systoles, while it does do away, for the time, with neurogenic irregularities of the heart.

A very similar irregularity of the heart may occur in overstrain of the heart or in chronic myocarditis. Here the left heart fails, dilatation of the left auricle occurs, and injury is thus inflicted on the bundle of His as well as on the auricular myocardium generally. The heart's action becomes irregular in force and frequency, and extra-systoles occur just as they do in the cases of mitral disease already considered. This paralysis of the auricles occurs when the blood pressure within them rises to 15–20 mm. of mercury.

There is only one more example of irregular heart that we need consider, and that is the rare disease known as paroxysmal tachycardia, in which the patient is liable to sudden attacks of very rapid pulsation of the heart. Here the rate of the pulse, which was previously normal, suddenly doubles or trebles, and reaches 150 to 250; and at the end of the attack it is as suddenly halved or reduced to a third. It is this suddenness in the change of rhythm that is the characteristic feature of paroxysmal tachycardia. The tachycardia up to 140 that comes on in highly nervous or in convalescent patients on slight exertion or excitement is quite different, inasmuch as it comes on gradually and goes away gradually; it is neurogenic in origin and due to temporary loss of the vagus control. It is not possible to say with any certainty what is the mechanism of the arrhythmia in paroxysmal tachycardia. It may be due, as Mackenzie supposes, to a state of affairs in which the auriculo-ventricular bundle of His becomes more excitable, and initiates the cardiac rhythm instead of the sinus region. The heart muscle seems to be abnormally irritable, and it is possible that to some extent paroxysmal tachycardia is neurogenic. The whole subject of the diagnosis of these arrhythmias is extremely difficult, and depends in the last resort upon the interpretation of the pulse tracings obtained from the jugular vein and carotid artery. I do not propose to go into the subject at all—you will find it discussed in most of the recent textbooks on heart disease, and also in a small special volume, which I show you, by Dr. Hay.¹

As regards prognosis, one has seen a great many cases of mitral disease with irregular pulse live a quiet life for years without any marked symptoms or any deterioration of their condition. But the irregularity which comes on with dilatation and failure of the hypertrophied heart is usually of much more serious importance.

REFERENCE.

¹ *Graphic Methods in Heart Disease.* J. Hay. London: H. Frowde, 1909.

A Lecture

ON

THEORY AND PRACTICE IN THE TREATMENT OF PULMONARY TUBERCULOSIS.

DELIVERED AT THE HOSPITAL FOR CONSUMPTION,
BROMPTON.

BY

W. CECIL BOSANQUET, M.D., F.R.C.P.,

ASSISTANT PHYSICIAN TO THE HOSPITAL.

THE title of this lecture may suggest to you that I have taken in hand an unduly vast subject, and, indeed, volumes might be filled—and have been filled—with a discussion of theory and practice in relation to tuberculosis. Within the limits of an hour's lecture I can only hope to draw your attention to certain points which seem to be of interest in this connexion. Since by "theory" we mean a connected account of the phenomena of the disease, unified by reference to the underlying cause at work, it is clear that our practice can only be looked on as scientific in so far as it is the outcome of, or at least in accordance with, the accepted theory of the disease. All other modes of treatment must be classed as merely empirical.

The theory of tuberculosis at the present day is, of course, founded on the discovery of the *Bacillus tuberculosis* by Robert Koch, whose recent death we have to deplore. Where there is no bacillus there is no tuber-

culosis. On the other hand, it is quite possible for the bacillus to enter the human body and yet fail to produce recognizable disease. There is, therefore, more than one factor to be considered, and we must not unduly concentrate our thoughts on the bacillus and forget the patient whom we have to treat. Starting, however, with the bacillus, we know that it produces disturbances in the living body—the sum of these disturbances being the disease tuberculosis—by means of the poisons to which it gives rise, but about these poisons we know little or nothing. This may seem an unduly pessimistic statement in view of the existence of preparations of poisonous bodies formed by the bacillus, to which the name "tuberculin" has been applied, and which can be submitted to chemical analysis; nevertheless it is not inaccurate, as may be seen by considering the nature of the principal tuberculins. The old tuberculin (T. or T.O.A.) is made by growing the bacilli in a fluid medium, filtering off the organisms themselves, and concentrating the filtrate to a small bulk. It thus contains the poisons formed by the bacilli in their growth on an artificial medium. It has been analysed, but the essential toxic principle is still undetermined, though the fever-producing substance is stated to be of the nature of an albumose, a body formed by breaking down of albumen. It is said that albumoses from other sources can induce the same rise of temperature in the tuberculous patient as does the albumose present in tuberculin. It is unlikely, then, that the albumose here is the specific poison of tuberculosis, and no other toxin has been isolated.

A peculiarity, indeed, of tuberculin is that it is not very toxic to healthy animals, whereas it is rapidly fatal in minute amounts to those which are infected with tuberculosis. It seems that the essential poison of the disease is formed by the interaction of two separate bodies. Its action may be compared with the process which has been called "anaphylaxis." If an animal is injected with a small quantity of the serum of one of another species, no harm seems to result; but if at the end of about twelve days a second injection of the same foreign serum is given, serious symptoms and even death may result. The nature of the phenomenon is not well understood, but it is likely that not only the action of tuberculin, but also the peculiar condition known as the "incubation period" of an infective disease, may be ultimately brought into relation with it.

The second form of tuberculin (T.R.) is produced by grinding up the actual bodies of the bacteria, and dissolving or emulsifying them with water; it contains the poisonous substances present in the bacilli. Its action differs somewhat from that of the old tuberculin, and it is therefore different in composition. Either it contains a different poison, or, if the same is present in both, its action is modified by mixture with other substances. Now if the poison formed in a culture differs from that extracted from the bacilli themselves, it is quite possible that the toxin formed within a living body, the actual poison of the disease, differs from both, and we cannot say that we know anything definite about it. We know, however, some of its effects. On the one hand, it produces a local destruction of tissue, which usually takes the form of caseation; and, on the other, it gives rise to constitutional symptoms, such as fever, wasting, sweating, and so forth. Possibly different poisons are at work in the two instances. The disease thus consists of two factors: there is the injury resulting from gradual destruction of some organ necessary for life, and there is also a general toxæmia or condition of poisoning of the whole system. When the malady affects the lungs the destructive process is acting on a large organ, with a considerable margin of tissue beyond what is absolutely needed for ordinary use, so that the disease can go on for a long time without causing death. It is a more chronic disease than, for example, tuberculosis of the kidneys usually is. There are, of course, acute cases of spreading miliary tuberculosis of the lungs in which death is due to toxæmia.

Now, with regard to the treatment of tuberculosis, two courses are theoretically open to us—we may endeavour to attack and kill the bacillus, or we may devote our efforts to strengthening the resistance of the patient. Actually, the former course is impracticable. We cannot bring bactericidal substances into contact with the bacilli in the living body in sufficient strength to kill them without at the same time killing the cells of the tissues. Attempts

have, it is true, been made from time to time to attack the bacilli directly, as for instance, by injecting chemical antiseptics into the veins, but the results were unsatisfactory. Recently some writers have spoken enthusiastically of the administration of volatile antiseptics by inhalation, but theory forbids us to hope for any striking results from this method. If you consider that the germicide is mixed with air and thus passes into the air-passages and out again, it is clear that it is only brought directly into contact with the lining membrane of the bronchi and alveoli; it cannot reach the deeply-seated bacilli which are attacking the tissues, except in minute quantities circulating in the blood. The most that we can hope to effect is to sterilize the contents of the air-passages, or possibly to prevent the occurrence of laryngeal infection, if this is really brought about by direct inoculation from the sputum passing over the larynx.

There remains, then, the second mode of treatment—the attempt to strengthen the resistance of the patient—and it is to this that all our proceedings are now directed. I need not trouble you with any detailed account of the factors in this resistance to infective diseases which have so far been discovered. There is the neutralization of toxins by antitoxins, the destruction of bacteria by chemical (*lytic*) bodies, and the capture and digestion of germs by leucocytes, aided by those peculiar bodies in the serum to which Sir A. E. Wright has given the name of "opsonins." An important factor of which we know practically nothing, and one which is probably of special importance in tuberculosis, is the resistance offered by the cells of the tissues to the bacterial toxins.

Now in the case of other infective diseases it has been shown that antitoxic and bactericidal bodies respectively are formed in the blood in response to the action of the toxins and to the presence of the bacteria in question, and the opsonins of the serum are also produced in response to the stimulus supplied by the bacteria against which they act. There are, indeed, some opsonins, and also perhaps some antitoxins and bactericidins, normally present in the blood, but the greater amount is produced in response to the stimulus induced by infection or injection. The theory of vaccine treatment, as developed in recent times, depends on this mode of action. We have to ask, then, in respect to tuberculosis, whether we can raise the patient's resistance to the disease by some such method. The attempt has, of course, been made by means of the different *tuberculin*s. The high hopes first excited by the announcement of the old tuberculin were doomed to disappointment, but the reaction which ensued probably went too far in the other direction. Much harm was done in those early days by the use of excessive doses of the remedy; but since then we have learned wisdom and at least endeavour to follow the old Hippocratic rule, "*Primum non nocere*." Still, we have to make use of doses which will have some effect, and I do not believe in the efficacy of such minute quantities as one sometimes sees administered—for example, $\frac{1}{100000}$ mg. of T.R. We may start with such a dose as $\frac{1}{10000}$, and work up, perhaps, to $\frac{1}{1000}$ mg.

The advice is generally given to use that dose of tuberculin which will just fail to give a recognizable reaction in the form of a rise of temperature. This is naturally a difficult rule to carry out, as, if a certain dose produces a slight rise of temperature on one occasion, it does not follow that it will do the same the next time it is administered; yet it is only by obtaining a slight reaction and then giving a smaller dose next time that we can attempt to carry out the rule. I am inclined to think that the production of a slight rise of temperature is not a bad thing, supposing it does not exceed, say, 1° F., and that it falls again directly. The dose may be repeated once a week or once a fortnight, according to the results obtained, as seen in the general condition of the patient—temperature, pulse, appetite, weight, and so forth. The control of tuberculin injections by estimations of the opsonic index, as has been suggested, is a complicated matter, since the estimations must be made regularly at fairly frequent intervals if they are to be of any value, and they must be made by a person skilled in this mode of investigation. Such control is clearly impossible in the case of the great majority of patients, and experience seems to show that it is not necessary.

The form of tuberculin usually employed is Koch's T.R.,

but some physicians prefer the preparation known as "emulsion of bacilli" (T.B.E.), in which the entire dead bodies of the bacilli are used as the vaccine. Other kinds of tuberculin have been devised, such as Béraneck's and Denys's. These are prepared in specially convenient forms for administering graduated doses by means of a series of dilutions, and have been highly spoken of on the Continent, but they do not seem to have been used much in this country.

As to the cases which are suitable for tuberculin treatment, it is difficult to lay down distinct rules, but for my own part I am not inclined to give tuberculin to febrile patients, though some observers state that a diminution of fever may result from this treatment. I am also sceptical as to the value of tuberculin given by the mouth. At all events, as the pain of an injection is considerable and action by this route is certain, this method is to be preferred. In some forms of tuberculosis, notably those affecting bones and joints and the genito-urinary system, the results of treatment with tuberculin are very encouraging. On the other hand, in pulmonary disease the remedy seems on the whole disappointing. There is a curious feature about tuberculin treatment which I cannot explain, and that is that while apparently existing disease may be favourably influenced and seem to be subsiding, yet some other focus may suddenly appear meanwhile. It is difficult to explain this on any theory of increased general resistance to the bacillus.

An attempt to obtain an *antitoxic serum* for tuberculosis has, as you doubtless know, been made by Marmorek, but, in pulmonary disease at all events, it has proved a disappointing remedy. Even the exact nature of this preparation seems doubtful, as it seems, when injected subcutaneously, to cause a fall in the opsonic content of the serum, thus acting like tuberculin. It is not impossible that the remedy really contains a small amount of this substance, and that its action is due to its properties as a vaccine. In any case, its potency in pulmonary tuberculosis is very small; better results seem to be obtained from it in disease of bones and joints, as with tuberculin. On the whole, we have to confess that specific remedies are disappointing in consumption.

We come, therefore, to general measures for strengthening the resistance of the patient—food, exercise, and so forth. With regard to *food*, theory teaches us that protective substances are formed by the cells of the body, and that to some extent they are to be compared with secretions. Now, for the formation of a secretion a plentiful supply of food materials must be brought to the cells of the gland concerned; and similarly for the production of antibodies good nutrition is required. No doubt the resistance of the individual cells to the destructive process to which I previously referred also requires the presence of adequate nourishment. We also know that in all febrile diseases there is an increased breaking down of tissue, shown by an increased excretion of nitrogen. The diet in tuberculosis must therefore be liberal. Fortunately in a great number of cases, even in the presence of fever, the digestion is still capable of dealing with ordinary viands, and we can give meat and other solid food freely, the condition thus differing from such diseases as the acute specific fevers, in which the patient can take little more than fluid diet. But, because we are endeavouring to supply plentiful food, we must not therefore lose sight of the ordinary principles of feeding—namely, that we must not administer more than the digestive organs can deal with or the system assimilate. In the early days of sanatorium treatment it used to be the fashion to force upon patients enormous meals, insisting on the whole amount being swallowed even if the sufferer were kept at the table so long as almost to cause one meal to run into another. The consequences were the reverse of beneficial—the digestion was upset and nutrition suffered instead of being stimulated. Actually, one of the most important objects in the treatment of consumption is the keeping of the digestive organs in the best possible order; they must not be overtaxed, but aided to work at full pressure. The existence of a good appetite is a factor of importance, since it seems that the secretion of gastric juice is influenced by it to a considerable degree. Thus it is that we find one of the most valuable aids in hospital work is the old-fashioned mixture of gentian and soda, which promotes appetite and helps digestion. The

addition to it of a few drops of tincture of nux vomica is often useful, as strychnine seems to act as a tonic to the nervous system, raising the vigour of the reflexes and counteracting the sensation of lassitude and depression.

The food that may be given to the patient embraces practically all wholesome articles of diet, and need not be too carefully specified. In addition milk may be drunk both with and between meals, and some additional nourishment thus absorbed. Fats are useful if they are well tolerated, and may take the form of bacon, cream, and butter, as well as cod-liver oil. Recently some theoretical support has been afforded to the almost universal empirical use of this last drug in tuberculosis. Dr. O. T. Williamson finds that the oil contains special fatty acids of the kind chemically described as "unsaturated." These seem to have a definite effect in promoting nutrition, but in addition to this they may exert an action on the tubercle bacilli themselves. These organisms are provided, as you no doubt know, with a coat consisting of a peculiar form of wax, to which their special staining properties are due, and which protects them to some extent against the action of the vital fluids. Unsaturated fatty acids, according to Williamson, have some power of dissolving this coat, and so aiding in the destruction of the parasites.

The question of the use of alcoholic drinks often comes up in connexion with the treatment of consumption. Prejudice apart, alcohol is undoubtedly a food, as it is capable of generating heat, and takes the place of other food material to some extent. It does not seem called for as a rule in pulmonary tuberculosis, but it is not specially contraindicated if taken in moderation. Some patients who have been used to taking a glass of beer or stout with their meals miss this if it is withheld; others find that this or a glass of wine is an aid to appetite and digestion. Here, as in other matters, each case must be a law to itself. The same may be said of tobacco. There are few persons to whom it does harm in moderation, and it is needless cruelty to deprive a consumptive of the solace of his pipe if he will only smoke the amount stipulated by his physician. Cigarettes are usually forbidden, owing to the habit of inhaling the smoke from them. Apart from this, they have no special demerit as compared with other forms of smoking.

A patient treated by a course of plentiful, not to say forced, feeding will usually increase in weight, and this increase may as a rule be regarded as a measure of his improvement. It is, indeed, the most important single guide that we possess, but by itself it is not sufficient as a true index of progress. The gain of weight is a proof that the tendency to wasting is overcome, and that the balance of nutrition is in the patient's favour. But the gain is largely due to deposit of fat, and this is an inert tissue, not in itself indicative of health in a consumptive any more than in a healthy person. We must remember that the consumptive only differs in certain respects from the normal person, just as the temperature in disease shows the same diurnal variation as in health, and he must to a great extent be judged by the same standards. Too much fat is not advantageous. A consumptive person may be fat and yet be going downhill.

Consequently a change has come over the spirit of our treatment, and whereas it was formerly the custom to treat cases of consumption almost entirely by rest, it is now recognized as advisable to give them an adequate amount of exercise. One wishes to get them into the best possible condition of general nutrition, not merely to make them heavier. The provision of exercise has now become almost a fine art in itself, and not only are measured and graduated walks mapped out at the institutions for consumptives, but a scale of labour has been devised in which the patient advances from light gardening to hard navvy's work. At the exhibitions which have been held in different parts of the country you may have seen the different-sized shovels and baskets which are used to maintain a definite scale of progression from lighter to harder work. Much ingenuity has been devoted to this subject, and there seems to be a tendency to ascribe an undue importance to this matter of work, as if in itself it constituted a specific remedy for tuberculosis of the lungs.

This matter of practice is now supported by a new

development of theory, by which it is taught that the effect of exercise is to cause a liberation of tuberculin in the patient's system, and to this theoretical process the name of "autoinoculation" has been applied. The ground for the belief seems to be that exercise causes a rise of temperature in a tuberculous patient, and also a fall in the opsonic index of the blood, just as an injection of tuberculin does; therefore, it is argued, the process is the same in each case. Further (if we believe the enthusiasts), not only is the process identical, but it is also different, in so far as the patient, as a result of exercise, is held to inoculate himself with "his own tuberculin," which is of superior efficacy to a foreign tuberculin, inasmuch as it is the poison produced by the very race of bacilli which are attacking him, and so gives rise to exactly the kind of antibody required. The word "auto-inoculation" appears to possess a comforting sound, for it figures largely in most discussions on the treatment of tuberculosis in these days. It is well, perhaps, to bear in mind that it is largely a hypothetical process. A rise of temperature as a result of exercise occurs in normal persons; and as the tuberculous person is one whose temperature is easily modified it may merely be that he exhibits this rise after exercise more readily than the healthy man. On the other hand, the nature of the opsonic property of the serum is but little understood, and we must not build too much on it as a groundwork for theories. Whether this theory is true or not, it is certain that rest is no more a specific remedy for consumption than is rest or cod-liver oil. It is very useful in suitable cases, but it may even do harm in others. This was forcibly brought home to me by the case of a young man whom I saw recently, and who went to a sanatorium where work was the order of the day. He was a thin, anaemic youth who had been a clerk in an office, unused to manual labour. After a few days of rest he was put to work, and as his temperature did not rise as the result of it he progressed through the different grades till he did the hardest work. His weight did not improve (and he was a thin subject with room for improvement), and when I saw him after he left the sanatorium he reported that he had always felt that the work did harm rather than good. He went rapidly downhill subsequently. I feel sure that he would have had a better chance of recovery if he had been treated with much more rest and less labour. It seems likely that in this case a mistake was made in judging of the effect of the treatment by one test alone—that of its effect on the temperature. It was assumed that as he had no fever the work was not too severe. In estimating the course of a case of consumption we must take all the circumstances into consideration—weight, temperature, pulse, digestion, feeling of illness or health, and so forth. Each case must be the measure of its own needs; there is no one remedy or regimen applicable to all.

You will think, perhaps, that in insisting that there is no universal specific remedy for consumption I am ignoring the most important advance which has been made in the treatment of it—the use of fresh air. No one can question the enormous benefit that has been conferred on the sufferers from tuberculosis by this revolution in treatment. Patients were undoubtedly killed—their deaths were hastened—by the old-fashioned method of keeping them in hot, unventilated rooms, under the idea that a febrile patient was liable to catch cold from the least contact with fresh air, and that he must therefore be protected from it by closing windows and doors as barriers against the enemy. Naturally, the disease was then more rapidly fatal than it is now, and its mortality far greater. It must, indeed, have been fortunate for a tuberculous patient in those days to escape diagnosis, while now we devote all our energies to early recognition of the disease, in order to have a better chance of curing the sufferers. Fresh air is indeed a specific remedy for consumption, in so far as without it recovery is improbable; but the truer way of stating it would be that vitiated air is a direct poison to the consumptive, and that what we aim at is the removal of this poison rather than the administration of a direct remedy. And it is becoming more and more widely known now that it is not only in consumption that fresh air is beneficial, but in all diseases. Acute pneumonia and the other infective fevers are all better treated in a plentiful supply of fresh air, and even in so apparently diverse

a condition as insanity it has been found that open-air treatment is often strikingly beneficial.

With the advantages of open-air treatment are closely connected the subjects of sanatorium and climatic treatment of consumption. In the minds of many persons, indeed, open-air treatment is synonymous with life in a sanatorium, and it is hardly realized that patients can be treated except in an institution devised for the purpose. There are, indeed, certain obvious advantages attached to treatment in a sanatorium. In the first place, the building is adapted especially to the purpose of treatment. The rooms are spacious and the windows large; they are arranged so as to avoid any objectionable wind that may prevail, and to catch a goodly amount of sunshine when it is vouchsafed. There are grounds suitable for exercise, and often paths measured out so that walks of known length and of suitable degrees of incline may be taken by the patients. There may be arrangements for gardening and a graduated scale of work. Then the hours of rising in the morning, of taking meals, of resting and going to bed, are carefully mapped out, and the patient has to conform to the ways of the institution in these respects. Finally he is under constant medical supervision: the state of his health is carefully observed and recorded, his temperature and pulse are taken at regular intervals, his appetite is observed and his meals are supervised, and the state of his bowels is regulated—in short, every detail of his daily life is controlled with a view to improvement of his health. In some cases the very association with other sufferers from the same disease may be of advantage; it may relieve depression and inspire hope—and there is no doubt that a contented, hopeful and determined disposition is of immense value in aiding recovery in this as in other diseases.

Who, then, are the patients who specially need this treatment in a sanatorium? They are, first, those whose homes are insanitary or otherwise unsuitable for an open-air life—town dwellers who cannot afford to change their abode to some more suitable place; those who live in damp and swampy neighbourhoods; members of large families whose homes cannot be turned upside down, as is necessary for systematic open-air treatment; all who need definite stimulus to change their ordinary routine of life or who have not intelligence enough to carry out a scheme of treatment without constant supervision; and, finally, those who, in this age in which self-control is so little cultivated, cannot be trusted to forego the pleasures and dissipations of life or to sacrifice any present indulgence for the sake of future good. All these need institutional treatment. But scarcely any sufferer from consumption would fail to derive advantage of an educational kind from a short stay at a well-managed sanatorium, as the details of treatment are much more readily impressed on the mind by practice than by precept.

Apart from this, there is nothing in the treatment carried out at a sanatorium which cannot be equally well managed at home by those whose means permit. A shelter set up in the garden serves admirably for an open-air life; ordinary forms of exercise, such as walking and riding, will serve to keep down a tendency to mere formation of fat, and will keep the digestion in good order—will effect the necessary "auto-inoculation," if you prefer to put it in that way; ordinary diet and times for meals, with but few additions, are quite suitable; and the patient will still enjoy the benefits of home life and society. And we must remember that most sanatoriums refuse to accept patients in any but the initial stages of the disease; and this is especially the case with the institutions which have to justify their existence or advertise themselves by statistics of cures. It is difficult, then, or impossible for a sufferer with developed consumption to gain admission to such a home, and we have to make the best of home conditions in his case. Even in such instances it is worth while to make every effort to obtain arrest of the disease; we should not despair even in cases which appear almost hopeless, and excellent arrangements can be made for such patients in their own homes by a little care and management. I have reason to remember the case of a lady who was found, after parturition, to be suffering from unsuspected tuberculosis, which not only involved both lungs, but also the larynx. It seemed impossible that she should survive more than a few months; but, with a view to prevent pain in swallow-

ing, the affected epiglottis was removed, and she went down to her home in the country and lived a strict open-air life. The trouble in the throat and lungs quieted down, and she was restored to a comparatively active life, living, I think, six years, and ultimately dying, not of the pulmonary disease, but of an outbreak of tuberculosis in the kidney and bladder. The case illustrates both the possibility of arrest of tuberculosis in apparently hopeless cases, and also the adequacy of an ordinary country house for all the purposes of open-air treatment. We have also to bear in mind that a person who has contracted tuberculosis through living in unfavourable circumstances—perhaps with insufficient food, in an insanitary house away from light and air—and whose disease has progressed owing to continuance of these conditions, may have a better chance of recovery when placed in a suitable environment than one who has recently contracted the malady while surrounded by comfort and plenty. There is nothing more than that a sanatorium, for example, can offer to the latter; he has broken down in spite of all advantages, owing to complete lack of natural resistance. To the former, on the other hand, the new life of plenty and fresh air means a relief from the depressing factors which dragged him down, and offers a chance of fighting the disease on equal terms. But, unfortunately, a patient of this type often returns, when his disease has been arrested by treatment, to the same depressing conditions which originally broke down his resistance to the bacillus. Hence, too often the good done is done in vain, and relapse occurs within a short time of leaving the sanatorium and returning to work. It is clear that effective treatment of consumptive patients from the poorer classes must not begin and end with a temporary spell of open-air life, but that care must be exercised over such a man after his return to his ordinary life, to assure that his occupation and surroundings are not such as to endanger the newly acquired balance of health. At present this question of the after-care of consumptives is one of the most difficult which we have to solve. Out-of-door occupations cannot always be easily found for such persons, and it has even been argued that the best thing for the patient is to return to his old occupation, irrespective of its nature, so that he may not run the risk of semi-starvation while looking for a suitable job. The advice may be good as circumstances at present prevail, but it clearly is not the ideal course of treatment.

Lastly, we come to the question of the climatic treatment of consumption. On the side of theory, we have to ask what exactly is meant by climate in this connexion—what influence on the disease can be exerted by mere change of locality? It is said that the actual proportions of the atmospheric gases—nitrogen, oxygen, and carbonic acid—vary a little at different parts of the earth's surface. The density of the atmosphere, of course, varies with the height above the sea-level, mountain air being rarefied, containing a smaller number of molecules of gas in a given volume. The air at high levels and in sparsely inhabited places also contains fewer germs than, for example, in towns, and these latter naturally contaminate their atmospheres with particles of soot and with chemical products of combustion (sulphuric acid and the like). Apart from this, places differ in their rainfall and the resulting humidity of the soil and the air; in their temperature; in the matter of the winds which prevail at different seasons, and the dust that these may carry; and in the amount of sunshine and cloud that may be expected. We can, of course, decide at once that the consumptive patient should not live in a large town if he can do otherwise, owing to the contaminated state of the air, and the difficulty of there leading a strict open-air life. There remains, for those who can afford to choose, the question of residence in a mountain resort, or at home in the country, or at the seaside, or the prescription of a sea voyage. Of course, there are many modifications, such as spending the summer in this country and the winter abroad.

Speaking in general terms, consumptive patients seem to do better in fairly cold than in hot weather, and better in dry than in damp places. But there are exceptions to the former statement, at all events, and we have to judge by our knowledge of individual cases what seems best in each instance. It must be confessed that we often can only experiment carefully in the matter, and even those who

have devoted most attention to climatic treatment make mistakes in particular cases.

Mountain climates are usually colder than the plains, and the loss of heat from the surface of the body acts as a stimulus and promotes nutritive changes. At the same time the rarefaction of the air stimulates the respiratory system, and an actual increase in the number of blood corpuscles is said to occur, to compensate for the smaller amount of oxygen inhaled at each breath. Now it is clear that the stimulus applied needs a certain degree of vigour in the subject, if the reaction is to be complete and beneficial. This warns us that we must select cases for this treatment with some care. We should choose, if possible, those in whom the disease is not far advanced, so that they are not exhausted by it; young persons rather than old; persons who appear comparatively robust and well nourished, possessing plenty of vitality and power of adaptation.

Very much the same considerations apply in a general way to the choice of a bracing seaside place, but here the stimulus is less sharp, if it may be so expressed—there is not the rarefaction of the atmosphere to compensate, only the stimulus of bracing air. Not only early, but moderately advanced cases may do well in such resorts as our East Coast watering places, but for debilitated cases we must choose a time of year when the air there is warm—summer, not winter—though robust patients do well here in the winter also. For more debilitated sufferers who cannot endure cold, warmer spots must be selected, either on our South Coast or inland. (I speak of our own health resorts alone, for I believe that they are just as beneficial for consumptives as are places on the Continent.) Sometimes this class can advance from a warmer to a more bracing climate as their strength improves. Persons with a weak circulation, shown by coldness and blueness of the extremities and feeble pulse, need warm climates. Those with weak digestions also seldom bear cold places well, and old persons have naturally less reserve power on which to draw. The existence of much emphysema of the lung usually contraindicates very bracing air. Nevertheless, I can only repeat what I said before, that each case is a law to itself, and advice is largely experimental.

It has often seemed to me that we are too much inclined to recommend residence or wintering abroad, even in cases which are unsuitable. I have especially in my mind the case of a gentleman owning a large estate, who had fairly advanced tuberculosis and was sent by one of our climatic authorities to winter in Egypt. He went, but found the hotel life much less comfortable than his home conditions. The journeys to and fro were exhausting, and it took him a considerable period of time to recover from the ill effects of his expatriation. We have also to consider all the circumstances of our patients—their social proclivities and dislikes, as well as their physical conditions—and also the general amenities, if I may so express it, of the places to which we send them. The question of hotels and lodgings is not an unimportant one, and the financial means of the individual sufferer bear largely on the question of the most suitable course for him to pursue.

A sea voyage has been recommended for the cure of consumption from very early times and considerable faith is still placed in it by many. On board ship there is, theoretically, plenty of fresh air, of a bracing kind, which stimulates the appetite. Rest is almost enforced, for there is little opportunity of exercise. On the other hand, there is, in the first place, the risk of sea-sickness, which may be very exhausting. There is the possibility of bad weather, when the passengers are to a great extent confined below in somewhat defective conditions of ventilation; the food is often monotonous and unappetizing; the doctor on board may be somewhat of a novice; and on the larger ships there is also the temptation to more social gaiety than is suitable for an invalid. Here again we must weigh all the circumstances of each case, and not prescribe this mode of treatment indiscriminately.

If I may sum up what I have been endeavouring to put before you it is that there is no specific remedy or universal mode of treatment for tuberculosis of the lungs. Neither tuberculin, nor rest, nor work, nor mountain air, nor a sea voyage, nor a sanatorium, is an infallible remedy to be administered to all, as we give quinine for malaria or mercury for syphilis. We have to study the individual patient, his circumstances and his idiosyncrasies, and,

armed with this knowledge, to try to raise his resistance to the bacillus and its poisons. Fortunately the human organism has considerable powers of resistance, if it is not debilitated by adverse conditions; and though we must, above all, endeavour to recognize cases early, before the disease has advanced far, yet even in advanced cases there is always hope of arrest of the disease or at least of a temporary reprieve and prolongation of life.

A SERIES OF ONE THOUSAND INOCULATIONS, CHIEFLY IN PRIVATE PRACTICE.*

BY
H. WARREN CROWE, M.D. OXON.,
YELVERTON.

AMONGST the many scientific achievements which have marked the opening of the twentieth century there is, perhaps, none which stands out so remarkably as the treatment of disease by means of vaccines. The medical world still waits to see the actual results of this new treatment before surrendering unconditionally to its claims. It seemed to me, therefore, that the publication of a series of 1,000 inoculations, tabulated without either suppression of unsuccessful cases on the one hand or italicizing of successful ones on the other, might be of use to the members of this society in assisting them to appraise the actual merits of vaccine-therapy when shorn of the inevitable halo of romance which ever enshrouds a new thing.

I do not propose to enter in any way on the technique of inoculation work, either by describing the methods of preparation of the vaccine or of determining the opsonic index, as these things are well described in other papers, but I should like to express my indebtedness to Allen's book on the opsonic method of treatment, which gives such extremely lucid descriptions of all the laboratory technique involved, though one might suggest that in some respects the work is made unnecessarily laborious.

As to the site of injection and method of sterilizing the skin, however, a word or two may not be out of place. The anterior surface of the thigh is the least painful, and in any patient who is at all needle-shy, I always inject in this region, varying each time the exact locality. Other situations are into the extensor surface of the upper arm, the deltoid, or into the skin of the abdomen, but I have usually avoided the conventional site, namely, that of the intrascapular region, as the skin is so tough that it is extremely difficult to avoid hurting the patient. Sometimes I give the injection deeply into the muscles, sometimes subcutaneously, but I do not believe the result is affected. One tries to avoid puncturing a venule, as this gives rise to an ugly looking bruise, owing to extravasation of blood under the skin.

The vaccine is usually taken direct out of a stock bottle by plunging the needle of a sterile syringe through a drop of lysol placed on the rubber cap which covers it. The amount required is withdrawn. A drop of pure lysol is then placed on the site of injection and the needle driven into the skin through the drop. This method, originally introduced, I believe, by Sir A. E. Wright, has proved quite safe. I have never known any local trouble arise at the point of injection as the result of sepsis.

Wright's method is also used for sterilizing the syringes, oil at 140° C. being substituted for boiling water. This prevents rusting of the needles. The syringe with which I have operated latterly is one made by S. Maw and Sons, which screws into a metal case and can therefore be preserved in an aseptic condition.

The vaccines have all been home-grown, with the exception of acne and tuberculin. The former I have never succeeded in making, and the latter is easily and cheaply purchased in bulk from the makers, Meister, Lucius, and Bruning. No vaccines have been administered by the mouth.

I have grouped my cases as far as possible under the causative germ, and have then divided each group into three classes, Alpha, Beta, Gamma. My reason for substituting these symbols for the time-honoured "cured," "improved," and "failed," or "died," is that my most important work is in phthisis, and in this disease it is

* Read before the Plymouth Medical Society, November 16th, 1910.