to impose, there will be no complaining or demurring at it. Had time permitted, I would have liked to have read to you a lecture by Sir James Paget, in which he shows the costliness of sickness and the enormous money-

loss which the nation annually sustains from sickness due to preventable disease.¹ Now, if this is true of the nation, as a whole, it is surely true of each one of its corporate parts; in short, it can, I think, be conclusively shown that any sum, however large, which is legitimately spent in the arrest and prevention of infectious disease, is well invested and well spent money. I strongly hold that it is a sound and good financial policy to provide for cases of fever and infectious disease the best hospital-accommodation, the best medical skill, the best nursing, and the best feeding and medical appliances which can be procured. Unless a fever-hospital be conducted on the most approved principles, and officered by the highest class of officials (and that, I need not say, necessitates a large expenditure), the public will not feel full confidence in it, and will not make use of it; and the very object for which it is provided, namely, the isolation of the sick and the arrest of infectious disease, will be defeated.

Satisfactory isolation in a private house is only possible when that portion of the house in which the patient is placed can be thoroughly cut off from the remainder. There must be no passing backwards and forwards between the general body of the house and the sick-room. Those who nurse the patient must submit to be isolated too. The sick-room should be cleared of all unnecessary articles of furniture; curtains and bed-hangings should be removed; free ventilation is essential, and care must be taken that the air from the sick compartments does not blow into the rest of the house.

2. *Destruction of the Poison which is given off from the Body of the Patient.*—This is a very important point. When, as in whooping-cough, the poison is given off in the breath, free ventilation, which dilutes it, and the frequent use of the steam carbolic spray in the sick chamber, are the best means which can be employed. When the poison is given off, as it is in cholera and typhoid fever, from the bowel, a powerful antiseptic—a solution of corrosive sublimate is probably the best—should be freely mixed with the evacuations before they are discharged into the house-drains. When, as in scarlet fever, the poison is contained in the particles of skin which are thrown off from the surface of the body, frequent washing with an antiseptic solution, and the inunction of carbolised oil, are probably the best means which can be employed.

The patient must, of course, be confined to the sick chamber until all risk of infection is passed. The medical attendant is naturally the person who decides this point; and in forming an opinion it is always right to err on the side of caution, and to keep the patient strictly isolated for several days longer than may at first sight appear absolutely necessary.

After the patient leaves the sick-room, it, together with all articles of clothing, furniture, bedding, etc., must, of course, be thoroughly disinfected. Books, playthings, etc., which have been in contact with the patient, must be either disinfected or destroyed. But to go fully into this and other points would require much more time than we have at our disposal this evening.

I cannot, however, leave this part of the subject without reminding you that we citizens of Edinburgh are fortunate in this respect, that we have only to make a request to the local health-authority, and we can have our houses, rooms, furniture, bedding, etc., disinfected for us. I would strongly advise any of you who are so unfortunate as to have cases of infectious disease in your houses, to avail yourselves of this assistance. You must remember that to carry out the process of disinfection thoroughly and satisfactorily, special knowledge and skill—which few private persons, unless they be medical men, possess—are required. If the assistance of the proper authorities were always called in, we should not hear complaints, as we now not unfrequently do, of bedding and articles of clothing, which have been used by persons suffering from infectious disease—such as scarlet fever—being aired and shaken close to the windows of a neighbouring dwelling, a most dangerous proceeding, which cannot be too severely condemned.

3. *Individual Sanitation.*—The third great means of preventing and arresting the spread of infectious disease is the most careful attention to cleanliness, drainage, and all other sanitary matters by each individual for himself.

The wise saying, "If you want a thing well done, do it yourself," is specially applicable to health matters. Public sanitary authorities and sanitary associations are all very well in their way—and far be it from me to say one word which would appear even to lessen their value and importance—but they can never take the place of individual effort. Unless each member of the community attend, so far as his knowledge enables him to do so, to the sanitary arrangements of his own house and premises, we shall never have that im-

¹ An Address on the National Value of Public Health (BRITISH MEDICAL JOURNAL, June 21st, 1884).

proved and perfect sanitary condition at which we are aiming, and which is so much to be desired.

4. *Public Sanitation.*—The fourth great means of preventing and arresting the spread of infectious and contagious diseases is the proper regulation of sanitary matters by the public authorities who have charge of and are responsible for the public health, such as the regulation of the drainage and water-supply, the proper cleansing of the streets, the prevention of overcrowding, the suppression of all forms of nuisance, the compulsory notification of infectious disease, the provision of ample and suitable hospital-accommodation for cases of infectious disease, of suitable means for the removal of infectious cases from their own homes to hospital, of disinfecting dwellings, bedding, clothing, etc.

I need not say that, to carry out all these requirements, an intelligent and active medical officer of health, who should be independent of private practice, and an adequate staff of inspectors and assistants, in addition to an enlightened and energetic health authority, are absolutely necessary. Nor need I add that we citizens of Edinburgh are fortunate in having all those matters provided for us in a remarkable degree.

5. *Production of Insusceptibility to Infectious Disease.*—The fifth great means by which an infectious disease may be arrested or stamped out is by rendering the population insusceptible to it.

As yet there is only one disease which can be with certainty controlled in this way, namely, small-pox, by vaccination and revaccination; though the illustrious Frenchman—M. Pasteur—to whom the world is already deeply indebted for his many remarkable observations and researches, has within the past few weeks claimed to have discovered a means of inoculation by which a person who has been bitten by a mad dog can be protected against that terrible disease, rabies or hydrophobia.

As you are doubtless all aware, compulsory vaccination meets in some parts of the country with vehement opposition. It is impossible this evening to attempt to enter fully into this question, which is one of national interest. But if I do not weary you, I would like very briefly to mention the leading arguments and counter-arguments, and to ask you to think over them, and to consider the matter carefully for yourselves. The question is certain to come up before the next or some future Parliament; and it is of the utmost importance that the mass of the population should be thoroughly informed as to its merits; more especially since, by the extension of the franchise, the power of influencing legislation has been largely placed in the hands of those who have not perhaps as yet given any serious consideration to the question, and are not therefore, without further information, in a position to form a sound judgment upon it.

Three main objections are advanced against compulsory vaccination. They are as follows.

a. *It is an Unwarrantable Interference with the Liberty of the Subject.*—Against this argument, I would say that an epidemic of small-pox is infinitely more destructive than an epidemic of dynamite explosions; and since, as we all know, the Legislature, backed by the unanimous voice of the country, has quite recently enacted, with unprecedented rapidity, the most stringent legislative measures against dynamite explosions, this argument falls to the ground.

b. *Vaccination does not Protect against Small-pox.*—Against this argument I have no hesitation in saying, that the results of the compulsory vaccination and revaccination, both in this and in other countries, are absolutely conclusive. I would ask any of you who wish for further information to study these statistics and results for yourselves, feeling confident that no unprejudiced person, who is capable of weighing evidence, and who carefully goes into the subject, can come to any other conclusion than that which, I may without exaggeration say, is the opinion of the overwhelming majority of the medical profession.

c. *The Remedy is worse than the Disease.*—It is alleged that grave injury is caused by vaccination, and that serious disease is propagated by it. Now, I do not deny that serious disease has occasionally been propagated by vaccination; but I say that such cases are infinitely rare, and do not occur provided that the lymph is selected with reasonable care, and the operation performed with reasonable care and skill. The danger of propagating disease by a carefully performed vaccination is, in my opinion, infinitesimal, while the benefits which the operation confers can hardly be exaggerated. Against the careless and improper performance of vaccination, the common law provides a remedy, just as it does against any other form of medical malpractice.

It is alleged that the opinion of the medical profession on this question of compulsory vaccination is valueless, for the doctors, it is said, are prejudiced. It is suggested that we medical men support compul-

sory vaccination, because it brings us in some few miserable half-crowns. In Edinburgh, where the medical profession is proud to be held in high esteem, such an argument, I feel sure, would be scouted by the public. I need not say that we indignantly repudiate such an imputation. If any of you should hear such an argument advanced, I would ask you to indignantly repudiate it for us. I would ask you further to meet the argument on its own low ground, and to say that epidemics of small-pox would pay us infinitely better. Further, I would have you ask whether it is alleged that we medical men care less for the health and lives of our own children than other people—whether it is supposed that we would be so inhuman as to vaccinate our children if we thought that there was any real practical risk of communicating serious, or loathsome, or indeed any disease whatever, to them by means of the operation.

The Prevention of Cholera.—Before concluding these remarks on infectious and contagious diseases, I am anxious to say a few words with regard to the prevention of cholera; which, as you all know, has during the past two years worked terrible havoc and desolation in the southern parts of Europe. I do not want to be an alarmist but to be forewarned is to be forearmed; and it is more than likely that the epidemic which is happily now subsiding may, during the summer or autumn of next year, again burst forth in France, Italy, or Spain; and, should it do so, it is not at all improbable that it may be carried to our shores.

Cholera, as you all know from the newspaper-reports, is one of the most dreadful scourges which affect mankind. I never shall forget the terrible three weeks' experience which I went through during the autumn of 1866, when, as a medical student, I was called upon to assist my father, who was in large practice in a North of England seaport town, which was very severely attacked by the disease. But my object is not to frighten you with an account of the disease, but to endeavour to give you some practical hints as to the precautions which it is advisable to take should we unhappily be invaded by it.

I very strongly agree with those who think that cholera is one of those diseases which is, in all probability, propagated by a living germ. The great German pathologist, Professor Koch, has, as probably most of you know, actually claimed to have demonstrated the germ (the cholera-bacillus); though other authorities—notably the English Cholera Commission—stoutly oppose his views. It would be out of place to enter here into the merits of that most interesting and important question; but, be that as it may, there are, I think, weighty reasons for supposing that the poison is a living organism.

No reasonable man doubts that cholera is carried from place to place by persons who are affected by it; that it follows the lines of communication of traffic. It is also proved that it is propagated by drinking water which has become contaminated by the evacuations of cholera-patients; further, although the disease is not directly contagious in the sense that scarlet fever and small-pox are, it is admitted that the evacuations from the bowel contain the cholera-poison, just as the evacuations from a case of typhoid fever contain the typhoid poison; washerwomen, for instance, who handle the bedding and linen which have been soiled by the cholera-evacuations, have been known over and over again to be attacked by the disease. Some of our army-surgeons seem to think that in India, which is the birthplace of the disease, the poison may be conveyed from place to place through the atmosphere; but that this ever takes place in this country seems, to say the least of it, very doubtful. Further, the cholera-poison—as indeed the poison of almost all of the specific contagious diseases which I have previously spoken of—delights in filth; this is undoubtedly one cause of the terrible way with which some of the continental towns have been decimated by the disease. Now, if you have thoroughly grasped these fundamental facts with regard to cholera, you are in a position to understand the more important precautions which it is necessary to take to ward off and prevent the disease.

It is impossible at this late hour to go into full details, but the following are the most important points.

1. Persons coming from an infected district should be inspected, and, if they present any suspicious symptoms, they should be isolated in hospital, and placed under medical observation and treatment. Ships, for example, coming from an infected port, are regularly inspected; if any actual cases of the disease have occurred, or if there have been any cases of suspicious illness during the voyage, they are placed for a time under observation in quarantine, and the sailors and passengers are not allowed to land until proper measures of disinfection have been adopted, and until the medical officer—representing the port sanitary authority—is satisfied that they may be allowed to land and mix with the population without risk or danger. In many of our sea-

ports, floating hospitals are provided, for the purpose of isolating suspicious cases of infectious disease.¹

Almost all the best authorities now recognise the uselessness of sanitary cordons, and of general and indiscriminate methods of quarantine.

The most thorough isolation of the first cases which occur in any district is essential; after the disease has assumed the proportions of an epidemic, isolation is, of course, impossible.

2. The most scrupulous attention should be given to sanitary arrangements, both by private persons and by public authorities. It is unnecessary, after what has been said in the previous parts of this lecture, to dwell on this most important means of diminishing the severity of an epidemic of cholera should it unfortunately arise. It is, however, with great satisfaction that I can assure you that our local sanitary authority seems fully alive to the importance of this matter. Never since I have known Edinburgh, have our wynds and alleys, which are the sort of places in which the cholera poison might be expected to chiefly locate itself and propagate, appeared to me to be in such good sanitary condition, as they have been during the past year.

3. In times of epidemic, every member of the community should look carefully after his own health, and should endeavour to keep it in the highest possible state of efficiency. In particular, the diet should be plain and simple; all foods should be thoroughly cooked; articles of food, such as unripe or rotten fruits, which are likely to cause intestinal irritation, should be rigidly avoided. Anything which produces gastro-intestinal irritation and diarrhoea is a most powerful predisposing cause of the disease. All depressing causes, such as over-fatigue, exposure to cold, excesses of all kinds, anything in short which exhausts the nervous energy, or lowers the vitality and resisting power of the system, should be carefully avoided; for they undoubtedly predispose to the disease. The wearing of a flannel belt round the bowels is highly recommended by many experienced authorities. Amongst the predisposing causes there is none more potent than fear; persons of a nervous temperament, and those who are afraid, should leave the infected locality. No water should be drunk which has not been previously boiled, for the cholera-poison is usually distributed through water, and boiling is the most effectual way of destroying it. Milk and other fluids, which could by any chance be contaminated with the cholera-poison, should also be boiled. The ventilation of private houses, both the sleeping and sitting-rooms, must be carefully attended to.

4. Should any symptoms of illness arise, medical advice should be immediately summoned. Diarrhoea is usually the first symptom. There is no difference of medical opinion as to the treatment of cholera, but I altogether agree with those who think that the diarrhoea should be immediately stopped by appropriate remedies. This was the treatment which was adopted in my own case (for I was attacked with this symptom, which may or may not have been the commencement of cholera, that I cannot say); and it is the treatment which I should again adopt were I to be again attacked with any manifestations of the disease. During an epidemic of cholera, every one should apply to his medical attendant, and have the appropriate remedies ready in his house; much depends on the early treatment, for the disease is one which runs a very rapid course, severe cases often proving fatal within a few hours.

5. Thorough disinfection of the cholera evacuations: thorough disinfection, or, better still, destruction (burning) of all linen, bedding, etc., which has been soiled by the evacuations, or been in contact with the patient; thorough disinfection of infected dwellings, etc., should be carried out. Patients affected with cholera, and houses in which there are cases of cholera, should be kept scrupulously clean. The cholera-evacuations should, immediately after being passed, be mixed with a strong disinfectant; a solution of corrosive sublimate or of persulphate of iron is probably the best; or after being received in a vessel containing sawdust, they should be immediately burned. Linen bedclothes, etc., which have been in contact with cholera-patients, or soiled with cholera-discharges, should be immediately immersed in boiling water, or in an antiseptic solution, and should be then boiled. Should the nurse or attendants become soiled with the cholera-evacuations, the dress should immediately be changed and disinfected, and the parts of the body which have been exposed to the contagion, or better still, the whole body, carefully washed with an antiseptic solution.

Before meals, care should be taken that the hands are scrupulously

clean; dishes, glasses, knives, forks, etc., should be immersed in boiling water before being used.

From what I have said, you will have perceived that (a) the isolation of early cases, (b) the destruction of the poison given off from infected persons, and (c) scrupulous attention on the part of every individual to avoid introducing any living cholera-germs into his own person, through food and drink, together with (d) the avoidance of all predisposing causes, and (e) attention to general sanitary matters, are the chief means by which we endeavour to limit the spread of this disease.

My Lord Provost, Ladies, and Gentlemen,—I had hoped, when I began to think over the subject of this lecture, that I might have been able to tell you something about the indirect or predisposing, as well as of the exciting, causes of disease; but that is both a large and important subject, and to treat it at all satisfactorily would occupy at least another hour. I dare not attempt to trespass further on your patience this evening. In conclusion, I can only say that I do most sincerely trust that the information I have given you may prove of real helpfulness and usefulness, to some of you at least, in the conduct of your future lives.

FURTHER RESEARCHES ON CHOLERA.

By R. KOCH, M.D.,

Professor of Hygiene in the University of Berlin.

Speech at the commencement of the Second Conference on Cholera, held at Berlin on May 4th, 5th, 6th, 7th, and 8th, 1885.

(Continued from page 8.)

It is only in the matter of experiments on animals that advance has been made, Nicati and Rietsch having succeeded in infecting dogs and guinea-pigs by injection into the duodenum of cholera-dejecta, or of pure cultivations of the comma-bacilli. These experiments have been repeated and confirmed here in the Sanitary Institute, and also by Babes, Flügge, and Watson Cheyne. Rietsch and Nicati at first believed that the infection could only be brought about by arresting the flow of bile; and therefore they ligatured the ductus choledochus. However, they afterwards found that the experiment succeeded without this ligature. Our experiments also were performed partly with and partly without ligature of the ductus choledochus, and gave the following results. Of ten guinea-pigs, in which the bile-duct was tied, and then cultivations of the comma-bacilli injected into the duodenum, six died of cholera in the first two days; the remainder died later, as the result of the ligature. You see here, preserved in alcohol, the abdominal organs of such a guinea-pig, which survived the injection, but quickly lost flesh, and died on the ninth day after the operation. The gall-bladder is enormously distended, as is also the ductus choledochus above the point of ligature. There is no trace of peritonitis in this case. In another guinea-pig, which died on the twelfth day after the operation, the gall-bladder had burst, and the abdominal cavity was filled with bile. The two remaining guinea-pigs died as the result of twist and closure of the intestine, in consequence of peritonic adhesions in the immediate neighbourhood of the seat of ligature. In these experiments it struck me that, the better the operation was performed, and the less extensive the manipulations, so much the less chance was there of the animals dying of cholera. Of the eighteen animals in which the injection was made into the duodenum, without ligature of the gall-bladder, thirteen died of cholera.

At the same time, control experiments were also made by injecting other forms of bacteria, for example, micrococcus prodigiosus, various forms of bacilli, etc., into the duodenum of guinea-pigs. Of these animals, in which the bile-duct was not tied, none died. This shows that the operation is not of itself dangerous to the animals. Klein asserts that the guinea-pigs in these experiments did not die of cholera, but of septicæmia. But, according to my experience, the danger of septicæmia after this very simple operation can be excluded with certainty, and one must proceed very clumsily to lose the animals from septicæmia.

In this set of experiments also (without ligature of the bile-duct) the results are so much the less positive, the less the disturbance, and the less the intestine is squeezed or torn in searching for and pulling forward the duodenum. Hence the experiment succeeds only exceptionally when one limits oneself to opening the abdominal cavity only to a small extent, and making the injection into the coil of intestine first exposed, instead of into the deep-lying duodenum. Of six guinea-pigs which were operated on in this way, only one died of cholera, the rest remained alive. The same experiment was then performed on four rabbits, without any of them dying or even becoming ill.

¹ The Tyne Sanitary Authority, of which my father was for many years the medical officer, was one of the first, I speak under correction, but I think I am right in saying the first, sanitary authority to adopt this arrangement, the great value of which I had many opportunities of observing during the four years and a half I was Visiting-Physician to the Tyne Floating Hospital.