Auto-inoculation in pulmonary tuberculosis / by Marcus Paterson.

AUTO-INOCULATION IN PULMONARY TUBERCULOSIS

MARCUS PATERSON

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S.a. Quarelli (Prof. Gustavo)
Lavoro e tubercolosi
Torino-Genova, S. Lattes & Co, 1922. pp. 98

S.a Rollier's Sanatorium fabrique et Leysin
built about 1930

Putti's Istituto Rizzoli
Cortina d'Ampezzo
visited & visited with Harvey Cushing & John Fulton
Sept. 1933

H. & J motored to Frimley in the summer of 1910 & were much impressed with Mr. P's work & personality.

Mr. & Mrs. Paterson came to us at Winterbourne, Oxshott in the winter 1911/12

Dumaresq was the Director of the Hante-ville Sanatorium where I met him visit Prof Wilson in Summer 1909

The American wife came to see us at Les Terrasses, Hyeres Oct. 23, 1926

Louise Paterson

AUTO-INOCULATION IN PULMONARY TUBERCULOSIS.

BY

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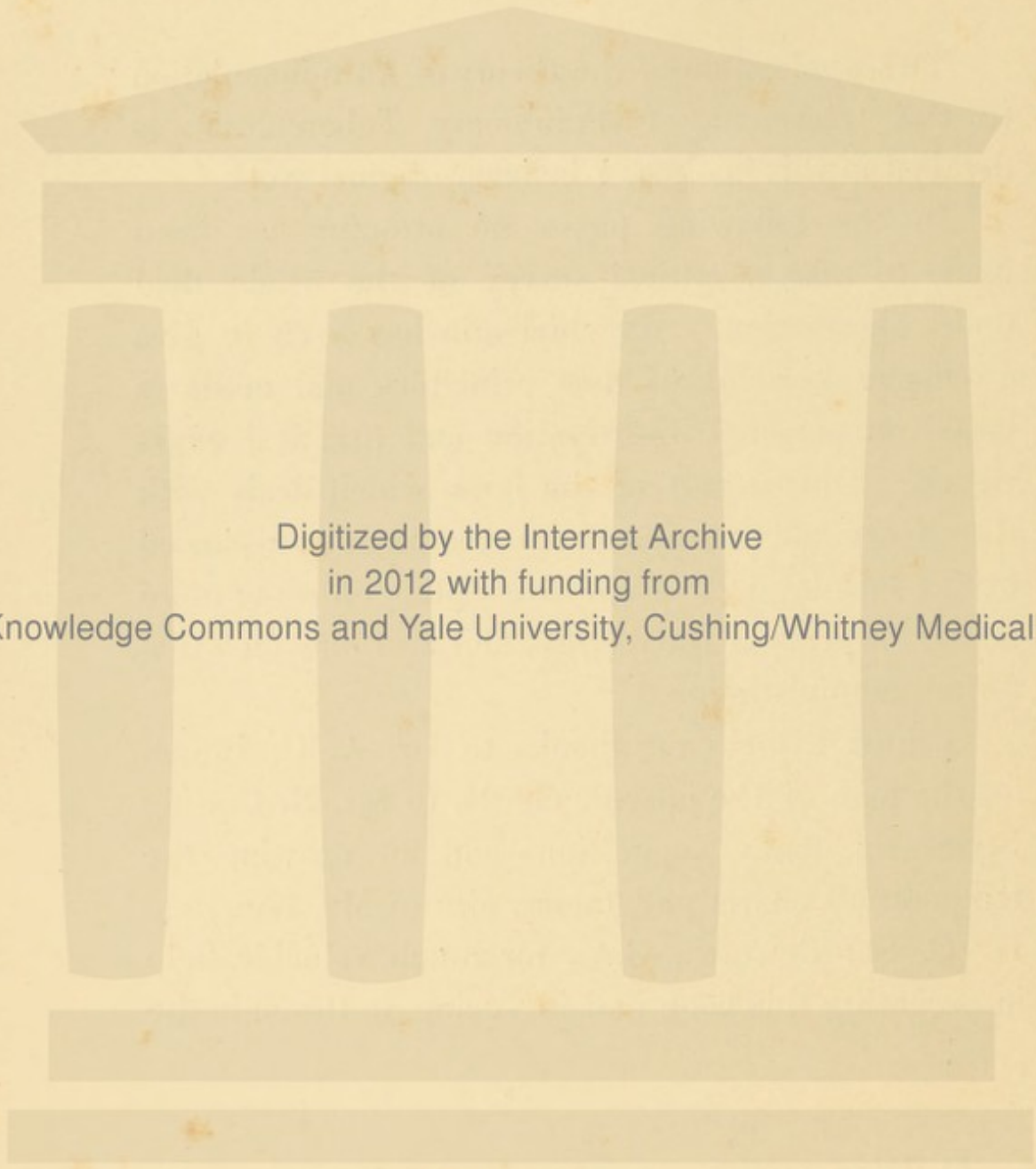
PREFACE.

THE application of the theory of Auto-inoculation to the treatment of Pulmonary Tuberculosis as detailed in this book is, I believe, original work.

In the following pages no attempt has been made to take a critical survey of the whole field under observation. My chief aim has been to give a concise account of new principles and methods based on personal investigation and practical experience. To that part of the book which deals with the theory and practice of the treatment now carried out at Frimley I have added chapters on some more general aspects of the disease, and also one on sanatorium administration.

I must express my thanks to Dr. A. C. Inman for the loan of the opsonic charts, to Mr. R. Curling Styles for many suggestions and for drawing the temperature charts and tables, also to Mr. Laurence H. C. Shuttleworth, B.A., for much valuable help in preparing this book and in seeing it through the press.

FRIMLEY;
April, 1911.



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AUTO-INOCULATION IN PULMONARY TUBERCULOSIS.

INTRODUCTION.

In the course of twelve years experience my views on the subject of consumption have undergone considerable modification. The object of this introduction is to explain in what respects they have been modified, and to give some account of the manner in which they differ from the views usually held by members of our profession.

The investigations of Sir Almroth Wright and others on the blood, and its *rôle* in bacterial diseases, have completely altered our ideas on the diagnosis and treatment of pulmonary tuberculosis.

Pulmonary tuberculosis is similar to all other infectious or bacterial diseases in that it manifests

itself in two ways: first, by physical signs due to local pathological changes in the lungs; secondly, by changes in the general health of the patient due to absorption of bacterial products produced at the primary focus into the systemic circulation.

Now, it is this latter effect which is of greater importance to the patient.

A few crepitations, more or less, matter little to the sufferer provided that the blood is not being adversely affected, and that no constitutional disturbances are produced.

I was trained to diagnose, treat, and give a prognosis in a case of febrile pulmonary tuberculosis by means of the stethoscope alone. I have since come to the conclusion that the value of the stethoscope has been largely over-rated, and I am convinced that too much significance has been attached to the local condition, and that not nearly sufficient attention has been given to the state of the blood and the general health of the patient.

We do not in other bacterial diseases attach as much significance to the local disease as we have done in tuberculosis. Take, for example, diphtheria. Does any physician consider himself in a position

to declare, after an examination of the throat alone, either that the patient will recover or that he will die? The information derived from the membrane does not enable him to give so definite a verdict. He has first to take into consideration the extent to which the condition of the blood-fluids is affected by the bacterial products. The membrane may mechanically asphyxiate the patient just as the local disease of the lung in consumption may cause death from hæmoptysis. Whether the patient recovers or no depends upon the bacterial products which are manufactured locally and discharged into the blood-fluids. If they are in quantities which cannot be dealt with they will produce fatal results. Similarly, in typhoid fever the local ulcers may kill the patient by perforation, but as a general rule they appear to matter little to the individual in comparison with the general toxæmia. From this point of view, therefore, a patient may actually be suffering from tuberculosis of the lungs, yet, as long as bacterial products are not given off in sufficient quantities to affect his blood, his general health in no way suffers from the local disease.

If the local disease becomes extensive dyspnœa

may result from actual loss of lung-tissue, but this will not otherwise injure his general health.

It should be recognised that in consumption, as in all other forms of bacterial disease, the question of "balance" is of supreme importance; this may be defined as the ratio between the virulence of the invading micro-organism and the specific resisting power of the body to that particular organism. The greater the resistance that is actually present or that can be artificially produced the sooner will a cure be effected. The more virulent the germ the greater the difficulty in dealing with its effects upon the body.

We know that the specific resistance can be increased until the toxic effect of the invading organism is no longer manifested, and with the raising of the level of resistance there is reasonable probability that the bacterial products will become less virulent, till finally they die out altogether. Once the focus of infection is extinguished there is little likelihood of its recrudescence.

A great deal of importance has been attached to the presence or absence of cavities, but a cavity has no effect upon the blood, and its presence has not the great prognostic value usually assigned to it.

Further, if after invasion by bacilli lung-tissue is coughed up and a cavity formed, the patient is probably much better off than he was before, since he has managed to get rid of ulcerated lung-tissue containing tubercle bacilli, which is obviously better out of the body than in it. This natural process finds its parallel in the artificial methods of the surgeon, who removes caseous material with the knife.

On the other hand, limited signs of disease do not furnish an infallible criterion of its activity. It is a mistake, therefore, to suppose that because a patient has few physical signs he has nothing much the matter with him and must soon regain his health. A tuberculous deposit the size of a pea may give off sufficient bacterial products to cause fever and complete prostration from the lowering of the patient's resistance, whilst a patient with extensive signs, even with a cavity, may be capable of the hardest manual labour if the focus of infection is not producing bacterial products in sufficient quantity adversely to influence his blood.

To say that a patient with limited signs of disease is bound to recover if treated at once implies that if every case of pulmonary tuberculosis was placed under

treatment within a few weeks of infection there would be 100 per cent. of good results.

There is no treatment for any disease, even in its early stages, that can claim to be universally successful, and there is certainly no treatment for tuberculosis that can show 100 per cent. of arrests.

From one cause or another 10 to 20 per cent. of patients give disappointing results, and in treating consumption we must expect, and should not be discouraged by, such failure, even when dealing with so-called "early cases." Persons who have become infected by the tubercle bacillus fall, I believe, into one or another of the following four classes:

(1) Those who will recover without being in any way aware of the infection.

(2) Those who will recover by going abroad or to the seaside, rest and change of air being sufficient to restore the balance.

(3) Those who will recover if placed under ideal conditions in sanatoria.

(4) Those who will not recover under any circumstances.

Leaving out of account Class 1, have we any means which will enable us to take a hundred patients

suffering from recent infection and state categorically that so many belong to Class 2, so many to Class 3, and so many to Class 4? Such means we do not possess, and until we do all infected persons should be regarded as belonging potentially to Class 3. Patients for whom recovery is possible will be cured, if anywhere, at a sanatorium conducted on the lines of graduated rest and exercise; and if there are some for whom such sanatorium treatment may not be absolutely necessary, yet by going to an institution of this kind they insure themselves against all possible risk, and receive at the same time a very practical education.

It will be clear from what has been said above that physical signs by themselves are untrustworthy guides to prognosis. The local conditions of the chest must not be considered alone, but should be taken in conjunction with the general condition of the patient as shown by the effect of the bacterial products on the constitution. After my first examination of the patient, having noted the extent of lung involved, I do not make routine examinations of the chest, save under exceptional circumstances, as I am of opinion that better information can be obtained

concerning his progress by watching the effect of the bacterial products on his general condition.

This is shown by—

(1) The temperature.

(2) The sputum (appearance and quantity).

(3) The patient's own feelings.

(4) The appetite.

(5) The weight.

These items will be considered in full detail later, and I hope to prove that the patient's progress can be gauged by them better than by crepitations or other signs in the lungs.

When I first started sanatorium work my object was to make the patients gain in weight and gradually to harden their physical condition. Now that I have had my eyes opened to the two main aspects of the disease my objects are :

(1) To raise the patient to his normal or highest known weight ;

(2) To raise the patient's specific resisting power to such a degree that he can perform the hardest work without the risk of introducing a dose of bacterial products into the blood large enough to produce constitutional disturbance ;

(3) To stop or greatly diminish discharge of sputum.

Now, I contend that if after treating a patient I have been successful in attaining these three objects, I am better able to say that the disease is arrested than from any information obtainable by examination of the chest alone.

The most important and neglected sign of progress or regress is the decrease or increase of the sputum. This decrease or increase frequently occurs synchronously with the presence or absence of the signs of auto-inoculation.

All surgeons know that a septic wound is not healing if the discharge increases or remains stationary. They know, also, that when the discharge ceases the wound should heal.

In an empyema of the chest surgeons do not use a stethoscope to find out whether the discharge is increasing; they look at the dressings. If physicians would pay more attention to the sputum-pot they would obtain much valuable information, for, after all, pulmonary tuberculosis accompanied by sputum indicates that there is an ulcer of the lung, and the discharge from that ulcer is the sputum. A patient

may be suffering from pulmonary tuberculosis, as is proved by the presence of tubercle bacilli in his sputum, without having any definite physical signs. The stethoscope here is of no value. Again, he may have definite physical signs, whilst his sputum is entirely free from tubercle bacilli. Many physicians will say that there is no evidence that such a patient is suffering from consumption. Here, again, the stethoscope is valueless. No prognosis can, in fact, be given in such cases by the physician who relies on the use of the stethoscope alone. He must extend his observations to the appearance and quantity of the sputum, to the constitutional symptoms and the temperature, taken in conjunction with the amount of work the patient is capable of performing.

Any patient with an excessive quantity of bacterial products in his blood will have fever, and until the dose can be controlled the fever will remain. The discharge of bacterial products into the blood-fluids is called by Wright "auto-inoculation," and nothing has been of greater assistance to me than the knowledge that it is possible to excite and control these auto-inoculations at will.

The treatment of consumption does not begin and end with "fresh air"; it is also necessary to employ means which will enable us to control excessive doses of bacterial products, and to co-operate with Nature in her task of counteracting the effects of the bacilli. Here, at any rate, we are not walking entirely in the dark; we have a definite end in view, and there are definite methods by which we can obtain it. That those methods are sound is shown by their practical results, whilst the evidence afforded by the opsonic index supports the conclusion that the theory on which they are based is scientific.

In the following pages it is proposed to go into details of the practical scheme of graduated rest and graduated exercise, by means of which, not only is the patient's resistance to the bacterial products raised, but at the same time he is restored to his full working capacity.

CHAPTER I.

GRADUATED LABOUR AND AUTO-INOCULATION; HISTORY OF THE IDEA.

Early in 1905, while Resident Medical Officer of the Brompton Hospital, I was asked by the Committee to organise the new sanatorium at Frimley, which was on the point of completion. For some time previously I had observed that many tuberculous patients, who had followed their ordinary occupations up to the time of admission, were in a very fair condition of health. The case of a navvy may be cited as an example. He had worked for forty hours almost without rest altering a large water main a few days before his arrival, and although he had extensive physical signs, was apparently none the worse for such arduous work. It occurred to me that if it was possible for consumptive persons under adverse circumstances and without any medical

guidance to act in this way without apparent injury, then under ideal conditions and with the work carefully graduated in accordance with their physical state they ought to be capable of undertaking useful labour.

On this assumption manual work should be of great advantage to patients undergoing treatment in a sanatorium, as first, it would do much to meet the objection that members of the working classes are liable to have their energy sapped and acquire lazy habits by such treatment; secondly, it would make them more resistant to the disease by improving their physical condition; and thirdly, would enable them, by its effect upon their muscles, to return to their work immediately after their discharge. The idea was a new one, and in opposition to the generally accepted medical opinion on the subject. It had, however, been clearly shown by Dr. Otto Walther, of Nordrach, that excellent results could be obtained by graduated walking exercise, especially when, in suitable cases, this exercise was pushed to the extent of twenty miles a day. In this form of exercise, however, the muscles used were chiefly those of the lower limbs. I had it in mind also to employ the

upper limbs, which are supposed to have a more direct influence on the expansion of the lungs. The objections naturally raised to this method of treatment were: (1) That the disease would become active again under the strain; and (2) that the exertion would produce hæmoptysis.

At the outset great care had to be exercised, not only from the fear that the views which had led to the adoption of the method were possibly unsound and might have harmful results, but also because the patients did not take kindly to the work, it being absolutely contrary to their preconceived views of the kind of treatment suitable to their condition. Some of them imagined for a time that it was not designed for their benefit, but purely for the advantage of the institution, and they regarded me rather as a labour master trying to get so much work out of them than as a medical man who was endeavouring to cure their disease. Care was especially necessary in the selection of patients for the work, as had there been a case of severe hæmoptysis, or high fever, or pleurisy, it would probably have been impossible to convince the patients that the method was sound, and they would have refused to work.

Walking exercise was first ordered, the distance being gradually increased up to ten miles a day. When a patient had reached this stage he was given a basket in which to carry mould for spreading on the lawns, etc. No case of hæmoptysis or of pyrexia occurred among these patients. When they had been on this grade, with nothing but beneficial results for from three weeks to a month, they were given boys' spades with which to dig for five minutes, followed by an interval of five minutes for rest. After a few weeks several of the patients on this work, who were doing well, were allowed to work as hard as possible with their small spades without any interval for rest. As they had all improved on this work larger shovels were obtained, and it was found that the patients were able to use them without the occurrence of hæmoptysis or a rise of temperature. About this time many of the patients were feeling so well that it became necessary to restrain them from doing too much. The tradition of absolute obedience to orders regulating the amount of work to be done had not yet been firmly established, and one of the patients, who had improved most of all, was found wheeling a heavy barrow, full of sand, without per-

mission. When scolded for breaking rules he replied that he felt quite fit for such work, and was anxious to get into condition for the work he hoped to do when he left the sanatorium. This argument appeared to be sound, and, as he was willing to take the risk, he was allowed to continue to wheel the barrow for the full labour period, which at that time was three hours a day. He suffered no ill-effects, but, on the contrary, did exceedingly well, and has since been at work for over five years.

It was thus shown that a tuberculous man could, in certain instances, do heavy manual labour and continue to improve in health. I accordingly decided to work out a carefully graduated scale of labour.

At the end of the first six months a great advance had been made, for the tradition of work as a method of treatment was firmly established, and the patients saw clearly that it was for their own benefit. The extension of this system required great care and supervision, for the patients, far from objecting to or attempting to shirk their appointed labour, now had a tendency to do more than they were ordered. Harder work was first prescribed for those patients who could be trusted. It was found that they could

gradually be trained to use the heaviest spades, shovels and 7 lb. pickaxes with advantage to their physical condition, and without hæmoptysis or rise of temperature. The patients all expressed the opinion that the work did them good, and that the harder they worked the better they felt. Many patients have since written to say that they date their improvement from the time when they began to work, and that they think the hardest work did them the most good. Within the first year there were several patients who would, despite all instructions, over-exert themselves, and use heavier tools than they should have done. No serious harm resulted, but several of the disobedient patients developed fever and subsequently pleurisy. One of these patients was laid up for nearly two months and was much worse at the end of that time, although eventually he did well, and was known to be at work two years afterwards. The extent of his disease was, however, increased by the over-exertion. The necessity for absolute obedience to the medical officer's orders was firmly established by such cases.

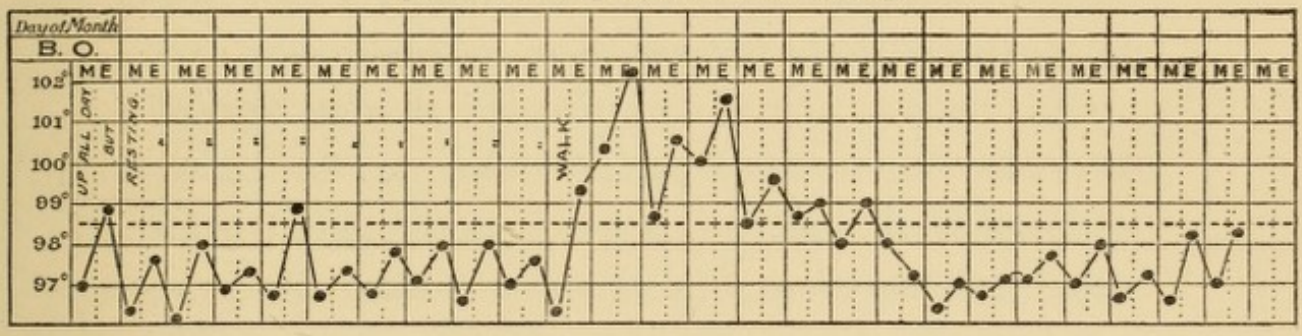
During the first year that the Sanatorium was opened the patients were allowed to play games, such

as croquet, quoits, etc., in the evenings and on Saturday afternoons—that is, out of the regular working hours—but it was soon found that many patients in this way took too much exercise. Their improvement was not satisfactory, because they were apt to get too keen over the games and forget that they were under treatment. A rule was therefore made that the patients were not allowed to play any games of this nature until they had reached the stage of basket work. Its adoption was found to produce much better results. The reason is obvious, namely, that a patient walking his prescribed four miles a day was having sufficient exercise, but when he played a game of croquet in addition, too much. It was therefore established that a consideration of what a patient is doing, not only during his hours of exercise, but during the whole twenty-four hours, is of the utmost importance; and that the hours of recreation must be regulated just as carefully as the hours of work.

The accompanying chart shows the effect produced by an act of indiscretion upon the temperature of a patient who should have been resting all day. It occurred upon a certain summer evening when, not having realised that he was always under treat-

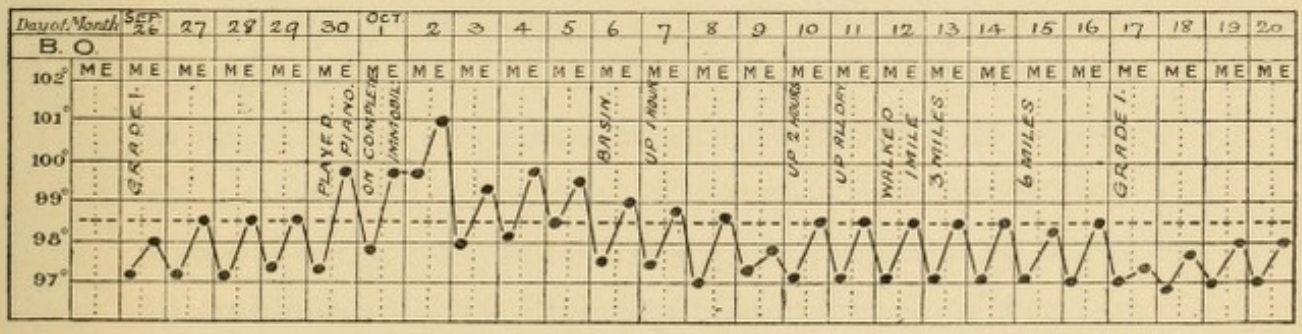
ment, and considering himself to be free from control, he went for a short walk of about half a mile. Playing the piano must be regarded as exercise, as I

CHART 1.—Showing effect of walking exercise on the temperature of a patient who ought to have been resting.



have known a musical patient, after an hour at the piano, experience a rise of temperature to 99° F., with headache and general malaise.

CHART 2.—Showing a patient on Grade 1 who played the piano without permission in ignorance of the regulations.



After the Sanatorium had been opened about eighteen months and further experience had been gained, I came to the conclusion that the patients

who had had a slight rise of temperature (99° F.) as a result of over-work, and had been consequently ordered a few days' rest, were not only none the worse for the set-back, but in some cases actually better. Some patients even appeared to date their improvement from the period of rest following over-work. It was accordingly decided that it was unnecessary to put these patients back to the earliest grade of work, and they were permitted, after a few days' walking exercise, to re-start work in the grade reached when they suffered from over-exertion. This practice has been continued ever since with satisfactory results, but it is impossible to lay too much emphasis on the fact that such patients require to be watched with especial care. Loss of appetite, the presence of *headache*, or a rise of temperature are danger-signals which it is fatal to ignore. In the course of my earlier experience I observed cases of another type, *i. e.* patients who, from the indications given by temperature, appetite, and demeanour, ought to have been making progress, but who remained in a stationary condition, and were, in fact, only marking time. It was doubtful whether such patients should be given harder work or more rest. They were con-

siderably under the normal weight and their general state of health did not suggest a capacity to undergo an increase of labour. After careful consideration it was determined to try the effect of harder work with a view to improving the appetite. All such patients were found to show progressive improvement on the higher grade.

I continued to work on the lines indicated above for a period of about two years, and at the end of that time the following facts were ascertained: (1) That suitable patients could perform the hardest manual work with general improvement in their physical condition, accompanied by a gain in weight and marked decrease in sputum, without the occurrence of hæmoptysis. (2) That some patients, who made no progress on lighter work, showed marked improvement on harder work. (3) That patients who had slightly over-exerted themselves and were kept at rest for a few days following the event were subsequently none the worse, and very often much better. Up to this point the experiment had been empirical. The investigations, so far as they had been carried out, showed that properly regulated labour, that is, labour graduated according to the

necessities of each individual, had undoubtedly an active effect on the disease, and raised the general health and resisting power of the patient.

The result of the new method of treatment proved beyond reasonable doubt that its principles were sound, though I was unable at the time to give a scientific account of the theory on which they were based.

In 1907 Dr. A. C. Inman explained to me Wright's theory of auto-inoculation, and suggested that the reason we were obtaining satisfactory results from the graduated system of labour was that the work caused an inoculation of the patient by his own bacterial products. This theory was supported by the following facts : After a rise of temperature, and therefore, presumably, an auto-inoculation, patients were often better than before ; whilst some patients who made no progress on a particular grade of work showed marked improvement when transferred to a higher grade. In other words, the harder work caused the patient to auto-inoculate himself, whereas the lighter work failed to do so. I proceeded to use the theory as a working hypothesis in determining the suitability of a patient for any particular grade of

labour, and found it to be of very great assistance. The method necessitated a more careful graduation of labour, as two important questions had to be answered.

(1) Was the patient doing too much work? (2) Was he doing enough? Theoretically, the end in view was an exact adjustment of auto-inoculations to the resisting power of the protective substances of the blood. In other words, suitable work had to be found for each patient, according to his condition. The next step was to apply a scientific test to the theory by tracing the effect of physical exercise on the blood as revealed by laboratory investigation. Accordingly Inman examined over 300 bloods of patients undergoing treatment at Frimley, the tests being carried out with great care to avoid all possibility of personal bias. The results of the investigation were convincing, and exactly confirmed the condition of the patients as determined by clinical observation. Conversely, when the pathologist required cases of a particular kind, I was able to detect them without any difficulty; as, for instance, a patient who was auto-inoculating himself slightly, or, again, one with a high opsonic index. The same is true of patients with a normal index, of patients who, from excessive

auto-inoculations, had low indices, and of patients whose index was constantly low.

Here, then, was the scientific explanation of the successful results obtained by graduated labour treatment. By means of the opsonic index it was clearly demonstrated (1) that physical exercise induced auto-inoculations, (2) that systematic graduations of exercise regulated and controlled their extent. The discovery was gratifying, not only because it confirmed the soundness of my theories, and gave a satisfactory explanation of them, but because it afforded new opportunities of immense practical value in checking and guiding my observations. This aspect of the matter will be considered later. Meanwhile I may quote as an instance one notable case. It was that of a man who was regarded as possibly fit for harder work, but whose condition was such that it was judged to be unwise to take the risk of increasing his task. The blood was examined and his index found to be practically normal. He was then put on harder work for a week and his index taken again. Once more it was practically normal. He was then put on the hardest work and performed it without harm. In this case the opsonic index proved

an invaluable guide, saving perhaps months of time by determining within a week that the patient was fit for the hardest work when clinically we hesitated to come to such a conclusion. Since these investigations were carried out it has not been found practicable to apply the opsonic test to all cases under treatment. The extensive laboratory work involved could not possibly be accomplished without the aid of a large and permanent extra staff. Fortunately such tests have been found to be unnecessary. The investigations served their purpose once and for all by establishing a practical working ratio between the evidence of auto-inoculations as furnished by the index and the physical symptoms manifested in various ways by the patient. We are consequently enabled to draw confident conclusions from the deviations of the temperature chart and the constitutional symptoms without any further help from the opsonic index. The importance of the experiment lies in the fact that it has confirmed the value of graduated labour in the treatment of pulmonary tuberculosis, and has done so in a manner that could otherwise only have been determined by a further trial lasting over several years.

CHAPTER II.

THE THEORY OF AUTO-INOCULATION.

In order to prevent misunderstanding I wish to make it clear that I use the word "auto-inoculation" to describe a process. That process is the introduction of bacterial products into the blood. It is not intended here to discuss the nature of these products; such a discussion belongs to the field of the bacteriologist. For the purpose of this book it is enough to regard them as equilavent to *x*. Before considering the subject in the light of practical experiment it will be well to recapitulate in brief outline the theory of auto-inoculation as it is at present enunciated. According to Wright bacterial organisms flourish in foci of lowered bacteriotropic pressure. In other words, areas of depression are formed wherever there is a diminution in the number of antibodies. Auto-inoculations may follow or be induced, in Wright's words, "upon all active and passive

movements which affect the focus of infection, and upon all vascular changes which activate the lymph stream in such a focus." It is by the agency of these auto-inoculations that the protective mechanism of the blood is set in motion, so that whenever bacterial products escape from localised foci and pass into the circulation, "intoxication phenomena and immunising responses must necessarily supervene." When this immunising response is adequate to withstand the attack Nature effects a spontaneous cure. When it is inadequate and when the auto-inoculations continue unchecked the inevitable end is death. "No one acquires protection against the disease save by the production of protective substances . . . No one can live in the presence of infection save by the aid of these protective elements . . . No one recovers from any bacterial disease unless it be by the production of protective substances in his organism." The importance of maintaining a high bacteriotropic pressure in the circulating blood-fluids is therefore obvious. Only by such means can it be held secure against bacterial invasion, and only by such means can it regain the upper hand if once the invasion has been successful.

Bacterial infections are differentiated from each other by the extent to which the lesion is in contact with the blood-stream. Where the contact is close, auto-inoculations may be constantly occurring. When the lesion is practically cut off from the blood-stream, as in lupus, the auto-inoculations are negligible. Pulmonary tuberculosis may resemble either of the above, or may be in an intermediate stage, the extent and frequency of the auto-inoculations varying in proportion to the motivity of the lungs.

Now it is clear, in the light of what has been said above, that where a focus of infection is in contact with the circulatory blood two combating motives must be taken into consideration: On the one hand, the action of all those protective elements which are contained in the blood and lymph streams; on the other hand, an active hostility and antagonism to those elements on the part of the bacteria and their products which are discharged from the focus of infection. It is the balance between these two opposing forces that constitutes what is known as resisting power. This power will be raised if adequate auto-inoculations are induced; it will be lowered if they are oft repeated or too aggressive. As long as the

dissemination of toxins is counteracted by the neutralising activities of anti-bodies in the blood the balance will be maintained—that is, no constitutional symptoms will be produced and the remaining protective substances will be available for a concerted attack on the lesion. When such anti-bodies are not available in sufficient numbers, and are consequently impotent for the purpose of neutralisation, the balance will break down. Constitutional symptoms will be produced and the extent of the lesion may be increased. Once the balance has been disturbed it can only be regained by accurate adjustments of blood supply to the focus of infection, so ordered that a control may be obtained over the amount of bacterial products discharged.

In this connection it may be observed that when the bacteriotropic quality of the blood becomes lowered and bacterial elements succeed in establishing a focus of infection, the latter must be regarded in the light of aggressors, whose combined forces are potentially more powerful than any which the blood can oppose to them. For this reason indiscriminate and oft-repeated frontal attacks on their stronghold are bound to end in disaster, since a

copious flow of blood to the affected centre, whilst it is in fact a counter attack, may involve the wide dissemination of bacterial products into the circulating blood and lymph stream, the defenders of which are already in a condition of lowered vitality. The result of such tactics will only be to enlarge the extent of the areas of depression, which are potential centres for the growth of fresh foci of infection. It must, at the same time, be observed that the very appearance of a suitable quantity of bacterial elements in the blood sounds the battle-cry for the multiplication of anti-bodies. The effect of bacterial invasion is, in fact, twofold: It rallies the existing anti-bodies to withstand the attack, and creates in the body a stimulus towards the manufacture of fresh forces.

The problem of control is therefore complicated to this extent: that in addition to the necessity of exciting adequate discharges of bacterial products, there is always the danger of exciting excessive doses which may overwhelm the protective substances of the body. Such a one-sided contest must end in the rout and destruction of the anti-bodies, those available being exhausted by the effort of resisting the invading

bacteria and there being no reinforcements at hand to take their place. Uncontrolled doses are disastrous. The inevitable result must be the ascendancy of the bacterial products and a lowered power of resistance on the part of the blood. It is therefore clear that any system of control must be guided and determined by the quantity and quality of the anti-bodies available in the protective organism; the aim and object of such control should be, in the first place, to protect the anti-bodies by preventing wholesale discharges of bacterial products, and, in the second place, to train the body gradually to the task of resisting larger and larger doses. The process may be described as one of progressive balance. If the doses can be adjusted to the fighting strength of the protective elements, if this ratio between the two forces can be gradually increased and maintained, then stage by stage the anti-bodies will wear down the assaults of the bacterial products, until the rising levels of resistance swell at last in full volume to the "high tide of immunity." In the light of the theory here outlined the treatment of patients suffering from excessive auto-inoculations should be subservient to the following aims:

(1) The control of auto-inoculations when the protective substances are unable to deal with them.

(2) The artificial inducement of auto-inoculations adjusted to the resisting power of the protective substances.

The ultimate end foreshadowed by the successful adjustment of these two controls is attainment of the standard of immunity—in other words, resisting power sufficient to deal with auto-inoculations of whatever extent. Once it is understood that immunity depends on the resisting properties of the blood, we may next proceed to consider by what practical means we can assist Nature in her task of immunisation. The answer to that question may be summed up in two words, namely, "rest" and "exercise." A detailed consideration of these two factors will be found in the following chapters.

CHAPTER III.

THE CONTROL OF EXCESSIVE AUTO-INOCULATIONS BY MEANS OF COMPLETE IMMOBILISATION.

Before proceeding to describe and illustrate the practical application of the principles just laid down, I wish to call particular attention to a point of vital importance, that is, the necessity of securing the willing co-operation of the patients themselves. In treatment by graduated labour or graduated rest everything depends on accurate adjustments of physical activities to individual needs, and the slightest deviation may incline the balance from success to failure. Since we are employing a method dealing with bacterial products, which may have toxic effects, our conduct should show the same scrupulous care that characterises our dealing with any of the poisons of the British Pharmacopœia. If

a patient exceeds his task he will give himself a bigger dose than was intended, and do himself harm; if he shirks, or for any reason fails to do the whole amount of work allotted to him, the exercise he takes will be insufficient to influence his lesion, and he will lose whatever benefit he would otherwise have obtained.

With this necessary warning I will proceed to discuss the treatment of patients who are suffering from excessive auto-inoculation.

It has already been shown that the sequel to an auto-inoculation of bacterial products is an immunising response on the part of the blood. When the inoculation exceeds the capacity of the protective substances to deal with it the patient suffers from toxæmia, the symptoms being, as a rule, headache, pains in the eyes and limbs, fever, anorexia, and a general feeling of malaise. These symptoms exactly resemble those of the disease known as influenza, but are, in fact, the symptoms of toxæmia which are present in all bacterial diseases, and indicate a condition of the organism in which the protective elements are inadequate to deal with the bacterial products. It is therefore important to observe that

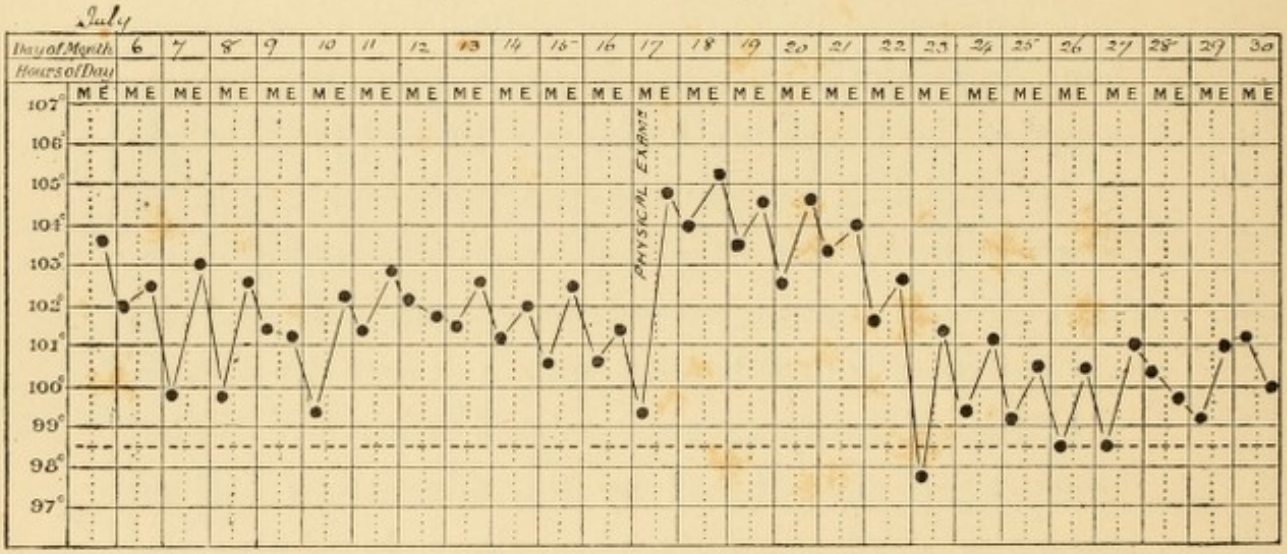
the extent of the auto-inoculation depends in large measure upon the activity of the lungs. So that if a patient is coughing violently and shaking the bed while he has fever, he is taking fairly hard exercise and supplying a stimulus sufficient to produce a severe auto-inoculation. Auto-inoculations can, in fact, be excited by movements much less violent than coughing ; the deep breathing sometimes required of a patient for the purpose of diagnosis and prognosis is alone sufficient to provide the necessary stimulus. For this reason the time-honoured custom of examining patients by means of auscultation should be altogether dispensed with unless it can be shown that the disadvantages associated with the actual process are out-weighed by the advantages derived from its results. Otherwise there is always the danger of exciting in the organism those very activities which it should be the first aim and object of the physician to control.

Whilst I was Resident Medical Officer at Brompton Hospital patients who were already suffering from fever frequently had a rise of temperature immediately after the visit of the physician. The nurses used to attribute such rises to excitement instead of

to excessive auto-inoculation caused by the physical examination. The accompanying chart is an illustration.

If the patient is doing well there is nothing to be gained by a physical examination. If he is going

CHART 3.—Illustrating the effect of a prolonged examination of the chest.



downhill this fact can be ascertained from the chart and general conditions; no physical examination will help him to recover. It follows that routine examinations of febrile patients should be avoided, and the chest only examined when complications, such as "fluid," are feared. There is no objection to listening with a stethoscope provided the patient is in no way disturbed or made to cough. All coughing

which is not pulmonary should be carefully observed, and steps should be taken to remove the cause. A long uvula, for instance, will often cause a persistent and irritating cough. Such abnormalities should be rectified.

Irregular pyrexia in pulmonary tuberculosis is associated always with irregular, spontaneously occurring inoculations of bacterial products. Persistence of this fever can only end in the death of the patient, and it is therefore obvious that every possible means must be taken to control it. To bring the patient's temperature to normal is our object, and this is most readily accomplished by enforcing Complete Immobilisation. If this condition is realised the motivity of the lungs will be diminished and the dissemination of bacterial products into the blood-stream appreciably lessened. In my system of graduated rest and exercise patients who have a temperature as low as 99° F., and constitutional symptoms, are not only sent to bed, but are in addition treated in every way, with exception of diet, like a typhoid patient. They are not allowed to move in bed, to read, to wash themselves, to cut up their food, or to go to the lavatory. They are instructed

to talk as little as possible. Every means is used to prevent unnecessary coughing—that is, all coughing which is not necessitated by the effort of bringing up sputum. In no case is a patient examined with a stethoscope, made to take numerous deep breaths, or allowed to sit up in bed, or to cough for the purposes of physical examination. If a patient is already under the influence of excessive auto-inoculation every possible source of further excess must be rigidly controlled.

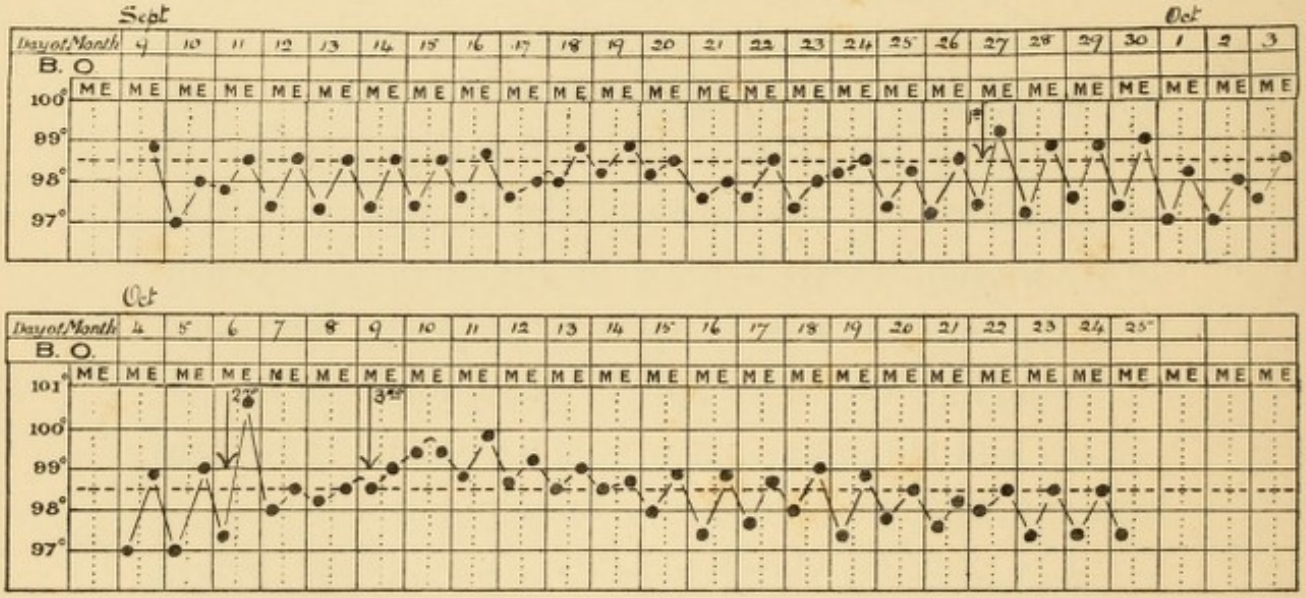
The irritability of a cough can be considerably relieved by inhalations of a solution compounded of oil of creosote, spirits of menthol 20 per cent. and spirits of chloroform in equal parts.* For many years Yeo's respirators have been worn when necessary by patients at the Brompton Hospital, and it has recently been suggested that the good results obtained would be even better if they were worn continuously, cough or no cough. One writer has even declared that these respirators are the "cure" for tuberculosis. The truth underlying this statement is that the relief of an irritable cough facilitates

* If this dries the patient's mouth, paroleine may be substituted for the spirits.

the control of auto-inoculations and so restores the patient's "balance." Inhalations are a means to the end. Once the cough is under control they have no further influence on the disease. It is very difficult to make nurses understand that a patient who is conscious and quite capable of looking after himself has to be nursed on these lines, and they are apt to overlook many movements which are unnecessary and ought to be prevented. Nurses should be told to remember the treatment of the typhoid, who has to lie motionless with arms at his side. They will then realise more readily what is required. The prohibition of visitors is essential; visitors *will* talk, and talking and laughing aggravate a cough and so induce auto-inoculations. Letters, again, ought to be censored to prevent the possibility of a patient being worried by bad news. Mental agitation has a deleterious effect, directly and indirectly, by increasing the physical restlessness of the patient and adversely influencing his progress towards recovery. In applying these methods the medical man must, of course, use his own discretion. Each case must be judged on its merits, since the capacity of different individuals to endure restraint necessarily varies

within wide limits. Patients who have been in bed with fever for a month or more should be kept in bed

CHART 4.—Showing a patient at work who received an auto-inoculation on the day marked by the first arrow, and an auto-inoculation with marked constitutional disturbance ten days later. Complete Immobilisation followed, the temperature remaining normal until the third day, when the patient was visited by her *fiancé*. The temperature immediately went up, and a further period of Complete Immobilisation was necessitated.



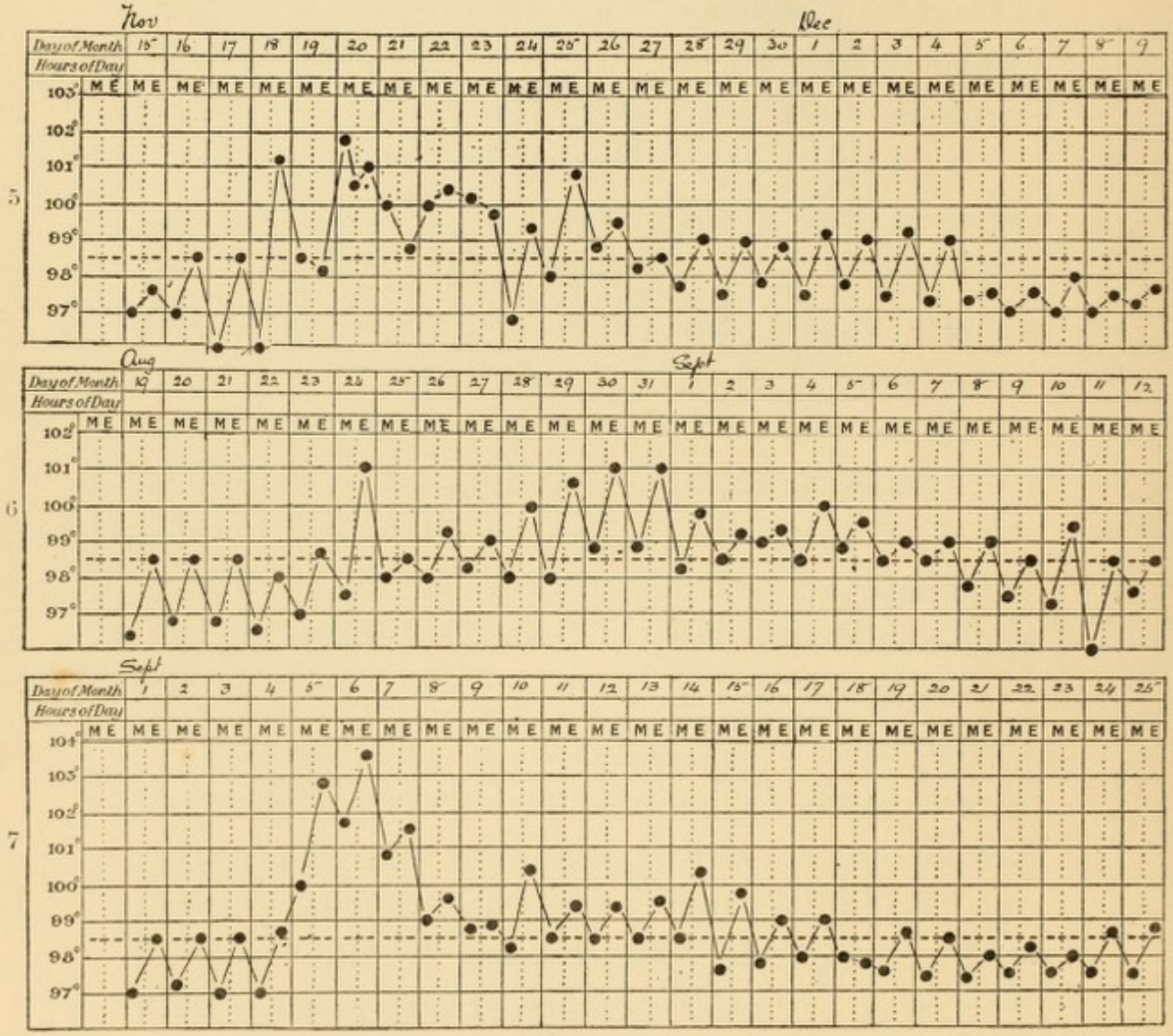
on Complete Immobilisation for about six to ten days after the temperature has returned to, and remained at, the normal level; followed by three days propped up in bed, with the privilege of reading. If the temperature remains normal they may be allowed to sit up in bed for half an hour on the following day, the period being again increased little by little until they are able to be up all day fully dressed.

As will be shown in detail presently the effect of Complete Immobilisation is to diminish the discharge of bacterial products into the blood, which gradually regains its resisting properties, until the constitutional symptoms altogether disappear.

If Complete Immobilisation has been tried for a period of three weeks or a month without effecting any appreciable improvement in the condition of the patient; if, that is, the indications given by the temperature chart are unsatisfactory, recourse must be had to other methods. It is in cases of this kind, when immobilisation has failed, that I should call in the aid of tuberculin, not as an alternative to rest, but as a supplementary method. Personally, I have had so little experience in the use of tuberculin that I am not entitled to express any opinion on its merits, but I certainly think that, just as the great advantage of auto-inoculation, if it can be induced, lies in the fact that it stimulates resistance to the products of the patient's own bacilli, so better results will be obtained in artificial inoculation if the patient's own strain of bacilli is employed rather than a stock tuberculin.

When I was quite ignorant of the theory of auto-

CHARTS 5, 6, 7.—Showing three patients on work which caused large auto-inoculations. They were sent to bed, but not treated on the lines of Complete Immobilisation. The temperature did not settle for a considerable period.

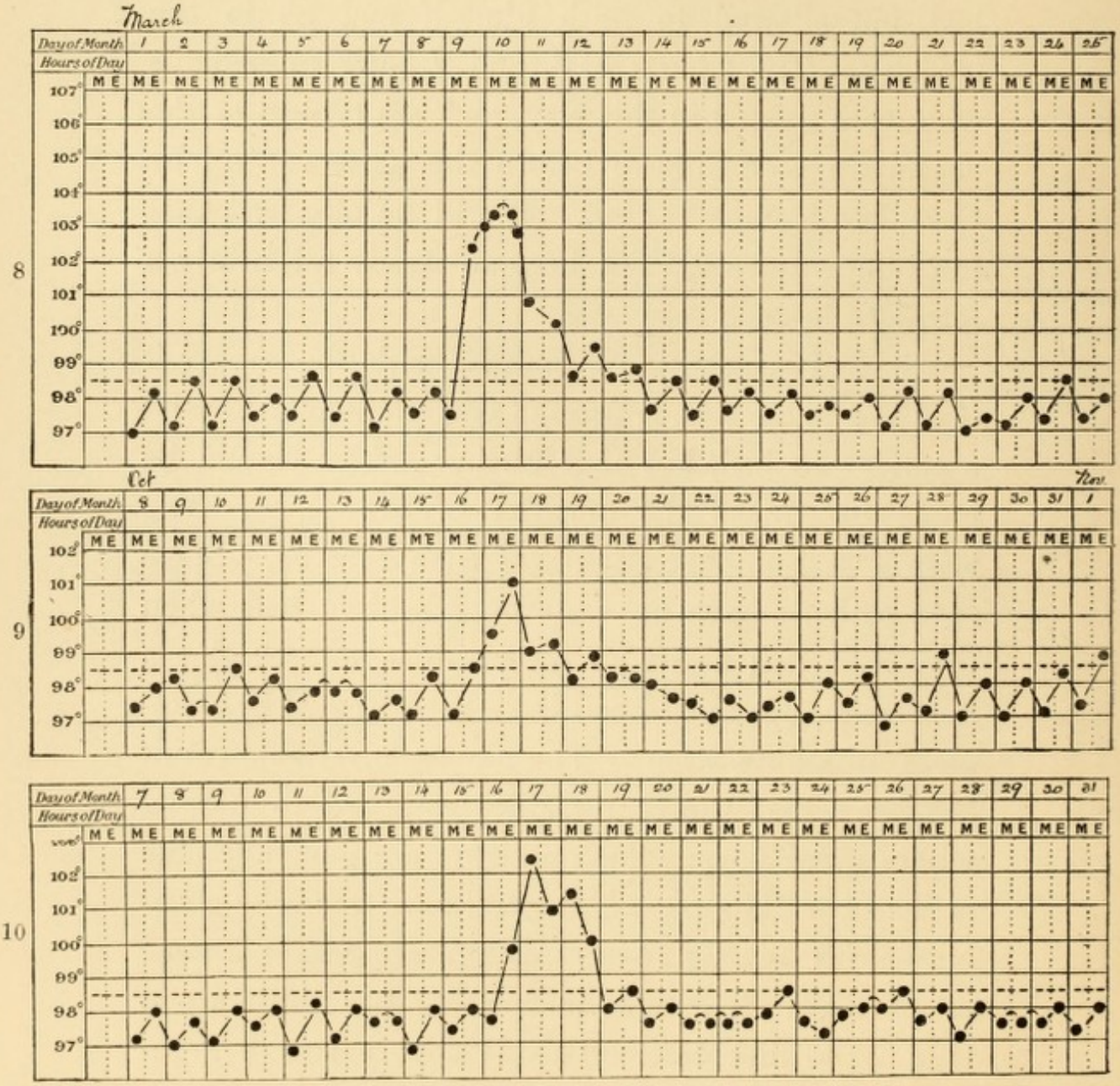


inoculation and a patient was worked to an extent which caused a rise of temperature to 99° F., plus a

headache and the other subjective symptoms associated with a severe auto-inoculation, he was sent to bed, but allowed to wash himself and go to the lavatory. The Charts 5, 6, and 7 refer to patients who were treated in this way, and are typical of the charts we used to have before the close control by Complete Immobilisation. It will be observed that the temperature did not become steady for nearly a fortnight in each case.

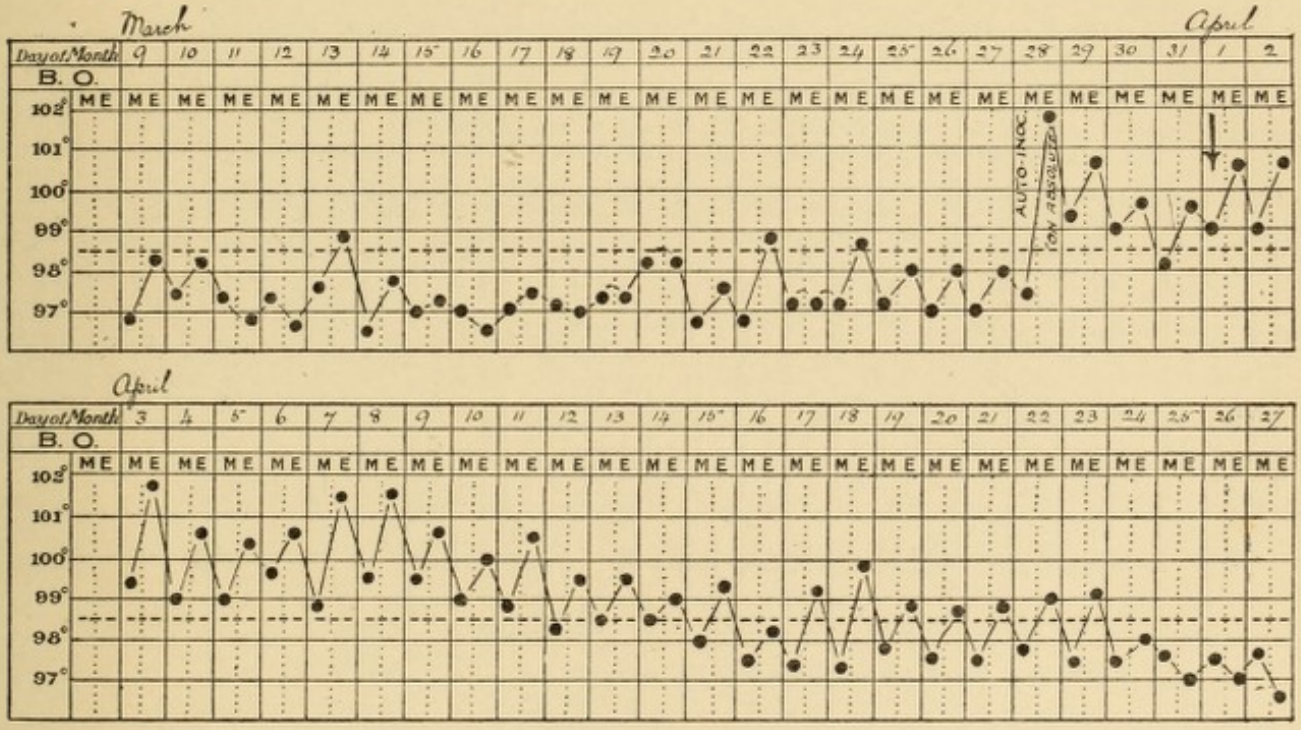
Since I became more familiar with the theory it occurred to me that it was not enough merely to send a patient to bed, but that further efforts should be made to control the motivity of the lungs. The system of immobilisation was then evolved. Since then patients have not only been sent to bed when they have had a rise of temperature (99° F. plus a headache), but in addition have been treated by Complete Immobilisation. The almost invariable result has been that the temperature returned to normal within a few days. Such patients are generally able *to return to the work which caused the excessive auto-inoculation and the rise of temperature within a week or ten days.* The auto-inoculation has made them immune to that dose. This is a very strong argu-

CHARTS 8, 9, 10.—Showing three patients on work which caused large auto-inoculations. They were placed on Complete Immobilisation and returned to work within ten days.



ment in favour of the theory. Many patients who have been through this process declare that they felt

CHART 11.—Showing a patient who received an excessive auto-inoculation and was placed on Complete Immobilisation. The temperature begins to fall until the day marked in the chart by an arrow, when the patient left his bed against orders and went to the lavatory. The Chart then reverts to the old type before the days of Complete Immobilisation.

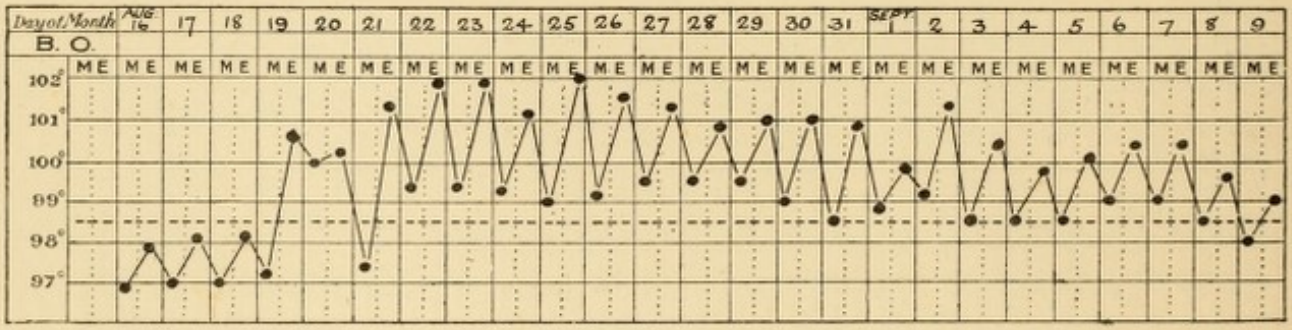


better after the rise than they did before; at all events, with the precautions indicated, they are never any the worse. On the contrary, some patients actually date the beginning of their recovery from the day of their feverish attack.

The Charts 8, 9, and 10 trace the history of patients for whom immobilisation has been prescribed, the temperature in each case becoming normal within four days. These temperatures conform to the usual type after a rather severe auto-inoculation.

Chart 11 illustrates the case of a patient who was on Complete Immobilisation, his fever declining,

CHART 12.—This is the chart of a patient who would not lie still in bed. It should be compared with the charts of other patients who faithfully observed the principles of Complete Immobilisation.

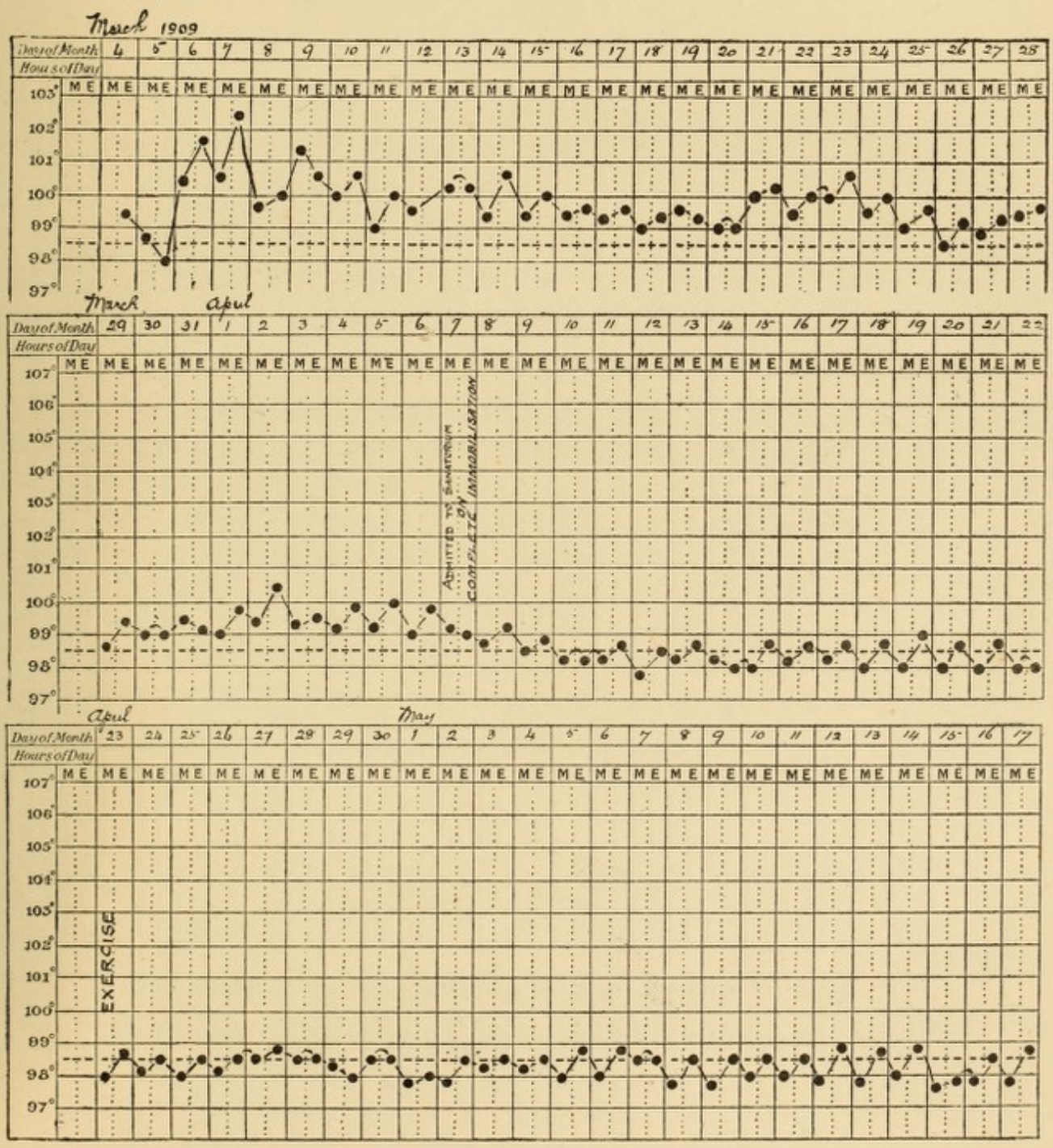


when, against orders, he rose from bed and went to the lavatory; it will be observed that his chart reverts to the old type.

Chart 12 is a warning to restless patients who do not, or will not, appreciate the subtle distinction between "rest" and "immobilisation."

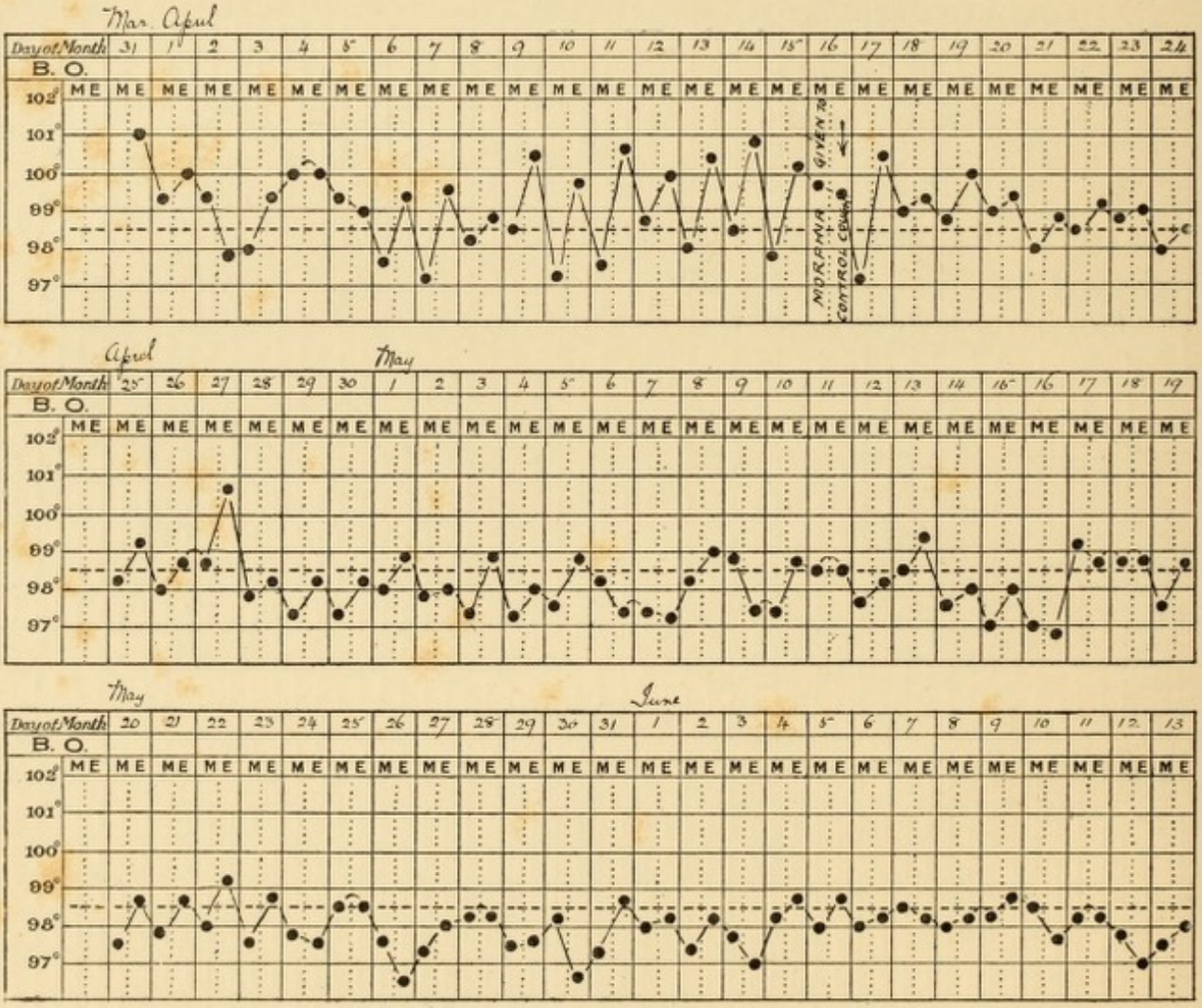
Chart 13 tells the story of a man who was treated in the fresh air at home and kept at rest in bed, but not on the lines of Complete Immobilisation. This

CHART 13.—Showing the effect of Complete Immobilisation on the temperature of a patient who had been treated before admission to the Sanatorium by the so-called "open-air" method.



temperature, it will be seen, remained much the same.

CHART 14.—Showing a patient on Complete Immobilisation under the influence of an irritable cough. The temperature does not settle down until the cough is controlled by morphia.



He was admitted to the sanatorium and placed on Complete Immobilisation, with the result that in two

days his temperature was normal. He rapidly regained his appetite—having had no relish for his food—a fact altogether due to excess of bacterial products in his blood; his constant cough and sputum, due to the same cause, at once decreased, and within a week he was a different man.

Chart 14 illustrates the history of a patient on Complete Immobilisation, with no beneficial effect on the fever until the day which is marked in the chart with an arrow. The explanation is simple: the patient had an irritable cough, which had little to do with the bringing up of sputum. On controlling the cough by administering morphia the fever rapidly disappeared and the temperature decreased. The morphia linctus was replaced by a simple linctus within ten days. It is obviously useless to insist upon Complete Immobilisation without attempting to control the cough, because the patient who coughs violently and shakes the whole bed is, as regards foot-pounds of work, taking vigorous exercise.

The significance of these charts lies in the overwhelming evidence they afford of the value and importance of Complete Immobilisation.

A comparison of 5, 6, and 7 with 8, 9, and 10

sufficiently indicates the measure of difference between what is vaguely known as "rest," and the method which I call "absolute."

Chart 13 illustrates in itself the lesson taught by this comparison. The remaining charts all point the same moral, which is simply this, that if we wish to benefit the patient with fever in pulmonary tuberculosis we must keep this question foremost in our minds, viz. "How can this excessive toxæmia be prevented?" Fresh air alone will not do it, and is not therefore the one and only treatment for tuberculosis, as it is generally supposed to be.

With the exception of Chart 11—that of the patient who rose from bed against orders—and Chart 12, which are the only examples of their kind, the charts given in this and other chapters are not by any means unique. The points they illustrate could be proved over and over again by similar charts, which need not be specially selected for the purpose. That there are exceptions is only natural, but the great majority of patients will be found to conform to one or another of the rules exemplified. I have, therefore, no hesitation in attaching to these charts the importance which I do.

CHAPTER IV.

THE INDUCEMENT OF AUTO-INOCULATIONS BY MEANS OF GRADUATED LABOUR.

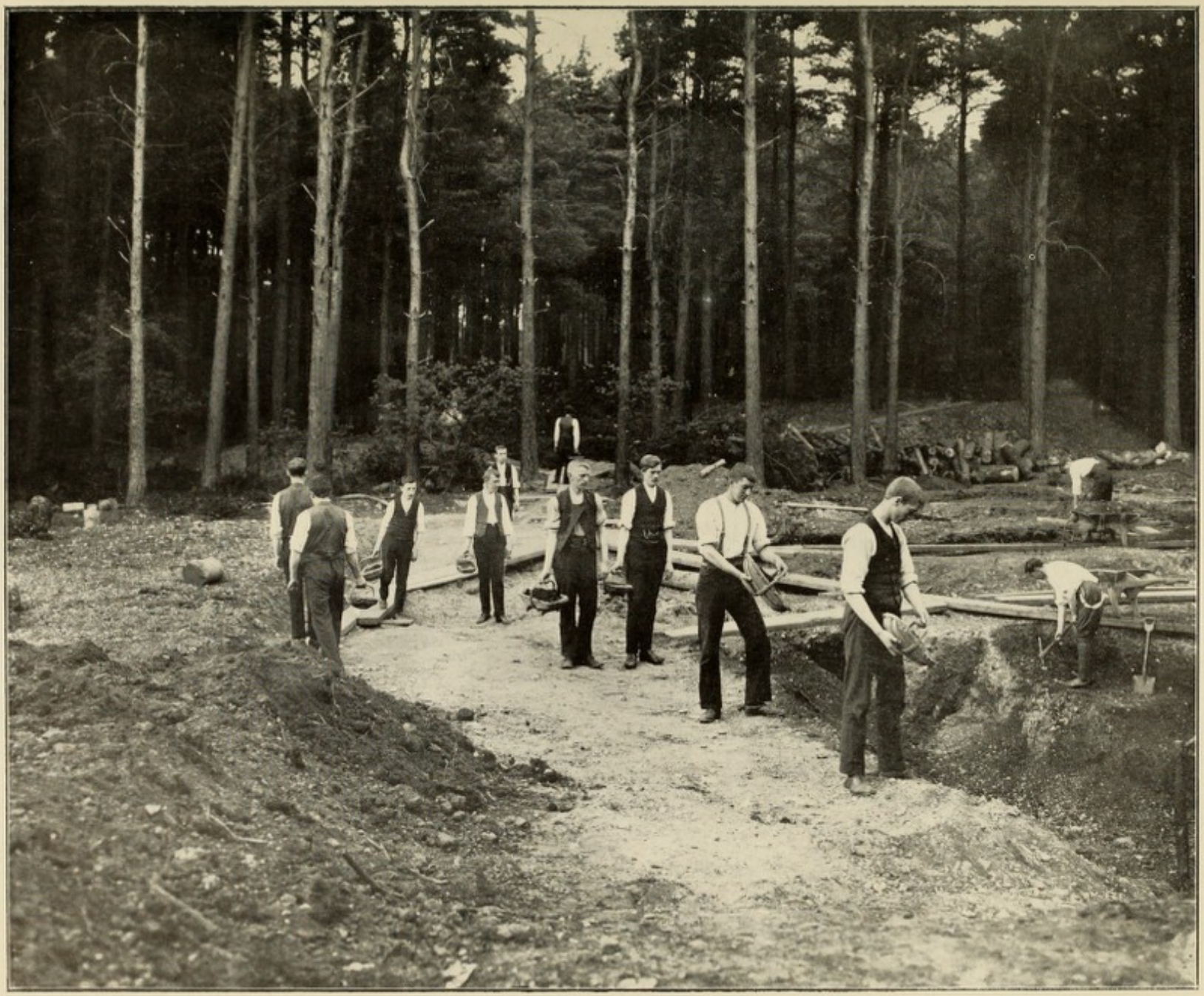
When the excessive uncontrolled auto-inoculations have been mastered by the methods already described, the next step is to raise the patient's resisting power by stirring up his bacterial products and driving larger and increasing doses into his blood until he is enabled to take severe and prolonged exercise without risk of suffering from fever or constitutional disturbance. In other words, his specific resistance must be raised by gradually training his protective substances to deal with each fresh dose of bacterial products, and his general resisting power must be strengthened by habituating his muscles to any strain they may have to bear. The objects in view are to induce auto-inoculation by increasing the motivity of the lungs, and to

restore the patient's physical capacity. These ends must be accomplished by systematised labour.

The system in vogue at the sanatorium includes six grades of labour, with a preliminary period of treatment by means of walking exercise, which varies in time and extent according to the necessities of each patient. Walking exercise is first prescribed for all patients, a distinction being made between those who have been in bed with fever and those who have not. The former start by walking half a mile a day, the remainder of the day being spent in resting. It should be noted that the time spent in resting is equal in importance to the time spent in walking, and unless it is faithfully observed as a period of enforced inactivity no accurate adjustment of the dose of bacterial products is possible. This treatment is continued for a week, and if at the end of that time the patient's temperature shows no marked deviation,* he is feeling well, and has shown no signs of constitutional symptoms, the half mile is increased to a mile a day for the following week. The conditions still being satisfactory, it is increased to two miles a day for a further week, and that again to

* See explanation in chapter on "Guides to Control," p. 70.

Walking.



Grades 1 and 2.—Small and Large Baskets.

four. Patients on the four-mile grade and over, including those on any of the labour grades, have also to sweep and clean their wards, make their beds, clean their windows, polish brass work, and perform similar "chores." The final walking grade is six miles. Granted favourable conditions, patients pass through these grades automatically; should the conditions be unsatisfactory, adequate adjustments and changes must be made. The patient on any particular grade who does not feel fit, who has a slight headache and an increase of sputum, these signs being accompanied by a marked deviation of temperature, must either be rested if the symptoms are severe enough, in the manner already described, or kept on that grade until all constitutional symptoms disappear and the sputum returns to normal quantity. Patients who have not been in bed with fever must be judged on their merits. Whether they should be started on one, two, four, or six miles a day depends entirely on their capacity, which can be ascertained by finding out what they have been doing up to the time of entering the sanatorium. If a patient has been engaged in manual labour immediately before his admission, it is obvi-

ously unnecessary to start him on the half-mile grade, granted, of course, that his constitutional symptoms are satisfactory. As a general rule, if a patient is able to be up and about all day, and is in fair physical condition with not more than an ounce of sputum, he is started either on the two- or four-mile grade.

I wish here to repeat what I have already stated in my introduction, namely, that the significance of physical signs has been widely misinterpreted. If a patient has very few or no physical signs, with tubercle bacilli in his sputum, if he is obviously ill and suffering from the effects of the disease, even though he has no fever, it is certain that the protective substances of his blood are not in fighting trim. Such a patient requires most careful watching. On the other hand, if a patient has what are termed "advanced" signs, with three or four lobes involved, nevertheless, if his physique is good and he has been working within a short time of his admission to the sanatorium, the inference is that his protective mechanism is in good order. Despite the condition of his lungs, this patient can be started without fear on the four- or six-mile grade. The question may very naturally be

asked why patients on the earlier walking grades should be kept for so long a period as a week in any particular class. The reason is that the aim in view is twofold—not only the inducement of auto-inoculations, but the restoration of physical capacity. One day on half a mile might be sufficient to cause the necessary auto-inoculation, but is not sufficient to habituate the patient's muscles to this amount of exercise, so that he could endure an increase without undue fatigue. Experience has proved that on these earlier grades about one week is necessary to satisfy the physical requirements of the patient. The period fixed is not arbitrary, and though it may be excessive in some cases, the margin of error is at any rate a margin of safety. Patients who have completed the six-mile walking grade pass into the first grade of labour. This consists in carrying small baskets containing various materials a distance of about fifty yards; the distance is not fixed, but varies according to the work which it is desired to accomplish. The weight carried is about 10 lb., and the distance travelled in one day, to and fro, approximates to seven miles. The basket grade is a very important one, as it provides work which is at the same time

definite and moderate, restoring the patient's physical capacity and testing his power of resistance to bacterial products. I would here remark that if in the early stage of treatment I am in any doubt as to the degree of a patient's susceptibility to inoculations, he is kept on basket work and not allowed to undertake any of the light work which corresponds to the basket grade. The reason for this precaution is that the basket work is clearly defined within fixed limits and cannot be exceeded at the patient's will, whereas weeding, potting, and similar work allow a certain margin for the personal factor, and afford greater opportunities of excess to a patient who for any reason is over-industrious or over-keen. If patients pass this grade successfully, that is, without constitutional symptoms, they are advanced to the second grade at the end of the week. This necessitates the carrying of a large basket containing about 18 lb. weight of material. Visitors often express the opinion that patients on the basket grades must find them very monotonous. This is not the case. If the work had no motive or purpose apart from its curative function boredom and depression would inevitably follow. For this reason

Grade 3.—Cutting Grass Edges, Etc.

Grade 4.—Digging with Small Forks and Mowing with 12-Inch Mower.

patients are always given useful work to do in order that their interest may not flag, and that they may enjoy the satisfaction of seeing the results of their labour. At the end of the day's work five "small" and five "large basket" men will have moved a heap of about 5 tons, and at the end of a five and a half day week about 27½ tons. This is a visible and tangible result, and when it comes to be compared with the work of one navvy these ten men have done half a full man's work.

Originally the third grade resembled the second, the number of pounds carried being increased to twenty-four. For various reasons it has now practically dropped out, and there has been substituted for it equivalent work, such as sweeping paths, chopping fire-wood, painting with a large paint-brush, cutting grass edges, hoeing, etc.—in short, what is generally termed light work about a house or garden. With a few exceptions patients remain on this grade also for about a week. The next grade, No. 4, is characterised by the use of a small shovel. Patients on this grade can dig 2 tons of earth a day, and raise it 7 ft. into a cart; as they increase in strength they often lift twice that amount. Mowing grass, with three men to a

16 in. mower, is equivalent labour. In Grade 5 the small shovel is replaced by a large one, and heavy navvy work of every kind is undertaken. Patients on this grade can lift about 6 tons a day a distance of 7 ft., or mix 10 tons of concrete in the same time. Three weeks from their discharge patients are promoted to Grade 6, and spend five hours a day at the hardest navvy work, in addition to the one hour's indoor work, which is incumbent on all patients in the labour grades. These definite statements are made to give an idea of the "foot-pounds" of work performed. Those patients who go through the grades successfully are put to work at their trades, if they have a trade, before their discharge, so that the muscles used in their particular work may become accustomed to it before they leave the sanatorium.

There is one aspect of the graduated labour system that is deserving of special mention. Everyone knows the demoralising effect produced upon the sick by long periods of mental and physical inactivity. It is one of the most difficult problems that confront our hospitals and sanatoriums. When bodily strength is lowered by sickness, and mental vigour is weakened by disuse, listlessness, ennui and morbid depression

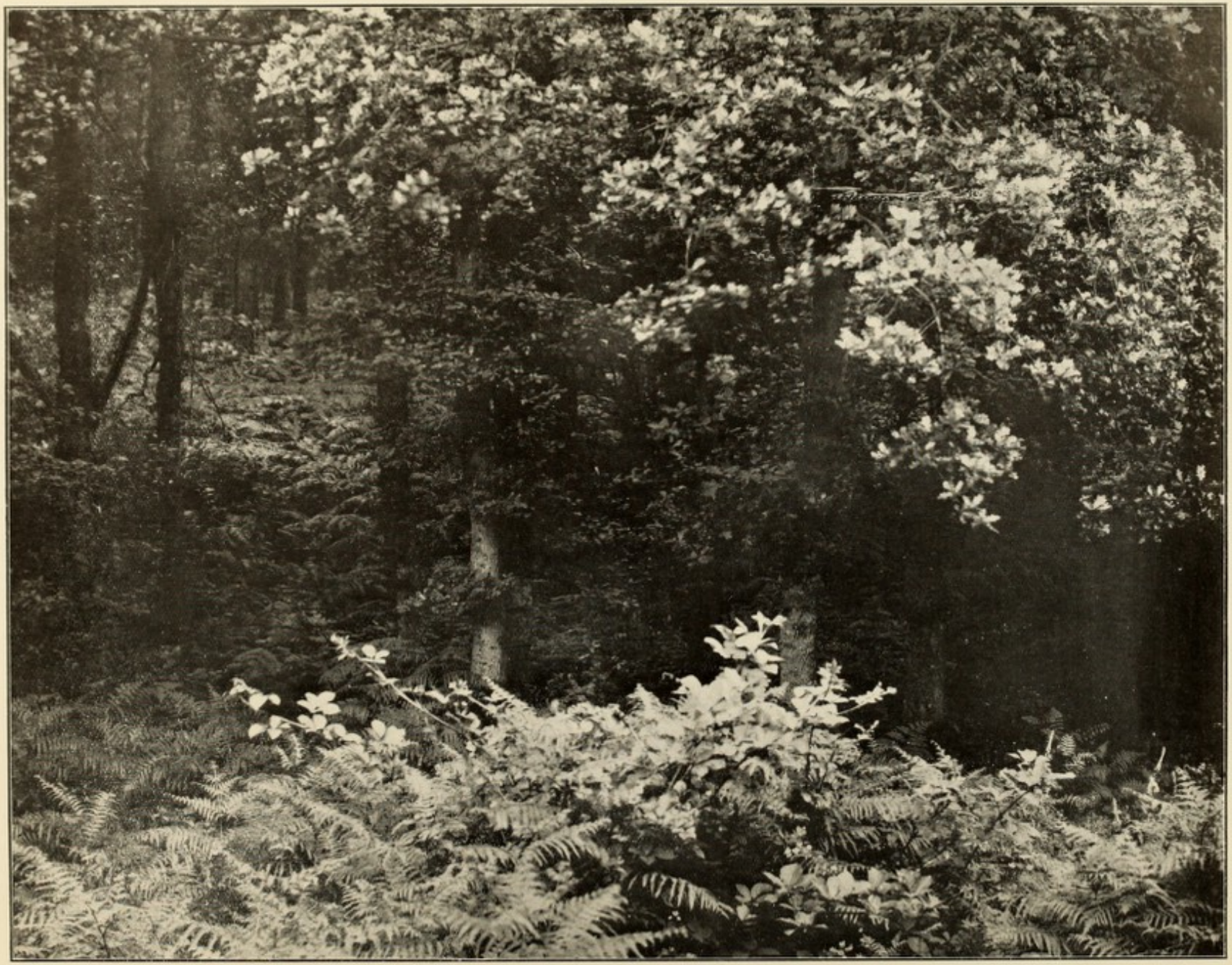
GRADE 5.—TRENCHING.

Women on Grades 4 and 5.

act and react upon each other in endless vicious circles. In this connection graduated labour has a moral value which it is difficult to over-estimate. Many patients when they first start work are remarkable for their sullen and apathetic attitude; as soon as the bacterial products become influenced and their physical condition improves all trace of gloom and depression vanishes and they become transformed into cheerful and lively individuals. Outdoor work is of course an admirable antidote to physical and mental disorders; it is a healthy occupation from every point of view; it hardens the body, and diverts the mind. But the value of graduated labour to the consumptive is much more than this. When it is remembered that the average patient going through the treatment spends a week on each grade of walking, a week on the first three labour grades, a fortnight on Grade 4, three weeks on Grade 5 and three weeks on Grade 6, it might well be supposed that the process is monotonous and dull. This is the reverse of the truth. To the patient who wishes to regain his health and return home, the grades are definite steps in his recovery which he is slowly but surely mounting. As the days pass he observes the diminution in his

expectoration, becomes conscious of increased physical fitness, and realises without medical prompting that he is making steady progress. Even if he receives a large dose of bacterial products and is sent to bed, he knows he will start again on the step where he left off, and not at the bottom of the ladder. There can be no monotony to the patient, who is aware that each fresh grade he reaches marks a higher level of improvement, and sees around him in his fellow patients practical object lessons in the successful results of the treatment.

The accompanying table explains in full detail the conditions that characterise each grade. It is of vital importance to keep a constant watch upon patients when they are at work. This is particularly necessary if they are working in gangs, since one man may be physically unfit to keep pace with his fellows, and overwork or excessive auto-inoculation will result. The grades of work for women are similar to those of men, but the various implements used are of a smaller size; these patients are not allowed to work so hard as the men, and consequently do not accomplish as much in the same time. They keep in order their own part of the grounds, cultivate a small kitchen



Land before it was Cleared of Trees by the Patients.

Excavating for Reservoir.

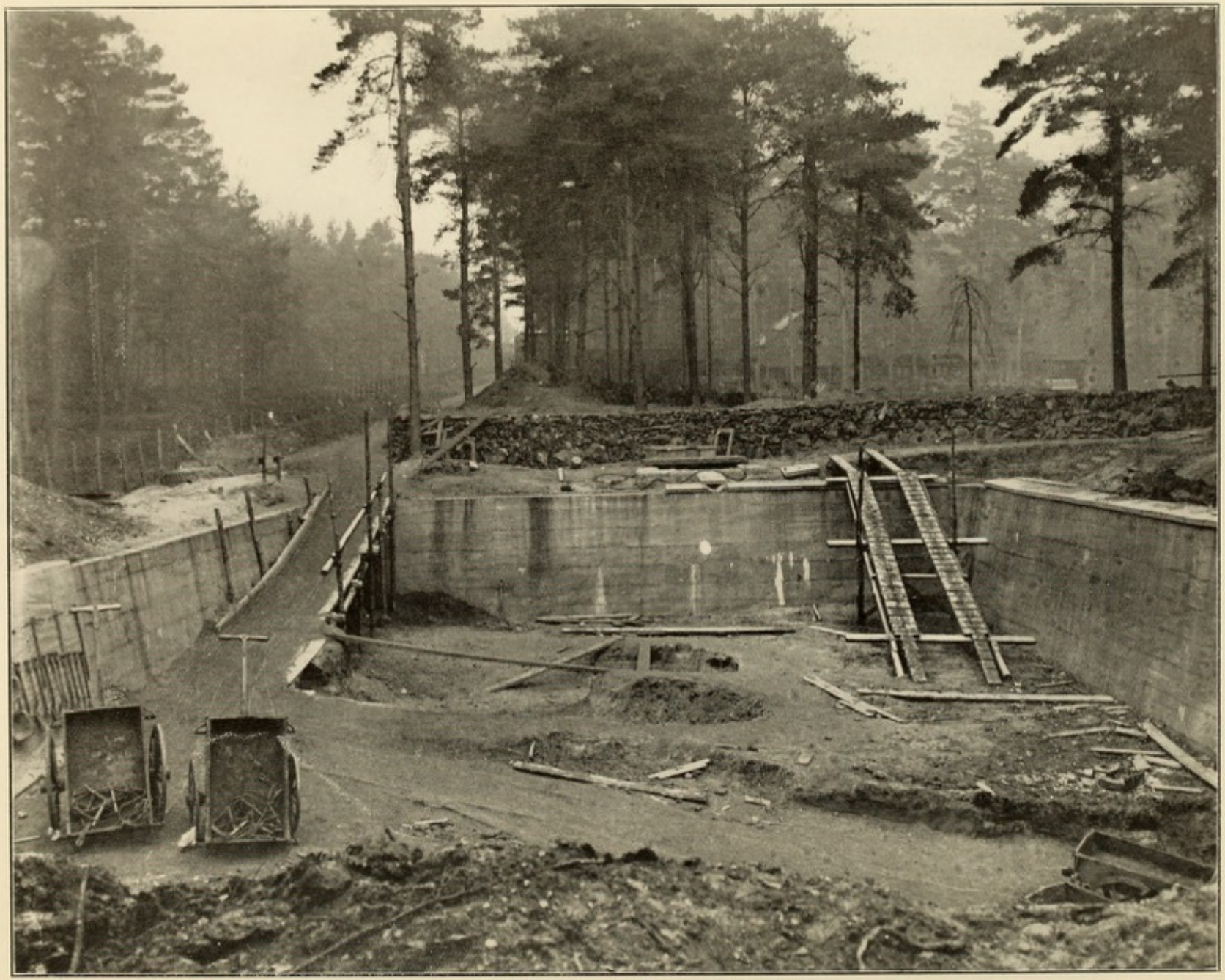
garden, and in addition look after the poultry. The final stage for women is the same as for men, namely, digging gravel in a pit. It is often said that this is unnecessarily hard work for women, but it may be noted that in practice women are found to be quite capable of doing it without injury, whilst in theory it is certainly necessary that they should do it, since its *raison d'être* is primarily the inducement of auto-inoculations.

In concluding this brief summary of the system I cannot lay too much stress on the fact that success in this, as in all other systems of the kind, must depend not merely on careful grading of labour, but on the intelligent application of grades to individuals. In a field where exceptions are so numerous it is dangerous to put blind faith in general rules; the latter are valuable only when they are considered in the light of each special case, and it is not possible to embody in a formula any method of treatment that will universally hold good. A system of graded labour is a necessary framework and a valuable basis for action, but it should be remembered that here, as elsewhere, the golden rule is that there is no golden rule, and that whilst patients may conform to type, they are none the less, each one of them, exceptions.

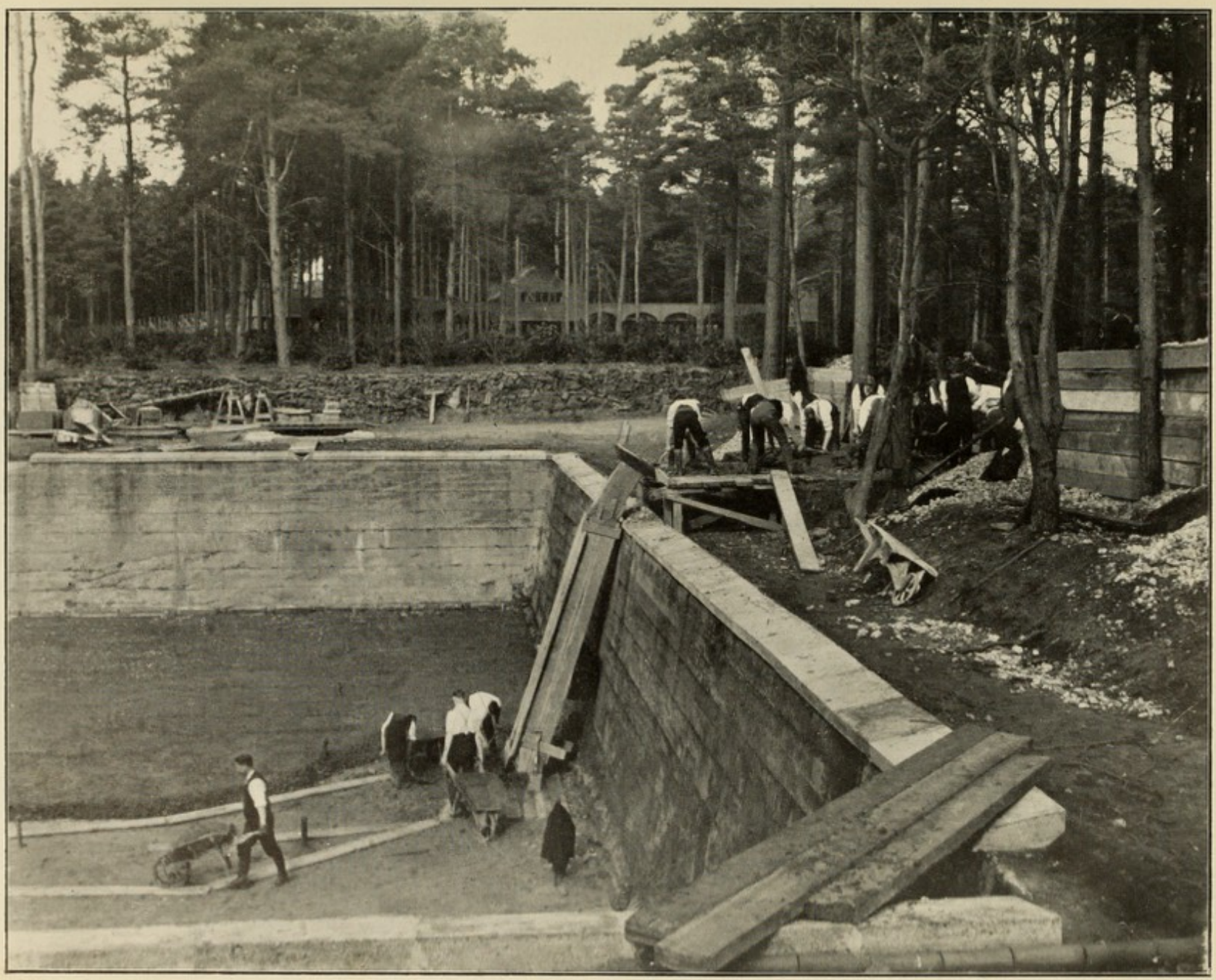
Table I.—Men's Work.

Course of treatment.	Period.	Work performed.
Walking	One to Four Weeks. Resting when not walking	Beginning at half a mile per day = 1 "round."* Rising to 1, 2, 4 and 6 miles per day, equal to 2, 4, 8 and 12 "rounds" per day. Half the number of "rounds" to be completed in the morning and the other half in the afternoon.
Graduated Labour: Grade 1	One Week. 9.55 a.m. to 11.50 a.m.; 2.30 p.m. to 4.50 p.m.; rest 12–12.45 p.m.	Small Baskets.—A weight of about 10 lb. is carried a distance of about 50 yds.; total weight carried, about 8½ cwt.; distance travelled to and fro, about 7 miles. *Equivalent work:* Light weeding, potting, pricking out seedlings, picking off dead flowers, watering plants (using 1-gallon can), etc., painting with "sash tool."
Grade 2	One Week. Times same as above	Large Baskets.—A weight of about 18 lb. is carried a distance of about 50 yds.; total weight carried, about 15 cwt.; distance travelled to and fro, about 7 miles. *Equivalent work:* Weeding with hand fork, planting out in open ground, cutting vegetables, watering plants with two 1-gallon cans, or one 2-gallon can, etc.
Grade 3	One Week. Times same as above	Sweeping paths and grass, cutting grass edges, chopping firewood, hoeing, painting with large brush, cleaning windows, etc.
Grade 4	Two Weeks. Times same as above	Using a small shovel or digging with a small fork. Five men can pull hand-cart containing soil or stones. Mowing grass, 3 men to 16-in. mower. Two tons of earth can be raised 7 feet in this grade. Three men to a roller weighing 4¾ cwt. Using mortice chisel and tenon saw, etc.
Grade 5	Three Weeks. Times same as above	Using large shovel and pick: digging with large fork. Pulling down trees and trenching ground 3 feet deep, hauling stones, etc., in cart, using wheelbarrow, doing general heavy navvy work. Six tons of earth can be raised 7 feet, or 10 tons of concrete mixed. Sawing. Planing.
Grade 6	Three Weeks. 10 a.m. to 12.45 p.m.; 2.30 p.m. to 4.50 p.m. "Off Rest."	Work similar to Grade 5, except that rest from 12–12.45 is omitted.

* In the temperature charts the word "rounds" refers to the distance travelled both morning and afternoon, *i.e.* 1 "round" = 1 mile, 2 "rounds" = 2 miles, etc.



Excavation Completed. About 5000 Tons of Earth were Excavated and Removed a Distance of 300 Yards by Patients.



Mixing and Laying Concrete. The Patients Mixed and Wheeled into Position 996 Tons of Concrete.

Table II.—Women.

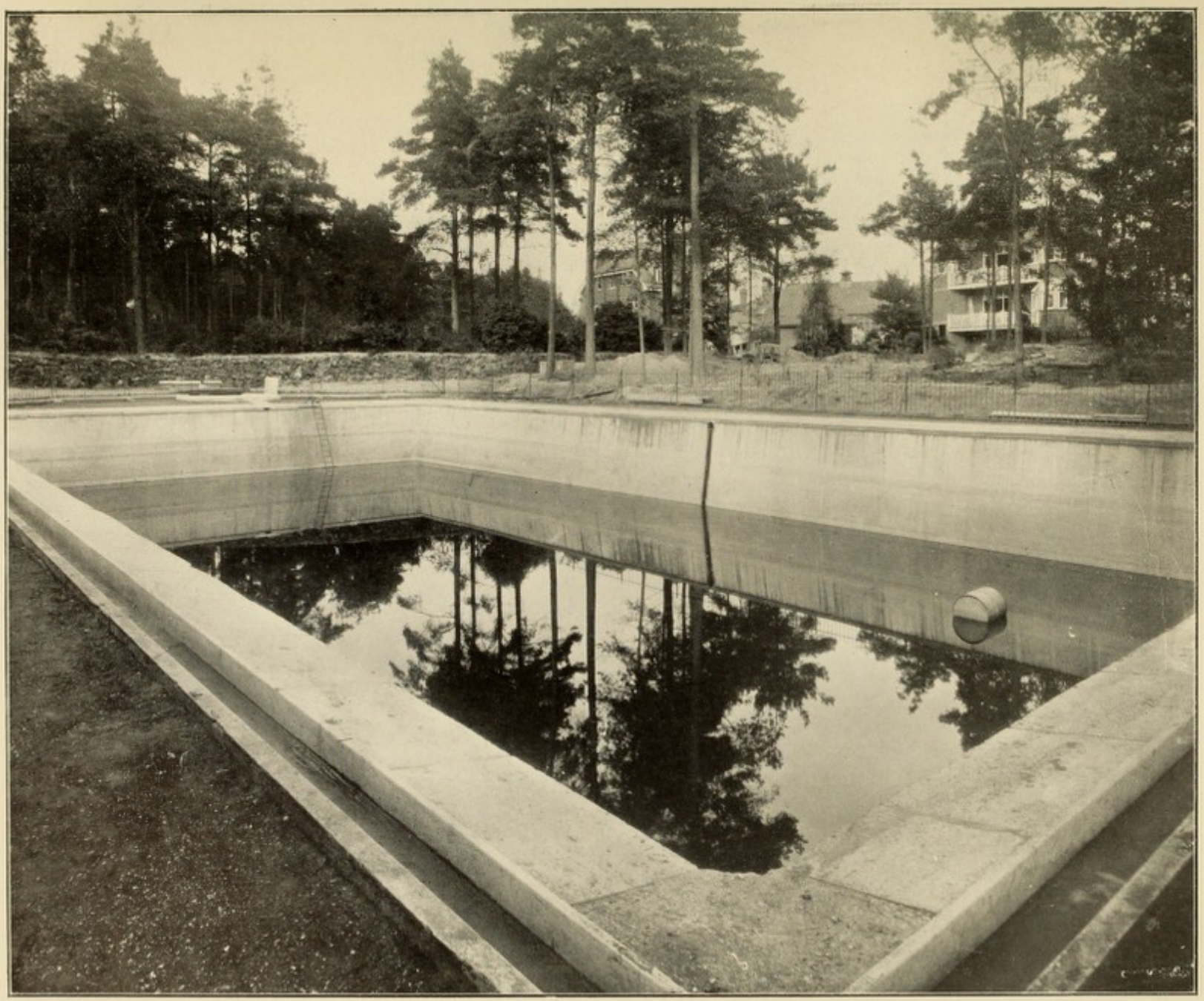
Course of treatment.	Period.	Work performed.
Walking	One to Four Weeks. Rest 12–12.45, with extra rest if necessary	Beginning at half a mile per day = 1 "round." Rising to 1, 2, 4 and 6 miles per day, equal to 2, 4, 8, and 12 "rounds" per day. Half the number of "rounds" to be completed in the morning and the other half in the afternoon.
Graduated Labour: Grade 1	One Week. 9.55 a.m. to 11.50 a.m.; 2.30 p.m. to 4.50 p.m.; rest 12–12.45	Small Baskets.—A weight of 8 lb. is carried a distance of about 50 yds.; total weight carried, about 7 cwt.; distance travelled to and fro, about 5 miles. *Equivalent work:* Preparing vegetables, light table work, watering, weeding, cleaning feeding-troughs for chickens, putting bracken in nests and setting same.
Grade 2	One Week. Times same as above	Large Baskets.—A weight of 15 lb. is carried a distance of about 50 yds.; total weight carried, about 14 cwt.; distance travelled to and fro, 5 miles. *Equivalent work:* In garden similar to that given for men; chopping suet; filling water dishes for chickens, also hoppers for grit and oyster shell.
Grade 3	One Week. Times same as above	Sweeping paths and light gardening. Scrubbing hen nests. Cleaning out small chicken-houses every morning.
Grade 4	Two Weeks. Times same as above	Digging with small fork, turning over soil. Whitewashing large chicken houses; changing mould and gravel as necessary. Preparing food for chickens, but not mincing it.
Grade 5	Three Weeks. Times same as above	Scrubbing. Trenching ground, using 3-lb. pick and small shovel; sifting sand. Mincing food and cutting bones for chickens.
Grade 6	Three Weeks. 10 a.m. to 12.45 p.m.; 2.30 p.m. to 4.50 p.m. "Off Rest."	Work similar to Grade 5, except that rest from 12–12.45 is omitted.

CHAPTER V.

GUIDES TO CONTROL.

It will be gathered from my remarks upon the use of the stethoscope (Introduction, p. 9), that it is impossible to give a prognosis from a consideration of the results obtained by a physical examination of the chest alone. Turban's classification is based upon physical signs, the extent of disease in the lobes involved, and the presence or absence of cavitation.

I have shown elsewhere that a patient whose signs would place him in Stage III of Turban's classification often does exceedingly well under my system of treatment. The presence of cavities, although denoting the past or present existence of extensive disease, also shows that the powers of resistance, either constitutional or acquired, are considerable. We must therefore endeavour to clear our minds altogether of the error of attempting to



Reservoir Completed. It has a Capacity of 500,000 Gallons. The Water is kept for Use in the Baths and as a Storage in Case of Fire.

classify patients according to the old methods in general use, and adopt the principles of auto-inoculation as our guide. The advantage of this will be readily acknowledged when it is pointed out that, until some definite information is obtained about a patient from an inspection of his temperature chart, read in connection with his ability or non-ability to move about, no classification is possible.

In the hope that it may be of some assistance to those who are called upon to deal with cases of pulmonary tuberculosis by routine treatment, I propose to outline the various headings under which patients naturally fall. Our first class will consist of two divisions, viz. :

Class 1.—(A) Those patients who are constantly inoculating themselves—even after being placed on Complete Immobilisation—during a period of weeks or months.

(B) Those patients who quickly recover from the effects of the bacterial products, the powers of resistance being restored by means of Complete Immobilisation.

Class 2.—Those patients who are well enough to be out of bed, but who are unable to take walking

exercise without producing an auto-inoculation as shown by a rise in temperature to 99° F. or over, accompanied by constitutional symptoms.

Class 3.—Those patients who are able to go through the grades of work, and whose charts show by the deviation in the temperature between normal limits that although auto-inoculations are being produced, they are under control.

Class 4.—Those patients who go through all the grades, but have occasional auto-inoculations accompanied by fever and constitutional disturbances controllable by immobilisation.

Class 5.—Those patients in whom it is impossible to produce a definite auto-inoculation by means of the hardest work.

A careful consideration of the temperature charts given will show that a patient may be in Class 1 (B) for a few days and shortly afterwards may be in Class 3 or 4; there is therefore no hard and fast defining line between the different classes.

Many patients who have been discharged from this sanatorium by their physical signs alone would be placed in Stage 3 of Turban, with a consequently unfavourable prognosis. These same patients I

should place in Class 5, as from my personal experience I know that their powers of resistance are sufficient to enable them to perform the hardest work without producing an excessive auto-inoculation. This is proved by the fact that they have often returned to heavy manual labour, remained well, and have been able to support themselves and their families.

We may now proceed to consider the various means at our disposal for ascertaining to which of the above divisions the patients under our control belong.

1. *Temperature and Constitutional Symptoms.*

It would appear at first sight that a method which aims at curing patients by means of auto-inoculation must be doomed to failure owing to the inherent difficulty of accurately measuring the dose. In practice there is very little evidence to support this objection, since the increase in the amount of bacterial products discharged into the blood-fluids in consequence of an increase of labour is not very considerable, and the transference of a patient from one grade to another is seldom marked by the occurrence of fever. If, however, the increase causes a discharge

of bacterial products which the blood is powerless to resist, the outward manifestations of the overdose will be a rise of temperature to 99° F. or over, and constitutional symptoms. Treatment by Complete Immobilisation follows as already described; if the patient co-operates with the physician control of the dose is easily obtained, and the temperature generally falls to normal within one, two, or three days at most. As soon as the patient recovers he is tested in various ways; when the temperature has been normal for at least twenty-four hours he is allowed to wash himself; the temperature remaining normal for another twenty-four hours, he is allowed to go to the lavatory and be up for half an hour.

If the conditions continue to be satisfactory he is allowed to be up for half the next day, and all being well, for the whole of the day after. He is then put to walk six miles a day,* and if he accomplishes this successfully, showing that the balance between his bacterial products and protective substances has been restored, he goes back to the grade of work on which he

* This only applies to patients who have been on one of the grades of labour. If the rise of temperature occurred during the walking period the patient would be tested on half the distance which caused the constitutional symptoms.

suffered from the large dose of bacterial products, and he does not have any rise of temperature, since his blood is now capable of resisting any dose which that grade can excite. He has acquired immunity on that grade.

It must be noticed that a temperature of 99° F. alone has not the same significance as a temperature of 99° F. accompanied by headache, loss of appetite, and similar signs of over-intoxication. In patients with extensive signs of disease a temperature of 99° F. or over often occurs without any constitutional symptoms, and it will be found that these slight rises of temperature can often be ignored, simply being observed as a sign that auto-inoculation is taking place without being excessive. A temperature of 99·6° F. in women corresponds to a temperature of 99° F. in men, and women with tuberculosis frequently have a temperature of 99° F. without any ill-effects. I can give no explanation of this fact.

I may here mention that at the Brompton Sanatorium all temperatures are taken in the mouth. The method has been criticised on the usual grounds. My answer to that criticism is, that I have treated over eighteen hundred patients by using the oral

temperature, and that it has been found in every way a practical working method.

2. *Appetite.*

In the absence of more obvious symptoms valuable information can be obtained by watching the patient's appetite. Loss of appetite is an indication that more bacterial products are being discharged than can be conveniently dealt with by the patient. In such cases Complete Immobilisation is generally unnecessary ; if the patient is put to bed for a few days in order to give his protective substances time to recover their balance, he will rapidly recover and will be quite fit for work again.

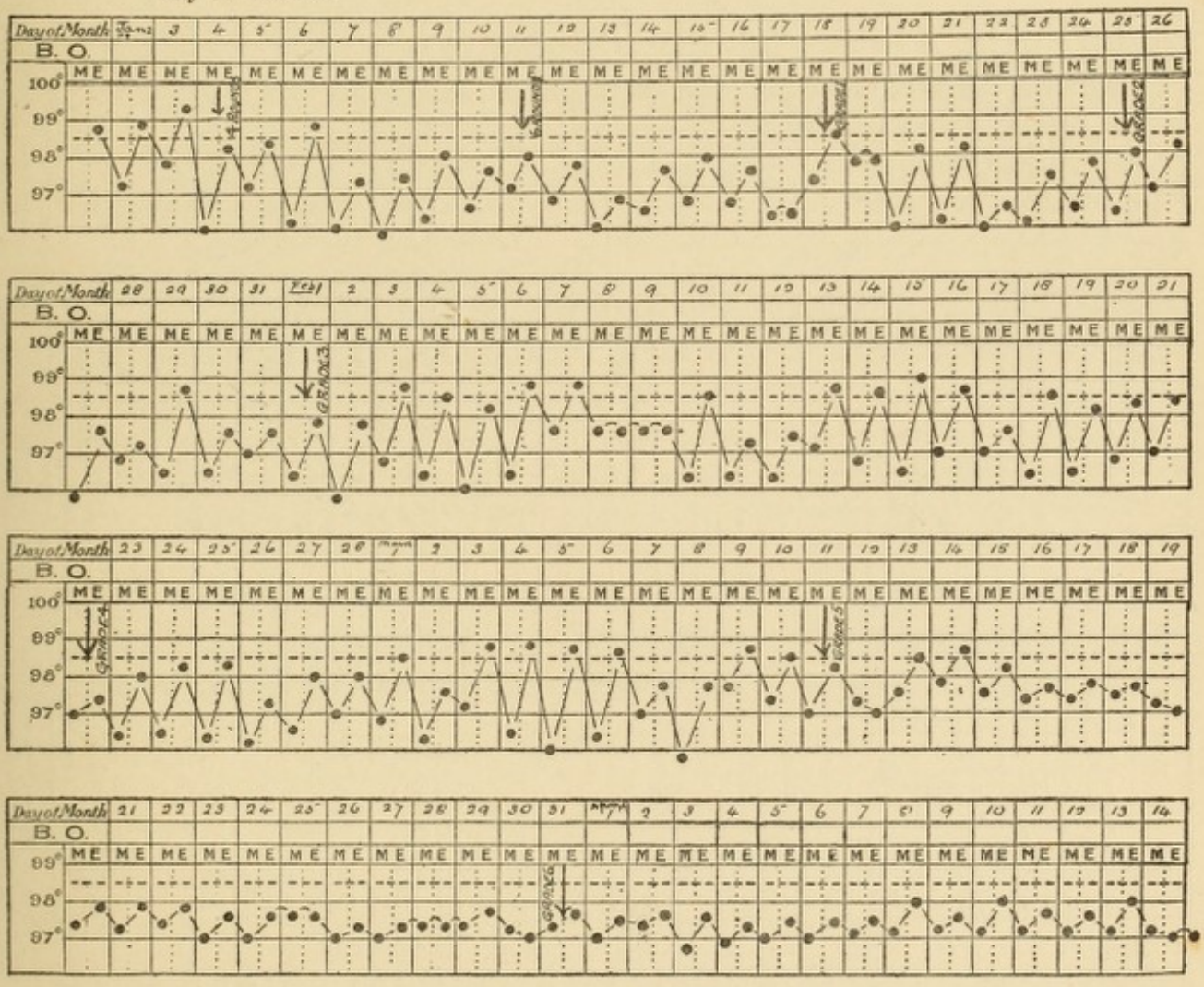
3. *The Temperature Chart.*

Whether or no a patient is having sufficient exercise can be ascertained by watching the temperature chart, even though it never rises above normal, and comparing this with an increase or decrease of sputum.

The charts of most patients who are not inoculating themselves show little deviation between the morning and evening temperatures ; when an auto-inoculation

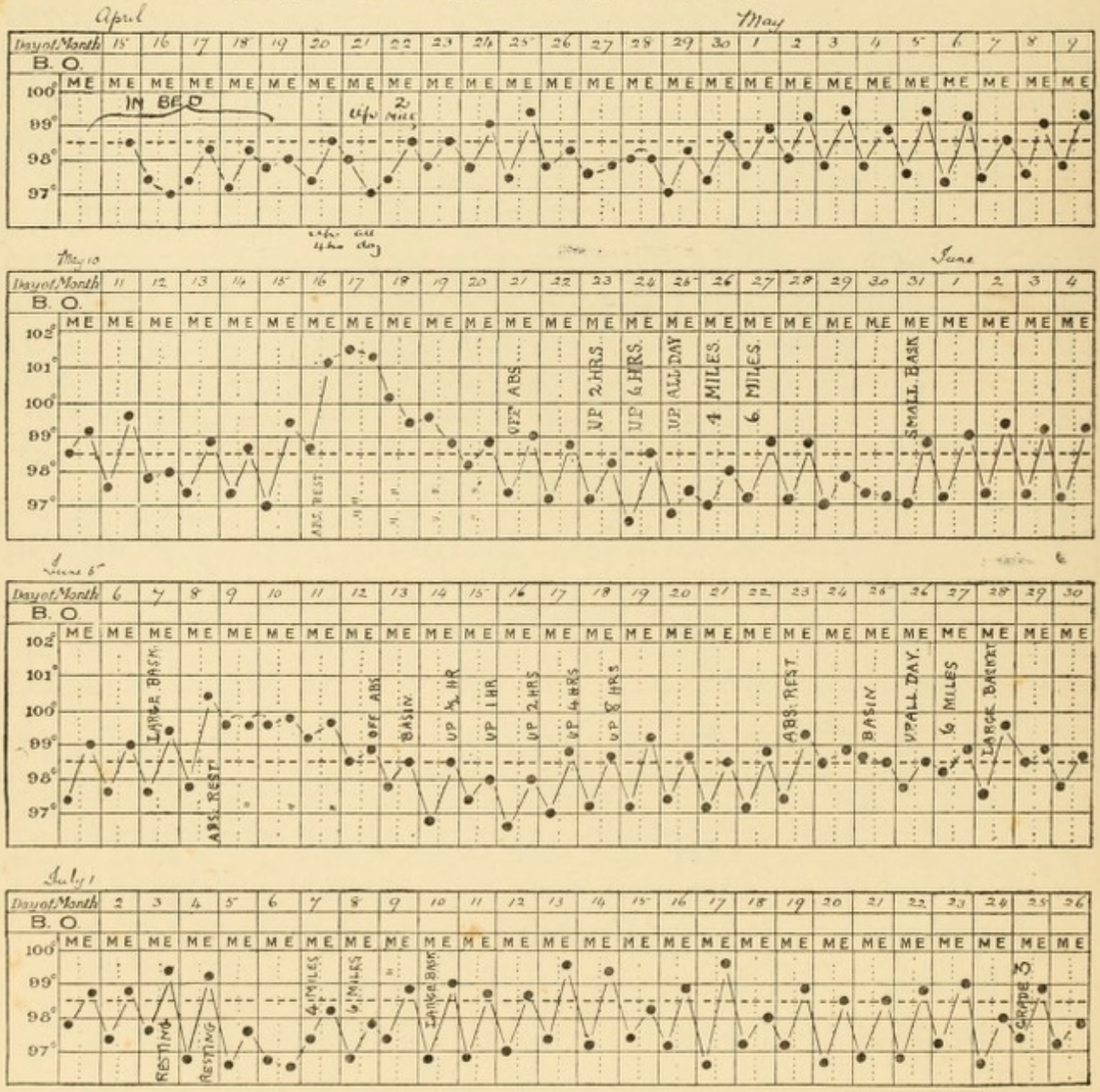
is in progress the common indication, though not a

CHART 15.—Showing deviations of the temperature throughout the grades, until finally the patient was able to do the hardest navvy work without any deviations.



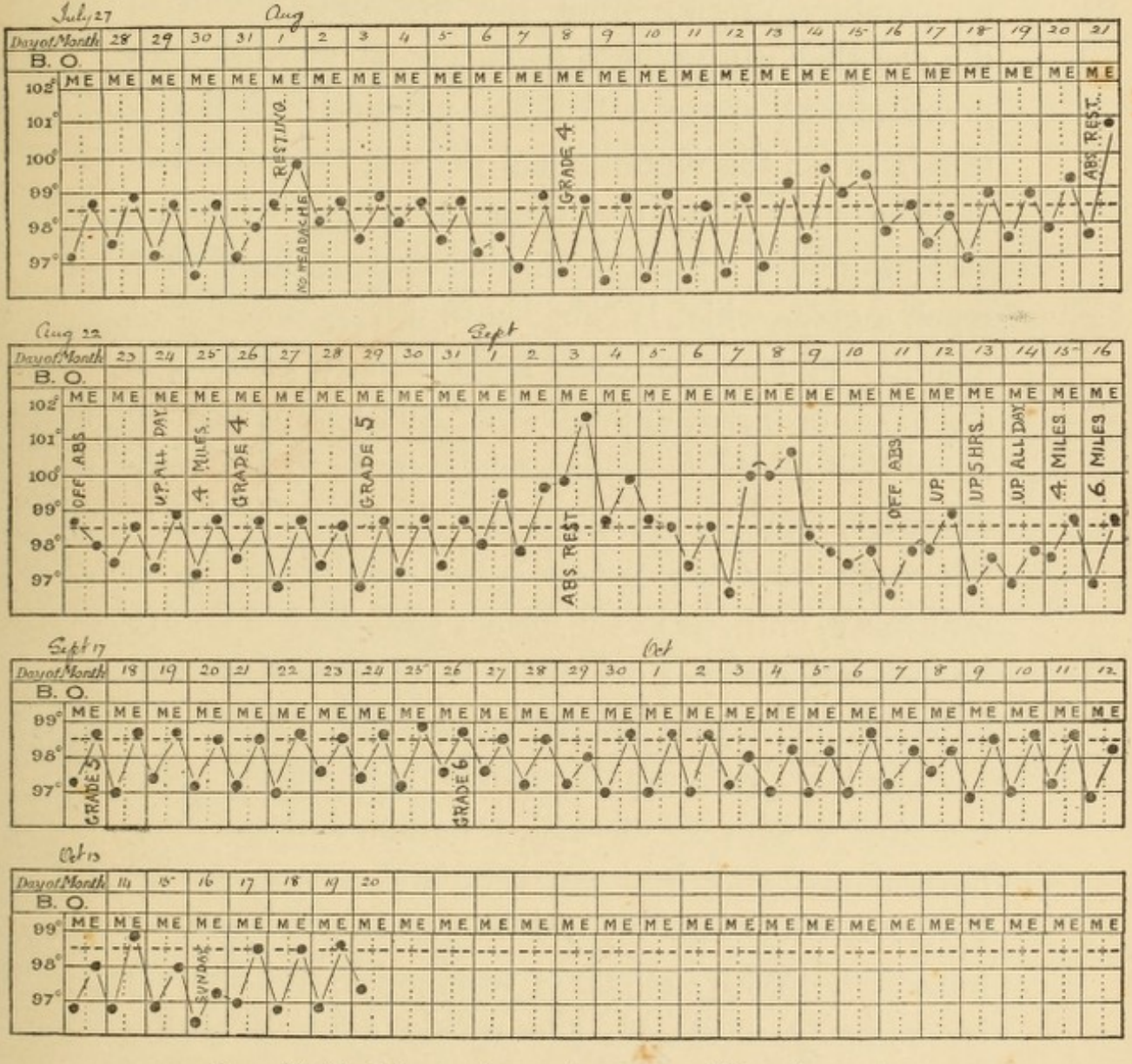
universal one, is a variation of two or three degrees between morning and evening temperatures. From the point of view of the temperature chart patients

CHART 16.—Showing a patient very susceptible to his bacterial products, large auto-inoculations occurring on almost every grade. The temperature was controlled by Complete Immobilisation until the patient was able to do five and a quarter hours hard navvy work a day for thirty-three days on end with a steady, even temperature. He started with about two ounces of sputum, which disappeared on Grade 4, returned on Grade 5, and disappeared again on the same grade. It finally reappeared and disappeared for good on Grade 6.



BASIN = Patient washes himself. ABS. REST = Immobilisation.
OFF. ABS. = Patient allowed to move about at will in bed.

CHART 16—*continued.*



may be divided into four classes. The first class are those who begin to inoculate themselves from the

start and have a moderate amount of sputum, the temperature varying from the first onset, until in the end they can perform five hours navvy work with practically no expectoration and practically no deviation between the morning and evening temperatures.

The next class are those who pass through various grades without auto-inoculations, until they reach a grade which is effectual in driving a sufficient quantity of blood to their lungs, and so exciting a discharge of bacterial products. And here it may be noted that the temperature, which formerly had little deviation, now shows a marked deviation, whilst at the same time the patient's sputum begins to be influenced, until, as in the former case, he can do five hours hard navvy work with no deviation of temperature, and rapidly decreasing sputum.

The third class are those patients who go through the grades with no marked deviation, and suddenly have marked constitutional disturbances accompanied by fever, 100°–102° F., which is controlled by immobilisation. With the rise of temperature the sputum is markedly increased, and within a week of the auto-inoculation the sputum markedly decreases and the temperature shows no abnormal deviation.

CHART 17.—Showing no deviation of temperature on the earlier grades; marked deviation later, and again no deviation for five or six weeks on the final grade.

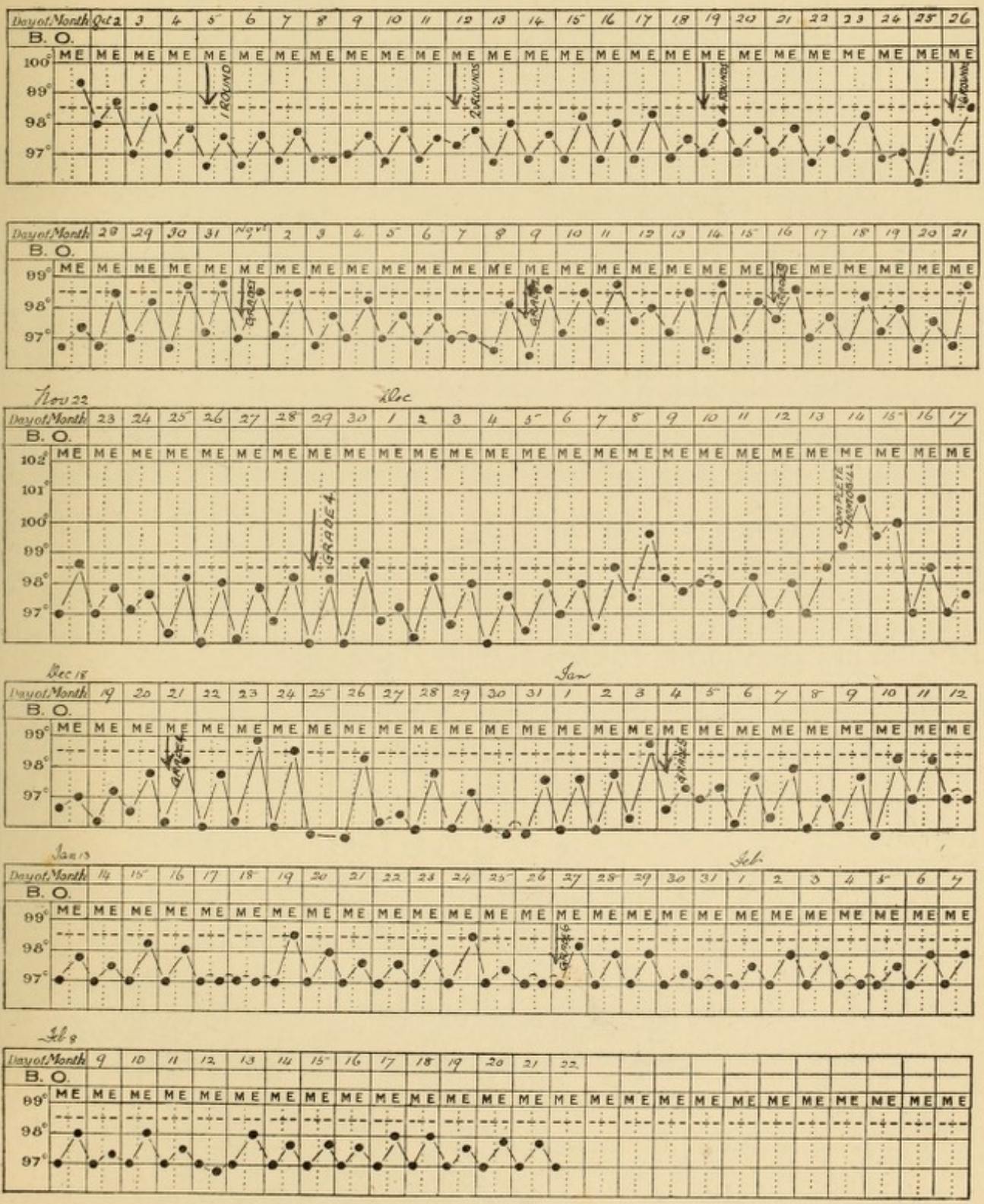
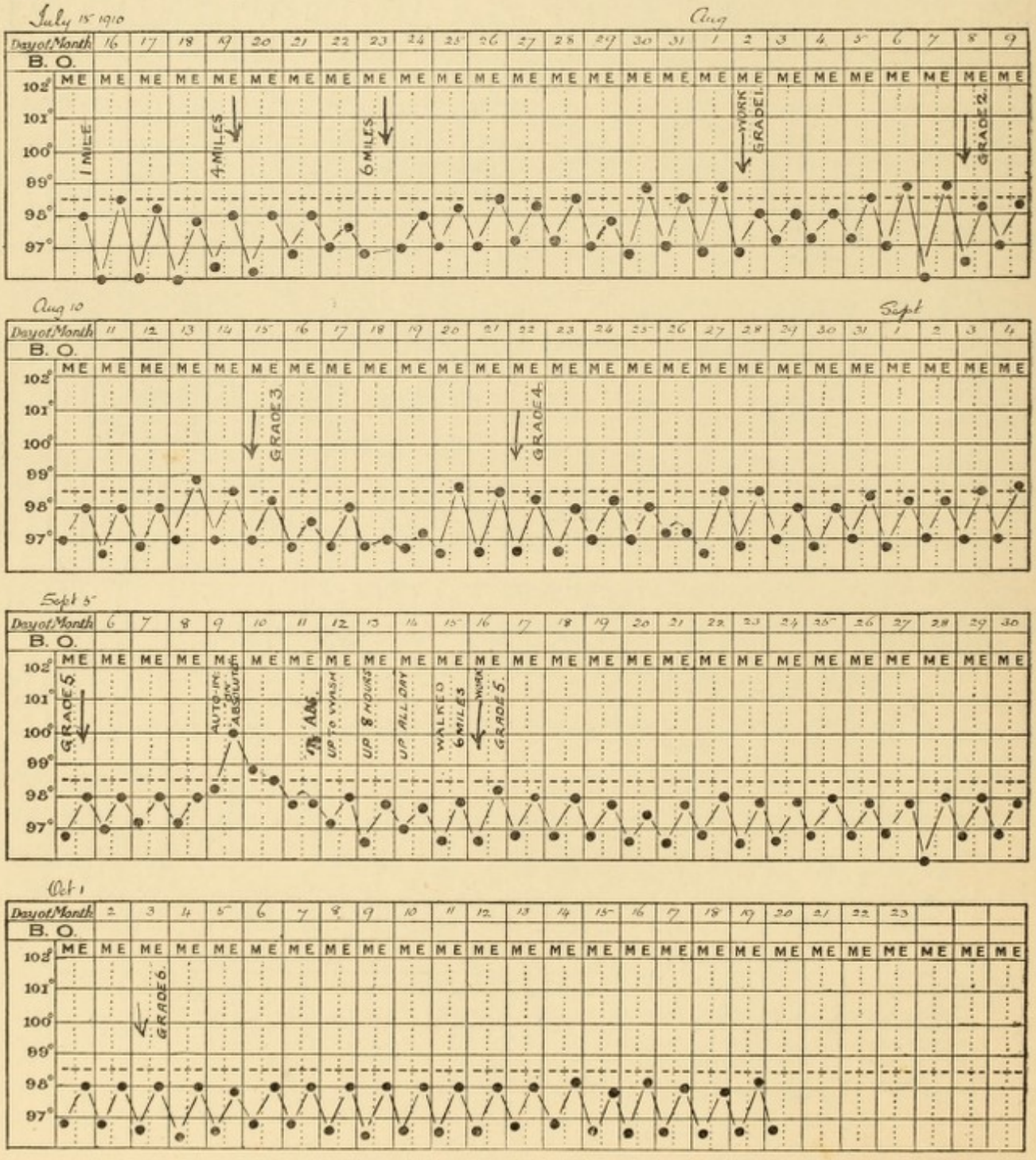


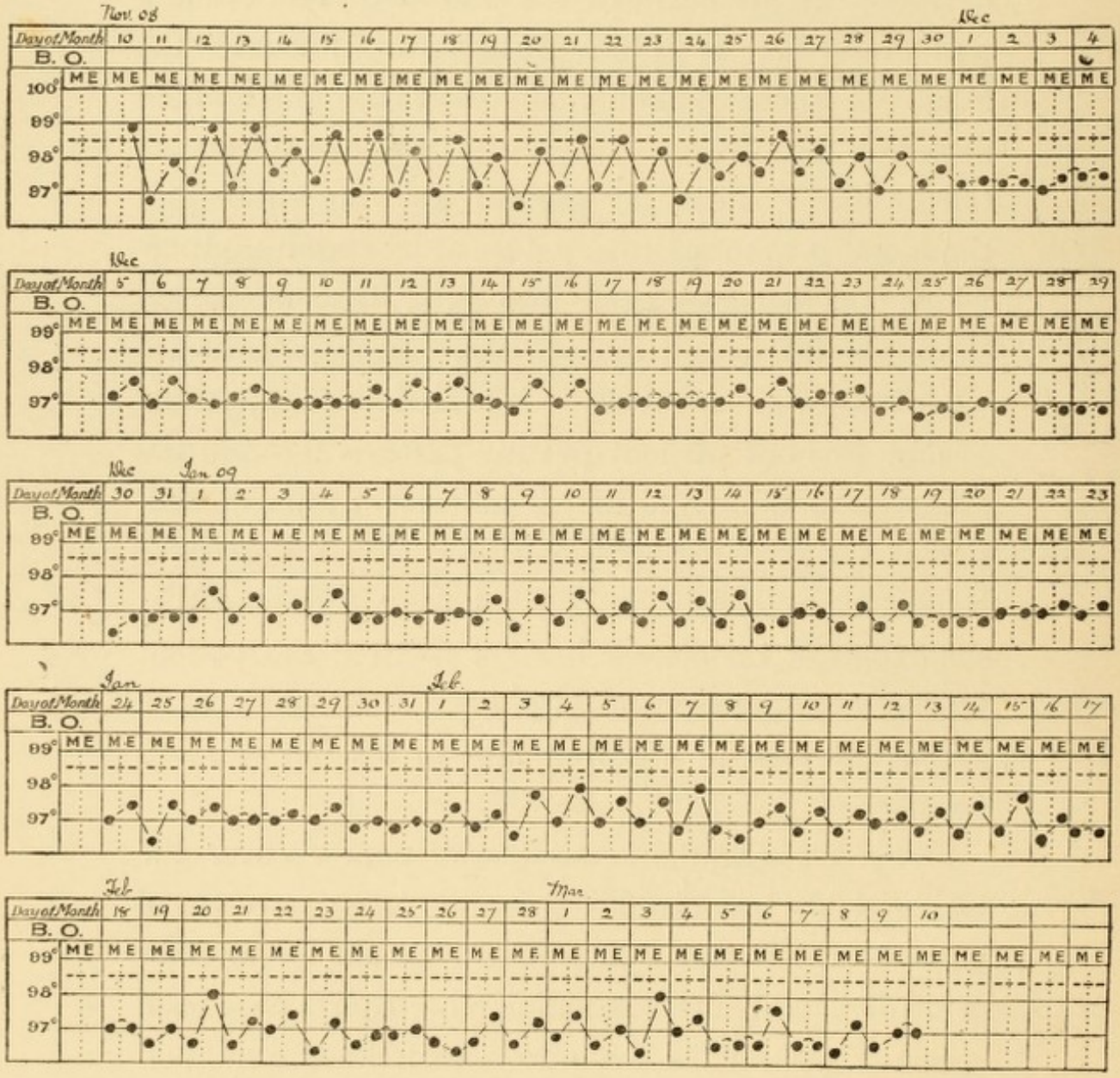
CHART 18.—Showing that until Grade 5 was reached the temperature did not rise above 99° F., although the deviations show that auto-inoculation was going on. The patient's cough and sputum persisted, and the latter contained tubercle bacilli at every examination. On September 9th he had an auto-inoculation with constitutional symptoms. He was placed on Complete Immobilisation, with the result that his sputum, which had temporarily increased, entirely disappeared. At arrow following rise to 100° F. he returned to the grade of work which caused the auto-inoculation, and was eventually discharged with no cough and no sputum.



The fourth class are those patients who go through all the grades and show practically no deviation at all between the morning and evening temperatures. It is not possible to influence the lesion of these patients, and therefore no marked deviation takes place. Moreover, there is no alteration in the quantity of sputum, showing either that the blood is immune to any dose of bacterial products which can be discharged into it, or that the lesion cannot be influenced by exercise. Such patients are what is termed "arrested." It is obviously impossible to find this out without putting patients through the grades, and though at first it may seem time wasted, this is far from being the case. Two things have been accomplished: first, we have ascertained that the extent of his disease has not unfitted the patient for hard work; second, we have succeeded, by a gradual system, in restoring him to his full working capacity.

This classification does not of course cover the whole field, but the history of a large number of patients will be found to conform to one or another of its divisions. The accompanying charts have been specially chosen for the purpose of illustration, and

CHART 19.—Showing a patient who went through all the grades without any regular deviation in temperature and no decrease in sputum from the time of his admission to the sanatorium. Auto-inoculations could not be induced even by the hardest navvy work.



are ideal in the sense that the indications they give are obvious and unmistakeable. It should be observed, however, that the variations are not always so clearly marked, and great care should be exercised lest significant tendencies and important fluctuations are overlooked. With intelligent study of the temperature chart correct information can be obtained.

It will be clear from the foregoing remarks that in using the temperature as a guide, the aim should be to increase the patient's labour—in so far as is consistent with his physical capacity—in order to produce a marked deviation in the temperature on one or another of the grades, and finally to enable him to do five hours hard out-door work with little deviation. I may here call attention to a common source of error. Patients who are capable of walking, for example, six miles a day with no rise of temperature and no marked deviation are frequently said to be convalescent or even "arrested." This is obviously incorrect. Six miles may not be enough to influence the lesion, but resisting power to the amount of work which that grade involves is no guarantee that the lesion cannot be influenced by a higher grade. Potential activity may exist in

spite of a normal temperature without deviations. The only way to find out whether a patient's lesion can be influenced is to test him. A normal temperature does not necessarily mean convalescence. Indeed, the word "convalescent" is misleading in tuberculosis. Either a lesion can be influenced or it can not be influenced. Nor can it be said that a patient has or has not active disease when the temperature is normal unless he is tested in the manner described. Activity should mean that auto-inoculations are going on or can be induced, and a patient may be inactive on one grade and become active on a higher one. Again, a patient may have a rise of temperature and constitutional symptoms, which are an indication of temporary activity, but will not recur on the same grade, owing to the raising of his powers of resistance to the auto-inoculations which that grade can excite.

The point I here desire to make is, that a patient after discharge from a sanatorium may take harder exercise than usual, and in consequence suffer from a severe auto-inoculation; if this is controlled by immobilisation, etc., the patient will be none the worse, but better, as the resistance to that amount of

bacterial products will have been raised. So that a rise of temperature does not necessarily mean a complete breakdown of the patient. Again, the presence of tubercle bacilli does not necessarily mean activity. Many of our patients on the final labour grade have a little sputum containing tubercle bacilli in the early morning. The patients show no deviation in temperature, and in the past have given a normal opsonic index. They are discharged under the classification "Arrest + T.B." My definition of the term "arrest" is as follows: a condition in which the patient is up to or above normal weight, has little or no sputum except in the early morning, without tubercle bacilli, and is able to do the hardest work for five hours without introducing into his blood a dose of bacterial products sufficient to produce constitutional disturbances. Patients discharged under the heading "Arrest + T.B." are therefore on the same footing as the "typhoid carrier." Their own health is not affected by the presence of the bacilli, but they are capable of infecting others.

It may here be pointed out that the deviation in the temperature which occurs when a patient is doing sufficient work to influence his blood is not neces-

sarily the immediate concomitant of an increase in the grade of labour. There are obvious reasons for this.

(1) The patient who is starting on a new grade is not so fit physically as he is later on in that grade, and therefore works harder at the end of it than at the beginning.

(2) Owing to climatic conditions and other causes, the physical fitness of patients varies within certain limits from day to day: on "good days" they will work harder than on "bad days," so that the amount of blood driven to the lungs necessarily varies. When deviations in the chart occur at otherwise unexplained times, one or another of the reasons given above will probably be found to meet the case.

Such deviations are, moreover, a very safe working guide. If a careful watch is kept, and the patient remains on his grade until the deviation disappears, progress is certain and there need be no cause for anxiety.

4. *Sputum.*

It has already been shown that valuable information can be obtained by watching the deviations of the temperature chart taken in conjunction with the

quantitative variations of the sputum. I propose now to discuss the latter phenomena more fully and to consider what bearing they have upon the theory of auto-inoculation.

It is indisputable that in pulmonary tuberculosis rest and exercise influence the temperature chart and occasion various constitutional manifestations in the patient. We know that a high temperature is an indication of fever, and that this fever can be controlled and reduced by adequate rest. On the other hand, over-exertion will cause its reappearance. Rest causes a diminution in pulmonary activity, whilst exercise increases it. If it is true, as I believe, that the blood supply is the connecting link between rest and exercise and the temperature chart, we may next inquire whether we possess any practical evidence that there is a definite relationship between the blood supply and the bacterial products. I think there can be no doubt that we do possess such evidence.

Pulmonary tuberculosis, or ulcer of the lung, is generally accompanied by a discharge of sputum from the focus of infection, and it is in the nature, extent, and occasion of its discharge that the evidence I refer to will be found.

I may briefly summarise the evidence as follows:

(1) Many patients begin to have a decrease in their sputum from the time they enter the first labour grade. Others have no decrease at all until they reach one of the higher grades, when the sputum entirely disappears, except for an inconsiderable discharge in the early morning.

(2) Patients often lose their sputum on one grade, the sputum reappearing with an increase of work, disappearing again as they become inured to that grade.

(3) Rises of temperature accompanied by constitutional symptoms, or physical manifestations alone, such as fatigue or loss of appetite, are frequently accompanied by an increase of sputum. With the restoration of balance there is a corresponding decrease of sputum.

(4) Deviations between the morning and evening temperatures are marked by an increase of sputum, even though the temperature does not rise above normal. As the deviation in the temperature is diminished the sputum begins to decrease in quantity.

(5) When, after a rise of temperature and an

increase of sputum accompanied by an increase of tubercle bacilli, the temperature falls and the volume of sputum is decreased, a decrease in the number of bacilli is often noticed, those left being beaded, broken up, and otherwise apparently decadent. When the patient returns to the grade on which the rise of temperature occurred, he has no further rise on that grade and no increase of sputum.

(6) Large numbers of tubercle bacilli frequently appear in the sputum of patients who have been transferred to a higher grade, whilst on the previous grade the sputum was less in quantity, different in appearance, and was not found to contain any tubercle bacilli.

Some of the manifestations here detailed are not invariable, but exceptions are rare. This affords a strong presumption that variations in the nature and quantity of the sputum are to be traced to the effects of graduated rest and exercise on the blood, and the influence of the blood fluids on the focus of infection. Many who read the foregoing pages, in which an attempt is made to describe the process of auto-inoculation, may be inclined to protest that very little is known of the mechanism of the subject.

With this view I cordially agree, but desire most emphatically to point out that whatever opinions we may hold regarding the various and interdependent causes of its manifestations, the fact remains that certain work causes certain deviations in the temperature, and that such deviations are accompanied by corresponding variations in the nature and quantity of the sputum.

Furthermore, all the facts given above can be accounted for by the theory of auto-inoculation. No other theory yet brought forward does account for them. I may add that when in the early stages of my experiments the deviations in the temperature chart had not been appreciated at their proper value, it was usual for patients on the first three labour grades to remain in each grade for a period varying from six weeks to three months. Since auto-inoculation has become the guiding star of the method, the time spent on any one of these grades rarely exceeds three weeks.

In conclusion, it may be said that whatever the limitations of our knowledge on this subject, it has been found to be an excellent working theory and has enabled me to carry out a systematic treatment,

which has been abundantly justified by results. Moreover, the usual effect upon the patients themselves is particularly striking, and is an important factor in the mental aspect of the disease. After having the principles of the treatment explained to them they take the keenest interest in their progress, and even come to regard a period of enforced idleness on immobilisation as a blessing in disguise.

CHAPTER VI.

THE INFLUENCE OF REST AND EXERCISE UPON THE BLOOD FLUIDS AS DETERMINED BY THE OPSONIC INDEX.

In 1905, when I first prescribed graduated labour for tuberculous patients, I had no idea that it would have any direct influence on the disease itself, but thought rather that the work would materially improve the general condition of the patient. After a year's experience I began to observe that harder work effected a marked improvement in a few patients whose condition on lighter work had hitherto remained stationary. At the time I concluded that the harder work had improved the appetite, and through that, the entire condition. Not till a year later did it become evident that the good results achieved were directly due to the influence of rest and exercise upon the blood fluids. I say "evident," because I am convinced in my own mind that the

phenomena manifested by patients undergoing the graduated labour system are explicable only in the light of the auto-inoculation theory.

At the request of Dr. Inman it was decided by the Medical Committee in 1907 to examine that theory scientifically by carrying out a series of tests, in order to ascertain what evidence, if any, was afforded by the bloods of patients undergoing graduated labour. Wright and Douglas had shown, by experiments upon the leucocytes separated from the serum, that amongst the anti-bacterial elements in the latter those which they called opsonins played a prominent part in the phenomenon of phagocytosis. The opsonins were found to exert an influence on every known species of bacteria, and their value to the investigator was enhanced by the practical possibility, afforded by Wright's method, of accurately measuring their quantity in the blood. This method consists in observing the average number of bacteria ingested by a given number of leucocytes exposed to the action of a normal healthy serum, and comparing the result with the average number of bacteria ingested by a similar number of leucocytes exposed under identical conditions to the

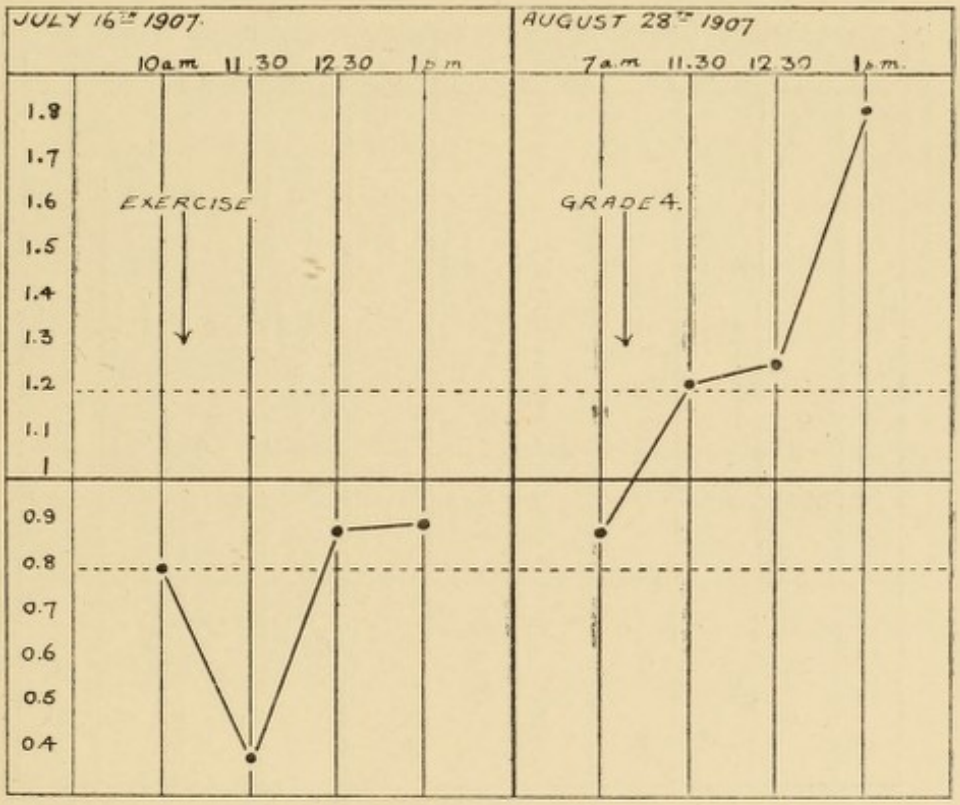
action of the serum to be tested. The former observation is referred to unity, and the ratio between the two numbers constitutes what is known as the opsonic index. Making use of the technique supplied by Wright and Douglas, Dr. Inman examined over 300 bloods of patients under treatment at Frimley, the investigation covering a period of over one month. To avoid all possibility of personal bias which might unwittingly influence the results of the experiment, so as to bring them into line with preconceived theories, the investigation was carried out in such a way that it was never known whose blood was being examined.* The bacteriologist, Dr. Inman himself, had no key to the bloods save the number attached to each tube, and to him the number represented an unknown quantity. In this way the personal element was eliminated and the validity of the experiment assured. The results of the investigation afforded convincing proof that variations in the opsonic content of the blood occurred during the ordinary treatment by graduated labour, and confirmed the belief that the success of the system was due to the accurate adjustment and

* See *Lancet*, January 25th, 1908.

control of auto-inoculations. Over 90 per cent. of the patients examined gave at one time or another

CHART 20.—Uncontrolled exercise at Brompton.

CHART 21.—Controlled exercise at Frimley.

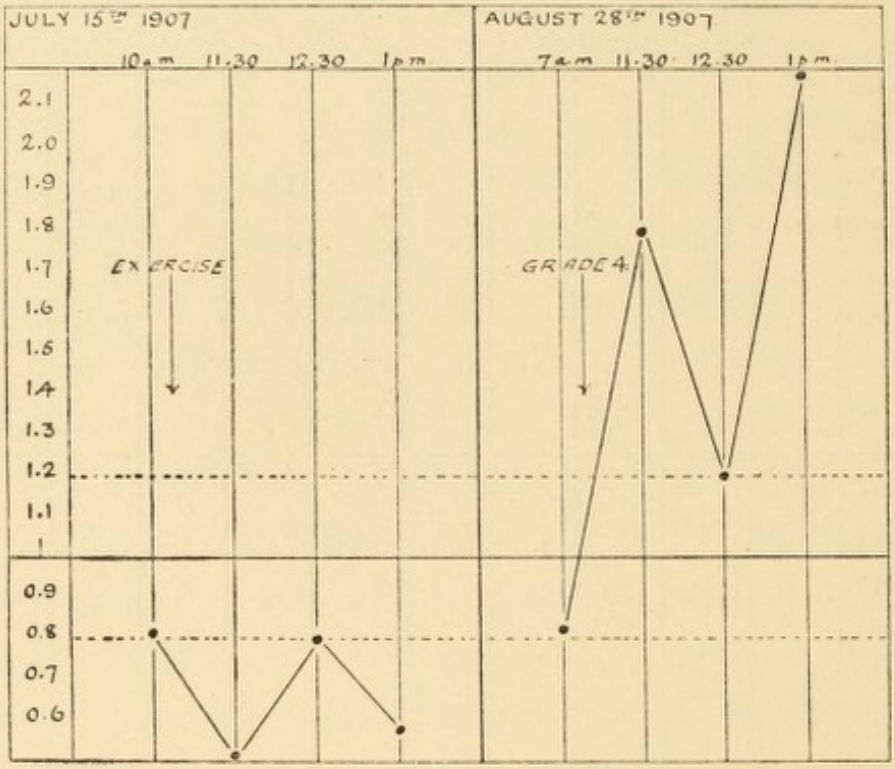


an index above normal, showing that the work prescribed for each was exercising a beneficial effect, and exciting auto-inoculations that were neither deficient nor in excess. The accompanying curves illustrate in various ways the influence of rest and exercise on the blood.

Charts 20—27 exemplify in a striking manner the effects of controlled as opposed to uncontrolled

CHART 22.—Uncontrolled exercise at Brompton.

CHART 23.—Controlled exercise at Frimley.

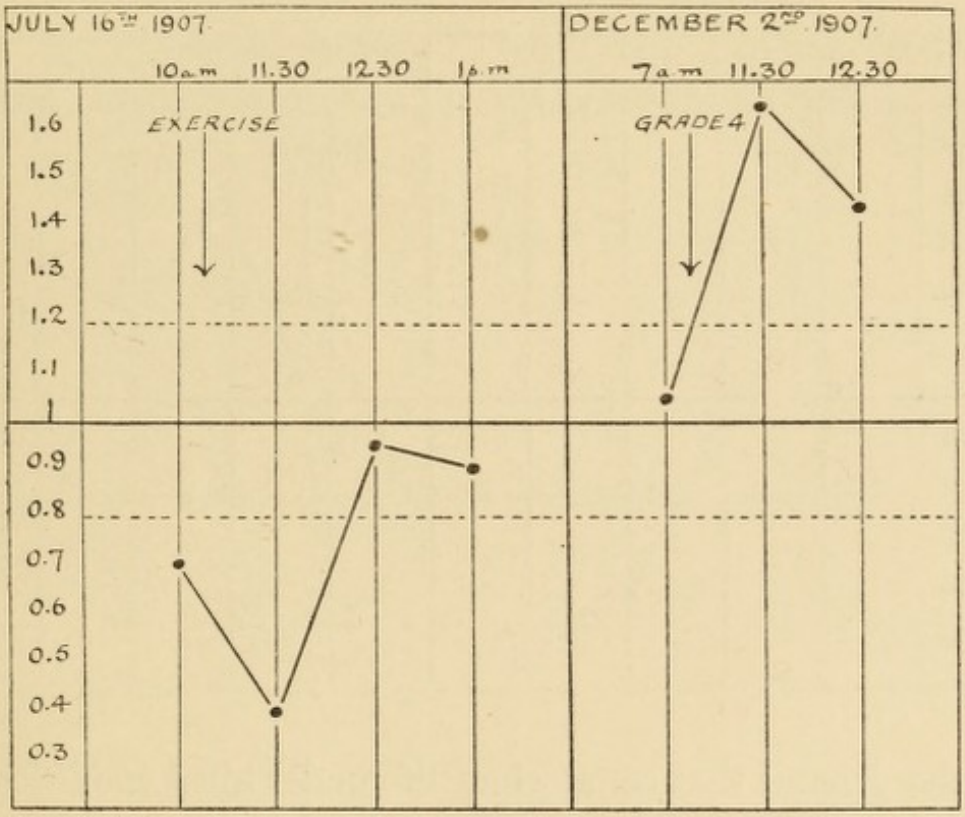


exercise. In the first four the index of the patient on uncontrolled exercise at Brompton remains below normal, whilst a course of graduated labour at Frimley raises it above normal and maintains the positive phase. In each case it will be noted that the index at Frimley starts within normal limits, and

so far as the determinations show, never descends below normal. In *Chart* 28 the patient starts on a

CHART 24.—Uncontrolled exercise at Brompton.

CHART 25.—Controlled exercise at Frimley.

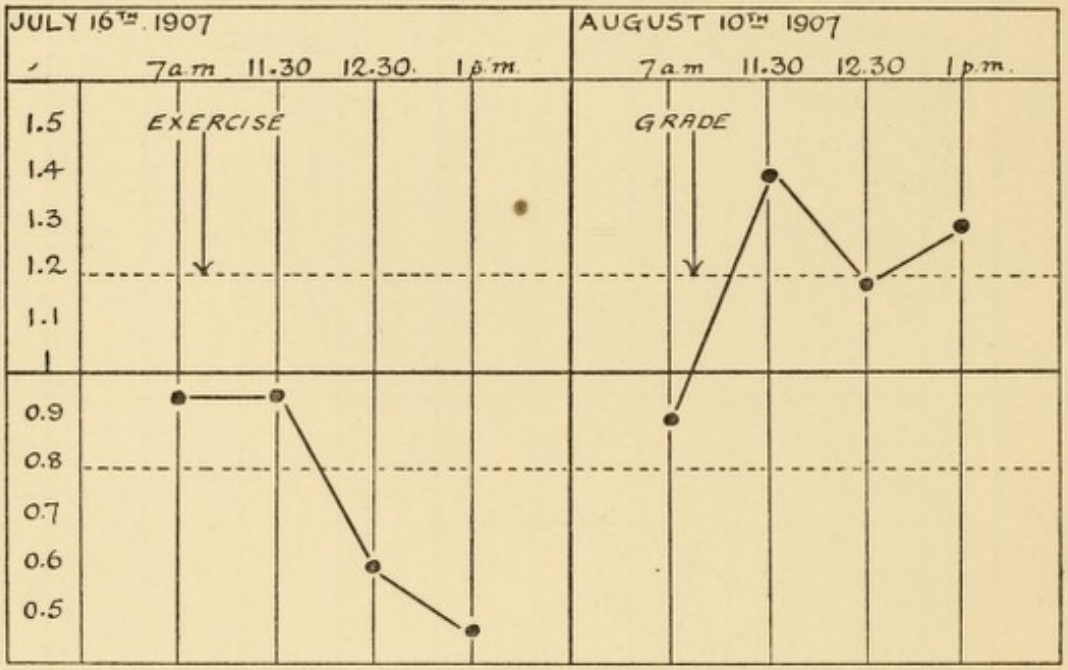


very low index after walking the previous day, showing that the exercise did not produce an adequate response. On the 29th walking temporarily raises the index, which then falls to normal. *Chart* 29 shows the same patient later on work equi-

valent to the hardest labour grade (floor scrubbing) the index remaining above normal. The significance of these high indices cannot be explained merely on

CHART 26.—Uncontrolled exercise at Brompton.

CHART 27.—Controlled exercise at Frimley.

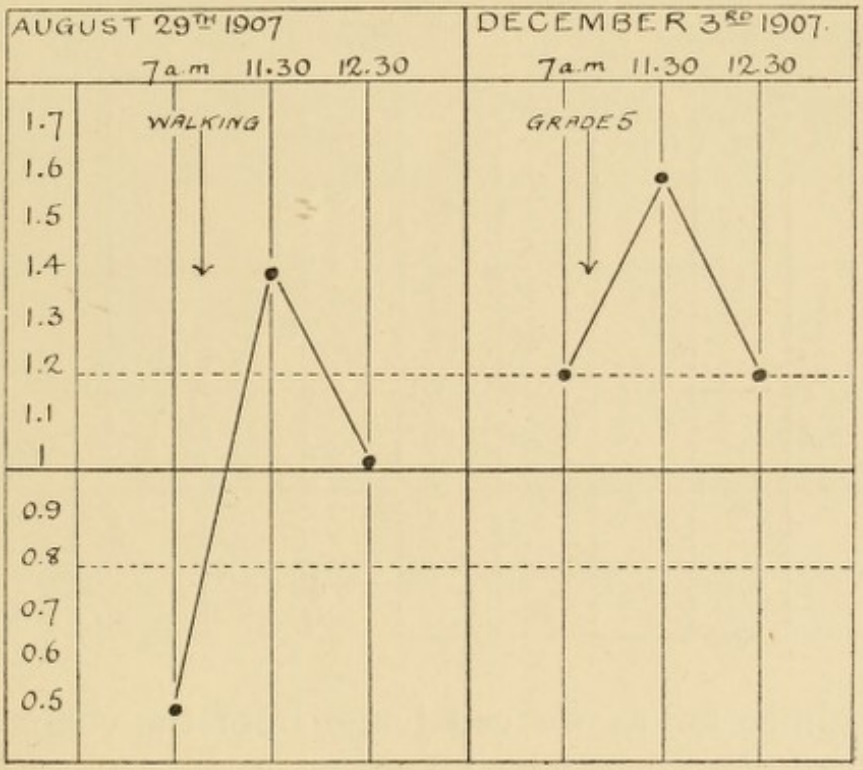


the ground that sanatorium life under ideal conditions has raised the general resisting power of the patient. A high index denotes abnormal phagocytic power in the blood fluids under observation, proving that there has been a discharge of bacterial products into the blood and lymph streams, and that the latter have responded to the stimulus by the elaboration of pro-

tective substances. Similarly the low indices are evidence of a lowered bacteriotropic pressure in the

CHART 28.—Walking exercise does not produce an adequate response.

CHART 29.—The same patient on work equivalent to the hardest labour grade, the index remaining above normal.

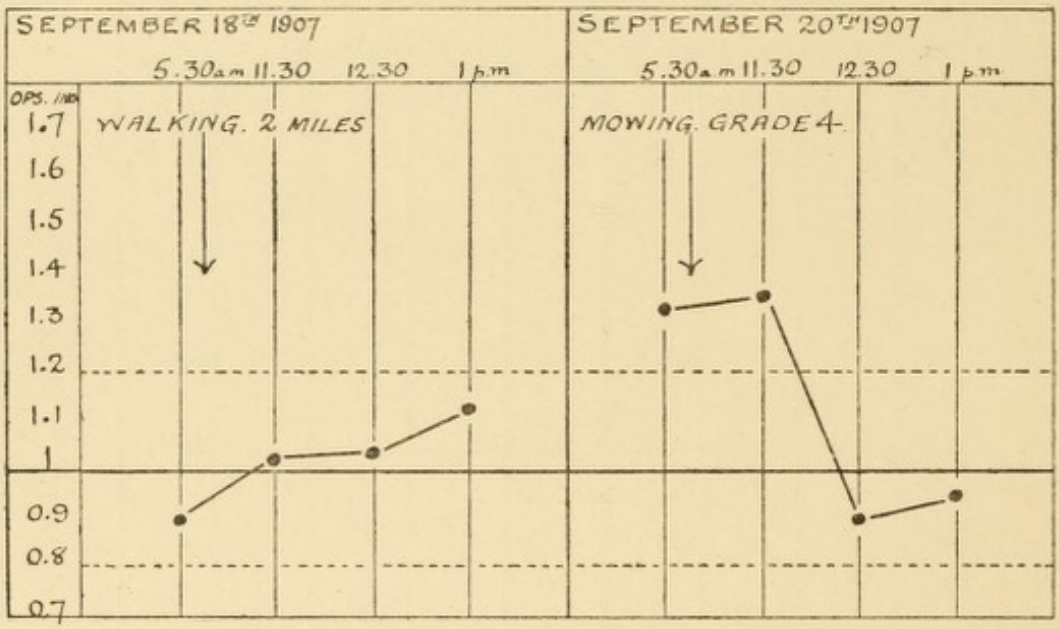


blood. *Chart* 30 shows a patient on the two-mile walking grade. His index remains within normal limits, showing that the exercise was inadequate to affect the opsonic content of the blood, insufficient bacterial products having been introduced into the

blood to provoke an immunising response. *Chart* 31: Two days later it will be observed that the mowing grade has temporarily raised the index,

CHART 30.—Walking exercise insufficient to affect the index.

CHART 31.—Mowing grade temporarily raises the index.

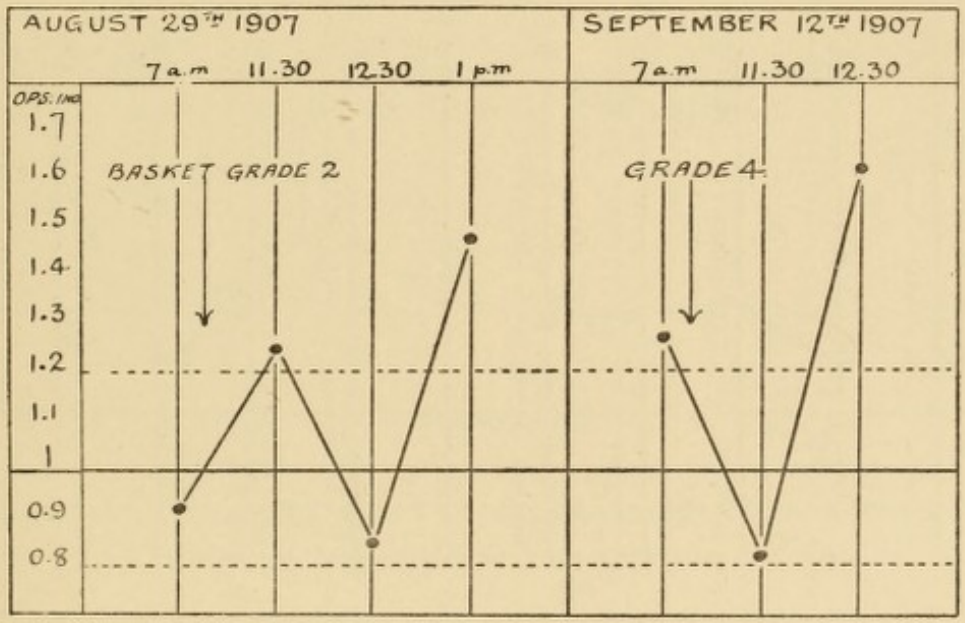


though, so far as we can judge from the chart, the positive phase is not maintained. It is obvious that when only three or four indices are given curves may be found which, taken by themselves, are capable of more than one interpretation. Whether, for instance, an incomplete descending curve is the preliminary indication of a rise, or whether it will

develop into a prolonged negative phase, is a question that can only be decided by making a much larger number of estimations of opsonic indices or by an appeal to the temperature chart and a study of the

CHART 32.—Showing the effect of the "large basket" grade on a patient with a normal index.

CHART 33.—The same patient on Grade 4.

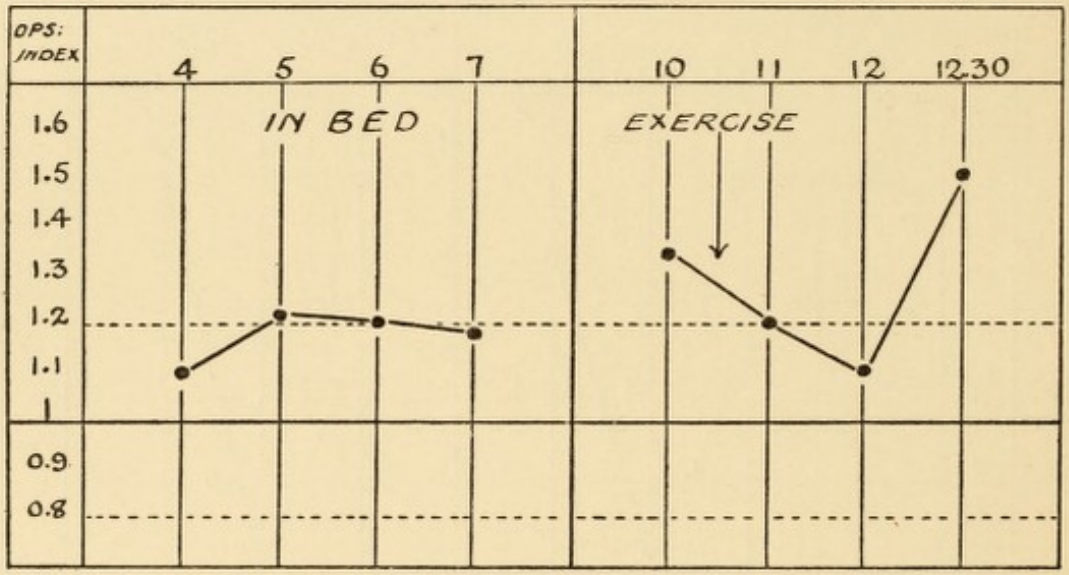


constitutional symptoms. The correct inference to be drawn from Chart 30 taken in conjunction with Chart 31 is probably that walking was producing no response, and that the patient might continue to walk that distance for months without affecting the lesion sufficiently to influence his index; that the mowing

grade also was insufficient to produce an adequate response, and that therefore the positive phase was not maintained. At the same time, whilst many of these charts do not afford sufficiently complete evidence to

CHART 34.—Showing a patient in bed with a normal index.

CHART 35.—The effect of exercise on the index of the same patient.

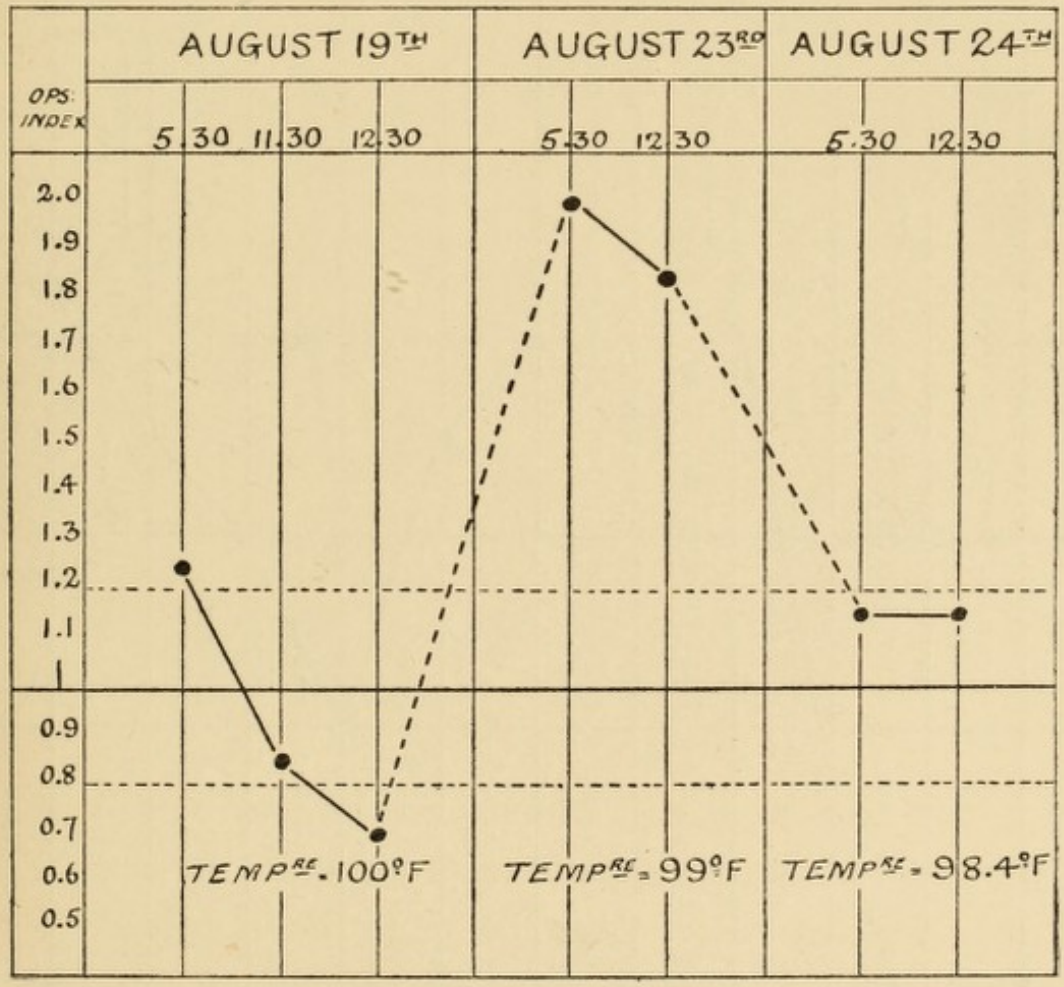


justify us in making particular assertions, they have in common certain general features which are unmistakable, and show clearly enough the influence of exercise on the index.

Chart 32 demonstrates the effect of the large basket grade on a patient with a normal index. *Chart* 33 shows the same patient fourteen days later

on Grade 4. The dissemination of the bacterial

CHART 36.—Showing an excessive auto-inoculation controlled by rest in bed, the rise of the temperature conciding with the fall of the index, and *vice versâ*.



products into the blood-stream causes an immediate fall of the index, and the ensuing rally of the protective substances raises it well above normal.

Chart 37.—Showing inverse ratio between temperature and opsonic index.

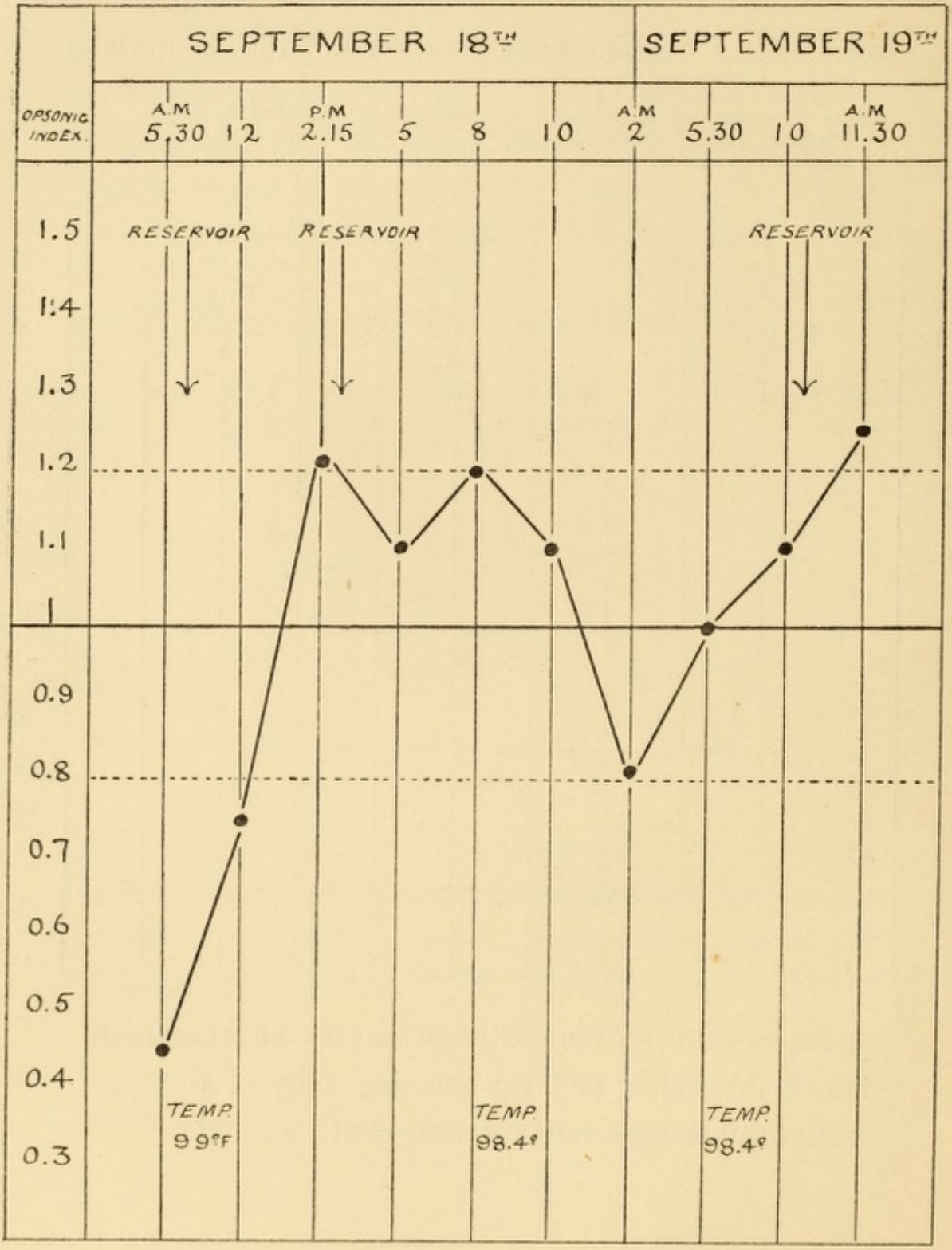


CHART 38.—Showing the effect of hard work upon the index of a patient who, one month later, is able to do the same amount of work without affecting the opsonic content of his blood.

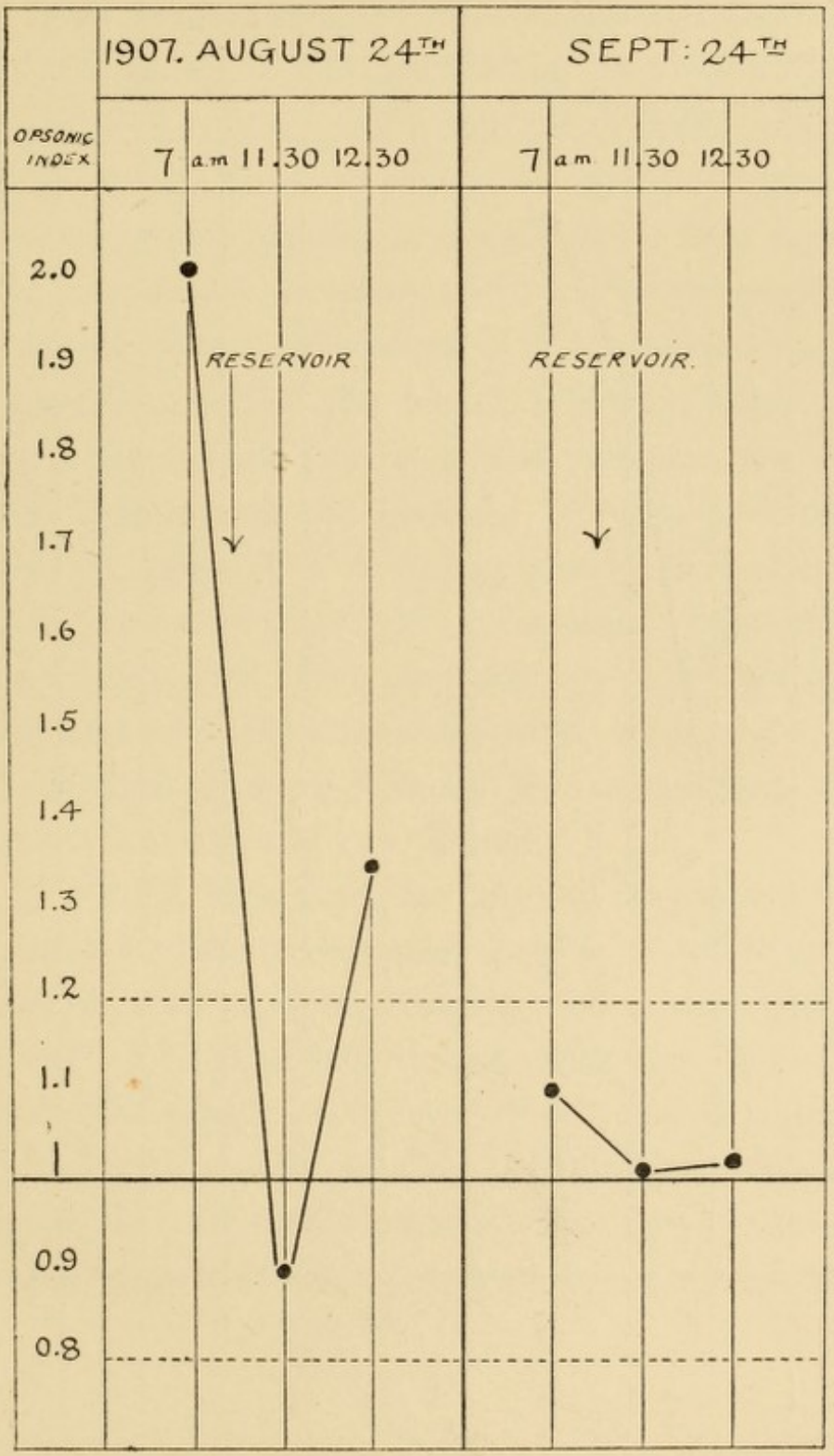


CHART 39.—Showing the elevation of the index due to work. Three weeks later with the same amount of work the index remains within normal limits.

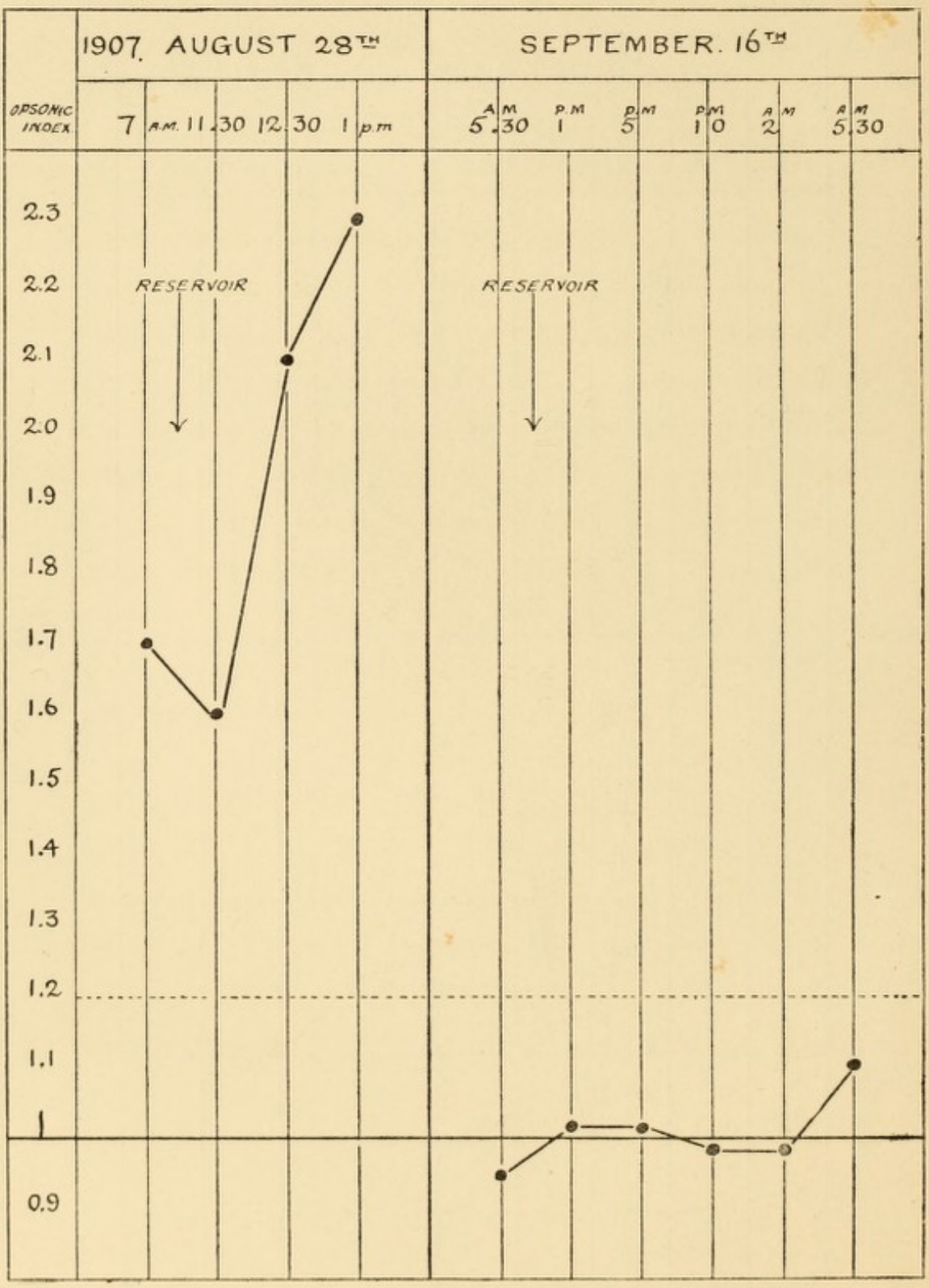


Chart 34 was obtained from a patient in bed, his index remaining practically normal. *Chart* 35 shows the effect of exercise on the index of the same patient. It may here be observed that the variations shown by the index after exercise are paralleled by those shown after inoculation by tuberculin. The immediate effect of artificial inoculation is a diminution in the opsonic content of the blood, followed by an abnormal increase as it responds to the stimulus, and finally a return to the normal. Wright has called these variations the negative phase, the positive phase, and the phase of maintained high level. Similar variations follow any exercise which, without being excessive, has been sufficient to affect the focus of infection, thus confirming the supposition that exercise induces auto-inoculations.

Chart 36 illustrates the case of a patient who received a dose of bacterial products sufficient to cause constitutional disturbance and a temperature of 100° F. The patient was rested in bed and a positive phase succeeded the negative phase, the index eventually settling a little above normal. It will be observed that the index curves are in inverse ratio to the temperature throughout, as has

been pointed out by Drs. Latham, Inman, and Spitta.

Chart 37. Another case of excessive auto-inoculation, the negative phase coinciding with the rise of temperature and positive phases reappearing with its fall. This inverse ratio between temperature and index holds good in a very large number of cases, but is not invariable. Exceptions from the general rule may be explained by the fact that rises of temperature are sometimes due to causes other than those which produce a low index to tubercle.

Chart 38 shows a patient under the influence of auto-inoculation caused by the hardest navvy work and the reaction of the protective substances to the stimulus. The same patient a month later maintains a normal index on the same work, showing that he has acquired immunity on that grade.

Chart 39. The patient starts on a high index from the previous day's work, and a quick response is evoked, driving it still higher. The second part of the chart shows the same patient one month later on the same grade. The index shows no variation during the whole twenty-four hours. The patient is "arrested."*

* For definition of "arrest," see p. 81.

The significance of the last two charts is that they illustrate the process of immunisation in its final stages. As long as the patient is susceptible to auto-inoculations protective substances are elaborated in response; when no bacterial products, or insufficient quantities, reach the blood fluids, these substances return to their normal level.

Much criticism has been directed against both the opsonic theory and the technique of the opsonic method. Without entering into a discussion upon the merits of this criticism, it may be said with regard to the Frimley investigation that the results revealed a uniformity of evidence that justifies me in drawing certain general conclusions. Whatever the result of future investigation regarding the place of opsonins in the protective machinery of the blood, it has been established beyond doubt that spontaneous auto-inoculations can in many cases be controlled by means of graduated rest and exercise, and that the success of such control is due to the raising of the specific resisting power of the protective substances of the blood. Since the investigations were carried out, practical considerations have made it impossible to continue them as a regular basis for treatment.

Nor, indeed, has it been found in any way necessary to do so. The cumulative evidence afforded by the Frimley opsonic tests so confirmed my belief in the soundness of the auto-inoculation theory that I was enabled to proceed with much greater confidence than before, and consequently to obtain successful results with much greater rapidity. In the light of this evidence, deviations in the temperature chart and other signs and symptoms of auto-inoculation have acquired a new significance, enabling me to gauge the exact stimulus needed to induce auto-inoculations, and to adjust necessary alternations of rest and exercise to each case with greater scientific accuracy.

The practical result of using the theory of auto-inoculation as a working hypothesis has been that the same number of beds accommodate 40 per cent. more patients per annum than when I employed graduated labour without any such theoretical knowledge.

CHAPTER VII.

DIET IN TUBERCULOSIS.

Since consumption has come to be recognised as a disease of bacterial origin, the loss of flesh and general wasting of the body by which it is characterised should no longer be regarded as the direct consequence of malnutrition; rather it is due to loss of appetite occasioned by fever and other constitutional disturbances. Diet, therefore, has not the paramount significance it had some years ago. During the lifetime of this sanatorium we have passed through various phases of dietary, in the course of which much valuable experience has been gained. In the early days our patients were compelled to undergo the tedium of the milk routine. Three and a half to four pints a day were given, with the result that the fat was deposited on the omentum, and the free movements of the diaphragm were hindered by the subsequent increase in weight. The natural sequel

was excessive corpulence and shortness of breath. Patients became lazy and unfitted to do the work which was the essential factor in their recovery. For the last four years we have given just that amount of milk which patients would take at home under ordinary conditions in tea, coffee, milk puddings, and so on. Circumstances, of course, occur which necessitate a departure from the general rule, but milk is not used as a routine "cure."

At one time we were guilty of the system of excessive stuffing; at another an attempt was made to raise the standard of bodily health by the provision of exceptionally rich and nutritious foods. All these methods have been abandoned. The milk diet has the effect of raising the weight to an extent out of all proportion to the normal, so that when patients leave the sanatorium and resume their ordinary diet their weight falls and they rapidly lose the fat which they have accumulated. The mental reaction is disastrous. Weight, in fact, is of no value to the discharged consumptive unless he is in hard physical condition; nor is increased weight evidence of "arrest," or even of satisfactory progress, until the lesion has been subjected to the severest possible test and can no longer

be influenced. Incidentally it may be observed that with 150 beds full, and milk at its present rate of tenpence a gallon, the lavish provision of an unnecessary article would increase the expenses of the sanatorium by £700 per annum. Indiscriminate stuffing, again, has nothing whatever to recommend it. A patient who is forced to eat an excessive amount of food cannot possibly absorb it all, and is liable to suffer from digestive disorders. Finally, dainty foods are not properly appreciated by those who are unaccustomed to take them. My aim and object at the present time is to give patients that quantity and quality of food which they can afford when they are well and at work in their own homes. The table given in Appendix I shows the diet in force for the winter and summer months, together with the quantities allowed of each food. Summer and winter have their special menus, and the diets are so arranged that it is impossible for the patients to tell with certainty what they are going to have for dinner on any particular day. In some institutions it is customary to provide the same meal on the same day of the week. This custom prevailed here when the sanatorium was first opened, but has since been

discarded, and for very good reasons: patients who always know what their next meal is going to be are apt to experience a mental reaction which turns them against their food when it is set before them. In the expressive language of one of my patients, "We feed on the thought of the meal all the morning, and when the time for dinner comes we have lost our appetites."

To obviate this, I have devised a plan by which it is still possible to arrange the meals for one month in advance, and at the same time to shuffle the menus in such a way that each one comes as a surprise. Its operation is simple. For the benefit of the staff a metal ticket bearing the words 1st, 2nd, 3rd or 4th week is attached to the menu frame in the kitchen and shows which week's menu is in force. Great care is taken to see that patients get their food hot and that it is served in an appetising and attractive manner. When food is palatable and eaten with relish it is much more readily digested and absorbed. Pavlov's experiments have shown that the activity of the digestive glands is largely influenced by the antecedent mental attitude of the subject. A strong instinctive desire for food is an essential factor in stimulating the digestive processes,

and so maintaining a progressive equilibrium between the secretion of the digestive fluids and the chemical reactions of the food ingested. The graduated labour system provides an excellent stimulus to appetite and has a marked effect on the quantity of food consumed; this is shown by the increased cost of running the institution. Very good evidence is afforded by the fact that on Sundays when there is no work the patients eat much less than on other days of the week. Apart from auto-inoculation, which is the main function of graduated labour, this increase of metabolism may have some effect on the resisting properties of the body.

It follows from what has been said that the presence of the medical superintendent at meals is all-important. Meals must be regarded as part of the treatment; the patients are put on their mettle and the kitchen staff are kept up to the mark. The medical officer should make a practice of carving at dinner, firstly, to insure that the food is being properly cooked and that patients are getting it under the best possible conditions; secondly, to find out by personal observation exactly how each patient is taking his food. In this way he will have direct

knowledge of individual loss of appetite, and may detect the early symptoms of an excessive auto-inoculation.

Three or four years ago we used to give our patients four meals a day. With the waning of faith in the beneficence of the stuffing principle we abandoned the system in favour of three. The meals are served at 8.15, 1.0, and 6.30. Other details will be found in the Appendix.

Under the conditions mentioned we have no difficulty in getting patients to eat their food, provided only their auto-inoculation is under control. They come in from work hungry and enjoy their meals more in proportion to the fact that they are few. Three meals a day do not overtax the digestion, and moderate helpings stimulate the patient to come again. Patients with fever are given exactly the same food as those without fever, if they have sufficient appetite for it; if not, they are given lighter food, such as fish, chicken, rabbit, eggs, milk, milk-puddings, etc. These patients are encouraged to eat their food and drink two to three pints of milk a day, but no pressure is brought to bear on them, and if inclination is absent they are not worried.

To sum up, cure of the disease depends not alone on nutrition, but on control of auto-inoculation. The food of consumptives should therefore conform to the ordinary rules of dietetics, attention being paid to local tastes and customs. Since the loss of tissue resulting from exercise demands rapid constructive metabolism, food should be abundant without being excessive. It should at the same time be appetising and varied. The function of diet in tuberculosis is to co-operate with other forces in raising the patient to his highest normal weight, and restoring him to work in hard physical condition.

CHAPTER VIII.

COMPLICATIONS.

1. Hæmoptysis.

Hæmoptysis may occur in any patient who has, or has had, tuberculosis of the lungs. Whether it is likely to occur in any given case is a question that cannot be answered in the light of our present knowledge; the available data do not enable us to form a judgment.

(1) *Cause.*—Hæmoptysis is generally supposed to result either as a consequence of "lifting heavy weights," or from some sudden exertion. After ten years' experience here and at Brompton I am strongly of opinion that even heavy manual labour has little or no influence on hæmoptysis.

If hard physical exercise occasioned hæmoptysis we should frequently find patients on the higher grades of labour coughing up blood whilst they are at

work. This is not the case. Moreover, if patients thought there was any real risk of hæmoptysis they certainly would not work hard, nor would some of them pay 25*s*. a week out of their own pockets to undergo the treatment of graduated labour. On the contrary, hæmoptysis most frequently occurs when patients are either resting or in bed. I may add that patients have often performed the heaviest navvy work here without hæmoptysis, but have suffered from it months or years after their discharge whilst engaged in sedentary occupations.

Though, so far as I am aware, there are no data which enable us to estimate pulmonary blood-pressures, the following explanation may account for the facts.

When a patient is on hard work there is more blood in his muscular system and in the capillaries of his lungs than when the muscles are at rest. Therefore it might be presumed that the blood-pressure is lower than when the patient is at rest in bed, with very little blood in the capillaries.

(2) *Significance*.—Again, hæmoptysis is not necessarily a sign of activity of disease; it may be, and more often is, purely a mechanical rupture of an un-

supported or ulcerated blood-vessel, from which the patient rapidly recovers. Such hæmoptysis is often followed by fever.

This fever is usually considered to be the result of the toxic effect of the tubercle bacilli, but I believe it is due to the residual blood left in the lung after the hæmoptysis —that is, to the same causes which occasion rises of temperature after the fracture of a bone. It is similar to the fever which follows extravasations of blood caused by a buffer accident.

Consequently I always allow the patient to get out of bed as soon as the fever disappears and the sputum is no longer coloured. After a few days' walking exercise to recover from the weakening effect of being in bed, he is allowed to return to that grade of work on which he was engaged prior to the hæmoptysis. From this it must not be inferred that hæmoptysis occurs during working hours. We have not yet had a case of hæmoptysis occurring whilst a patient was actually at work.

Many patients after being discharged from this sanatorium have had hæmoptysis, and the medical man who was called in, after examining the chest and finding physical signs—which were pro-

bably there when the patient was discharged—has told the patient that he must go to a sanatorium. Some of these patients have written to me for advice, and I invariably reply, "If you are feeling fit and well, stay in bed until your sputum is no longer coloured and then return to work." It is found that these patients are able to return to work without any ill-effects. Other patients are sent back without seeking my advice, and if they give me a history of past good health up to the time the hæmoptysis occurred, and assure me they are feeling fit, they are at once put to work, and nothing but good results.

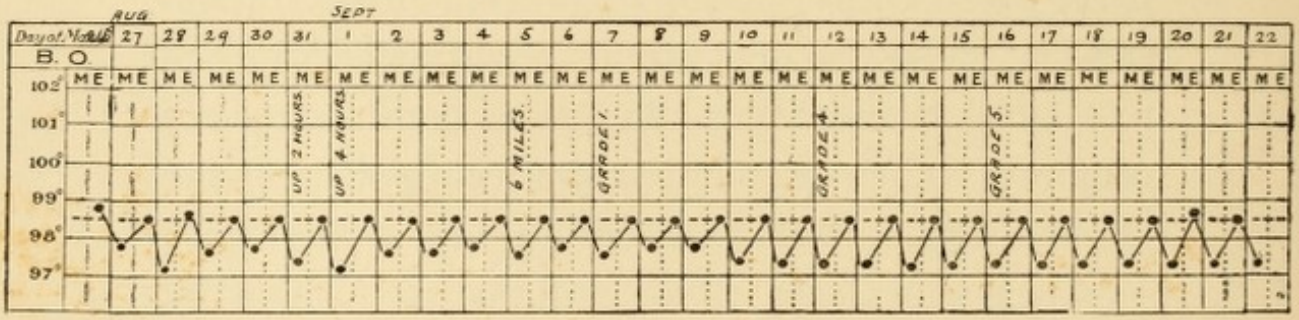
These are facts which I think prove that all hæmoptyses do not indicate the presence of active disease. In such matters medical men should not be guided solely by physical signs, but by ascertaining whether there has been an increase of sputum and whether the patient felt perfectly well and fit for work before the hæmoptysis occurred.

The following charts illustrate the statement that hæmoptysis is not necessarily a sign of active disease.

Chart 40 is that of an ex-patient who had 3 oz. hæmoptysis and returned to the sanatorium. He was sent to bed, but had no fever and was allowed

up within a week. On September 7th he was at work on Grade 1, and at the end of three weeks was doing the hardest navvy work. This patient soon after returned to State employment, and was ordered two months' leave by the medical officer on the ground that he had had recent hæmoptysis, and that

Chart 40.

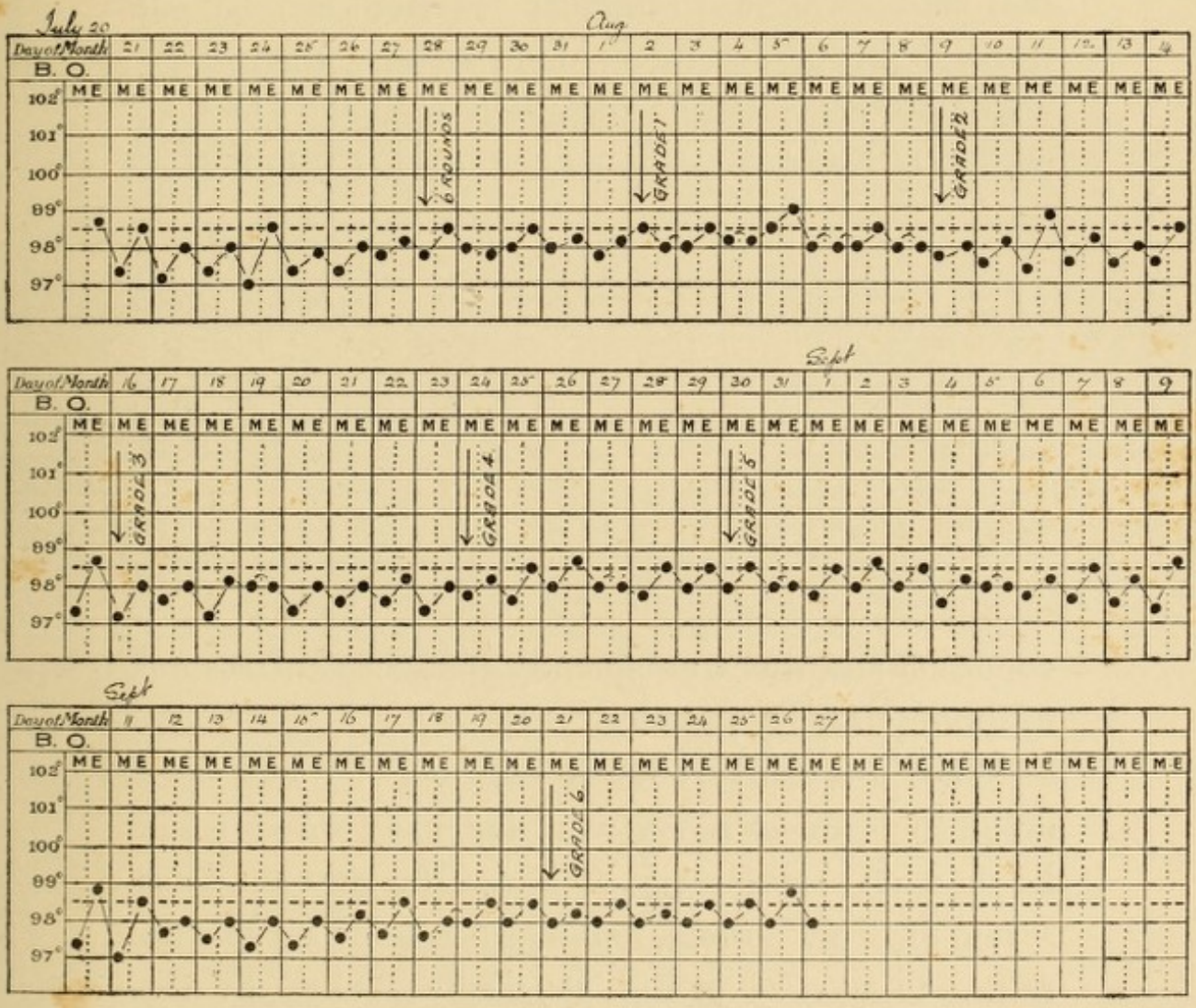


the disease was therefore active. There are no signs of auto-inoculation in the chart.

The next chart is that of a patient who, one year after her discharge, had hæmoptysis followed by fever which lasted for over a week. She was sent back to the sanatorium on the ground of active disease, and on re-admission started on the six-mile walking grade. Within one month she was doing the hardest work. The chart gives no evidence of auto-inoculation.

Chart 42 supports my contention that hæmoptysis, *even when followed by fever*, is not certain evidence

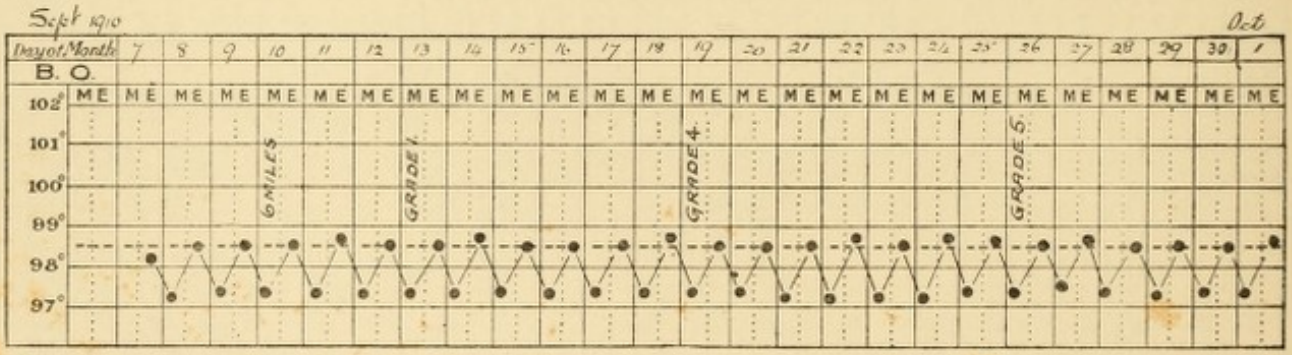
CHART 41.



of active disease. It shows an ex-patient, who had an hæmoptysis followed by fever and was sent back

to the sanatorium, rapidly passing through all the grades within a month of re-admission, the temperature giving no indication of activity. It is obvious that patients in good muscular condition can be put through the grades much more quickly than those who enter a sanatorium physically weakened by long periods of inaction. This patient was in hard physical

Chart 42.

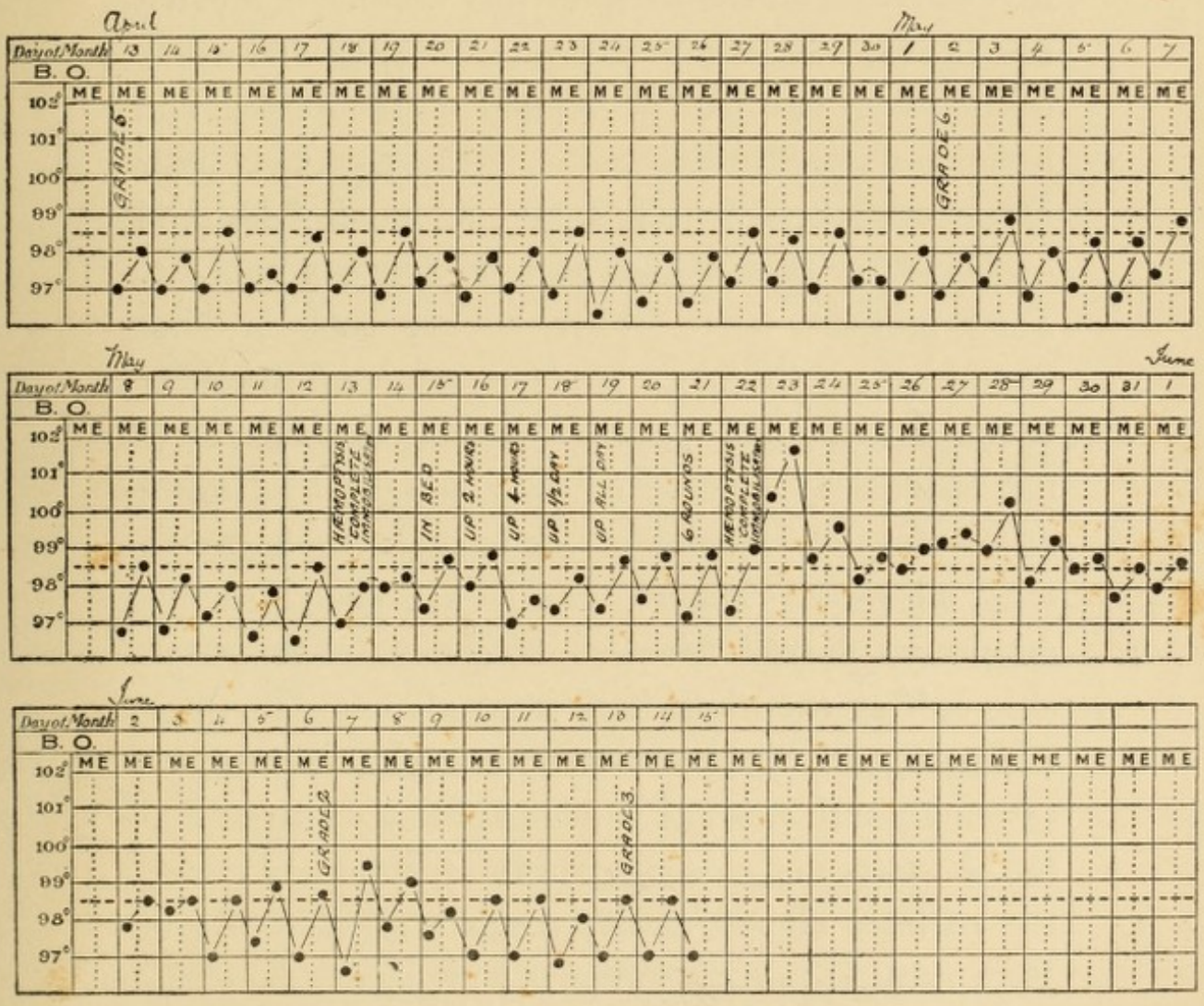


condition and was consequently able to skip several of the intermediate grades.

The last chart shows a patient who had been doing the hardest navvy work for many weeks when he had an hæmoptysis followed by fever. After seven days of normal temperature he was able to return to work. Being physically shaken by the pyrexia and weakened by rest in bed, he was started on light work, viz. Grade 2 on June 6th, Grade 3

on the 13th. On the 15th for various reasons he left the sanatorium, and three or four days later was

Chart 43.



back at his work, *i. e.* bricklaying. At the time of writing he has been at work for over eight months.

(3) *Treatment.* — The traditional treatment of hæmoptysis is by rest, semi-starvation, limitation of liquids, and the administration of morphia when necessary. The results from this treatment are not good; if the hæmoptysis is spread over several weeks or months, the patient rapidly loses weight and becomes subject to depression. The treatment now in operation here is by rest plus as much food, solid or liquid, as the patient can be induced to take. Food may be taken either hot or cold, without restriction. Of the two forms of treatment the latter is the better. The patient's power of resistance is not lowered by a policy of starvation, and adequate rest causes the cessation of his hæmoptysis in practically all cases. Hæmoptysis is not nearly such a dangerous complication as is generally supposed, although at the time it is most alarming to those unaccustomed to the occurrence. Except in the extremely rare cases of sudden fatal hæmoptysis due to the rupture of an aneurysm of a pulmonary vessel, the patients almost always make a good recovery. With regard to drugs, morphia $\frac{1}{4}$ gr. should be given immediately to insure rest, and to soothe the mental agitation of the patient. Sucking ice and inhalations

of turpentine are quite unnecessary, and only disturb the patient whilst passing under the influence of the opiate. What influence can ice have on a bleeding point in the lung? It is admitted that a piece of ice applied to a bleeding vessel will stop hæmorrhage, but this cannot be done in pulmonary hæmoptysis. The ice sucked only enters the stomach, and can have no effect on the local coagulability of the blood.

The rational treatment for hæmoptysis is therefore—

Rest in bed.

A saline purgative to lower the blood-pressure and to facilitate action of the bowels.

A hypodermic injection of morphia, repeated if necessary.

Ordinary food should be taken—anything from bread and milk to roast beef and chops. It is not necessary that the food should be cold. The amount of liquid taken need not be limited.

Calcium lactate should be given in four doses of 10 gr. each, repeated every four hours. It certainly appears to do good in some cases, and I have not seen it do harm.

In the course of my experience in the treatment

of hæmoptysis I have not been impressed with the efficacy of drugs excepting only morphia, which is my sheet anchor.

(4) *Coloured sputum.*—Besides hæmoptysis, there is a condition of affairs which is usually known as "coloured sputum." The patient means by this that he coughs up a piece of sputum which is tinged with blood. It has been the custom in the past to treat this condition in the same way as hæmoptysis.

For the past five years I have always put the following question to the patient suffering from coloured sputum: "Are you feeling perfectly well?" If the answer is in the affirmative, if his appetite is good and the deviations in the temperature chart normal, then he is allowed to go on with his work and neglect the coloured sputum altogether. We often have patients doing the hardest work who for weeks on end have coloured sputum.

Coloured sputum appears most frequently in patients who give evidence that contraction of the lung-tissue is taking place, or who are otherwise making favourable progress. More often than not it occurs the first thing in the morning, before the patient has begun the day's work. In the light of

this and similar evidence, I am of opinion that coloured sputum does not indicate active disease. Generally speaking the phenomenon may be ignored; should it continue for three or four weeks, calcium lactate should be administered. Future investigators may be able to demonstrate clearly what the significance of coloured sputum is. In the meantime I may suggest that, under the conditions named before, it may be due to the tearing of some small capillaries through the contraction of the lung.

2. Pleurisy.

Patients often have dull pains in their lungs, which they call pleurisy, but they are not accompanied by any constitutional symptoms, and are, I believe, due to the contractions of fibrous tissue which are formed as the lungs heal. The treatment of true pleurisy is, of course, Complete Immobilisation and strapping of the affected side. A symptom not uncommonly met with, more especially when it is diaphragmatic, is pain on swallowing and aversion from taking much liquid or solid food from fear of the discomfort it will cause by dilating the stomach.

If the pleurisy is followed by effusion it is better

left alone, so long as it does not cause distress by pressure. It acts as a splint to the affected side, and as a rule speedily clears up under treatment by complete rest. There is nothing to be gained by tapping, and there is also a risk of causing an auto-inoculation by interfering with the blood-fluids. Should there be distress, a certain amount of fluid drawn off, say one and a half pints, will relieve the condition. These purely tuberculous effusions practically never become purulent, unless some discharge from the lung enters the pleural cavity, that is, when accompanied by a pneumo-thorax.

3. Pneumo-thorax.

This is a somewhat rare complication, and is almost invariably accompanied by a sudden onset of fever and dyspnœa. The patient looks obviously ill, as though suffering from shock, and the pulse is small and rapid.

Oxygen will afford relief, and as long as patients keep quiet and do not over-exert themselves it has been my experience that they nearly always recover from the severe symptoms in about three weeks. The prognosis is of course hopeless. The patient

may live for a month or years, but will not regain the use of the lung, which has collapsed. This condition frequently develops into—

4. Pyo-pneumo-thorax.

The question of operation immediately arises. I have seen a number of these cases drained, and provided the condition is tuberculous, do not know one in which recovery was effected, even when the resection of the rib was followed by an extensive Estlander operation. For my own part I should prefer to be left alone and have the pus aspirated whenever it caused distress, rather than spend the rest of my life with a poultice of smelling pus covering one side of my chest.

I regard this condition as hopeless.

5. Tuberculous Laryngitis.

This is a serious complication. At one time I used to teach the house-physicians at Brompton that it was almost always a fatal sign. My views have been altered since I have seen the many good recoveries made under treatment by laryngeal rest. The serious nature of this condition should be

explained to the patient, and he should be informed that nothing can be done without his loyal co-operation. He must cease to talk altogether, and must carry a book and pencil with him in which to write down anything he wishes to say. Pain on swallowing can be relieved by spraying the larynx just before meals with 2½ per cent. of cocaine. A properly designed spray should be used—one that sprays vertically downwards, not backwards on to the pharynx. Insufflations of orthoform are also useful when the pain is less severe, and have this advantage —that the patient can perform the operation himself. The use of cocaine lozenges I consider bad.* Firstly, they render the tongue analgesic and so spoil taste and appetite; secondly, the dissolved lozenge is swallowed and does not come into contact with the affected larynx. Surgical interference with active laryngeal tuberculosis is certainly attended with grave risks; it is better to wait and see what results can be obtained by three months of complete rest before embarking on an operation. If either the knife or cautery are used a reaction must follow in the lesion unless all diseased portions are removed or destroyed.

* An irritable larynx can be relieved by inhaling two drachms glycerine of carbolic acid added to a pint of boiling water in a "Maw" inhaler.

This reaction will cause an auto-inoculation, the extent of which can in no way be gauged, and may upset the balance of the patient's resistance. When it is remembered that bacterial products may be discharged into the blood-stream by "any movements, active or passive, which affect the focus of infection," it will be more readily admitted that surgical interference with the larynx in tuberculosis is dangerous, and should only be undertaken as a last resort.

These remarks, of course, refer to laryngitis in its active condition; they do not apply to old chronic ulcers of the cords, etc., which are practically cut off from the blood-fluids.

6. Ischio-rectal Abscess.

This complication is rare. If opened at once and dressed with iodoform the abscess almost invariably heals, and so far as I have been able to judge does not affect the prognosis of the case.

The fact that in the past ischio-rectal abscess was considered a more or less grave complication may have been due to the practice of scraping the walls of the abscess cavity. The same objections apply to this latter operation as to surgical treatment of the larynx.

CHAPTER IX.

INFECTION.

1. Sources.

Despite the fact that the origin of consumption has been traced to the tubercle bacillus, public opinion on the subject continues to be characterised by ignorance and superstition. The child of tuberculous parents ignorant of the dangers of expectoration is born into a very hot-bed of infection to which it must be constantly exposed. Yet when a man contracts this disease it is the common experience of medical men to hear some such comment as the following, "I cannot understand how so-and-so got consumption. His brothers and sisters are all strong and healthy. His father and mother were hale and vigorous, and lived to a good old age. The grandparents on both sides had equally good histories. It is extraordinary. . . ." Now, when a man con-

tracts typhoid or scarlet fever we hear no talk of family history. Why then single out one infectious disease and persist in the endeavour to attribute it to hereditary causes? Tuberculosis is due to infection alone, the main sources being the expectoration of tuberculous individuals and the milk or milk products of tuberculous animals.

When expectoration containing tubercle bacilli is allowed to dry it breaks up into minute particles of dust, which are scattered broadcast, and may easily be inhaled or swallowed by persons who come into contact with them. It is obvious, therefore, that the risks of infection are widespread. To appreciate the danger at its full value, it is only necessary to consider that thousands of ignorant or reckless and irresponsible infected persons are daily travelling from place to place and mixing with their fellows without ever taking the necessary steps for the safe and cleanly disposal of their sputum. In spite of the bye-laws which prohibit spitting in public places this filthy habit is prevalent in all quarters. The most flagrant examples will readily occur to those who travel at all frequently in local areas, whether by tram, bus, or rail. The public notices, which are presumably

intended to deter, have little effect. The penalties are rarely carried out. And so consumption spreads, and the public remain either brutishly ignorant of the danger or callously indifferent to its cause.

Spitting into handkerchiefs, if less disgusting, is equally dangerous. The expectoration dries, and when the handkerchief is taken from the pocket millions of bacilli may be disseminated in all directions. In the theatre, the church, the office, and the private house the danger may be present and is generally ignored. And this indifference is allied to the most amazing obscurantism. People who are not dismayed at the prospect of spending an hour or two in the reeking atmosphere of a railway carriage, where shut windows and shut ventilators conspire with stale air to harbour and nourish every virulent germ in the vicinity, are nevertheless afraid to visit a consumption sanatorium, where the value of fresh air and cleanliness is known and appreciated.

The obstinate opposition to unfamiliar things that is characteristic of the less intelligent is well exemplified in the attitude of the general public towards the use of pocket spitting-flasks. Consumptives who use these flasks when travelling—the only safe and

cleanly method possible—have often told me that their appearance is the signal for a general exodus of passengers at the first possible opportunity. The intelligent public prefer to rub shoulders with those individuals who more worthily indulge in the good old custom of spitting on the floor. It remains for the public to be educated.

Certain occupations are supposed to be dangerous from their very nature rather than from the extra risks of infection which they involve. Barmen, for instance, are said to contract the disease owing to alcoholic habits. We often have barmen as patients, and they are nearly always young men entirely free, as far as can be judged, from alcoholism. It may be assumed that there are many consumptives who frequent public-houses, where the presence of spittoons does not prevent a large amount of spitting on the floor—hence the sawdust. Public-houses are generally ill-ventilated, and, being kept shut all night, afford ideal conditions for the drying of sputum. Consequently the barman who sweeps up in the morning is almost certain to inhale or swallow germ-laden particles of dust in the process.

Laundry girls, again, are supposed to become ill

from working in a steaming atmosphere. This may be a contributing cause, but it is more likely that they are infected by the handkerchiefs and sheets of tuberculous persons in the dirty sorting-room. Frequently from 15 to 20 per cent. of our women patients are nurses, not from consumption hospitals, but from the general hospitals and infirmaries. The explanation is, probably, that in consumption hospitals the risks of infection are well known and special care is taken to avoid them. In general hospitals phthisical cases are not welcome, and if they are admitted the nurses are not sufficiently impressed with the importance of attention to detail in the disposal of infected articles. Pus-covered dressings, for instance, ought to be disposed of immediately, and patients in bed should not be allowed to spit into handkerchiefs and leave them to dry between the sheets or under the pillow. Again, it is a dangerous habit to collect sputum in open porringers instead of in closed vessels, it being well known that flies are powerful agents in the spread of infection.

The second main cause of infection is the milk of tuberculous cows. The part played by milk in infecting adults is difficult to estimate, since adults

rarely drink milk which has not been over 160° F., it having been raised to that temperature by the heat of their tea or coffee. This is a source of danger that can be partially checked by State control. Supervision of dairies and State-regulated conveyance and distribution of milk and milk products by responsible experts would do much to ensure a pure and wholesome home supply. It would not, however, solve the problem of tuberculous butter imported from other countries. At the Washington Congress on Tuberculosis in 1908 the United States Department of Agriculture gave statistics showing that of 775 samples of butter tested 12 per cent. were found to contain tubercle bacilli. Various experiments were made upon guinea-pigs, and it was demonstrated that butter infected by tubercle bacilli could remain virulent for *at least* 99 days. When so much attention is being drawn to the necessity of sterilising milk, these facts are significant and must not be under-estimated.

The risk of infection from tuberculous meat is probably small, because meat is generally cooked and so sterilised. When the bluish tint of uncooked meat changes to the reddish tint of underdone

meat it has passed the temperature of 170° F. It is only in steaks which are raw in the centre that germs may survive. This does not preclude the possibility of raw meat infecting other articles of food which are eaten uncooked. The danger from this source of infection could be largely removed by enforcing stricter regulations in regard to the inspection of slaughter-houses. It would be well if private slaughter-houses were abolished. Under the present system the holders of slaughter-house licences are under no obligation to notify the authorities of intended slaughtering, which frequently takes place out of the sanitary inspector's ordinary working hours. The French and Belgian systems minimise the possibility of abuses by ensuring that all slaughtering is done in abattoirs in the presence of inspectors who are always on the spot. Reform in this country should aim at securing efficient inspection of cattle on every occasion at which slaughtering takes place; either notification to the sanitary authorities should be made compulsory or slaughtering should be made legal only within certain fixed periods. In the meantime offences should be punished by imposing penalties severe enough to deter the unscrupulous

from attempting to profit by dealing in tuberculous meat, and by giving adequate compensation to the honest trader who inadvertently buys cattle which are subsequently found to be tuberculous.

2. Predisposing Causes.

All the so-called trivial ailments which lower the general health are predisposing causes of consumption. Mild illnesses, such as colds and sore throats, are dangerous for this very reason that they render the sufferer more liable to infection by the tubercle bacillus. The same conditions apply to lowered resistance following excessive fatigue, deficient sleep, and under-feeding.

Carious teeth are one of the most frequent causes predisposing to this disease: when the mouth becomes septic and bacterial products are taken into the stomach the nutritive functions are deranged and digestive disorders are bound to follow. Ideally, teeth should be cleaned after every meal; if they are only cleaned once a day, this should be done in the evening, not in the morning. Our first duty to the person infected by the tubercle bacillus is to remove

any obvious cause of his lowered resistance. Failure to do this reminds me of the children's story which describes a method of testing lunatics before their discharge. The patient is placed in a room with a stone floor, and a water-tap is turned on, the patient at the same time being given a broom with instructions to sweep up the water. If he does not turn off the tap he remains in the asylum.

Before admitting a patient with chronic indigestion to a sanatorium, his carious teeth should be taken out. If he cannot eat solid food it can easily be minced. In this connection it may be said that so long as the available number of beds is limited, patients with complications should be refused admission to sanatoria. It is hard enough in any case for the consumptive of the working classes to regain his health, but when he is additionally handicapped the chances of a cure are reduced to a minimum.

Again, it is doubtful if any good end is served by treating a patient who has no reasonable prospect of obtaining work on his discharge. Many of our patients have made good recoveries in the sanatorium, only to relapse afterwards owing to lack of employment and consequent semi-starvation. When the

accommodation is equal to the demand selection will be unnecessary. All patients will receive sanatorium treatment whose condition demands it.

Insanitary dwellings, ill ventilated and ill-lighted rooms, personal uncleanliness and overcrowding are all contributing causes to the spread of infection. We do not yet sufficiently realise the importance of the part played by light and air in the economy of the human machine. Abundant light and pure air are essential to the healthy functioning of the digestive organs, and the inhabitants of dwellings from which their beneficent influence is excluded are living under conditions which lower resisting power and prepare a fruitful soil for the growth of bacilli. Statistics show that the mortality from consumption is in proportion to the number of inhabitants per room, and that in the absence of light and air mere cleanliness in the house is of no avail against infection. The problem of combating tuberculosis is inseparably bound up with the abolition of insanitary dwellings and the creation of a healthy environment for the poor. So long as individuals are content and allowed to obtain their rents at the expense of poverty and disease, the evil conditions which charac-

terise living in crowded tenements and congested slum areas will be a standing menace to the health of the community at large. Private interests must be subordinated to public health. There is no more profitable investment than the health of the nation, and a liberal scheme of compensation would be cheaper in the end than a policy of half measures and *laisser-faire*.

CHAPTER X.

STERILISATION.

(1) *Sputum.*—As no trouble is taken to sterilise tuberculous stools, and millions of bacilli must therefore enter the drains, it would appear that such a method of disposal is perfectly safe. Nevertheless, a practice of emptying tuberculous sputum down the drains would create an atmosphere of false security and would not have the educational value that attaches to the system of steam sterilisation. Experience has shown that to sterilise sputum it is only necessary to raise it to boiling-point—the bacilli being killed before that point is reached. The steriliser in use at Frimley consists of an iron vessel having at the bottom two steam jets so arranged that a circular motion is given to the contents. The accompanying diagrams illustrate the principle to be aimed at—which is that of an ordinary copper with some means of draining off the sputum. The cover

was made for the purpose of boiling under pressure, but for the reasons already given this costly addition has been found to be unnecessary. It is generally admitted that so long as sputum is kept moist it is not dangerous, so that the method of disposal by

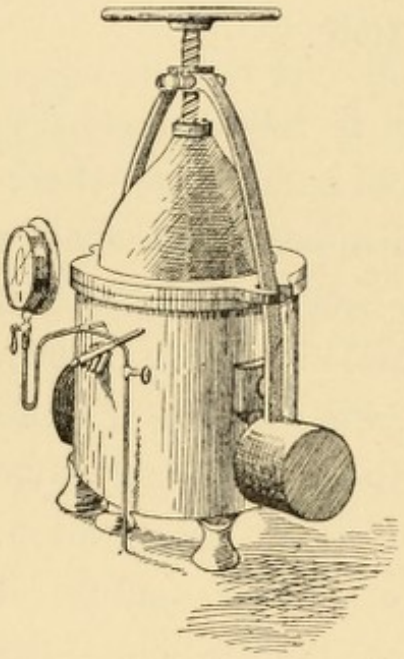


Fig. 1.—Sputum steriliser with cover on.

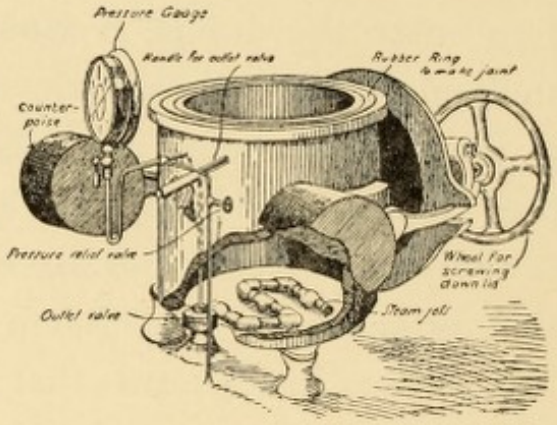


Fig. 2.—Sputum steriliser with cover off.

keeping it damp until sterilised is safer for the operator than the American system of collecting sputum in paper pots, which are burnt. In the latter case there is the risk of dry sputum escaping through indifference or carelessness on the part of the workman.

(2) *Sputum-pots.*—So long as the number of pots and flasks is limited there is no objection to having them cleaned by hand. This is the method in use at Frimley, and it is efficacious when the work is thoroughly and carefully done. Whoever is entrusted with this duty should be provided with an apron, gloves, and boots of india-rubber, which must be sterilised after use.

At Brompton Hospital—where the number of pots to be cleaned is very much greater than at Frimley—a special washing tank is used, having the necessary valves for admitting water and steam, and a valve in the bottom of the tank through which the contents can be emptied into the drain. Inside the tank is a cage, which can be raised out of, or lowered into, the tank at will. This cage is constructed of brass tubes framed and braced together. On the horizontal tubes the sputum cups are suspended by their handles and the covers of the cups are placed in suitable trays provided in the cage. For the purposes of sterilisation and cleaning the cage full of soiled sputum cups and covers is lowered into the tank. Water is admitted into the tank and boiled by the admission of steam. After boiling this water is

emptied and the process is repeated. The cage is then raised and the cups and covers are removed.

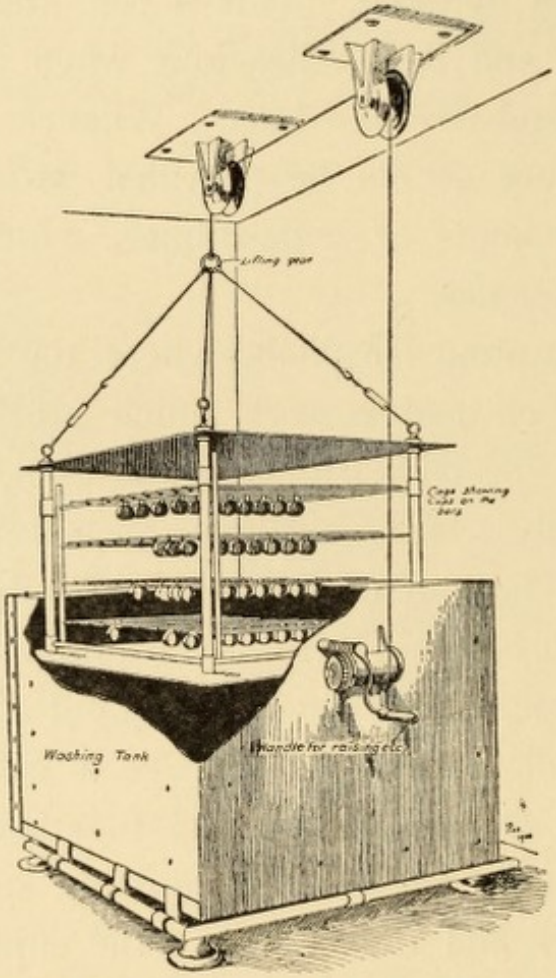


Fig. 3.—Tank for washing sputum pots.

This method saves time, ensures efficiency, and minimises the risks of infection.

(3) *Bedpans.*—The great attention paid to the sterilisation of sputum and its receptacles is due to

the fact that they are both prominent in the wards or sick-rooms. Bedpans are not kept in evidence at the patient's bedside, and consequently no attempt is made as a rule either to sterilise them or the fæces. It is an established fact that tubercle bacilli can be found in the stools of patients suffering from consumption, even in its early stages, and it follows that the same care should be bestowed upon the disposal of fæces as of sputum, and the sterilisation of bedpans as of sputum pots. It is essential that all sputum should be sterilised by steam, this being the only method of ensuring that bacilli in the midst of mucus are rendered inert. The thick, sticky mucus referred to seldom, if ever, exists in tuberculous stools, so that if the bedpan is properly flushed little infection will remain. This may be dealt with either by steam sterilisation, or by the more practical method of immersing the pans in 1 in 20 solution of carbolic acid. It is useless to place a few ounces in the pan itself. The whole of the interior at least must be considered infectious, and complete immersion is necessary.

(4) *Handkerchiefs.*—The old method of disposing of soiled handkerchiefs by burning them after they

have once been used is costly and wasteful. It has been found that handkerchiefs costing 11*d.* a dozen can be treated by sterilisation and washing, and yet last for many years. The procedure at this sanatorium is as follows. The soiled handkerchiefs are conveyed from the wards in covered pails, water having been added to keep them damp. There is no special combined steriliser and washing machine, but sputum and handkerchiefs are sterilised in the same vessel. While the sputum pots and flasks are being sterilised the handkerchiefs are put to soak in cold water to which soap and soda have been added. When the sputum is disposed of the handkerchiefs along with the liquor are sterilised in their turn, and after sterilising are dried. The temperature used is 212° F. At the end of a week about 1200 handkerchiefs have been treated in this manner. They are then removed to the laundry and washed in the ordinary way.

(5) *Bed-linen.*—The ordinary patient who is capable of using a spitting-flask is not likely to infect his bed-linen unless through great carelessness. Patients who are very ill and unable to control their actions frequently infect sheets or pillows with their

sputum or their handkerchiefs. For such patients a damp sheet should be provided over which to spit, and this, together with the whole of their bed-linen, should be placed in a bag and sterilised by steam before sending to the laundry. On the death or recovery of the patient all the bedding, including mattresses and pillows, should be sterilised. For patients who can take proper care of themselves these precautions are, of course, unnecessary.

CHAPTER XI.

DIAGNOSIS.

The onset of pulmonary tuberculosis is so insidious that the majority of those who are infected by the bacillus do not become aware of the nature of their complaint until the disease gives some definite manifestation. The frequent discovery of tubercle bacilli in the sputa of accident cases admitted to the hospitals, the evidence revealed by post-mortem examinations, the known reaction of clinically non-tuberculous cases to various tests, and the daily proof afforded by the past history of patients actually diagnosed as tuberculous combine to show that latent tuberculosis exists in a far greater number of individuals than the actual cases treated would lead us to suppose.

This latent activity, unassociated with external signs of ill-health, or associated only with mild symptoms, or with generally ignored symptoms such

as fatigue and loss of appetite, constitutes a great danger by disarming suspicion in the patient, and enormously complicates the problem of early diagnosis.

The fact that many persons are able to ward off the attacks of the bacillus by means of the natural resisting properties of their blood, without perhaps ever being aware of the process, does not minimise the gravity of the risks run by those members of the community who are less well equipped.

The importance of early diagnosis, and the necessity of making the best use of available methods, is sufficiently obvious in view of the difficulty of dislodging the disease when once it has obtained a hold. If we approach the question from the standpoint of auto-inoculation we shall, I think, find it much easier to detect the early onset of disease and at the same time appreciate more justly the significance of its manifestations in various stages.

Consumption being a general rather than a local disease, every endeavour should be made to form a diagnosis before the appearance of physical signs. There are certain clinical symptoms which, in the

absence of more specific data, are generally regarded as denoting insignificant or at any rate only temporary derangements. These symptoms vary from slight and almost imperceptible constitutional disturbances to extreme manifestations identical in kind and degree with those which characterise the disease known as "influenza." The latter condition is marked by an elevation of temperature accompanied by headache, pains in limbs and eyes, loss of appetite, rapid pulse, and general malaise. Many consumptives date their illness from an attack of this kind, but the difficulty of differentiating between such symptoms and those of "influenza," without supplementary tests, frequently misleads both the sufferer and his medical adviser, and postpones a course of treatment for which there is urgent and immediate need. If the patient under-estimates or ignores his symptoms and disregards the warning to give up work and rest in bed, the attack is liable to develop into pleurisy. This, again, is a complication to which many consumptives trace their illness. Consequently those who are known to have suffered from pleurisy in the past should be regarded with suspicion, particularly if they are not in the best of health, even

though no physical signs can be detected at the apices of the lung. More insidious, because more readily ignored, are those modes of onset which are manifested by some apparently insignificant constitutional symptom. For example, the feeling of fatigue. A well-defined type is that of the man who wakes in the morning fresh and well, but feels tired out at the end of the day. The work he does in the day-time produces auto-inoculations sufficient to cause slight constitutional disturbance, the "balance" being restored by the night's rest. This is a most dangerous condition. Such a man may continue to work for months knowing perfectly well that there is something wrong with him, but totally unaware that he is seriously ill, and disinclined to make a fuss about what he imagines to be a trivial and temporary ailment. For this reason I am of opinion that the most favourable onset in adults is hæmoptysis. Hæmoptysis has a salutary moral effect upon a patient who has hitherto been ignorant of the tuberculous processes occurring in his lungs; after such an outward and visible sign of his trouble he is generally much more amenable to reason, and it is clear that his protective sub-

stances have not been sorely tried if it needed an hæmoptysis to make him aware of the existence of disease. The fact that hæmoptysis often occurs before resistance has been lowered by continuous, uncontrolled, excessive auto-inoculations probably explains why so many hæmoptysis cases eventually do well. Those who complain of fatigue after the day's work can be tested by observing the daily deviations of the temperature. If the temperature is taken for a few days while the patient is resting the deviations will be slight; if, then, he is told to take as much exercise as will produce the feeling of weariness the deviations will probably be much larger. In applying this test and using the mouth temperature it is important that the patient should be told to breathe through the nose. If the test is successful it can be supplemented by the tuberculin test.

The presence of tubercle bacilli in sputum is certain evidence of pulmonary tuberculosis, though not always of activity (*cf.* p. 81). On the other hand, an examination which produces negative results does not justify the conclusion that the patient is non-tuberculous any more than the absence of sputum

denotes evidence of freedom from disease. Sputum is a sign of ulceration, but not every tuberculous focus breaks down.

At Frimley the sputa are examined in a routine manner, and it frequently happens that no tubercle bacilli are found until the fourth or fifth examination. The sputum of many patients has been examined as often as seven times before giving positive results, and there is one case on record in which no evidence of tuberculosis was found until the eighteenth examination. It is clear that negative results should be accepted with reserve, and that examinations should be conducted by those methods which experience has shown to be the most reliable.

Obvious disadvantages attach to partial examinations; the Ziehl-Neelsen method may serve its purpose for routine processes, but there can be no doubt that the methods of concentration, viz. "ligroin" and "antiformin" are more thorough and more reliable.*

At the same time thoroughness is a waste of energy if the material under examination is of poor quality. Patients whose sputum is to be examined

* See Appendix II.

for purposes of diagnosis should be impressed with the fact that quality, not quantity, is required. They should be instructed to send for examination the first expectoration of the early morning.

Whether the fæces have an independent diagnostic value is a question that can only be answered in the light of further experience. If tubercle bacilli can be demonstrated in the fæces of a patient whose sputum gives no evidence of tuberculosis after repeated examinations, we shall have acquired a new and important aid to diagnosis. Investigations are at present being carried out at Brompton Hospital,* but have not yet reached a stage at which it is possible to estimate their value. Unless intestinal tuberculosis is indicated the presence of tubercle bacilli in fæces would appear to be due to the swallowing of sputum containing tubercle bacilli coughed up from a tuberculous ulcer in the lung; under these circumstances it seems improbable that fæces can afford evidence of pulmonary tuberculosis which is not at the same time demonstrable by the presence of tubercle bacilli in the sputum.

* "The Specific Diagnosis of Pulmonary Tuberculosis," by A. C. Inman, *Lancet*, December 17th, 1910.

Variation in the opsonic content of the blood is, I believe, evidence of tuberculosis if the technique for estimating the index is in competent hands. This statement is based on my knowledge of the fact that at Brompton, Inman, by means of the opsonic method, diagnosed as tuberculous sixteen patients whose sputa gave no evidence of tuberculosis. Subsequent examinations revealed the presence of tubercle bacilli in the sputum of all these patients. Here, again, in pulmonary tuberculosis a negative opsonic test signifies nothing unless the determination is made after an amount of exercise has been taken sufficient to show the influence of the bacterial products upon the opsonic content of the blood.

The value of cutaneous or ophthalmic instillations and subcutaneous injections of tuberculin is largely discounted by the difficulty of forming an unequivocal judgment upon the significance of their reactions. The fact that positive reactions are not necessarily indicative of active tuberculosis, and that negative reactions are not conclusive evidence of inactivity, is further complicated by the problem of deciding in any given case whether a positive reaction

is specific or general. Calmette claims for his conjunctival method that non-tuberculous subjects, with the exception of a few typhoids whose reactions can be distinguished from the specific tuberculous reaction, do not respond to the test. Whatever the value of this method, there seem to be serious objections to exciting local inflammation, which may be re-kindled by subsequent inoculations of tuberculin. The von Pirquet test is positive in 87 per cent. of young subjects clinically tuberculous, and in 25 per cent. of those who give no sign of tuberculosis. If there are a few crepitations at one apex and no other evidence is obtainable, the method may be of use in testing adults, though positive reactions do not prove activity.

In estimating the value of the various means of diagnosis at our disposal it is important to realise that what is required is not so much a "high degree of diagnostic precision" as a method, or combination of methods, which will enable us to detect "the probable nature of a suspicious lesion" (Calmette).

A test which merely indicates latent tuberculosis is not in itself an agent of diagnostic value; we need definite evidence either that the disease is active or

that it is inactive. I do not wish to minimise the importance of certain tests and reactions as corroborative or supplementary indications, but my conclusion is that until more certain methods are forthcoming our most valuable asset in diagnosis is the knowledge that we can detect the premonitory or early symptoms which characterise the processes of auto-inoculation by applying to suspected cases the clinical tests and observations which I have described.

To sum up, the most definite evidence of active tuberculosis is the presence of tubercle bacilli in sputum, or an opsonic index varying outside normal limits, together with the patient's own feeling that he is out of health.

The patient who complains of fatigue at the end of the day and whose temperature shows deviations should be regarded with suspicion; if he gives a positive reaction to tuberculin there is a strong probability that he has active disease. Equally suspicious is the patient who feels tired at the end of the day with loss of appetite accompanied by loss of weight. The tuberculin test may be applied here also, but whether a tuberculin reaction indicates activity or not can only be decided by increasing the

amount of exercise taken by the patient, and watching the deviations of the temperature. It is clear that the general practititioner who is confronted with a suspicious case need not feel himself entirely dependent on the laboratory for his tests; an acquaintance with the symptoms of auto-inoculation and the clinical methods of testing the patient will go far towards enabling him to give a diagnosis. It would be well if medical students, who are already compelled to undergo a course of instruction in fevers, should also receive compulsory training in the diagnosis and treatment of consumption.

CHAPTER XII.

THE OCCUPATION TO BE FOLLOWED BY THE DISCHARGED CONSUMPTIVE.

The aim of the discharged consumptive should be to find work which will enable him to live under those conditions which are essential to the maintenance of his health. Nourishing food, regular hours, rest, and pure air are indispensable. The important point to remember is that lowered vitality increases the chances of relapse. Consequently work should be chosen which will bring in enough to ensure a decent standard of living in the home. Now the man with a trade has a definite market value, and will be much more likely to make adequate provision for his needs by this means than by seeking work in other spheres where the advantages of pure air are nullified by low wages and insufficient food. The skilled man who is well paid for indoor work should not throw up his job on the

bare chance of getting another equally remunerative out of doors. These remarks are necessitated by the fact that discharged consumptives are often given the most reckless advice by members of the medical profession. They are told that they must get a "light open-air job," must "live in the country," "emigrate," or "go to sea." If it were possible for every consumptive to obtain open-air work at a living wage, no fault could be found with this advice. The facts are very different. Unless a man is skilled at outdoor work he will find it very difficult to get employment, and if he does so, it will certainly be badly paid. He must therefore be guided by the relative economic value of his work, and must take into consideration the nature of his environment when off duty. A point frequently overlooked is that the 54 working hours per week are considerably less than the 114 non-working hours, so that if a man earns good wages he can live the latter under hygienic conditions. It is also overlooked that for at least one third of the year the opening of office windows will not meet with protest. Again, the number of outdoor workers with tuberculosis is considerable—a fact probably due to their

unhygienic habits of living at home. The medical profession have been so impressed with the importance of outdoor work for consumptives that they have been inclined to forget the first thing necessary, namely, enough money to buy nourishing food. Unless that can be guaranteed, it is fatal to advise a man to leave his job. Yet this advice is often given in the most reckless manner. The consequence is that a large number of indoor employees are deprived of their only means of making a living, and are then sure to relapse from semi-starvation. In this way sanatorium workers are hindered, and much of their work has to be done all over again. There are hundreds of ex-sanatorium patients engaged in indoor work at the present time, and if they can do it, others can do it too.

At a conference of the C.O.S. held in 1910, convened to discuss the future of patients discharged from sanatoria, all the practical workers in sanatoria present were agreed on this point: that for a man brought up without experience of outdoor work it was useless to endeavour to obtain such employment. In what does the "light outdoor job" consist? Ex-soldiers, with many medals, who haunt

the precincts of our shops and restaurants, park-keepers, and their like, might conceivably come under the category; otherwise it is practically non-existent. Gardening is a skilled profession, and the fact of having had consumption does not qualify a man to enter it. Nor is it always by any means light work.

I may quote as an instance the case of a man who gave up a post as a stoker in an electric light station, where he was earning 30*s*. a week, to become a gardener at 15*s*. a week. He found the work actually harder, and in addition had to bicycle five miles each way to and from his work. Under these conditions he rapidly broke down, and ultimately came to the sanatorium. He has since worked as a stoker for three years with excellent results. That gardening is a light outdoor job is a delusion. Moreover, a man who spends several hours a day in and out of a hot-house runs grave risks of catarrhal attacks, which predispose to a recrudescence of the disease.

Emigration has many serious drawbacks. The only valid reason for emigrating is the certainty of obtaining outdoor work, which is not obtainable at

home. Inadequate means and indefinite prospects are not a suitable equipment for the consumptive emigrant. If he is not refused admission under the stringent immigration laws in force in the United States and many of the colonies, he has to face the problem of finding work in a new country, under circumstances which tax the pluck and stamina even of those who are not handicapped by ill-health. The popular notion that all places outside England are health resorts is erroneous. Medical men in America, Canada, and Australia have often expressed their astonishment to me at the haphazard and indiscriminate way in which consumptives are advised to emigrate. America, South Africa, Canada, and Australia all have their sanatoria, and are building more; if the climate of these countries does not prevent those who live there from getting consumption, it is not likely to do much for the consumptive who goes there in the hope of being cured; climate does not control auto-inoculation. If a man has friends to go to, if he has definite work at an adequate wage in view, and if his disease is arrested, there is no objection to emigration. He must, however, be careful to take into consideration his wage-earning

capacity in relation to the cost of living in the country to which he goes. Of the colonies South Africa, Tasmania, New Zealand, and Australia are probably better than Canada. The custom in the latter country of shutting all the windows during the long winter and keeping up a high temperature by means of hot-water pipes is not conducive to the maintenance of health.

"Going to sea," again, is an attractive phrase with a healthy ring about it. But the man who goes in a working capacity does not have the same advantages as the consumptive passenger who can spend the whole day on deck and obtain the benefits, if any, of sea air. The purser's assistant, whether at sea or in port, spends most of his time in a small and stuffy cabin. The ship's steward is in even worse case. His quarters are confined and overcrowded, and generally so near the water-line that the scuttles can rarely be opened. As it was put once to the writer, "the only time I sees salt water's when I 'ave a bath." The steward is at the beck and call of everyone, living between decks day and night, with few opportunities for regular rest. In bad weather it is impossible for him to sleep on deck, and he is

driven to take refuge in a close, ill-ventilated space, where the use of a pocket spitting-flask would attract instant notice and probably lose him his berth. That going to sea affords no guarantee against infection is proved by the fact that in 1909 no less than 315 cases in the Navy were reported tuberculous. The majority of these men had served from five to ten years, showing that they became infected whilst in the service. Though no statistics, so far as I know, are available, a number of consumptives are admitted to the hospitals from the Mercantile Marine, which is a much larger service.

To sum up briefly, the discharged consumptive should not be guided in his choice of occupation by considerations, often illusory, of pure air alone. The question is primarily an economic one, and must be judged mainly from that standpoint. So long as the work does not involve over-strain or fatigue the man who has a trade should do his utmost to return to it, remembering that the most favourable conditions during working hours are no compensation for insufficient nourishment and unhygienic habits in the home.

CHAPTER XIII.

SANATORIUM ADMINISTRATION.

One of the chief mistakes made by the public and other bodies who have built and who are building sanatoria is that they build small institutions of from twenty to forty beds, instead of combining to build one large sanatorium to accommodate 150 to 250 patients. In consequence of this initial mistake they can seldom obtain either economy or efficiency. In the first place, the small institution must have fully trained heads, and they could equally well supervise many more subordinates. In the second place, with a sanatorium of twenty-five beds it is impossible to offer a salary sufficient to induce first-class men to undertake the work. The result has been too often that medical men have accepted these posts at small salaries because they themselves have been broken down in health by tuberculosis. Now it does not follow, because a

medical man has had consumption, that therefore he will make a successful superintendent of a sanatorium. It is as though a big business company, in order to save managerial expenses, should appoint a bankrupt to look after its interests. Sanatorium work carried out on the lines indicated in this book is not work fitted for anyone who is not in robust health. I do not wish to be misunderstood. If a man has had consumption and has completely recovered, and if on other grounds he is considered fitted for sanatorium work, there can be no possible objection to his appointment. My sole point is this —that it is false economy to offer small salaries and run the risk of converting sanatoria into homes for invalid doctors. The obvious remedy is to build for *e. g.* 150 patients, and distribute amongst the medical officers at least £600, instead of giving £100 to one medical officer for twenty-five beds. It is only in this way that it is possible to obtain the best men from our medical schools. Well paid work is nearly always good work; it attracts the best men and stimulates effort. The existing system puts a premium on inefficiency, and is responsible for many of the unkind comments passed upon sanatoria at

the present time. Whatever business a public body undertakes it cannot achieve the best results without a competent manager.

Staff.

Medical superintendent.—The medical superintendent in charge of the sanatorium should be conversant with all the details of administration in addition to the medical work. He should be directly responsible to the Committee of Management, or other authority, who should supervise his work, and so long as he performs his duties satisfactorily should be allowed full control over the details of administration. This is a well-tried system, and has been in force in our infirmaries, asylums and fever hospitals for many years. It is necessary that the medical superintendent should be given a free hand; no one will do good work if he is being constantly worried by persons who seldom have the inside knowledge and first-hand experience of a competent man on the spot.

It is, of course, essential for the sanatorium authorities to have a thoroughly trustworthy, loyal and efficient medical officer; if at the end of a pro-

bationary period he is found wanting in any respect, it is better to let him resign at once, and find a reliable man to replace him.

When sanatorium treatment is carried out on the lines of auto-inoculation the medical superintendent must be equipped with a knowledge of many things not learned in the ordinary course of his medical training.

Medical officers elect can most quickly acquire such knowledge by spending a few months at an efficient sanatorium under the supervision of an experienced medical superintendent, from whom they can learn the details of the work, just as at the present time junior officers of the asylums learn from the medical superintendents, or general practitioners intending to adopt laboratory work practise under a trained pathologist. When there are numerous large sanatoria run on the lines of graduated rest and exercise there will be no lack of suitable men, but until that time comes no other method of training is possible. A medical man may be a patient in a sanatorium for months and yet know nothing about the inner workings of its administration.

Matron.—The matron should be directly respon-

sible to the medical superintendent for the efficient discharge of her duties. These include entire control of the nursing and domestic staff, and supervision of kitchen and laundry. In small sanatoria she should in addition have charge of the stores.

If it does not follow that in hospital work a good nurse will make a good matron, this is more especially true of sanatoria, where work has to be done in which nurses can have had little training. Take, for example, the laundry. Not only must the matron know when things are badly done, she must know also how they ought to be done, and the way to do them. Otherwise she will have no disciplinary influence with her maids.

The same remarks apply to the kitchen. In sanatoria the kitchen almost takes the place of the dispensary, so that good management is essential.

Tact and vigilance are no less important. Whatever may be said to the contrary, the mixed sanatorium will never lack patients eager to take advantage of opportunities for flirtation or intrigue. When windows are habitually kept open, there is an easy means of access from one ward to another, and those who refuse to acknowledge the necessity for

night nurses are either ignorant of the facts, or wilfully blind. Apart from all questions of propriety, the sanatorium is, first and last, a place to which patients go to be cured. Anything that interferes with that motive should be discountenanced and opposed. Where the sexes are mixed, the men's quarters should be in a separate building at some distance from the women's. When they are in separate wings of the same building, continual surveillance is necessary, and the matron must use every means in her power to prevent patients of opposite sex from becoming acquainted.

She should be responsible for seeing that all patients do the indoor work allotted to them, and in default, report the offender to the medical superintendent. All patients should be treated alike, and favouritism by the nurses should be discouraged.

The work of the matron in a sanatorium is entirely different from the corresponding work in a hospital; it is work for experts and requires special knowledge. To give one more example, unless the matron is well schooled in the principles of Complete Immobilisation, she will not be able to train her nurses. My final observations upon the

training of the medical superintendent apply equally to her.

Assistant medical officer.—This officer should have held at least one resident hospital appointment, and should not be under twenty-five years of age.

The salary must be high to attract good men, and should be at the rate of at least £1 per bed. At present the post leads to little, and only suits a man who wishes to work for an examination, or who requires a resident post which will enable him to save a little money.

Duties: generally to assist the medical superintendent.

To do dispensing.

To visit all patients in bed every day.

To treat all minor ailments.

To supervise the laboratory work.

To examine the patients at regular intervals.

To act as medical superintendent in the latter's absence.

Nurses.—For 150 patients seven fully trained nurses are sufficient and may be distributed as follows: four on day duty, with one extra to help wherever

work happens to be heaviest, and to relieve any of the day nurses when necessary. Two on night duty. One could probably do the work, but two are company, and a sanatorium with all the windows open is a very lonely place at night.

A night nurse is essential in a large sanatorium. There are always some patients on Complete Immobilisation who have to be looked after, and where the sexes are mixed it is necessary to have a nurse who will act as policeman.

It is useless to have probationers. Apart from practical considerations such as loss of efficiency, it is unfair to obtain cheap labour in return for the offer of a thorough training which neither matron nor nurses have time to give.

Ward maids.—It must be remembered that all patients capable of working make their own beds, clean their wards and corridors, polish brass work, etc. Under these conditions four maids are enough for 150 beds. The work cannot be done by less than four, since it is never possible to tell how many patients may be put to bed on Complete Immobilisation, which necessitates extra work for the staff. Apart from immobilisation cases, the maids are

required to scrub the wards of patients who, though not in bed, are not yet permitted to work.

Salary £15, rising to £16. Distribution of other maids as follows:

Nurses' home—two maids, £18 and £15.

Medical officers—one maid, house and parlour, £20 to £24.

To look after men's and maids' quarters, dining-rooms, etc.—two maids, £15.

Kitchen staff.—The cook who has to provide for the needs of a large sanatorium must have other qualities besides the ability to cook. She must be a woman with a head on her shoulders, and the will to seize opportunities for effecting legitimate economies. Discrimination, judgment, and the faculty of looking ahead will make all the difference between efficient and inefficient management. Meat, for instance, must be ordered in good time to see that it is properly hung before being cooked. Hundreds of pounds can be wasted, yet never missed, by thoughtless and indiscriminate cooking. A joint of 24 lb. needs more roasting than one of 20 lb.; the one must not be under-cooked, nor the other over-cooked. Common-sense and thoughtful attention to

detail will effect a large saving of money, and ensure proper feeding of patients and staff.

A good cook can be obtained for £30 to £40 per annum, but you cannot expect the desired combination of qualities for that sum. On grounds of economy I would give £80 for a capable cook-manager; it must be remembered that £80 is not excessive for the manager of a dispensary, which is to a great extent replaced in a sanatorium by the kitchen. If it is contended that the matron should be responsible for kitchen management, my answer is that the matron has already enough to do, and whilst she can undertake the duties of general supervision, she cannot possibly afford the time to pay close attention to business details.

Kitchen maid, £24.

Two scullery maids, £16.

Engineer.—If the sanatorium has electric light engines, boilers and laundry, a certificated engineer is necessary.

It is the custom in many hospitals to employ a so-called "engineer," whose only claim to the title consists in the fact that he affects an expert knowledge of matters which no one else in the

hospital pretends to understand. This individual usually begins as a fitter, and works his way gradually upwards until he is made "chief engineer." When there is no one in the institution with expert knowledge, bluffing is a simple matter. If anything goes wrong, it is easy enough to send for the nearest repairers and allow them to put things straight.

The Board of Trade would not employ such a man even as second engineer in the smallest of sea-going ships. It is impossible to bluff at sea; a man must depend on himself, and cannot count on external aid to get him out of difficulties.

If the machinery and plant are to be properly looked after, and the repairers' bills saved, good wages must be paid to secure a competent man, that is, one with sea-going experience and a Board of Trade certificate. He should be given a house on the premises so that in case of emergency he is always on the spot. His coal and washing should be free, and his salary at least £10 a month. This may sound excessive, but it will be found more economical to pay a man liberally in view of what he saves, than to underpay him and lose money by his wastefulness. An untrained man will send £10 up

the chimney in smoke which the trained man will convert into steam. I have had personal experience of both kinds, and know that it is cheaper in the end to get a capable man, and pay him well.

Assistant engineer.—This man is required to relieve the engineer, and to keep fittings, etc., in repair. He should be a trained electrician. Salary 18*s.* a week and all found.

Stoker.—A first class sea-going stoker can be obtained for 12*s.* a week and all found.

Sputum porter.—To clean and sterilise sputum pots, etc.; to look after coal, pig-pails, and do other odd jobs; 12*s.* and all found.

Night-watchman.—To act as general policeman, and to keep fires going where necessary. To look after the main boiler fire, and do other work in engine room.

Tool-keeper.—If any out-door work is to be done a tool-keeper is a necessity. Duties: to keep tools in repair, and to see that they are brought in by the patients after work. To keep stock, look after renewals, etc. This man should be able to use a forge; 15*s.* and all found.

Gardener.—It is not to be expected that a

professional gardener will have much sympathy with a system which is firstly therapeutic and only secondly horticultural; if patients are entrusted to his untender mercies the results will be disastrous. He will get as much work as possible out of them, regardless of their condition, to secure his own ends; he will declare at the same time that they are quite useless as gardeners, and that he could do much better without them. Naturally he is disinclined to look at gardening from the standpoint of auto-inoculation; the theory that roses do not matter so long as the gardener patient takes his proper amount of exercise is to him a damnable heresy. His object is to produce crops, not to cure consumption. It follows that *the whole of the out-door work must be superintended by a medical man.* The end in view is not the production of crops, but the restoration of consumptives to full working capacity. If, in spite of the patients, the crops are good, so much the better.

There is another side to this question. Patients who are under medical treatment will not do their work properly unless it is supervised by someone who knows more about it than they do

themselves. I find it difficult at first to make medically trained assistants realise the importance of detail in graduated labour, so that it is not surprising if the system fails in the hands of a gardener. Fortunately, we always have a few gardeners, either professional or amateur, amongst our patients, and they are able to act as instructors to the rest. Skilled work can only be done by those patients who have "heads"; the unskilled may be left to those gifted with less intelligence.

Patience, personal supervision and the large amount of labour at our disposal generally enable us to get crops as good as are grown anywhere.

Of course, there are disappointments. A patient put to weed a definite bed will finish the work, and may in a fit of industry or a moment of enthusiasm pass on to the next and uproot thousands of promising seedlings.

Such accidents are only natural. Personally, I did not know the difference between a young cauliflower and a small geranium when I first started at Frimley, nor for a long time could I find a book on the subject simple enough to understand. Most books on gardening open with the exhortation

to "make a rich compost," but if you are unaware of the nature of a compost to begin with, the task of making a "rich" one is beset with insuperable difficulties. To those who know nothing about gardening I can thoroughly recommend the children's book, by E. T. Cook, called, *Gardening for Beginners.*

Carpenter, etc.—If it is intended to keep the buildings in repair without employing outside labour, the following extra staff will be required:

One carpenter, 16*s.* a week and all found.

Two painters, 15*s.* and 12*s.* a week and all found.

So long as there is a man in charge working with them patients can do a great deal of the work themselves. This work is not so skilled as gardening, and can be graded by using brushes of different sizes.

Laundress.—A laundress at £30 and all found with three maids at £15 will do the work for 150 patients and a staff of fifty. Machinery necessary: two washing machines, one large calender, one collar machine, one mangle. Dresses, etc., are done by hand. One man will do all the wash-house work for above, and will cart and deliver the goods when cleaned.

Storekeeper.—The storekeeper must see that correct diets are issued for patients and staff, must check all deliveries, and keep all books in order and up-to-date.

Accommodation.

In working-class sanatoriums, at any rate, the sexes should be kept apart, if possible, in separate buildings.

If the mixed sanatorium is inevitable, we have then to consider the question of accommodation. At first sight it would appear that we ought to provide the same number of beds for both sexes. This is a mistake. The number of women patients is always less than that of the men, owing to the fact that the consumptive married woman of the working classes only enters a sanatorium as a last resource, when she is incapacitated for work. The difficulty of her position is obvious when it is remembered that she is nurse and mother, servant and cook, housekeeper and washerwoman all in one; she cannot surrender all these responsibilities unless she has a reliable person to take her place, and so keeps putting off the evil day until she is no longer

of any use in the house. Even if she is persuaded to enter a sanatorium, it is by no means certain that she will remain for the full course of treatment. The first letter from her husband hinting of domestic trouble will be enough to send her home again. With the married man it is different; he is the wage-earner, and knows perfectly well that the maintenance of his family depends on his capacity to work. His first object is to get cured; in the meantime he trusts to his wife to keep the home together.

Men patients out-number women in the proportion of two to one, and accommodation should be provided for each on that basis.

Wards.—Both from the patient's point of view and that of the medical man there is much to be said in favour of the single ward. The English working man generally prefers a ward to himself; the Englishwoman of the same class always does. The single ward is more comfortable and less draughty; it is always better kept when one person is responsible than when five patients share a ward between them. It also has this great advantage, that if a patient is on "absolute rest" he has no opportunities of talking with his fellows. For these

reasons the single ward is to be preferred, though the argument generally advanced in its favour, that patients do not disturb each other by coughing, is fallacious. With open windows, coughing can easily be heard two or three wards away.

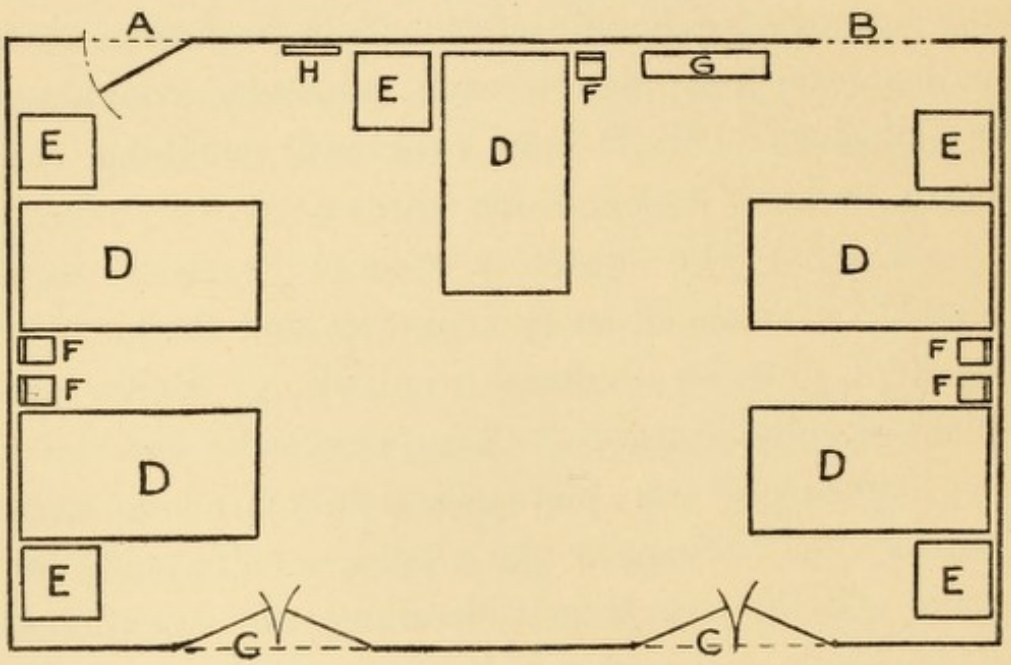
Whether the wards are large or small they should be arranged in such a way that the air may be kept pure by thorough ventilation. Below are plans of suitable wards for five patients, or one.

These wards were planned and built on a large scale with a view to securing the necessary cubic space for each patient. Such considerations are superfluous when windows are kept wide open, and the means for ventilation are thorough and up-to-date. Under these conditions the patient is to all intents and purposes living out-of-doors, so that the question of cubic capacity can be safely ignored, so long as adequate floor space is provided for the comfort of each patient.

Glass windows to the wards of a sanatorium are of no value, because when they are shut they keep out the air. The accompanying illustrations* show how ward windows should be arranged, viz. they should

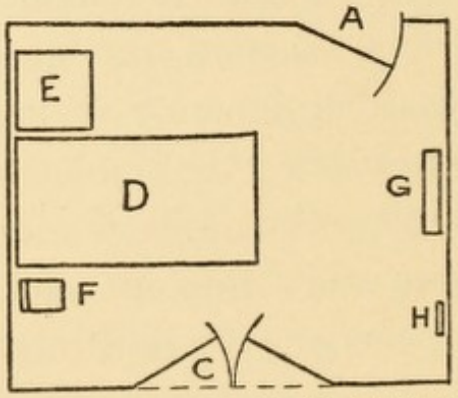
* This form of window has been adopted for the King Edward Memorial Sanatorium at Ipswich.

PLAN OF FIVE-BED WARD.



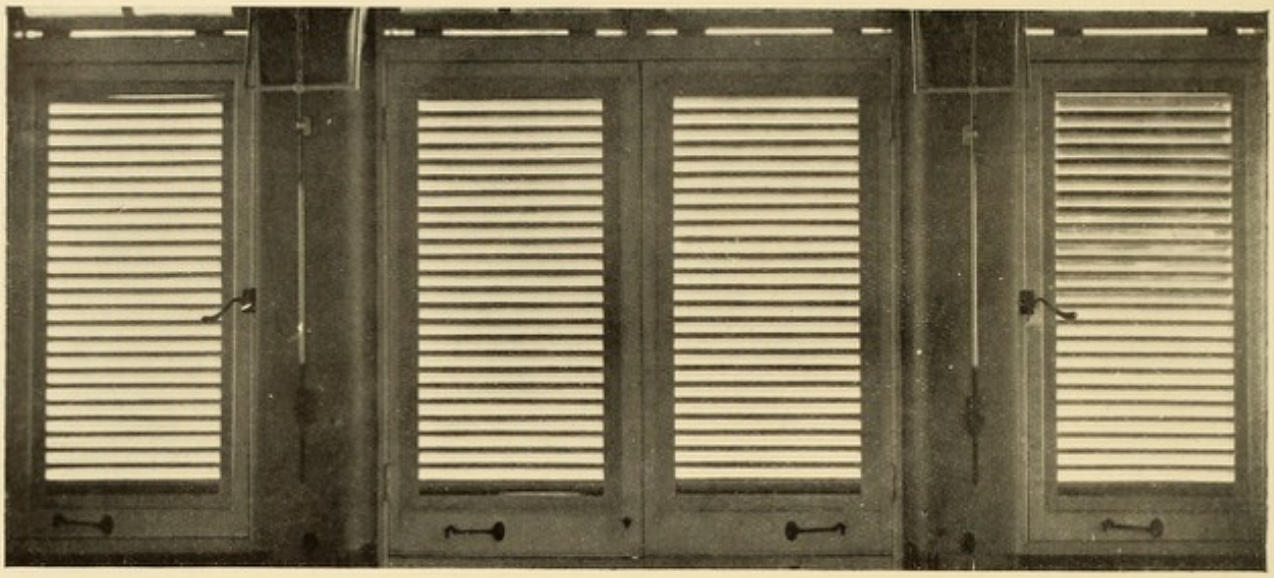
Length 27′ 0″; breadth 16′ 6″; height 10′ 0″.

PLAN OF SINGLE-BED WARD.

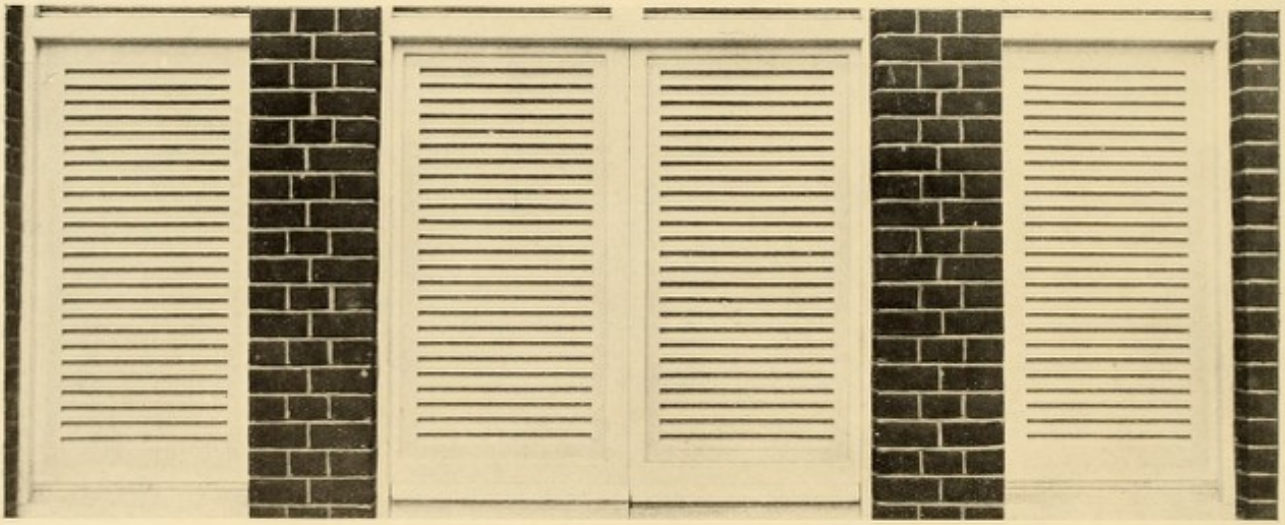


Length 12′ 0″; breadth 10′ 0″; height 10′ 0″.

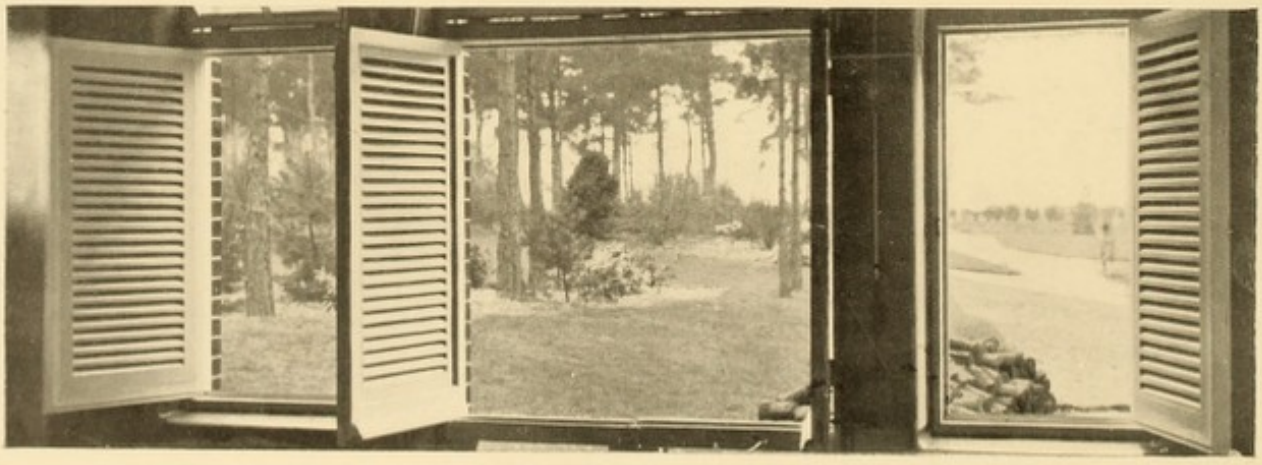
Arrangement of single and five-bedded wards. Reference letters: A. Door with fanlight over. B. Fanlight 6′ 0″ from floor. C. French windows to ground. D. Beds. E. Clothes lockers. F. Chairs. G. Radiators. H. Looking glass.



1.—View from Within—Windows shut to keep out a Driving Rain.



2.—View from Without—Windows as Above.



3.—Position of Windows under all Ordinary Circumstances.

be fitted with jalousies to be closed when there is violent or driving rain. These will keep out the wet, and at the same time will admit plenty of fresh air. In the illustrations there is one error due to the initial construction of the sanatorium, *i. e.* the jalousies open inwards; if they opened outwards there would always be a lee-side, and even one window projecting outwards would be sufficient to keep the rain out of the ward.

The floor should be covered with linoleum. The objection to bare boards is that they are noisy and collect dirt. Linoleum is a silent material, easily cleaned, and in a 12-ft. room will only have one joint in the middle of the floor. The furniture provided should be enough for the patient's comfort and no more. There should be a bed with bedding, and an allowance of four blankets to each bed. An additional blanket may be provided for use as a wrap during resting hours, when patients are lying down. The rest of the furniture should include a locker for holding clothes and for use as a bedside table, a chair, a mirror, and a toilet basket. In this sanatorium each patient takes the latter with him to the lavatory.

Many sanatoriums manage entirely without heating even during the winter months, and for most days in the year it is certainly unnecessary. Patients do not need to have their wards heated either in the daytime when they are at work, or at night when they are in bed. All that is required is some means of heating which will save them from the misery of cold hands and cold feet on frosty nights and mornings during the periods of dressing and undressing. Hot-water heating is expensive, and whether it is wanted or not, the furnace has to be kept going day and night practically throughout the winter. Steam, on the other hand, can be turned on and off whenever necessary, and if there is a steam-engine on the premises the exhaust steam can be used for heating and so diminish the cost of upkeep. Although architects generally object to this method on the ground that it takes all the moisture out of the air, it is, nevertheless, the best method as well as the cheapest. The objections urged against it have little weight when it is remembered that the windows are always wide open, and the air constantly changing.

The following sanitary accommodation is found to be sufficient for thirty-three patients:

Two baths.

Six washing basins.

Three water-closets.

Baths.—When the bathing accommodation is limited, shower-baths will be found quite as effective and very much quicker than the lengthy procedure of filling and emptying baths for each patient. In this sanatorium shower baths in the morning are compulsory for the male patients, who are advised to take them cold; to prevent the baths being used the taps should have movable keys, which can be taken away by the nurses in the morning and afterwards replaced. Patients are allowed a hot bath once a week in the evenings.

Water-closets.—The doors of the water-closets should be a foot from the ground, and should be fitted with louvres so that the face of the person inside cannot be seen, though the whole of the lower half of the compartment is visible. This arrangement gives privacy for defæcation, and at once exposes any accident such as fainting or hæmoptysis.

Urinals.—The advantages of urinals are so obvious that it is difficult to understand why architects fight shy of building them. The fact that they have been

adopted in all up-to-date hotels is sufficient argument in their favour. From every point of view their provision in sanatoria is essential.

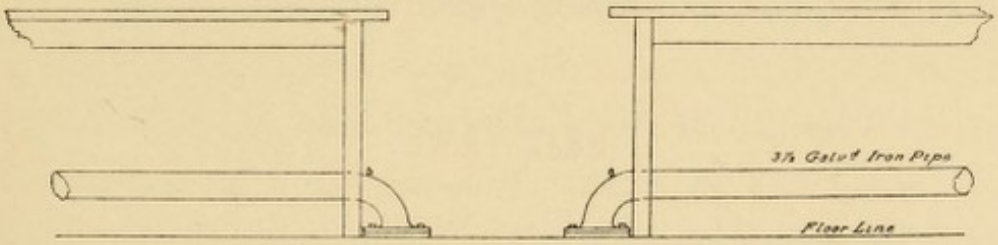
Drying room, etc.—A large room must be provided for drying the clothes of patients after they have been working in the rain. It should be heated by steam or gas, and have a fan to circulate the air.

Other rooms necessary include a non-heated room for rubber mackintoshes, a box-room for storage, a dry room for bath-towels, and a boot room.

Reading rooms.—Reading rooms are necessary for the patients in the evenings, and should have adequate arrangements for heating. In a large room with open windows the prevailing temperature is little above that of the outside air, so that only those patients within the area of radiation feel any warmth. If the heating apparatus is confined to one corner of the room a few patients get the benefit of it, and the rest are crowded out. Whether fires or radiators are used, they should be distributed round the room as widely as possible. For fifty patients there should be three fires at least with open fireplaces. Radiators should be small in size and many

in number. The reading rooms can be used in cold weather by those patients who are unable to take any or only limited exercise.

Dining halls.—At the opening of this sanatorium the dining rooms were heated by five radiators, placed at intervals along the walls. The result of this arrangement was that those patients who happened to be near a radiator enjoyed its warmth at the expense



of others less fortunately situated. There is no valid reason why patients should be made to endure the unmitigated discomfort of cold and draughty rooms; the fact that wide-open windows are necessary to provide a continual supply of fresh air does not argue that consumptives will derive any benefit from being frozen. On the contrary, patients take their food much more readily when they are feeling warm and comfortable.

The halls are now heated by 4-inch cast iron pipes, similar to those used in greenhouses. These

pipes, which run from one end of the room to the other, are raised above the floor under each table, and carried beneath it in the intervening spaces.

This arrangement has been found most satisfactory, both economising space and enabling patients to sit with their feet on the pipes, and eat their meals in comfort. The method is not extravagant, and the prophecy that patients would suffer from chilblains, if it were adopted, has not been fulfilled.

ROUTINE.

Kitchen.—In the kitchen the same method of monthly menus is in operation for the staff as that in use for the patients. The diet is not the same, but whenever roasting is to be done for the patients it is arranged, if possible, to have a roast for the staff on the same day, for the sake of economy in fuel. For the first five years that the sanatorium was in existence we used an old-fashioned cooking range ; nowadays we use gas and prefer it. It is no more expensive and certainly cleaner, more efficient and more easily controlled. In most institutions the cooking of meat does not receive the attention it demands. Careless

cooking is not only wasteful, but seriously depreciates the nutritive values of food.

The proper method of roasting meat is as follows:

The joint should be placed in an oven, of which the highest temperature is anything from 300° to 500° F. To eliminate guesswork a thermometer should be permanently fixed in the oven.

The high temperature first seals the outside of the meat and so prevents the juices from escaping. The temperature of the oven should then be lowered to about 180° F., and an allowance of 20 minutes to the pound should be made, instead of the usual 15 minutes; if meat is cooked by this method it will be found to retain its natural juice, instead of being dry and hard.

Basting is an important detail in good cooking, though proper attention is rarely paid to it. A very good method is to skewer a large lump of fat to each joint, which should be turned twice or three times before it is finally cooked. The common practice of putting a joint of meat into a tin and then placing it in the oven to be roasted is one which fails to obtain its object: the meat is surrounded by dissolving fat, and the result is the same as it would have been if

the lower part of the meat had been fried. The essential idea of "roasting" is that heat should be kept all round the joint, and this can only be done by hanging it either in the oven, or before the fire.

Legs of mutton, lamb, etc., should be hung with the thick end uppermost, to prevent the juices escaping; for the same reason the cook should never put a fork or skewer into a joint after the surface has been sealed.

If these details are observed, the meat juices will not be wasted, and the meat itself will be tender and more nutritious.

In boiling, the same ideal should be aimed at as in roasting. Meat should be first plunged into boiling water, and then cooked at a temperature of 180° F.

This method should always be followed in cooking hams; the temperature at which they are cooked should be less than the boiling or simmering temperature. Most cooks are unaware that a thermometer registers the same number of degrees in simmering as in boiling water.

However well meat is cooked, unless it is properly hung before cooking it is bound to be tough.

The first thing necessary is to come to a definite understanding with the contractor, who must undertake to deliver meat in proper condition for immediate cooking.

In summer, if cold storage is used, meat should be completely thawed for at least twenty-four hours before being put in the oven.

In catering for a large number of patients it is useful to remember that some articles, such as beef and bacon, are cheaper if bought in certain ways.

For instance, I have found it economical to buy a whole side of bacon, instead of the middle only, which is always in demand. The two ends are cooked, and served as "cold ham" on Wednesday and Sunday mornings; the middle is used for bacon on other mornings. Again, sirloins of beef are always in demand; necks of beef, which are full of nutriment and make better pies than steak itself, are not generally wanted, and are consequently very much cheaper.

These are but a few examples of the numerous ways in which economies can be effected by careful cooking and thoughtful catering.

All the cooking utensils in this sanatorium are

made of aluminium. The advantages are, firstly, they do not have to be re-tinned; secondly, food which is easily burnt in ordinary vessels can be cooked in aluminium with much less risk; thirdly, aluminium does not break like cast iron. The objection that it is difficult to remove grease from aluminium owing to the deleterious effects of soda on the metal is one which I have not found in practice to be of any weight.

The bread of the establishment is made in the kitchen with what is known as stone mill ground flour. This flour contains the whole of the germ which in most flour is removed before baking. As little water is used as possible, and every endeavour is made to produce a loaf which is nourishing and pure.

Laundry.—The soap used in the laundry is made on the premises from all the refuse fat from the kitchen. Any fat will do, whether burnt or not, so long as it is clarified. Details of the method of making this soap can be obtained from the United Alkali Co., St. Helens, Lancashire, who supply the necessary materials. The advantages of making one's own soap are: (1) Articles washed with it are whiter than when ordinary soap is used; (2) it saves money.

Stores.—Each patient has a diet card on which is entered his diet, any extras of diet ordered, and the day on which the order is to be cancelled. The latter precaution serves as a check on the storekeeper. If a patient is prescribed half a pint of milk a day, and the date on which it is to be discontinued is not notified in writing, an unscrupulous storekeeper has it in his power to appropriate this quantity every day until the patient for whom it was ordered is discharged. Without the provision of adequate safeguards against dishonesty no system of accounts can be satisfactorily carried on.

The storekeeper enters on a sheet the diet and extras of each patient, which he summarises at the bottom of the page, as shown in the accompanying diagram.

Having done this he takes the diet order book, containing a list of all the articles that may be required during a month's menu; so long as the storekeeper goes through this page he cannot omit to order or to issue anything that is required. This summary gives the total amount of each article of food necessary for any particular day; by keeping a table showing the amount of food required in pounds

SAMPLE PAGE OF DIET ORDER BOOK.

Date.	Meat.	1. 1st Dinner.	1. 2nd Dinner.	2. 1st Dinner.	2. 2nd Dinner.	Total.

Dining Hall.	No. of patients.	Extras.	Fish.	Bacon.		Butter.		Milk (pints).		Sugar.		Bread.		Suet.		Groceries and Vegetables.
				lbs.	ozs.	lbs.	ozs.	Morn.	Even.	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.	
No. 1. 1st.																Vinegar
No. 1. 2nd.																Pepper
No. 2. 1st.																Salt
No. 2. 2nd.																Mustard
Puddings																Flour
Total																Fruit

GROCERIES AND VEGETABLES.

Tea		Cornflour		Oatmeal		Cabbage		Salad		Cheese	
Coffee		Barley		Split Peas		Carrots		Onions		Pickles	
Tapioca		Jam, E.		Lentils		Turnips		Mint		Castor Sugar	
Rice		„ Pudd.		Beans		Swedes		Syrup		Peel	
Sago		Sultanas		Potatoes, Stew		Parsnips		Eggs, M.		Baking Powder	
Semolina		Currants		„ Dinner		Beetroot		„ E.		Marmalade	

SAMPLE DIET SHEET.—DINING HALL 1.

Date.		SUNDAY.		MONDAY.		TUESDAY.		WEDNESDAY.		THURSDAY.		FRIDAY.		SATURDAY.	
No.	Name.	Diet.	Extras.	Diet.	Extras.	Diet.	Extras.	Diet.	Extras.	Diet.	Extras.	Diet.	Extras.	Diet.	Extras.
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
			PATIENTS A B C D Butter Milk (M)		PATIENTS A B C D Butter Milk (M)		PATIENTS A B C D Butter Milk (M)		PATIENTS A B C D Butter Milk (M)		PATIENTS A B C D Butter Milk (M)		PATIENTS A B C D Butter Milk (M)		PATIENTS A B C D Butter Milk (M)

and ounces for any number of persons from 1 to 150 it is easy to adjust the diets according to the increase or decrease of patients. As has been shown in the chapter on "Diet," every detail has been worked out to a fraction of an ounce per patient. This prevents a great deal of waste. The storekeeper then transfers the quantities of each article required to a third book, and when the tradesmen deliver the goods, weighs each article as it comes in and enters the figure on the back of the counterfoil. Orders are given about two days in advance. Practically the same system is adopted for the staff, the quantities being increased or decreased according to the numbers; separate accounts are, however, made, and separate orders given, for patients and staff, the two operations being kept distinct both in stores and kitchen.

To make certain that everything is properly accounted for, it is well for the medical superintendent to inspect the various articles as they come in, and check the entries made by the storekeeper or tradesmen. The inspection need not be regular, but should be made occasionally without warning.

The storekeeper in this sanatorium also has charge of brushes, hardware, etc. These he should never

issue without a written order, and should be careful to keep sufficient quantities of each article in stock.

With our system of numbered plates, the maximum stock kept is three of each article of each number; the breakages being few, the number replaced is small.

A book is kept in which each kind of plate is recorded, the numbers from 1 to 150 being written against them. When an issue is made it is noted, thus showing stock in hand.

I was once asked if there were any perfect system of managing stores; if there is, I do not know it. Whatever the system, its efficiency must depend upon the care and attention shown by the storekeeper, and upon his proper supervision by the head of the institution.

Meals.—Each patient is provided with a numbered set of crockery, consisting of a mug, cheese plate, soup plate, and meat plate; an economy of material is effected by using the soup plates either for pudding or for soup. Patients supply their own knives, forks, spoons, etc., and have charge of their own crockery and cutlery. Each patient washes his own utensils, placing the plates in a numbered rack, and the

cutlery in a numbered tray. This serves the double purpose of preventing any risk of infection, and lessening the number of breakages. Should any article be broken, it at once enables the medical superintendent to detect the culprit. Visitors frequently remark that the risk of infection from these sources must be negligible*; to this I reply, if there is no risk, are they prepared to drink from a loving cup which has just passed round fifty tuberculous patients? So far no one has accepted the challenge. In any case no harm is done by taking this precaution, even if unnecessary. Its educational value is by no means to be despised; patients who have learned this lesson in carefulness at a sanatorium are more likely to apply its principles at home.

One nurse superintends breakfast and supper. Patients practically help themselves to breakfast and so reduce labour. They enter in a queue, the nurse standing at the serving table and by her a maid; as

* Owing to the risk of mouth-to-mouth infection, we do not use a chalice during the celebration of Holy Communion. I obtained the consent of the Bishop of the diocese to use the method known as "intinction." By this method the Priest has the bread cut into small squares. He then consecrates the bread and wine. Next he dips one piece of bread into the wine and touches each of the pieces of bread to be administered. He then hands to each communicant the two elements in one.

each patient enters the latter takes his plate from the pile, which has come out of the heating oven, and hands it to him. The patient then goes to the nurse, who serves him with his meat ration and his butter, then to the coffee urn, where he helps himself, and then to the bread board. At the conclusion of the meal, patients, as they finish, get up, form a queue outside the washing room, and take turns at the dish-sinks in groups of eight. There are eight running hot-water taps, the water being at a temperature of nearly 200° F. Patients wash their plates in the dirty water standing in the sinks, and then hold them, for the purpose of sterilisation, under the running taps. The washing over, they proceed to the passage which contains the plate racks, take their numbered towels, dry their plates, return with them to the dining-hall and sit down, each in his accustomed place, until the rest of the patients have finished their washing. This system has the merit of preventing individuals from hurrying over meals, and enables seventy-four patients to eat their breakfast, wash up, and be out of the room in 65 minutes.

When patients have left the dining hall, the maid removes the plates which are to be heated

for the next meal, and puts them in the heating oven.

The routine of the mid-day dinner is the same, except that the medical officers are present to see how patients take their food.

Supper at 6.30 is on much the same lines as breakfast. There are seven tables, which take turns at "table-duty"; this consists in sweeping and cleaning the dining halls, and keeping in order all the utensils and brasswork. In order so far as possible that the linen shall be kept clean patients are not allowed to dirty the table-cloth with impunity. The offender is reprimanded, and made to put a halfpenny in a china pig, which sits beside him for the rest of the meal; if the loss of a halfpenny is not a serious matter, the subsequent pleasantries to which the culprit is exposed make him more careful in future, and have generally an admirable deterrent effect.

Patients on table duty are not allowed to take advantage of their position in order to secure the cleanest linen for themselves; if they upset things they have to bear the consequences, and endure the discomfort of dining off a dirty cloth. Various

devices and counter-devices have been invented by the patients to relieve themselves of the responsibility for such disasters, and by the medical superintendent to make sure that a misdemeanour shall recoil on the head of its author. To prevent table-linen being changed from meal to meal each table has its own cloth, which is especially marked for identification. Again, if the patient who sits at the head of the table makes a mess, he is not allowed to manipulate the cloth at the next meal so as to secure the clean end for himself. This trick was countered by sewing to each cloth a piece of red turkey quill, which must always be shown on the side nearest the hall entrance.

Taking temperatures.—The procedure is as follows :

Each patient has his own thermometer, for which he is responsible, and pays a small fine if it is broken.

A nurse sits at a table in the reading room and the patients form a queue, each one with his thermometer in his mouth, and a tin case containing the temperature chart in his hand. Each in turn hands his thermometer and chart to the nurse, who enters the reading on the chart, and makes a duplicate entry in her own book. Patients clean their thermometers themselves. One nurse unaided can by this

method register seventy-four temperatures in half an hour. It is both cleaner and quicker than the ordinary method of taking the thermometer from the mouth of one patient, wiping it with a solution of 1 in 20 carbolic, and putting it in the mouth of the next.

Weighing.—Patients are weighed once a week under the direct supervision of the medical superintendent. They proceed to the reading room, dressed only in their "rest-blankets" and slippers, form a queue, and place their charts one by one beside the assistant medical officer, who registers the weight of each in turn. As the patient sits on the scale, the assistant reads aloud the last weight recorded on his chart, thus enabling the person weighing to fix the weights exactly as they were the week before, and to notify any gain or loss without fumbling or delay. To avoid inconsistencies it is necessary for patients to wear clothes of the same weight every week; the regulation dress order in this sanatorium is "rest-blankets and slippers."

Passes.—To provide a break in the weekly routine, patients on "basket" work are allowed to go out on Sunday afternoons, and patients on Grade 3 or over

on Saturday afternoons as well. They may leave the premises at 2.30 p.m., and have to be back at 5.0 p.m. The only restriction placed upon them is that they must not enter a public-house for any reason whatsoever.

Compromise on such matters is dangerous; the regulation is essential, not so much because moderate indulgence in stimulants would be necessarily harmful, but from fear that a privilege affording easy opportunities of misbehaviour would be abused. Misdemeanours, if they occurred, would have a bad moral effect, and rumour would exaggerate their importance to the detriment of the institution.

Each patient is told personally that faithful observance of this regulation is the price of his freedom. Absolute prohibition is necessary, or patients will give the most innocent reasons to account for their presence in a public-house.

Control is secured by a system of passes, on each of which is written the hour at which the holder may go out, and the hour at which he must return, together with all the regulations regarding public-houses. A man on special duty examines the passes as patients go out and come in. If any

patient returns after 5.0 p.m. his pass is kept and in due course is sent to the proper quarter for consideration.

The system works efficiently. The first time a patient breaks a rule it is noted on his pass, and he is warned. At the second offence his leave is stopped for one afternoon. At the next for two afternoons, and so on. The privilege of going out is so highly valued, that it is rarely abused. Patients prefer to keep the rules than to stop in on Sundays.

Sputum pots, flasks, and handkerchiefs.—Each patient has 2 numbered sputum-flasks for day use, 1 numbered sputum-pot for night use, 2 bags or pocket liners for holding handkerchiefs and flasks, and 14 numbered handkerchiefs. To get over the difficulty of leaking flasks, every nurse has a number of spare flasks marked with the letter "S." If a patient has trouble with his flask he can immediately obtain an efficient one, which can be used until his own is repaired.

On rising in the morning each patient goes to the room where the sputum trays are kept, places in position the pot he has used at night, and takes his own flask for use during the day. At 8 a.m. the

sputum porter removes these pots, and at the same time changes the pots in the water-closets and bath, rooms. He then proceeds to clean and sterilise them, together with the flasks and handkerchiefs of the previous day, in the manner elsewhere described.

On leaving the dining hall after supper at the end of the day each patient puts his handkerchief and pocket liner into a pail, under the supervision of a nurse. Patients then proceed to the main building, where clean handkerchiefs await them.

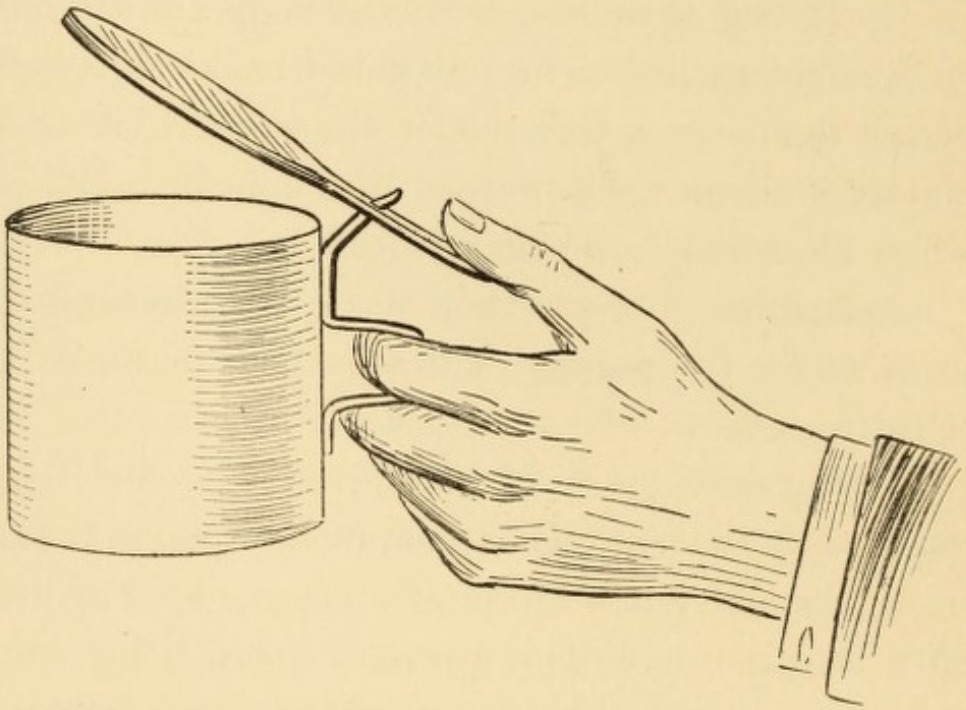
At bedtime they put their flasks into the baskets provided for the purpose, and take the sputum pots to their wards.

During the night flasks and handkerchiefs are removed by the night-watchman to the sputum room.

All handkerchiefs are numbered, and are counted after sterilisation. This prevents them being lost, and makes it impossible for patients to keep infected handkerchiefs in their lockers without being discovered.

My great objection to paper handkerchiefs is that they are quickly used up, and there is no means of preventing careless patients from storing them, or leaving them about.

Sputum pots.—The accompanying diagram illustrates what I consider to be the best sputum pot available. It is one of my own design, and is made of metal, either aluminium or tinned iron, so as to be unbreakable.



Its advantages are, firstly, it can be manipulated with one hand; secondly, the hinge is sufficiently far away to enable the patient to expectorate without difficulty into the pot itself; thirdly, it is much less easily upset, because the lid cannot go back beyond a right angle, and is thus self-closing; fourthly, the lid

is movable, and can be taken off when the pot is cleaned; fifthly, the lid cannot fall off.

The sputum pot provided with a loose cover necessitates two hands for its manipulation, and is a constant source of irritation to the patient, who has to rise from his bed whenever he wishes to use it.

The funnel-shaped variety which has no lid suffers from the disadvantage that in advanced cases of disease patients expectorate on the side of the funnel, where the sputum remains to dry.

Pots without lids cannot be recommended; exposure to the air dries the sputum, particles of which can be carried from one place to another by flies, or in other ways.

Sputum flasks.—Very few sputum flasks are satisfactory, and many are positively dangerous.

Glass flasks are easily broken.

The hole provided in the bottom of some flasks, to facilitate flushing, has no advantages; it is a frequent source of leakage, and if the flask is sterilised, superfluous.

What is wanted is a flask of metal, fitted with a cast bottom to avoid the defects of thin aluminium, and constructed in such a way that whatever its

position the contents cannot come in contact with the lid.

So far as I am aware, the flask best answering to this description is that of Dettweiler. It is designed on the principle of the unspillable ink-bottle, and if used with ordinary care is effective for its purpose; even though it is turned upside down in the coat pocket, no sputum can be deposited on the lid.

Most flasks are not designed to secure this elementary precaution; consequently, when they are opened small particles of sputum adhering to the lid are scattered broadcast. This can be demonstrated by filling a flask with water, shaking it, and then loosing the catch of the lid in the ordinary way.

It is sometimes urged against aluminium pots that they will not stand soda; after eight years experience I am of opinion that this objection is unfounded.

TABLE OF ROUTINE.

6.50: Patients rise.
6.50–7.30: Temperatures taken.
7.30: Patients bathe, shave, dress, clean their boots, clean their wards, make their beds, and do other necessary work.
8.15: Breakfast. After breakfast smoking is allowed until 9.25.
9.30: In-door brass work.
9.55: Gong rings for out-door work or exercise.
11.50: Gong rings to cease work.

12.0 noon: Rest lying down on bed; no talking allowed, but reading permitted.
12.45 p.m.: Bell rings for patients to rise and prepare for dinner. Patients "off rest" cease work.
1.0: Bell rings for dinner.
1.45: Smoking.
2.15: Patients on walking exercise proceed to their wards and lie down.
2.30: Gong rings to cease smoking and start work.
3.0: Bell rings for patients resting to start walking exercise.
4.50: Gong rings to cease work; patients are not allowed to cease work until the gong sounds.
5.0–5.20: Temperatures taken.
5.20–6.30: Recreation time. Only patients "on work" may play out-door games. Patients on walking exercise may play sitting-down games, *e. g.* dominoes, etc.
6.30: Supper.
7.5–7.55: Smoking permitted.
7.55: Bell rings for prayers.
8.0: Bed.
8.30: All lights out. Patients are not allowed to talk for any purpose after the bell has sounded.

CONCLUSION.

HITHERTO the general attitude of the medical profession to tuberculosis has been that rest and fresh air are the beginning and end of treatment. Attention has been concentrated upon factors of proved value to the exclusion of others at least equally important. The truth is that while rest is often sufficient to restore the balance, there are numerous occasions when it can do nothing more than maintain the *status quo*. Health resorts are crowded with consumptives, who exhibit from day to day deceptive appearances of improvement; they become fat under a *régime* of over-feeding and a habit of physical laziness; they are bronzed by sea or mountain air; in their own eyes and in the eyes of the onlooker they are making steady progress towards recovery. Yet if the truth were known their condition amounts to nothing more than what may be described as immunity within bath-chair limits; and if, under such circumstances, they may

continue for an indefinite time to present an appearance of vigorous health, a return to the normal activities of life will sooner or later cause a breakdown, and leave them in worse case than before. Until it is recognised that the function of rest in tuberculosis is limited to the extent of affording temporary relief to the defensive forces of the blood fluids, what has well been called the "expectant" method of treatment will continue to meet with failure and disappointment.

Fresh air, again, has come to be regarded as a sovereign remedy. No one disputes its value as an essential factor in health, but if it is a "cure" for consumption, we may well ask what need there is of physicians or sanatoria. Experience does not warrant this easy optimism; fresh air has no specific properties which can affect bacterial products in the blood.

The city man who seeks a change of air when he is run down or out of sorts benefits only because he escapes from the harmful effects of bad air. Because impure air predisposes to disease, it does not follow that fresh air can cure it. No one has yet suggested that the health of a town is improved by a pure water-supply, unless it supersedes an impure one which has already injured it. The two cases are analogous. And

yet time after time the consumptive is told that his only hope of recovery is to give up work—possibly his livelihood—and live in the country or by the sea. The results of this indiscriminate advice are to be seen in our consumption hospitals. In the same haphazard way a six months stay in a sanatorium is recommended; the period fixed is arbitrary with no intelligible basis in reason, but so long as the patient is in fairly good condition at the end of it he is discharged under the flattering title "arrested." Too often the term bears no relation to his specific condition; it means merely that he is free from fever and has gained a stone or two in weight. Such patients are said to have done extraordinarily well, but they have not been tested with their own bacterial products, and their resistance has not been proved.

The term "arrest" is meaningless if it does not imply in the subject capacity to undergo the exertions and fatigues of ordinary life without risk of suffering from fever and constitutional disturbance.

Fresh air, rest and good feeding are necessary and valuable factors in treatment, but in themselves

they do not constitute a universal cure. There may be many who recover under these conditions alone, but there are many, too, in whom the process of auto-inoculation has reached a stage at which the balance can only be restored by applying the principles of graduated rest and exercise. If our means of diagnosis enabled us to distinguish between the two classes, a course of graduated labour need only be prescribed for those whose condition required it. Such distinctions cannot be made.

In every case which comes up for treatment the crucial question is this: Is the disease active or inactive?

Physical signs, tuberculin reactions, and the presence of tubercle bacilli in the sputum do not give a definite answer. It must not be imagined from what has already been said about physical signs that I consider the information they give is of no value; it is of undoubted value in forming a preliminary diagnosis, both in pulmonary tuberculosis and in other forms of chest disease, but examination by the stethoscope alone does not enable anyone to decide whether a patient is suitable for treatment by graduated labour or not. A general idea of his

suitability can, of course, be formed by comparing the physical condition with the physical signs, but the only certain method is to put the patient to a practical test, and see if his lesion can be influenced.

Similarly, patients who react to tuberculin or who have tubercle bacilli in their sputum are not necessarily suffering from tuberculosis any more than "typhoid carriers" are suffering from typhoid.

It has been established that a patient who has no constitutional symptoms and is able to go about his ordinary occupation may yet give a positive reaction to tuberculin; he may, in addition, have tubercle bacilli in his sputum, but if he is in good health and fit for work he is not suffering from the toxic effect of bacterial products in his blood, and the fact that he has tuberculosis does not materially affect his every-day life. It is clear, then, that diagnosis of active disease cannot be made on the sole basis of a tuberculin reaction; the results of treating all patients who react positively with large and increasing doses of tuberculin undoubtedly appear flattering, but are, nevertheless, misleading. A large percentage of such patients would recover in any case, whether tuberculin was given or not. Patients, for

instance, in divisions (1) and (2) of the classification given on p. 6 would react to tuberculin, and though actually tuberculous, would yet recover without any specific treatment.

If no evidence of active tuberculosis is given by temperature or constitutional symptoms—if in other words, the lesion is quiescent—the only way to detect potential activity is to test the patient in one or another of two ways:

(1) By applying the system of graduated labour and waiting for a reaction in temperature, as shown either by a marked deviation, increase of sputum, etc., or by an elevation to 99° F. or over, with constitutional disturbances.

(2) By observing whether gradually increased exercises cause marked variations in the tuberculo-opsonic index.

The ideal would be to apply the test of graduated labour to every case that arose for treatment. Before the advent of the diphtheritic antitoxin many cases of diphtheria recovered without specific treatment, but physicians of to-day do not on that account postpone action when confronted with a suspected case. They inoculate at once to make sure. Similarly, every

case of consumption should be definitely treated by the best available methods. Sanatorium treatment on the lines of auto-inoculation may not be a specific, but it is the best we have at present, and should be utilised until something better is discovered.

Graduated labour is a certain test, based on scientific principles systematically applied. Even if the theory is not accepted, practical results show it to be worthy of trial, just as practical advantages demonstrate its superiority over other methods.

The sanatorium is too often the home of neurotic individuals, mentally and physically deteriorated by long periods of ease and idleness. The introduction of graduated labour transforms a refuge for chronic invalids into a workshop of busy, hopeful men and women. The system hardens the body, invigorates the mind, encourages self-respect, and keeps alive a spirit of independence. Its educational value is not least in importance. At Frimley regular lectures are given, and systematic instruction in the nature of the disease, its causes and its cure; at the same time patients have daily before them a practical demonstration of how to live under hygienic conditions. Even if the results were no better than, but only equal to,

those of other systems, this can claim the advantage of being a quicker method.

The average length of time spent by the majority of the patients at this sanatorium is three and a half to four months; at the end of it they are discharged with their disease arrested and their physical capacity restored to the full.

Many other sanatoria have now adopted organised schemes of graduated labour, and the curative value of exercise in treatment is widely recognised in Australia, New Zealand, and the United States. The success of all such schemes depends on the scientific application of the principle of work as a therapeutic agent. If the primary function of work is regarded either as a diversion for the patients or an economy for the sanatorium it cannot achieve the best results, nor can any success be hoped for if the system is unscientifically graded, or unscientifically applied. From a secondary point of view the utilisation of the patient's labour is of the utmost value in reducing expenditure. In this sanatorium economies have been effected during the last six years amounting to over £1170 per annum, in addition to the capital value (£3157) of the labour put into the

grounds (see Appendix III). It has been urged as an objection to the system that it is fitted for none but manual labourers,* and that the well-to-do would refuse to undertake it. From personal experience I know this objection to be unfounded; in any case it is difficult to believe that the well-to-do consumptive is not as anxious to be cured as the working man, and would not as willingly submit to a course of treatment which would quickly enable him to accomplish his purpose. Equivalent treatment can without doubt be undertaken in the patient's home, but unless it is carried out under close and competent medical supervision, its results cannot be expected to compare with those of systematic treatment in a sanatorium. So far as the general practitioner is concerned, the principles of graduated rest can be applied even at times when those of graduated exercise necessitate too much supervision. The results obtained in some cases where the movements of the lung have been controlled by introducing nitrogen into the pleural cavity are additional proof, if further proof is needed, of the value of treatment by Complete Immobilisation.

* Manual labourers at Frimley are much in the minority.

The ultimate value of treatment by graduated labour depends on the permanence of the cures effected. A separate report will shortly be published by the Committee of Management containing complete statistics of Frimley results up-to-date. In the meantime it may be of interest to give a brief summary of results for the year 1908, this being the first complete year of the applied system. The total number of patients admitted from Brompton was 297, and of these, 55 left the sanatorium for various reasons without undergoing the full course of treatment (see Appendix IV). Of the remaining 242 patients, 2 died in the sanatorium, 197 were discharged in full working capacity, and 43 under one or another of the two designations "improved" and "*in statu quo.*" Letters were written to all these patients in February of this year (1911), and as a result it was found that 146 were well and able to work, 19 not at work, and 31 dead. Forty-four patients failed to report themselves, and though this number represents an unknown quantity, and strictly should not be allowed to prejudice the results either one way or the other, it has been included in the total to avoid over-estimating the percentage of

permanent arrests. Even with its inclusion, 60·3 per cent. of those who went through the treatment in 1908 are found to be fit for work between two and three years after their discharge. It is a significant fact that of the 146 patients still in good health, no less than 124 are indoor workers, *i.e.* 85 per cent. This is a sufficient answer to those who refuse to employ discharged consumptives indoors,* and supports the arguments put forward in Chapter XIII of this book.

Under prevailing economic conditions statistics

* The following is a typical letter from an employer of indoor labour who refused to take back an old employee on his discharge from the sanatorium:

London, E.C.,
February 28th, 1911.

DEAR ———

Replying to yours of the 26th inst. to our Mr. ———, I am instructed by my Directors to tell you that they regret they are unable to make a vacancy for you.

Speaking personally I am quite convinced, in spite of what your Medical Superintendent says, that you would be exceedingly foolish to come back again, if you had an opportunity.

I return herewith Mr. Paterson's certificate, and remain,

Yours faithfully,

———

Secretary.

Mr. H. H. ———
Brompton Sanatorium,
Frimley.

do not fairly represent the value of treatment by graduated labour. No system is of any value to the patient who fails to get employment on his discharge; semi-starvation follows, then relapse. Nor is there anything to be gained by treating a man who gets tuberculosis owing to poverty following unemployment; if he contracted the disease through lack of work, he will in all probability relapse from the same cause.

Permanent cure, no less than prevention, is ultimately a social problem; until that fact receives practical recognition, sanatorium workers are heavily handicapped. Again, there are numerous cases which have gone too far to obtain any lasting benefit from systematic treatment. The responsibility for many of these advanced cases may be traced directly to the inherent defects of the Poor Law, with its principle of medical relief to those who have qualified for it by becoming destitute.

Neglect of early diagnosis and early treatment is fatal; by the time the consumptive has reached the stage of destitution he is probably beyond medical aid. Efficient provision for the treatment of the tuberculous poor can only be obtained by making

the Public Health Department exactly as responsible for the treatment of all cases of tuberculosis that would otherwise go untreated, as it is to-day for other infectious diseases such as smallpox, enteric, and scarlet fever.

In the meantime, so long as the number of beds available is limited, it is important to consider what cases are most suitable for treatment. The present methods of selection are not satisfactory, being largely determined by the extent of physical signs, without any regard to the actual resistance of the patient. Under these conditions patients are frequently admitted for free treatment who for several years have been more or less incapacitated for work, and have not consequently so good a chance of recovery as those whose balance has only recently broken down.

Granted that the "early case" should take precedence over others, it is necessary at the outset to understand clearly what the term implies. In this matter medical men should be guided, not by physical signs alone, but by the general appearance, general condition and past history of the patient. The term "early case" should be recognised as defining a

specific condition, viz. recent collapse of resistance to tubercle.

If patients were treated within two or three months of the time when their balance broke down efficient sanatorium treatment would, I believe, effect something like 80 per cent. of permanent arrests. At the present time numerous "hopeless cases" are manufactured by a process of tinkering in the early stages; people recommend the seaside "cure" and other speculative methods of so-called treatment, and when these have failed, expect the sanatorium to repair the damage.

Personally, I am in favour of treating all early cases, whether febrile or not, so long as they have some means of earning their living, being convinced that a large number of the former would rapidly recover if placed immediately on Complete Immobilisation. In addition, I would treat all those who have tubercle bacilli in their sputum, even though their resistance has not broken down.

It is of the utmost importance that these patients should be treated at once, for three reasons: first, it would do all that is humanly possible to insure them against the risk of developing into hopeless

consumptives; second, it would prevent them from spreading infection to others; third, it would give them a practical education in sound hygienic principles.

When the supply of beds is equivalent to the demand the question "Who shall occupy them?" will not arise; until that day comes cases should be selected on the lines here indicated.

APPENDIX I.

Table of Diet Quantities, Brompton Hospital Sanatorium.

	Men.	*Women.*
Mutton, roast, uncooked, with bone	12 oz.	9 oz.
„ boiled „ „	12½ „	9½ „
Beef, roast „ without bone	9½ „	8 „
„ boiled „ with bone	11½ „	8½ „
„ stewed steak „ without bone	10½ „	8½ „
Veal and ham or steak and kidney pie, uncooked, without bone	9 „	6 „
Steak and kidney pudding, uncooked, without bone	7 „	5½ „
Cold veal and ham pie „ „	7 „	5½ „
Roast lamb, uncooked, with bone (part of this is used at night as Irish stew)	17⅓ „	10⅓ „
Pork, roast, uncooked, with bone	13 „	9 „
„ boiled „ „	13 „	10 „

Pea-soup: 1¼ oz. each split-peas, lentils, carrots, and ½ oz. onions, each patient.

Fish: ½ lb. haddock or whiting, or 1 bloater or kipper.

Sago pudding: ⅞ oz. cereal, 10 oz. milk, ⅔ oz. sugar.

Rice „ 1¼ „ „ 10 „ „ ⅔ „ „

Semolina „ 1 „ „ 10 „ „ ⅔ „ „

Tapioca „ 1 „ „ 10 „ „ ⅔ „ „

Cornflour „ 1 „ „ 10 „ „ ⅔ „ „

Roly-poly jam pudding:

Men: 2½ oz. flour, 2 oz. suet, 3 oz. jam.

Women: 2 oz. flour, 1¾ oz. suet, 2 oz. jam.

Plum pudding:

Men: 2¼ oz. flour, 2 oz. suet, ⅔ oz. sugar, ¾ oz. currants, ¾ oz. sultanas.

Women: 1¾ oz. flour, 1¾ oz. suet, ⅔ oz. sugar, ½ oz. currants, ½ oz. sultanas.

Fruit pudding:

Men: 2¼ oz. flour, 2 oz. suet, 1 oz. sugar
Women: 2 oz. flour, 1¾ oz. su et, ¾ oz. suar } 6 oz. unprepared fruit.

Fig pudding:

2 oz. flour, 1½ oz. bread-crumbs, 2 oz. suet, ⅔ oz. sugar, 2 oz. figs, 1½ oz. milk.

Suet pudding and treacle { Men: 2¾ oz. flour, 2 oz. suet / Women: 2¼ oz. flour, 1¾ oz. suet } 3 oz. treacle.

	Men.	*Women.*		*Men.*	*Women.*
Potatoes	6½ oz.	4½ oz.	Parsnips	6½ oz.	5 oz.
Carrots	5 „	3½ „	Turnips	6½ „	5 „
Greens	6½ „	4½ „	Swedes	8 „	6½ „
Onions	5½ „	3½ „	Beetroots	2½ „	2½ „

Butter: 1 oz. "A" diet; 1½ oz. "B" diet.

Cheese: 1½ oz.

Bacon: 6 oz., men; 3 oz., women.

Cold ham: 5 oz., men; 4 oz., women.

Tea: 1 oz. to 6 patients; ⅔ oz. sugar each; 4 oz. milk each patient.

Coffee: ⅓ oz. coffee, ⅔ oz. sugar each patient; 10 oz. milk, men; 5 oz. milk, women.

Cocoa: ½ oz. cocoa, ⅔ oz. sugar, 5 oz. milk.

Bread: 12 oz. per diem, men; 10 oz. per diem, women.

Mustard, vinegar, salt and pepper as required.

All the quantities given are the maximum allowances. If, owing to hot weather or other causes, patients are eating less, the quantities are reduced. As their appetites improve the quantities are increased. It is only by an elastic scale, directly supervised from headquarters, that undue waste can be prevented.

Patients' Breakfasts.

Sunday:	Cold ham, bread and butter, coffee or cocoa.
Monday:	Bacon and egg, bread and butter, coffee or cocoa.
Tuesday:	Fried bacon „ „ „ „
Wednesday:	Cold ham „ „ „ „
Thursday:	Fried bacon „ „ „ „
Friday:	Haddock, marmalade, bread and butter, coffee or cocoa.
Saturday:	Fried bacon, bread and butter, coffee or cocoa.

Patients' Dinners.—Winter Menus.

1st	Sunday:	Cold roast lamb, pickles, potatoes, jam tart.
	Monday:	Roast mutton, onions, potatoes, rice pudding.
	Tuesday:	Roast pork, parsnips, potatoes, sago pudding.
	Wednesday:	Roast beef, greens, potatoes, apple pudding.
	Thursday:	Roast lamb, swedes, potatoes, fig pudding.
	Friday:	Steak and kidney pudding, greens, potatoes, rice pudding.
	Saturday:	Stewed steak, vegetables, potatoes, suet pudding and treacle.
2nd	Sunday:	Cold roast pork, pickles, potatoes, rice pudding.
	Monday:	Roast lamb, greens, potatoes, jam tart.
	Tuesday:	Steak and kidney pie, swedes, potatoes, tapioca pudding.
	Wednesday:	Roast mutton, greens, potatoes, roly-poly jam pudding.
	Thursday:	Roast beef, swedes, potatoes, rice pudding.
	Friday:	Stewed rabbits and pork, onions, potatoes, apple pudding.
	Saturday:	Boiled pork, peas pudding, potatoes, semolina pudding.
3rd	Sunday:	Cold silverside, pickles, potatoes, jam tart.
	Monday:	Roast beef, greens, potatoes, rice pudding.
	Tuesday:	Roast lamb, turnips, potatoes, ginger pudding.
	Wednesday:	Roast pork, parsnips, potatoes, cornflour and stewed fruit.
	Thursday:	Boiled mutton, onion sauce, greens, potatoes, suet pudding and treacle.
	Friday:	Steak and kidney pudding, swedes, potatoes, tapioca pudding.
	Saturday:	Roast beef, greens, potatoes, roly-poly jam pudding.
4th	Sunday:	Cold roast lamb, pickles, potatoes, rice pudding.
	Monday:	Boiled pork, peas pudding, potatoes, sago pudding.
	Tuesday:	Stewed steak, vegetables, potatoes, plum pudding.
	Wednesday:	Boiled silverside, dumplings, carrots, potatoes, rice pudding.
	Thursday:	Roast mutton, turnips, potatoes, suet pudding and treacle.
	Friday:	Roast beef, greens, potatoes, cornflour and stewed fruit.
	Saturday:	Stewed rabbits and pork, onions, potatoes, roly-poly jam pudding.

Patients' Dinners.—Summer Menus.

1st	Sunday:	Cold silverside, salad or pickles, potatoes, jam tart.
	Monday:	Boiled mutton, caper sauce, onions, potatoes, rice pudding.
	Tuesday:	Stewed steak, potatoes, suet pudding and treacle.

	Wednesday:	Steak and kidney pie, greens, potatoes, sago pudding.
	Thursday:	Roast beef, greens, potatoes, fruit pudding.
	Friday:	Roast mutton, turnips, potatoes, semolina pudding.
	Saturday:	Roast lamb, mint sauce, greens, potatoes, poly-poly jam pudding.
2nd	Sunday:	Cold veal and ham pie, salad or pickles, potatoes, rice pudding.
	Monday:	Roast lamb, mint sauce, turnips, potatoes, jam tart.
	Tuesday:	Roast beef, greens, potatoes, plum pudding.
	Wednesday:	Stewed steak, potatoes, cornflour and stewed fruit.
	Thursday:	Roast mutton, turnips, potatoes, suet pudding and treacle.
	Friday:	Steak and kidney pudding, greens, potatoes, rice pudding.
	Saturday:	Roast beef, greens, potatoes, fruit pudding.
3rd	Sunday:	Cold silverside, salad or pickles, potatoes, jam tart.
	Monday:	Roast mutton, turnips, potatoes, tapioca pudding.
	Tuesday:	Steak and kidney pie, greens, potatoes, rice pudding.
	Wednesday:	Roast beef, greens, potatoes, roly-poly jam pudding.
	Thursday:	Roast lamb, mint sauce, turnips, potatoes, fruit pudding.
	Friday:	Hot veal and ham pie, greens, potatoes, sago pudding.
	Saturday:	Stewed steak, potatoes, suet pudding and treacle.
4th	Sunday:	Cold roast lamb, mint sauce, potatoes, rice pudding.
	Monday:	Boiled silverside, dumplings, carrots, potatoes, semolina pudding.
	Tuesday:	Roast lamb, mint sauce, greens, potatoes, plum pudding.
	Wednesday:	Roast mutton, turnips, potatoes, fruit pudding.
	Thursday:	Stewed steak, potatoes, rice pudding.
	Friday:	Roast beef, greens, potatoes, suet pudding and treacle.
	Saturday:	Steak and kidney pie, greens, potatoes, cornflour and stewed fruit.

Patients' Suppers.

Day.	*Summer Menu.*	*Winter Menu.*
1st Sun.:	Eggs and jam.	Eggs and jam.
Mon.:	Cheese and salad or pickles.	Cheese and pickles.
Tues.:	Cold boiled beef.	Soup.
Wed.:	Sausages and mashed potatoes.	Cold silverside.
Thur.:	Soup.	Irish stew.
Fri.:	Eggs and jam.	Bloaters and jam.
Sat.:	Irish stew.	Sausages and mashed potatoes.

2nd Sun.:	Eggs and jam.	.	Bloaters and jam.
Mon.:	Irish stew.	.	Irish stew.
Tues.:	Cheese and salad or pickles.	.	Eggs and jam.
Wed.:	Cold boiled beef.	.	Soup.
Thur.:	Eggs and jam.	.	Sausages and mashed potatoes.
Fri.:	Sausages and mashed potatoes.	.	Cold silverside.
Sat.:	Soup.	.	Cheese and pickles.
3rd Sun.:	Eggs and jam.	.	Eggs and jam.
Mon.:	Cheese and salad or pickles.	.	Sausages and mashed potatoes.
Tues.:	Bloaters and jam.	.	Irish stew.
Wed.:	Eggs and jam.	.	Bloaters and jam.
Thur.:	Irish stew.	.	Cheese and pickles.
Fri.:	Cold boiled beef.	.	Cold silverside.
Sat.:	Sausages and mashed potatoes.	.	Soup.
4th Sun.:	Eggs and jam.	.	Kippers and jam.
Mon.:	Sausages and mashed potatoes.	.	Irish stew.
Tues.:	Irish stew.	.	Sausages and mashed potatoes.
Wed.:	Eggs and jam.	.	Eggs and jam.
Thur.:	Cold boiled beef.	.	Soup.
Fri.:	Soup.	.	Cheese and pickles.
Sat.:	Cheese and pickles or salad.	.	Cold silverside.

Bread and butter.

Tea or cocoa as desired served with this meal.

APPENDIX II.

Sputum Examination.

(1) *The ligroin method of Lange and Nitsche.*— Place 5 c.c. of sputum in a conical flask and add 50 c.c. of caustic potash (5 per cent.). Shake vigorously and allow the mixture to remain at room temperature until the sputum is thoroughly homogenised. Dilute with 50 c.c. of tap water and shake again. Then add 2 c.c. of ligroin and shake vigorously until a thick emulsion is produced. Warm the mixture to 60° C. until distinct separation of the hydrocarbon occurs as evidenced by effervescence and the formation of a superficial layer of small bubbles. A number of drops are then taken from immediately below this superficial layer with a platinum loop and placed on a warm slide. The dry film is then fixed with a saturated solution of perchloride of mercury and stained by the Ziehl-Neelsen method.

(2) *The antiformin method of Uhlenhuth and*

Xylander.—The sputum is homogenised with 15 per cent. antiformin (a mixture of equal parts of sodium hypochlorite and sodium hydrate, obtainable from Oskar Kühn, Berlin). The mixture is sedimented in a high-revolution centrifuge. After decanting the supernatant fluid the deposit is washed in physiological salt solution and again centrifuged. Films are then made from the resulting deposit, dried, fixed in perchloride of mercury, and stained by the Ziehl-Neelsen method.

(3) *Loeffler's modification of above.*—To 5 to 20 c.c. of sputum is added an equal quantity of 50 per cent. antiformin. The mixture is heated until a clear liquid results. To 10 c.c. of this mixture is added a 10 per cent. solution of chloroform in alcohol (5 c.c. generally suffice). After thorough shaking the fluid is centrifuged for fifteen minutes. An opaque layer is then found to exist between the chloroform which occupies the bottom of the centrifuge and the supernatant fluid. The latter is pipetted off and the intermediate opaque layer removed wholly on to a slide. Films are made, dried, fixed, and stained.

APPENDIX III.

Economies effected by Employing Patients' Labour.

In order to ascertain the commercial value of the work done by the patients, I have obtained the services of expert estimators. The figures received fall under two headings :

(1) *Capital.*—The labour put into the ground, such as preparing it for cultivation by trenching, has been measured and valued by a contracting practical gardener ; the building work, construction of reservoir, etc., has been valued by a quantity surveyor.

They estimate the capital value at £3157.

(2) *Maintenance.*—The economies effected under this heading must be calculated by the amount of extra assistance which would be required if the patients did not do any of the domestic work, or help to keep the grounds in order.

The extra indoor help necessary has been esti-

mated by the matrons of two of the leading London hospitals, the outdoor by the two gentlemen mentioned above.

The result is as follows:

	£	s.	d.
4 nurses and 9 maids (with salaries, board, uniform, etc.)	710	0	0
4 gardeners	240	0	0
Window cleaning	70	0	0
Repairs	60	0	0
Firewood and block cutting	20	0	0
Poultry keepers	70	0	0
	£1170	0	0

The garden would not be kept in its present state of efficiency under these conditions; the top soil would not receive the constant and necessary hoeing which it does at the hands of the patients.

In six years the actual expenditure saved amounts to £10,177.

Owing to these economies in administration, the cost per bed in a properly repaired, equipped, and efficient sanatorium has been reduced to an average of £65 per annum.

APPENDIX IV.

Table showing Treatment of Brompton Patients during 1908.

Classification on leaving.	Total in each class.	At work, Feb., 1911.	Not at work.	Un-reported, Feb., 1911.	Dead.
Arrest	137	97	6	27	7
Arrest + T.B. . . .	60	33	7	6	14
Improved	24	12	3	2	7
I.S.Q. or worse . . .	19	4	3	9	3
Died (0·8 per cent.) . .	2	—	—	—	—
Total . . .	242	146	19	44	31
Percentages . .	—	60·3	7·9	18·1	12·8

Surgical*	2
Convalescent*	26
Children	11
Discharged for constant disobedience . . .	2
Discharged for entering public-houses . . .	5
Discharged, own wish	9
Total	55
Cases analysed above	242
Total	297

* Denotes patients sent down to the sanatorium for a few weeks, not for the ordinary course of treatment.

ADLARD AND SON, IMPR., LONDON AND DORKING.