THE SANATORIUM TREATMENT OF PULMONARY TUBERCULOSIS

F. RUFENACHT WALTERS

THE OPEN-AIR OR SANATORIUM TREATMENT OF PULMONARY TUBERCULOSIS

THE OPEN-AIR

OR

SANATORIUM TREATMENT

OF

PULMONARY TUBERCULOSIS

BY

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PREFACE

An attempt has been made in this little book to give a complete description of the methods of treatment employed in a good open-air sanatorium, for the use of physicians in charge of consumptives, whether in such a place or elsewhere. Some years' experience in directing a sanatorium has convinced me that many people refuse to undergo systematic treatment for pulmonary troubles until the disease is well advanced and correspondingly difficult to cure, partly because in early stages the patient often feels pretty well, and partly because of an exaggerated idea of the discomforts of sanatorium life; and that a stay at the seaside or in the country is often substituted, which does but little good because the patient is ignorant of the fundamental rules of sanatorium treatment, and thinks he need do no more than walk about in the open air and eat big meals. Promising cases fail to recover completely because systematic treatment is thought to be unnecessary in the most curable stage, while later on the patient either cannot or will not give sufficient time to the necessary régime.

Another reason for imperfect success is that many people do not realize the limitations of open-air treatment, which needs in many cases to be supplemented by medicinal or vaccine treatment. Recent publications in France and Germany on this aspect of the problem deserve more attention than they have hitherto received in this country.

In dealing with intelligent patients, it is a great advantage if the doctor can secure their co-operation by explaining the reasons for treatment adopted. Moreover, since pulmonary tuberculosis is transmissible long before the patient is obviously ill, while such transmission can easily be prevented, it is important in the public interest to point out to the layman where the danger lies and how it may be avoided. I have also been repeatedly asked by my patients when they were leaving the sanatorium whether there were any books telling them how and where to live, and what precautions they should take on rejoining their family and friends. Every sanatorium doctor is continually being asked questions as to the nature of the disease and the hygienic measures to be adopted, and has to spend much time in answering them. For practical reasons it was not possible to publish the technical and the non-technical details in separate volumes. An attempt has therefore been made to combine them in one, the first part being concerned with matters which an intelligent patient should know, while it forms a convenient summary for the use of his doctor. Numbers in this part refer to corresponding paragraphs in the second portion of the book, which contains the more purely technical matters. Should the patient also read this part it will do him no harm. Moreover it would be of little or no use to him if he were to attempt self-treatment, which is always a mistake. He will more likely be impressed with the fact that many remedies are in existence for the different forms and symptoms of pulmonary disease; that it requires medical knowledge and experience to use these aright; and that consumption is mostly curable, but that it cannot be cured without docility and perseverance on his own part, skill and a plentiful expenditure of time and patience on the part of the doctor.

My best thanks are offered to the authors and publishers of 'A Manual of Surgery,' by Rose and Carless; to Messrs. Hall and Young for the use of blocks, and to Miss J. M. Gilbert for artistic help in making the diagrams in this book.

F. R. WALTERS.

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SANATORIUM TREATMENT OF PULMONARY CONSUMPTION

PART I

CHAPTER I

THE NATURE AND CAUSES OF PULMONARY TUBERCULOSIS

CONSUMPTION, pulmonary tuberculosis, or phthisis, is an extremely common disease, which may be so slight as not even to be detected,* [24] or so severe as to cause death within a few weeks. The former course is so common that most people dying from accidents or from non-tuberculous disease show evidence (if it is sought) of healed tubercle; whereas a rapidly fatal 'galloping consumption' is decidedly rare. It is stated that four out of every five persons attacked with tubercle recover from it, although the completeness of the recovery depends on circumstances which will be discussed in the next chapter.

The disease is more correctly called 'pulmonary tuberculosis,' meaning thereby tuberculosis attacking the lungs; the other two names are given to it because of the wasting or loss of weight which it causes when allowed to become well marked.† Tuberculosis results from the presence in the body of the living tubercle bacillus at a time when the body is incapable of properly defending itself, and may be found in almost any part of the body, although the lungs are more commonly affected than any other organs. The tubercle bacillus (Fig. 1) is a rod-like organism about $\frac{1}{80000}$ inch ($\frac{1}{3000}$ milli-

* The numbers refer to sections in the second part of this book.

† Phthisis = wasting (φθίσις).

metre) in diameter, usually from $\frac{1}{6000}$ to $\frac{1}{16000}$ inch long ($\frac{1}{240}$ to $\frac{1}{640}$ millimetre), but sometimes more. It was discovered in 1882 by Dr. R. Koch, who showed that it could be stained with aniline dyes,[1] and grown under certain conditions on potato, coagulated blood-serum, glycerinated beef-broth, and other substances. It is destroyed by bright sunshine,[13] and grows with difficulty outside a living body, requiring special conditions as to heat and moisture. It is, however, able to survive for as long as ten months in dark corners of a dirty room, and is able to infect any susceptible animal or human being into whose body it gains entrance while still active. There are several varieties of the tubercle bacillus, one of which infects birds, another chiefly found in cows, a third specially affecting man.[6]

The bovine variety also causes disease in human beings, though usually of a slightly different kind. If introduced into a susceptible body, the tubercle bacillus multiplies in the tissues, causing the formation of tiny inflammatory overgrowths, called ‘tubercles.’ These are about the size of a large pin's head, but may be so numerous as to occupy large portions of the lungs or other parts of the body. They are apt, after a time, to degenerate, soften, and break down, so that it commonly happens that the piece of lung attacked first becomes choked up, and later on perhaps riddled with holes. In order to protect itself and facilitate its spread, the tubercle bacillus forms several poisons (toxins), which weaken the body or destroy the vitality of the tissues. A healthy constitution, however, reacts against these, and forms antibodies, which kill the bacillus or limit its activity, so that it is quite common to find, after death from causes other than tubercle, nodules and scars in the lungs and other parts of the body, with perhaps the remains of dead bacilli, showing that the individual had once upon a time had an attack of tubercle from which he had completely recovered.[23]

It is also very common for the apparently healthy to carry about with them tiny tuberculous foci, with living but dormant bacilli, ready to break out afresh if the defences of the body are weakened, but incapable of mischief so long as the health remains good. Indeed, it is probable that in most cases tuberculous disease breaks out after a period of latency of uncertain length, in consequence of some indiscretion or illness which temporarily weakens the bodily resistance.[24]

Most animals are susceptible to tubercle, some more, some less, man occupying an intermediate position between those which are least susceptible (such as the horse and goat) and those which are most susceptible (rabbit, guinea-pig). The disease is usually transmitted from one person to another, owing to the common neglect of certain simple precautions. Since it was publicly realized that the tubercle bacillus was transmissible in this way, there has been an unreasonable scare about it, not justified by facts. Unlike measles or scarlet fever, which are extremely likely to be caught by those who have not already had an attack, the tubercle bacillus is but feebly infective, only capable of attacking those who are susceptible, and easily destroyed by quite simple means. What these are will be pointed out later.

Susceptibility to consumption used formerly to be entirely attributed to inheritance, and if a man's parents died of consumption he was regarded as almost doomed to it, while if there were no history of the disease in his family he was thought to be free from all danger of it. But this is far from the truth. Inheritance does count for something, but the manner and conditions of life count for very much more, and whereas the former cannot be altered, the latter are to a very large extent under our control.[21] There is almost as much consumption amongst those whose parents have been free from the disease as among the offspring of consumptives, and apart from infection (which ought to be preventable), there are many things which predispose people to catch the disease and to suffer from it disproportionately.[7]

Some infectious fevers, such as measles, whooping-cough, influenza, and typhoid fever, cause an unusual tendency to consumption, so that those (especially children) convalescing from such diseases should be removed from any dirty, overcrowded place to one in which the air is pure and free from infection. It is a great mistake to regard measles as always a trivial ailment. In its complications and in the diseases to which it gives rise it is responsible for a vast number of deaths in childhood.

The commonest predisposing cause of tuberculosis is a life under unhealthy conditions. Ill-ventilated, overcrowded rooms,[13] overindulgence in alcohol,[12] late hours, and irregular habits, predispose to the disease, as also do starvation and overwork,[11] although in these cases dust and dirt and the intimate association with careless or ignorant consumptives also play their part. Consumption is especially common in women exhausted by too frequent pregnancies or overlong suckling,[17] and prolonged sick nursing without a proper amount of rest and food may cause a similar breakdown. People who are engaged in sedentary work and do not properly expand the lungs[9] are more liable to consumption than those who live a more active outdoor life. Those compelled to be out in all weathers are far less subject to tubercle than those who stay much indoors.

It is commonly believed that consumption is caused by a series of neglected colds, but as a rule the ' colds ' are probably themselves the first sign of the lungs being diseased. Those who are constantly catching cold should live more out of doors and consult their doctor. If they are already consumptive, they may then be cured ; if not, by timely advice they may avoid the risk of getting the disease. Exposure to an over-heated or dusty atmosphere[18] commonly leads to catarrhal conditions of the lungs (bronchitis, winter cough, and the like), and these may undoubtedly end in consumption. This is why the disease is so common amongst the Sheffield knife-grinders, the potters, and factory hands.[10] In a dusty workshop, a cotton or flour mill, or a linen-draper's shop, the dusty particles in the air injure the surface of the breathing tubes, and lay them open to receive the tuberculous infection. Attacks of pneumonia or pleurisy may act similarly, although they are more often themselves the first evidence of tuberculous disease. The term ' congestion of the lungs ' usually means a tuberculous affection, unless it is part of some other disease. In some well-ventilated mines there is very little consumption amongst the workers, whereas in others with bad ventilation and a dusty atmosphere it is extremely common.

Probably the dusty atmosphere is one reason why there are so many more consumptives in towns than in the country. It is stated that an adult in Manchester inhales 37,000,000 bacteria in ten hours, and that in London there are from 80,000 to 210,000 solid particles in each cubic centimetre of air (about $\frac{1}{17}$ cubic inch), whereas in the Western Highlands there are only sixteen.* Dust particles irritate the mucous membranes of the air passages, and make them susceptible to infection by the tubercle bacillus.

Coming next to the sources of infection, the chief is undoubtedly the expectoration of other consumptives, spread broadcast by indiscriminate coughing and spitting, leading to the introduction of bacilli into the mouth or air passages. After Koch's early experiments with pulverized sputum it was long taken for granted that the bacilli were usually inhaled direct into the lungs, but it is by no means certain that this is the usual explanation. In those who breathe (as people should) through the nose, the inhaled particles have to run the gauntlet of a complicated set of passages lined with moist mucous membrane well calculated to arrest them. Some of the particles probably get no farther than the nose, others may settle in the throat, while many are no doubt swallowed.[5] In mouth-breathers fewer obstacles are placed in the way of inhaled bacilli, and some are likely to be carried to the tonsils, finding lodgment in the crypts or depressions of those organs.

It has been shown by Flügge and Heymann that an explosive cough is capable of spreading tiny air bubbles with attached bacilli to a distance of about a yard from the mouth, unless something (such as a piece of rag or a handkerchief) is interposed. However, the danger from this source is very small,[4] excepting possibly for those in attendance on patients in the last and most helpless stages of consumption.

The greatest danger is from actual masses of sputum,

* Street: Presidential Address, *Journal of Balneology and Climatology*, January, 1904.

allowed to mingle with the dust on the floor or transferred mechanically by fingers or food to the mouth. Young children who live in the same room with a consumptive who takes no precautions are extremely likely to introduce bacilli in this way into their mouths. The danger is also great for every occupant of a room where such expectorated bacilli are left to dry and blow about in the air. If, however, the expectoration is received into a suitable vessel with a little water, and is destroyed before the latter evaporates, there is absolutely no danger of infection in this way. Out of doors and in well-lighted, well-ventilated rooms most of the bacilli probably perish, since light and air have a powerful bactericidal effect. Broadly speaking, there is little or no danger out of doors, but considerable risk in dirty, overcrowded[13] rooms which are visited by a number of people, for in a crowd there is, unfortunately, likely to be at least one who is consumptive and who carelessly spits about him or coughs without shielding his mouth. This danger will continue until it is generally understood that such practices are not only filthy, but full of risk for others. The consumptive in an advanced stage of illness may cough up several billions of tubercle bacilli in twenty-four hours ;[4] and although it is easy in most cases to prevent their doing any mischief, the danger is very real where precautions are neglected. Many cases of consumption may originate in a visit to dirty lodgings or a health resort, possibly even the railway waiting-room, while infection from a comrade in the workshop or at the bank or office is extremely common. To show that this need not happen, it is enough to refer to the experience of the consumption hospitals in this country and the sanatoria for consumptives here and abroad, where it is the rarest thing in the world to find an attendant, a nurse, a doctor, or a visitor infected from the patients.[8] Of course, these places enjoy the advantage that they are so constructed and furnished that they may be easily kept clean ; but the chief difference lies in the fact that elementary precautions are insisted upon, whereas elsewhere they are too often disregarded.

Apart from the spread of disease from the human patient, there remains a source of infection which accounts for much of the ' strumous diseases ' and ' wasting diseases ' of infancy—milk from infected cows. There is a vast amount of tuberculosis amongst our dairy herds ; moreover, it has been shown that the milk may be infected with tubercle even when the cow's udder seems to be all right.[6] By the tuberculin test such disease can easily be detected ; and if those who supply tuberculous milk and neglect this test were always punished, one great source of danger to our children would be removed. The chief difficulty is the cost, as the cow-keeper is not willing to bear the expense, and fails to see that it would in the long-run be to his advantage to weed out all tuberculous cows from his herd, while the public authorities do not always give sufficient compensation to cover the cost. Our late Queen set a splendid example in this respect by giving orders to have all the tuberculous cows destroyed which did not pass the tuberculin test in one of the royal herds.

Some years ago tuberculosis was so common in Denmark as to threaten the existence of the export trade in butter and cheese. Stringent measures, however, were adopted, the healthy and unhealthy cows being separated, with the result that Denmark is now almost entirely free from the disease in her dairy farms. Probably a system of compulsory testing, together with an insurance fund to cover the cost of cows destroyed, would do much to free our herds from the disease.

For the protection of the household, boiling or ' pasteurizing ' the milk* will destroy the bacilli ; but this (especially boiling) makes the milk a trifle less nourishing and less palatable. Public opinion might do much by insisting on a guarantee that the milk is from tuberculin-tested cows.

To sum up, there is no difficulty in preventing the spread of tuberculous infection if only people will take the trouble ; moreover, if the bacillus gets into the body, no ill-effects follow unless the constitution has been undermined by unsatisfactory conditions of life, or has been enfeebled by a strong hereditary taint ; so that the best safeguard of all is to improve the constitutional vigour by a return to more healthy ways of life.

* Heating in a special kind of vessel for twenty minutes at 155° F. See also p. 125.

CHAPTER II

EARLY RECOGNITION AND SYMPTOMS

It is of great importance to recognize an attack of tubercle in the earliest possible stage. Hippocrates, who died about 380 B.C., taught that 'phthisis, if treated early enough, gets cured,' and many others since his time have been convinced of the same fact. Discovered early and suitably treated, tubercle of the lungs usually ends in recovery, while if neglected it is far more dangerous to life, requires many more months of treatment, and usually leaves behind it more or less permanent damage to the lungs, and consequently to the general vigour and working capacity. Moreover, while there is no possibility of transmitting the disease to others in the earliest stage, this is very likely to happen when the disease is only discovered after there has been free expectoration for some time.

The popular conception of the nature and symptoms of consumption is entirely based upon the characters of the disease in an advanced stage, and even medical men are found to countenance a haphazard treatment in the early stages, on the plea that the patient is not ill enough to require sanatorium treatment or any substitute for it worthy of the name. And yet it is during the earliest stages, before any tubercle bacilli have appeared in the expectoration, and when the patient is merely 'run down,' or suffering from 'debility' or 'congestion of the lungs,' or some other vague ailment, that the results of systematic treatment are likely to be the most brilliant and recovery to be the most complete.

So long as the change in the lungs is confined to a few scattered tubercles, and the constitution is as yet not undermined, there is no reason why we should not see a recovery so complete that the patient will enjoy as good or better health than before his illness, and will be indistinguishable from his unattacked companions save by his horror of close rooms and his dislike of coddling ways. Treatment adopted at a later stage, when destructive changes have begun in the lungs, will necessarily result in, at the best, incomplete recovery, for it is almost as impossible to replace lung tissue that has been destroyed as to make an amputated limb grow again.[35] Moreover, the more active the disease and the more extensive it is, the greater is the tendency to dangerous degrees of fever, to crippling of the heart, and to incomplete recovery of the lungs, leaving smouldering patches of tubercle behind, which are capable of breaking out afresh at the least encouragement, even if the patient survive at all.

Treatment in an early stage, then, will often restore the man to full working capacity ; but in a late stage, if he recovers, he will often be an invalid for the rest of his life, unable to bear his part in the work of the world. When the recovery is incomplete, much will depend on the conditions of life after apparent recovery ; so that the man who can study his health and his needs may live for many years, but the man who is compelled by lack of means to live an unhealthy life, or whose occupation or place of residence is unsuitable, will be continually in danger of a fresh breakdown.

If we look at pulmonary tubercle from the public health point of view, the most important thing is to prevent infection from spreading from well-marked cases who are expectorating tubercle bacilli ; but from a curative aspect, the most important thing is to recognize and adequately treat the disease before this stage has been arrived at.

It is exceptional to have actual illness in the earliest stages of tuberculosis, unless this follows influenza, pleurisy, pneumonia, or other acute disease. In the latter case the chief symptomatic evidence of tubercle is incomplete recovery from the illness, to which are gradually added the more distinctive characters of tuberculosis. Thus one of my old patients fell ill with an attack of acute pneumonia due to the pneumococcus ; the usual crisis failed to appear, resolution was incomplete, and presently tubercle bacilli were found in the expectoration. In another case the tuberculous attack was led up to by whooping-cough. In a third case a gentleman caught Malta fever, which returned the following winter. A third winter he had a feverish attack, with bronchial catarrh, as on the former occasions, but this time tubercle bacilli were discovered in the expectoration. In another case, a young naval officer fell from the rigging on board ship and broke some ribs. He never thoroughly convalesced from this accident, and after a while the lungs were found to be diseased. Pleurisy is so often a tuberculous trouble that it should always be regarded as a sign of tubercle unless this can be clearly excluded or the attack traced to some other cause, such as a rheumatic taint.[28] During influenza epidemics it probably happens from time to time that early tuberculosis with fever is mistaken for influenza ; but apart from this, an attack of influenza increases the susceptibility to tubercle. In the same way typhoid fever may lead on to tubercle ; but each of these diseases may at times counterfeit the other, and be with difficulty distinguished.

Apart from cases of tubercle which date their attack from an illness or accident, the disease usually begins insidiously, with slight debility or lack of tone, which cannot be thrown off when a holiday is taken. There is perhaps a little difficulty in doing physical or mental work against time ; possibly a tendency to irritability of temper or to restless nights, or, in other cases, lack of appetite and dyspepsia. None of these symptoms are distinctive of tubercle, and they may well be due to other and much more harmless causes. Still, whenever there is persistent debility or dyspepsia, or slight ill-health of other kinds, especially if it follows an attack of influenza, measles, whooping-cough, or typhoid fever, the possibility of a tuberculous cause should be remembered, and the matter properly inquired into. Persistent pallor or anæmia is also sometimes due to tubercle. I once had a young man under observation who for fully six months had anæmia and debility without obvious cause and without any cough or other sign of chest disease, but in whom eventually tubercle was discovered.[24] Progressive loss of weight is still more characteristic of tubercle, and when present should be carefully looked into (see p. 108).

In these early stages of tuberculosis the most useful tests are the bodily temperature[30] (see p. 80), the opsonic index,[32] and the tuberculin test[31] in one of its varieties. When even slight fever is present, it is common to get a slight flush over one or both cheeks for part of the day, usually the afternoon. This is sometimes felt by the patient when it is not obvious to other people. The pulse-rate is increased, especially after even slight exertion, and if the patient is injudiciously clad or sleeps in an unventilated room, there may be night-sweats (or sleep-sweats). Otherwise these are quite unusual, excepting in advanced stages of the disease.[39]

A dry cough is quite common in early tuberculosis, so that any cough which lasts more than a month should be investigated. Needless to say, there are many possible causes for a cough, but it is persistence rather than severity that should make one suspicious of tubercle. Cough may at first only be excited by laughing, talking, or exertion. When expectoration begins, there is usually just a little pellet brought up on first waking, and this may contain bacilli in cases where examination of the chest leaves one in doubt. It is advisable to make repeated examinations of the sputum at short intervals where at first no bacilli are found ; they may at first be quite few in number, but a single unmistakable tubercle bacillus is enough to make the diagnosis certain. The number of bacilli expectorated is no measure of the extent of the disease, as they may be numerous in cases of limited disease and absent where the disease is widespread. The presence of bacilli in the expectoration is a sign that softening has taken place in at least one spot in the lung ; but softening may happen without free communication with the bronchial tubes, in which case there would be no bacilli coughed up. Moreover, there would be no expectorated bacilli in widespread tuberculosis without softening. So, also, the quantity of expectoration is not necessarily a measure of the amount of disease. Quite commonly tuberculosis is grafted upon an ordinary winter cough or bronchitis, in which case there may be much expectoration, with few or no tubercle bacilli.

It is not uncommon to meet with cases in which repeated examination of the sputum fails to show the presence of tubercle bacilli, while injection of the sputum into a guinea-pig causes unmistakable tuberculosis, with unmistakable tubercle bacilli. This may be explained by the multiplication

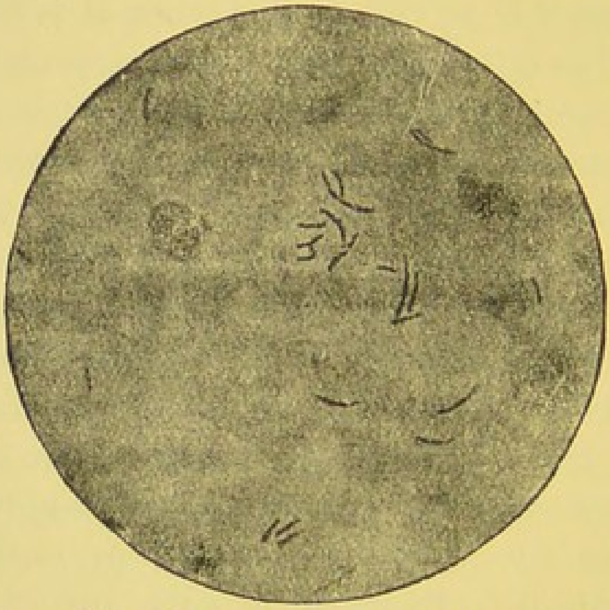

FIG. 1.—THE TUBERCLE BACILLUS. × 1000.
(From Rose and Carless' 'Surgery.')

in the susceptible animal of bacilli which were too few to be discovered. Another possible explanation is that only spores existed in the sputum, which require special staining methods to be revealed. Spengler has pointed out that in some cases fragments (*Splitter*) are found in the sputum which are a modification of the tubercle bacillus. He recognizes two kinds, one of which he maintains is the spore of the bovine form of tubercle bacillus.[1]

Blood-spitting is a very common symptom in tubercle of the lungs, and is often most useful in calling attention to the disease while it is still of limited extent. Where blood-spitting takes place without any discoverable signs of chest disease, people are sometimes assured that the blood came from the throat and is of no importance. This is most unwise. In the absence of unmistakable non-tuberculous causes, blood-spitting should always be regarded as a symptom of early tubercle of the air passages, and other tests applied. By timely resort to open-air treatment and other measures, many such cases might be cured which by neglect pass into pronounced consumption.

Careful examination of the chest is a most important help in the discovery of early tubercle. The parts especially attacked are those in which expansion is less complete than elsewhere, such as the apices of the lobes, the edges of the lungs near the heart, or parts which have been damaged by disease of other kinds. Those who have had experience in Röntgen-ray examinations declare that this method gives earlier evidence of change than ordinary physical examination of the chest, but probably many cases are allowed to drift into well-marked disease merely from lack of careful examination by the ordinary methods.[33] In really early disease there should be no well-marked alterations discoverable in the lungs, so that careful attention to the clinical history and the use of the thermometer, the opsonic test, or the tuberculin test, are of more importance at first than even the examination of the chest.

Since tubercle attacks other parts of the body besides the chest, examination of the eye, the larynx, the lymphatic glands, etc., may help to establish the diagnosis. Loss of voice or slight hoarseness is very common as a forerunner of tuberculosis.[38] Tuberculosis is no exception to the rule that in medical matters every part of the body and every physiological system should be passed in review in examining a doubtful case of disease.

CHAPTER III

THE MODERN TREATMENT OF CONSUMPTION

ALTHOUGH good food and a life in the open air were early recognized as being of importance in the treatment of consumption, their value was later on lost sight of under the influence of mistaken notions as to its nature, so that systematic treatment only dates back to the middle, and in this country to the end, of the nineteenth century. So long as consumption was regarded as a hereditary disease, brought on by catching colds or by a succession of chills, it seemed natural to confine the sufferer to a warm room, from which draughts and damp air were carefully excluded. Even the possibility of recovery was lost sight of, so that in 1815 Sir Thomas Young wrote: 'Even with the utmost powers of all, perhaps not one in a hundred will be found curable,'* and all that was thought of was to make the patient comfortable until he died.

A few doctors, however, from time to time advocated more sensible methods. One of the earliest of these in this country was a Scotch physician, who in 1747 wrote a letter to his friends in London,† insisting on the importance of fresh air and good food; while in 1840 Dr. George Bodington, of Sutton Coldfield, near Birmingham, wrote an essay‡ forcibly advocating the modern methods.

* Quoted by Dr. Bulstrode, Thirty-Fifth Annual Report of the Local Government Board, 1905-1906, p. 121.

† *Ibid.*, p. 119.

‡ 'Treatment and Cure of Pulmonary Consumption on Principles Natural, Rational, and Successful,' p. 125. Republished by New Sydenham Society, 1901.

Bodington described his treatment in the following words: 'To live in and breathe freely the open air, without being deterred by the wind or weather, is one important and essential remedy in arresting its progress. The cold is never too severe for the consumptive patient in this climate; the cooler the air which passes into the lungs, the greater will be the benefit the patient will derive. The common hospital in a large town is the most unfit place imaginable for consumptive patients, and the treatment generally employed there very inefficient, arising from the inadequacy of the means at command.'

Bodington went so far as to establish a home for the treatment of consumptives, and met with some success on a small scale; but, owing to the fierce opposition of the profession, who ridiculed his methods and doubted their value, the place had to be transformed into a lunatic asylum. Some distinguished physicians, such as Dr. Henry MacCormac, of Belfast (1855), and Sir B. Ward Richardson (1857), supported these rational methods, at some personal cost; but their views gained no acceptance in this country until many years later. In Germany, however, Hermann Brehmer, who may have read Bodington's essay, wrote an inaugural thesis in 1856 on the subject, which has been the foundation of the modern methodical treatment. Brehmer advocated a life spent in the open air in a mountainous district, the avoidance of all debilitating influences, methodical hill-climbing when the patient's condition permitted of it, an abundant dietary, and sundry hydropathic methods, together with constant and unremitting medical supervision. Recognizing the difficulty in controlling the conditions of a patient's life in his own home, Brehmer opened a small home for consumptives in 1854, and five years later, with the help of the distinguished scientists von Humboldt and Schönlein, he opened the sanatorium at Görbersdorf, in Silesia, which has been the means of restoring many thousands to health, and has become the forerunner of many other more or less similar institutions in both Europe and America. Brehmer was himself a consumptive, but recovered with the help of the method he so powerfully advocated.

His pupil, the late Dr. Dettweiler—also a consumptive who owed his recovery to the methods of Brehmer—started, in 1876, the second sanatorium in Germany, at Falkenstein, in the Taunus Mountains, near Frankfort. Dettweiler, seeing what harm may be done to consumptives by exercise before they are fit for it, laid more stress on persistent rest in the open air than on graduated exercise, although he still recognized the need of systematic hill-climbing in the later stages of treatment. In 1888 another German physician, Dr. Otto Walther, started an institution of the same kind at Nordrach, in the Black Forest, which became even better known in England than in Germany, and attracted many English patients. Walther in some respects returned to Brehmer's original methods, and obtained distinctly better results, if one may judge by his reputation and by the general statements of those who have been under his care, without actual statistics, which have not yet been supplied. Perhaps now that he has retired from active sanatorium work this will be remedied.

There is no doubt that the elaborate and costly buildings which had become the fashion in Germany were quite unnecessary, and that Dettweiler's method of rest for many hours on a cane lounge or in bed, although essential in early stages, was not calculated to harden the patient or to complete his recovery. Walther has been most rigid in enforcing rest while fever lasts, and equally strict in insisting upon a prescribed amount of exercise later on. His methods have had a great influence upon the treatment adopted at British sanatoria, several of which are managed by old patients and pupils of his. Nearly all the British sanatoria, in fact, profess to base their treatment on Walther's practice; but there are many differences in detail, although the general principles are the same in all.

The modern treatment of consumption, as carried out in the best sanatoria, is based upon an enlightened common sense, and embraces all those measures, hygienic and medical, which have been shown by the accumulated experience of fifty years to be useful in curing or relieving the patient. Many of the details may be learnt by an intelligent person, but some demand medical knowledge, with a certain amount of special experience only to be gained by actual practice. The modern treatment does not merely consist in exposure to the open air, although this is an essential part of it. Pure air alone is insufficient to cure a well-marked case of consumption, even if carried out with the thoroughness usually insisted upon in a good sanatorium. The regulation of rest and exercise, according to temperature, circulation, strength, body-weight, digestion, and lung condition, is of the greatest importance; and this can only be successfully done under the guidance of a doctor experienced in sanatorium methods and able to devote a large amount of time to his patient. A suitable dietary forms part of modern sanatorium treatment, as do a number of other details which will be discussed as far as possible in the following pages.

Hygienic treatment alone is capable of restoring to health many of the slighter forms of tubercle in the lungs, but it should be understood that there are distinct limits to its powers. Even early cases in which there is high fever are not curable by hygienic means alone, however rigidly carried out; and in these cases, as well as in some progressive or complicated forms with a moderate degree of fever, other measures will be necessary if the disease is to be arrested before serious damage has been done to lungs, heart, or constitution. In the acute attacks with high fever the most useful remedies are such as give rest to affected organs and diminish the absorption of poisonous matter from the diseased lungs. Other important aids are medicines which strengthen the heart or help digestion, or help to neutralize noxious substances in the bowels. In its fight against the disease, substances have to be added to the blood which antagonize the bacilli and their poisons; and the manufacture of these natural antidotes can be stimulated by the use of appropriate vaccines, such as some of the various kinds of tuberculin. There is also good evidence to show that some other kinds of drugs are of use in fighting the disease, although it is still uncertain when and under what circumstances some of these are most likely to be useful. Among these remedies may be mentioned quinine, arsenic, the hypophosphites, and a number of substances derived from creosote. The specialist in lung diseases has gone some way towards solving these problems, but much still remains to be done. Considerable importance is attached in France to an exhaustive examination of the urine as an indication for treatment, and laboratories for such examinations and for the investigation of the blood and expectoration are attached to the better sanatoria.

It should be evident from the foregoing remarks that much is included in the modern treatment of consumption which is not merely an application of the laws of hygiene, although these are also necessary and of great value.

We need a short descriptive name for the modern method of treating tuberculous patients. It has been called the 'hygienic' or 'hygienic-dietetic' method; but it is both more and less than this, for it includes remedies which are not strictly hygienic, but rather medical, and does not include some hygienic measures which are suitable for the healthy, but not for the average consumptive. To call it the 'open-air treatment' suggests that a life in the open air is the whole of the treatment, which is far from being the case.

In Germany it is often called the 'Brehmer-Dettweiler' method, in England the 'Nordrach' method; but both of these terms are too narrow to be recommended, as they would exclude many remedies of proved value. Walther, of Nordrach, was stated to have no faith in any but hygienic measures, employing almost no medicine, and none of the special antituberculous remedies. Personally, I am convinced that these have their place in successful treatment, so that a wider name is preferable. If we call the treatment by the name of the 'sanatorium treatment,' we appear to exclude the same methods when applied outside a sanatorium. However, so long as it is understood that by this term we mean the modern methods as commonly adopted in open-air sanatoria, whether they be carried out in a sanatorium or elsewhere, little harm will be done by using the term, which has, therefore, been placed on the title-page of this book.

CHAPTER IV

TREATMENT ABROAD

Is it necessary for the consumptive to go abroad ? Not so long ago people believed in curative climates, and doctors thought they had done their whole duty to the consumptive patient when they had sent him to some chosen place, with injunctions to live out of doors. A health resort was regarded as a sort of automatic machine, in which the patient pressed the button and the climate did all the rest. Even now there are many otherwise well-informed persons who appear to hold this view. When Brehmer started his sanatorium in the Silesian Mountains, it was generally held that people never became consumptive in places above a certain height, which varied with the latitude, and that if consumptives went to a place at such an altitude they began to get well automatically. It is, however, a mistake to regard any climate as capable by itself of curing a well-marked case of consumption, and people have got well in the most diverse climates. Alpine health resorts and elevated plateaux (which still are the most freely recommended), although possessing great advantages in certain cases, do not prevent the onset of consumption ; for the disease is rife amongst the watchmakers in the high Alps, and is extremely rare or unknown in the Kirghiz Steppes, which are below the sea-level, and in the low-lying parts of Iceland. Having regard to the varied climatic characters of places with a reputation for curing consumption—high and low, cold and warm, rainy and dry, marine and inland—it is natural to conclude that, however the climate may help or hinder, it is not so essential as the manner of life and the details of treatment, although certain qualities possessed in common by all these places are of considerable importance. The most necessary of these common characters are a pure atmosphere and facilities for an open-air life, and many of the other differences may be reduced to these factors. Since these are also possessed by many places in the British Isles, it follows that many cases of consumption will get well without going abroad, and so experience proves.

Healthy people in need of a holiday find that many places do them good, but each one knows by experience that some places suit him better than others. In just the same way there are many places where any given consumptive would do well, but he might get well faster in one than in another, according to the circumstances of his case. It is a mistake to suppose that residence in the Alps, or a sea-voyage, or a stay in the South of France or in Egypt, is best for every consumptive. In each case all the circumstances should be passed in review and weighed before deciding what to do and where to go.

A few general rules will here be useful. No consumptive who is feverish or very ill should undertake a long journey; nor should he go to a place where he cannot be properly nursed and medically attended. On the other hand, the consumptive who is not feverish, and whose constitution is not yet undermined, has a much wider choice. There are many places which will suit him well, both here and abroad. He should not, however, go to any place without being definitely under medical supervision. It is said that the doctor who treats himself has a fool for his patient. Still more is this true for the tuberculous layman, however slight the nature of his attack. Nor is it wise to go to any place much frequented by invalids of a different kind or by pleasure-seekers, for there the conditions of life are sure to be wrong for the consumptive. Places which advertise a *Kursaal*, indoor balls and concerts and the like, should be avoided. The tuberculous patient, however well he may feel, should go in order to get well, not in search of amusement. Fashionable places with a large visiting or resident population are also best avoided. Their reputation for the cure of consumptives was probably made when there were few people and the air still pure. Busy roads, many houses and people, are a great drawback for the open-air treatment.

Places which are naturally dusty should also be avoided. Dust irritates the lungs; and although we are provided with a natural filter in the nose and throat, it is not well to overwork it.

The consumptive who is still fairly vigorous should avoid warm, relaxing places. Within limits (which depend on the individual), the cooler the place, the more likely is he to get hungry and to feel well.

It is important to go to a place where plenty of good, well-cooked food may be obtained, suited to the tastes of the individual. Many foreign health resorts provide a fare which does not tempt the British appetite, and to which the consumptive cannot easily accommodate himself.

The consumptive should always go to a place in which the food, the cleaning of the rooms, and the ventilation, not only of his own room, but of the neighbouring part of the house, are in the hands of one who knows what is wanted and will see that it is provided. From this it follows that until the patient is thoroughly convalescent, he should go to a sanatorium, or live in rooms which are arranged and managed like a sanatorium, not to an hotel or boarding-house which is intended for the non-consumptive invalid or pleasure-seeker.

The completely convalescent patient has a somewhat wider choice. To this we return in Chapter XXIV.

Consumptives who are sent abroad are usually recommended to go for a voyage or to go to an Alpine health resort, or else to the South of France, Germany, or Egypt. Occasionally South Africa, parts of Australia, or one of the American health resorts, is prescribed. The advantages and disadvantages of a sea-voyage are discussed elsewhere (Chapter XXVI.); here we need only say that it is unsuitable for those who are really ill or feverish. So also is treatment in Egypt, South Africa, or Australia, partly because of the distance, partly because of the difficulty in getting suitable food and medical supervision in proper quarters. For the American or Australian there are good sanatoria and health resorts within a reasonable distance in those parts of the world, but for the British patient who is still an invalid it is a great mistake to go so far.

The journey to Egypt is usually undertaken to escape the British winter, and for those who are not ill, but who dislike the cold and have sufficient means, it may answer well. But in summer-time neither Egypt nor the Riviera can be recommended, so that they are not suited for prolonged treatment. In winter-time the Riviera is usually sunny and exhilarating. The breezes from the sea and the cold winds from the mountains prevent the heat from becoming oppressive, so that life out of doors is usually very pleasant. Occasionally, however, there are hot winds from across the Mediterranean, and at other times bitter cold blasts from the Alps, while at sundown there is nearly always a considerable fall in temperature, necessitating a corresponding change in the clothing. The chief drawback is the lack of real sanatoria under medical supervision. There are plenty of hotels and one sanatorium for paying patients ; but the Riviera is too much the haunt of the tourist to be recommended for the consumptive who still needs medical care, and since the advent of the motor-car the conditions there have distinctly changed for the worse.

Alpine Climates.

Since Spengler discovered the advantages of Davos and the Engadine after 1848, and Meyer Ahrens and Unger aided him in making known to the world the climatic advantages of this Alpine retreat, it has been customary to recommend consumptives to go to one of the Swiss Alpine resorts. These places are situated from 3,000 to 5,000 feet above the sea-level, near the line of perpetual snow, which covers the ground of these places for five or six months of the year. Their chief advantages are the rarefied atmosphere, cold dry air, hot sun, absence of wind, and absence of dust. A rarefied or thin atmosphere compels people to breathe more deeply, and helps to expand the lungs, much in the same way as systematic breathing exercises ; but in the Alps people cannot forget to breathe deeply, being compelled to do so day and night. This is an advantage if the lungs are little damaged, but is dangerous when part of the lung is inflamed, or the breathing surface is much diminished in extent, or the circulation defective. Even strong people who ascend to a great height are liable to get 'mountain sickness,' in which the least exertion brings on giddiness, faintness, and a feeling of sickness, and in which they have to lie panting on the ground. Consumptives who think of going to such elevated places should therefore seek medical advice before doing so, as it may be quite the wrong thing for them to do.

Cool air, within limits (which depend on the individual), is bracing and reviving, as it improves the appetite and stimulates the circulation. Just as a cold bath braces up a strong man, so does cold air, provided that the degree of cold be not beyond the reacting powers of the individual. But what braces up one man may turn another blue, and do him harm. The drier the air and the less wind there is, the more easily is cold borne. This is why the chief Alpine health resorts have been placed in sheltered valleys, where strong wind is unusual. Such conditions tempt people to live out of doors, when otherwise they might be unwilling to do so. The hot sun in Alpine health resorts also helps people to stand the cold without discomfort. There is, however, another side to the question, as hot sun is bad for the feverish; moreover, the great difference between sun and shade temperature (often as much as 40° F.), and between the temperature of day and night, is trying to those who have a feeble circulation. The absence of dust in Alpine health resorts, especially in the winter-time, depends partly on the covering of snow (which mechanically stops it), partly on the scanty population, partly also on the thin atmosphere, and the cleansing effect of the snowfall. The more fashionable Alpine resorts in their growth began to destroy this advantage, so that there was a saying that 'the snow is never white in Davos,' which at one time often lay under a thick pall of smoke. Much, however, has been done to diminish this evil by the introduction of electric lighting and traction.

Assuming that the Alpine climate is suitable for the individual concerned, the greatest drawbacks are those inseparable from a place of fashionable resort, frequented by pleasure-seekers as well as invalids, and those involved in the journey and the foreign food. There are sanatoria in Alpine health resorts where some of the above-mentioned dangers are avoided; but most English patients who go to the Alps flock to an hotel or pension, where there is no one to remind them when they do a medically wrong thing, where the dining-rooms and bedrooms are overheated, and the ventilation and general arrangements are for the healthy pleasure-seeker, and not for the man who must live by rule, and where the temptations to attend concerts, balls, and the like are often very great. There are many amusements which are perfectly harmless to the healthy, but most injurious to the consumptive. An exciting, lively place is not suitable for the average consumptive, who will recover more quickly in a quieter abode.[40]

Hill Climates.

When Brehmer started his sanatorium at Görbersdorf he was influenced by the belief that consumption died out spontaneously in an elevated spot, and that by systematic graduated hill-climbing the heart (which is so often small and feeble in the consumptive) may be strengthened. Although he was mistaken in the first of these reasons, there is much truth in the second. After the stage of fever has been passed, it is impossible for the convalescent from lung disease to make a complete and lasting recovery without gradually increasing exercise, of which the most useful kind is probably hill-climbing. The vast majority of German sanatoria are placed in hilly districts, and some of the best British ones likewise. The feeble convalescent may not be able to climb hills, but as soon as he is able he should do so in the way described in Chapter XV.

Fresh-air sanatoria in Germany are found at various heights, from a few hundred to over 2,500 feet above the sea-level. Those to which British patients are most commonly recommended are the sanatoria at Nordrach, Falkenstein, and Hohenhonnef. At Nordrach treatment was very thorough and strict under Walther, carried out in a lovely but secluded valley in the Black Forest. The climate is a little like that of the Cumberland hills, with a heavy rainfall, and in summer-time hot sun, while in winter the ground is covered with snow.* The treatment at the other sanatoria is less strict, more luxurious, and usually more expensive, and presents few, if any, medical advantages to the British patient which cannot be obtained nearer home. Still, we are greatly indebted in this country to the German sanatoria and their medical directors, since it was they who first proved the great value of sanatorium treatment in a hill climate comparable to that of parts of Great Britain.

* Walther has lately retired, and sold his sanatorium to the German Government.

CHAPTER V

TREATMENT IN THIS COUNTRY

It is often supposed that the British Isles are quite unsuitable for the treatment of consumption, owing to their climatic drawbacks, although it is hard to say why this notion has arisen.

Primâ facie one would imagine that a country in which so startling a reduction had been made in the death-rate from consumption would not have an altogether unsuitable climate for the consumptive.* Many recognized authorities consider the British climate quite satisfactory for the open-air treatment. Thus, Dr. Walshe wrote: 'It is quite possible to obtain all the requisites that have been mentioned as desirable within the bounds of the British Isles, and often without going far from home. . . . There are many places in this country where, on a dry soil, and in a sunny, sheltered part, on the southern slope of some upland, most of the conditions can be obtained which are now dearly bought and far sought, and often not obtained, in distant parts of the world.'† England is believed to be unsuitable for the weak-chested, because it is comparatively cold and sunless, damp and rainy; but not one of these supposed reasons will bear investigation. Experience shows that the consumptive often makes satisfactory progress in England during cloudy winter weather. Sunshine is chiefly a matter of comfort, and although grateful to those

* The death-rate from phthisis in England and Wales has fallen from 2,530 per million in 1869 to 1,143 per million in 1905 (Newsholme, Presidential Address, Epidemiological Section, Proceedings of the Royal Society of Medicine, November, 1907, vol. i., No. 1).

† 'Diseases of the Lungs,' London, 1871.

who have a poor circulation, is not a necessity. Cold within reason is restoring; heat is often debilitating.

Rain is not an unmixed evil, for it purifies the air, so that the lungs are not irritated by dust particles. Dry, rainless spells of weather are often depressing to health, so that the changeable climate of these islands is really more healthy than many which are more pleasant and more esteemed. Excepting that rain may keep people indoors when they should be out, there is little harm in it, and much good. As Dr. Ransome says: 'Nothing is more certain than that this form of treatment is almost independent of the weather. There is therefore no necessity for the average consumptive to live abroad, although some may have to do so. To most of those convalescing from consumption it is a matter of indifference whether they live in the Alps or at lower levels.'*

If, then, it has been decided to carry out the open-air treatment in England, the choice of locality may be guided by the following considerations:

The selected place should be somewhere in the country, far away from towns, factories, railways, and busy highroads. The air of a city never approaches that of the country in purity. Place a sheet of white paper in front of an open window in London, and in a very short time it will be covered with smuts, while in the country it will remain clean. Shut up a room in a town on a sunny day, admitting a single beam of light through a small hole, and you will see myriads of tiny floating particles. Repeat the experiment in the country, and there will be a noticeable difference. Dr. Miquel found the air at the Montsouris Observatory, near Paris, contained 480 bacteria per cubic metre (35·3 cubic feet), whereas in the streets of Paris there were on an average 3,480, while in inhabited rooms there may be ten or even twenty times this number.† Pure air, then, is the first essential. For the later stages of treatment it is almost essential to choose hilly country, preferably a district with a wide choice of gradients and heights. The place should not be exposed to strong wind,

* 'Treatment of Phthisis,' p. 118. 1896.

† Quoted by Parkes, 'Hygiene and Public Health,' p. 186. 1889.

or, if in a breezy district, should be provided with abundant shelter from trees, hills, or otherwise. This shelter is needful both while resting and while walking, so that it is not enough to put up a few protected seats for the purpose on a windy promenade.

It is never wise to attempt the open-air treatment of consumptives in a windy place. As a rule, the more elevated the place, the greater the need for woods and artificial shelter. Wind, especially in a damp climate, greatly taxes the reactive powers of the individual, and it is only in exceptional cases that the weak-chested can stand wind with impunity. For this reason bleak moorland is best avoided, except during quiet summer weather.

Seaside places also suit few consumptives. Dr. Ransome writes:* 'In my experience the results of sending patients with tubercular disease of the lungs to any exposed seaside resort have been little short of disastrous. . . . I am glad to find that these views as to the danger of many seaside places are supported by such authorities as Broussais, Beneke, and others. Fodéré long ago maintained that marine air both favoured the development of phthisis and acted injuriously on those already affected.'

Dr. Walshe says: 'On the whole, the weight of evidence seems to bear rather against than in favour of marine air—that is, on the seashore.' †

I have myself had a number of instances of the bad influence of the seaside on tubercle of the lungs. A well-protected spot a few miles inland is, however, free from objection, as also are those few seaside places in which protecting hills and trees are abundant. Unfortunately, most of these well-wooded seaside places are relaxing; but this is largely an individual matter, as there are people who do well there at certain seasons of the year.

The soil should be dry, but not dusty. The advantage of a dry soil is that in the colder seasons there is less likelihood of fog, and the ground is not chilling to the feet. This, how-

* 'The Treatment of Phthisis,' p. 133. 1896.

† *Loc. cit.*, p. 591.

ever, is for many people chiefly a matter of comfort. If they go well shod, and are willing to persevere with their outdoor exercise notwithstanding the discomfort, they may make good progress in a place with a damp soil. To those, however, with but feeble reacting power and a poor circulation, there is a great advantage in a dry soil, and whoever has had experience of such a place will not wish to change to a damper one. The air over a damp soil is raw in cold weather, which is apt to prevent the delicate from taking a proper amount of exercise.

Absence of dust is necessary, because dust irritates the mucous membranes, and so predisposes them to inflammatory changes. For this reason, if the soil is light it should be covered with vegetation. Probably the best soil for the consumptive under treatment is well-drained rock, sand, or gravel. All the best sanatoria in England and Germany are on such soil, which dries quickly after rain, and makes walking pleasant. Sand near the seashore is only suitable while it is moist, or in perfectly still weather, because there is little vegetation, and the wind blows up the dust. Inland the most suitable sandy tracts are such as are covered with heather and gorse, or with pine-woods. Chalk which is bare of grass becomes very dusty in dry weather, and muddy if waterlogged; the middle of a chalk slope is therefore better than the top or bottom, but not so good as the other soils mentioned. Gravel or sand which rests on a hollow in an impervious stratum (clay, rock) becomes like a wet sponge after rain, and is far less healthy than even a clay soil with a rapid slope. River-valleys and the neighbourhood of lakes and canals are best avoided. The subsoil water is usually near the surface in such places, so that the soil remains damp. Some of the best agricultural land is in river-valleys, but the consumptive, even if he wishes to take up agriculture, should not choose a house in such a place, and should be careful to wear stout boots if he goes there in damp weather.

The prevailing vegetation is a useful guide to the nature of the soil. Where there are pine-trees, heather, or gorse, there is usually a dry, sandy, or chalky soil. Long lank grass is found in damp places, short herbage in a moderately dry one. Beech-trees grow best on well-drained limestone, or chalk well covered with mould ; oak-trees where there is more or less clay or loam. Willow and alder are usually found near streams. Reeds and rushes are a sure sign of a marshy spot.

As a rule, the consumptive should be treated in a place which to him is bracing rather than relaxing. This is largely an individual matter. The same place may be bracing to one, indifferent to another, relaxing to a third. What makes a place bracing is a somewhat complicated question, but it probably depends chiefly on stimulation by cool breezes, not strong enough or cold enough to chill. Whatever the explanation, there is usually no difficulty in distinguishing such a place, as it increases the appetite and the sense of well-being. It should, however, be borne in mind that after a severe illness a place which used to have a bracing effect may be altogether too cold or windy, and actually depress the strength. This is especially likely to happen in a place which is much visited by cold, wet winds, for damp air carries off more heat from the body than dry. Long-continued quiet sunny weather is also depressing to many people, unless redeemed by a decided change of temperature towards night-fall. Such a change is more likely to be met with in a hilly district or near the sea-coast than on a low-lying plain.

CHAPTER VI

TREATMENT IN A SANATORIUM

THE modern treatment of consumption can only be properly carried out in a sanatorium, or in a place which has been converted into a kind of sanatorium. Of these alternatives the first is by far the easiest. As Professor von Leyden says :* 'If it is asked whether treatment in sanatoria is absolutely necessary, we must admit that the same results may also be obtained elsewhere, but with greater difficulty, and only under unusually favourable circumstances. . . . The possibility of the treatment outside a sanatorium with equally good results cannot be denied, but it requires much more prolonged rest and much more time on the part of the physician, and has by no means so certain a result. In any case, I regard it as a great advantage if the patient can spend once or twice a period of several weeks or months in a good sanatorium.' And Dr. Latham says : 'With few exceptions, patients should be sent to a sanatorium as soon as we are in a position to say positively that they are suffering from consumption. It is true that in some instances just as good results can be obtained by a patient being sent away from his friends in the charge of a physician or nurse specially trained in this form of treatment. Treatment on these lines, however, is expensive, and is seldom called for.'†

Apart from climate and situation, a sanatorium is built in such a way as to favour cross-ventilation and surgical cleanliness, which the ordinary house is not. The furniture and

* 'Ueber den gegenwartigen Stand der Behandlung Tuberkulöser,' pp. 15-17. Berlin, 1897.

† 'Pulmonary Consumption,' p. 118. London, 1905.

decorations of the sanatorium are such as to make it comparatively easy to keep the place clean without raising any dust. No servant in an ordinary household ever does this unless specially trained, and having regard to the difficulty in making servants adopt new methods, this counts for something. In febrile stages of the disease, which may happen at any time during its progress, much depends on nursing conducted on right lines, and on being able to keep the patient in the open air while still in bed. This is easy in a sanatorium, but only exceptionally so in an ordinary house. Many hospital-trained nurses have no idea of ventilation as the consumptive requires it, and the supply of efficient sanatorium-trained nurses is still very small. In later stages sanatorium treatment consists largely of a kind of progressive training of the muscles, lungs, and heart, requiring daily observation of the patient's condition on the doctor's part. With a resident medical and nursing staff, and a specially trained staff of servants, under a competent head, these important points can all be attended to without much difficulty; but in a house not specially intended for the open-air treatment it is extremely difficult to do so. If treatment is to be successful, it is essential to place the control of food, ventilation, and servants in the hands of someone who knows what is wanted, and will see that it is provided, and to entrust the physical training to a competent doctor on the spot. Half-hearted methods are sure to lead to disappointment, and bring discredit on the system of treatment.

The ordinary conditions of life in an average household are not calculated to help the consumptive to recover. Many things are done there as a matter of course which are bad for him, while other things which would be useful are as carefully avoided. A large room is supposed to supply enough fresh air for a number of people without any windows being open. If it rains the window is shut to save the furniture; if it is cold, the window is shut, with the idea of preventing the patient from catching cold. Most of the feverish patients who enter a sanatorium are found to have been walking about freely before admission, spite of their fever. Night air is regarded with distrust in an ordinary household; the use of broom and duster in the patients' quarters is considered to be harmless.

Apart from actual hygienic and medical mistakes, it is disturbing to the consumptive to be in the midst of the worries, distractions, and excitements of an ordinary household. He needs a quiet, restful atmosphere, free from the injudicious fussing of anxious relatives. He is apt to be at one time depressed about himself, at another too venturesome, and will find it a great comfort to be able to rely on the advice of a doctor who knows the treatment.

What, then, are the supposed drawbacks to treatment in a sanatorium? They may be summed up in the statements that a sanatorium is depressing, dangerous, or expensive. It is commonly said that those who go to a sanatorium for treatment must be very miserable, because they are supposed to be a community of sick people ruled with a rod of iron. But the consumptive who is put under proper conditions from an early stage does not look ill, and only exceptionally feels ill. It is the so-called 'healthy' visitor who looks ill at a sanatorium, compared with the patients, because the latter lead a more healthy life, and very quickly respond to it. This is no exaggeration, but a familiar experience at every properly conducted sanatorium. Moreover, although the patient for his own good is debarred from certain pleasures, trouble is taken to substitute every pastime or amusement which, under the circumstances, is medically free from objection, and for those who are but little affected by the disease there are a fair number of such games and occupations to choose from. Certain essentials have, of course, to be insisted on: a warm, stuffy room is tabooed; so are highly exciting games or entertainments, and all forms of exertion which cause shortness of breath, overfatigue, or feverishness. A reasonable amount of well-chosen food must be insisted on, and a regular and sufficient amount of rest or exercise, according to the patient's condition.

To the tuberculous patient life in a sanatorium is far less dull than life in an improvised 'home sanatorium,' as many of my patients have testified who have continued open-air treatment at home after leaving the sanatorium. To see other members of the household going about their business while the patient is compelled to rest is often trying, whereas in a community where nobody ' goes to business,' but everybody is occupied in getting well, or in helping others to do so, this is not felt. To be in the midst of anxious relatives is a disadvantage to the tuberculous, who usually actually prefer, once they have settled down in a sanatorium, to see their people at intervals, rather than to have them on the spot the whole time. These remarks, of course, do not apply to the hopelessly ill and bedridden ; but the tuberculous should never wait until they are gravely afflicted, but should enter a sanatorium while the disease is still in an early stage. As things are, a certain number of seriously ill patients do enter some sanatoria ; but this does not appreciably affect the bulk of the patients, because while fever lasts the patient is necessarily confined to his own room. Indeed, it is quite common to put the graver cases into a special part or building in the sanatorium, away from the other patients.

There is absolutely no proof that sanatoria are dangerous. On the contrary, there is good reason to say that they should be the safest places in the world as regards tubercle, the least likely places to spread consumption. Moreover, there is plenty of evidence to show that this actually is the case. No instance of infection has ever been reported from any modern chest hospital with even elementary precautions about the expectoration. At the Adirondack Cottage Sanatorium, in America, the dust from the seventeen cottages was repeatedly and systematically examined during a period of ten years, and in only one cottage was it found to be infectious, and here there had been a patient who would not obey orders. On the other hand, the dust of street-cars was found to contain tubercle bacilli once out of every five times.* The mortality from consumption in Görbersdorf and Falkenstein, both small villages containing large sanatoria, was shown to have strikingly diminished since the latter were erected.[8]

* I. H. Hance, *New York Medical Record*, December 28, 1895.

Dr. Arthur Newsholme pointed out in his presidential address before the Epidemiological Section of the Royal Society of Medicine* that treatment of consumptives in an institution had had much to do with the striking reduction in the phthisis death-rate in this country during the last thirty-five years. In England and Wales the death-rate from phthisis has steadily fallen from 2,530 per million in 1869 to 1,140 per million in 1905. In Ireland it has gradually risen, being lowest in 1874 (1,780 per million) and highest in 1900 (2,260 per million). He shows that this difference is not due to the neglect of social and sanitary improvements—there is less overcrowding in Ireland than there was; wages are higher; food is cheaper; the population has not deteriorated in physique—but that there is only one reason capable of explaining the difference: that whereas in England consumptives have been more and more treated in institutions (such as infirmaries, hospitals, and sanatoria), in Ireland they have been more and more treated in their own homes, owing to discouragement of indoor poor relief. Now, if the accumulation of consumptives in an institution led to the spread of the disease, there would surely have been evidence of the fact; and if home treatment were better than treatment in an institution, the Irish death-rate from consumption would have diminished instead of increasing.

Indeed, under ordinary hygienic conditions, the danger of infection from a consumptive patient who is not helplessly ill is purely imaginary, so that it is absurd to say that a well-conducted sanatorium is dangerous.

The statement that treatment in a sanatorium is expensive is equally beside the mark, when we take into account what is provided. A sanatorium for the poor costs a little more per day than a general hospital of the same size, but it does work which the hospital is incapable of doing. In a sanatorium for paying patients it is true that the fees are a little more than board and lodging at an ordinary boarding-house; but they include medical and nursing attendance, and the accom-

* Proceedings of the Royal Society of Medicine, November, 1907, vol. i., No. 1.

modation from a medical point of view is far superior, while the food is usually at least as good. If, then, the fees are beyond the means of certain patients, the remedy is to go to a free sanatorium, or to put up with inferior quarters or inferior food, or dispense with the skilled attendance. It is usually the latter which is done by those who try to carry out treatment at home, but in the writer's opinion it is not good policy. Even if both the patient and those who have to look after him have been trained by residence for a time at a sanatorium, medical supervision is still required, and where the cost has to be reduced it is better to have primitive quarters in a suitable country district, with skilled attendance, rather than better quarters in a town without such help.

The choice, then, lies between staying at a cheap sanatorium or starting a 'home sanatorium' elsewhere, and in this case the cost will be less at a cheap sanatorium than at home. One should, however, be careful in the selection of the sanatorium, for they differ greatly in quality. Setting aside a few sanatoria in which the fees are low because the place is endowed, or has been built as a charity, one often finds in a cheap sanatorium that there is no electric lighting, no heating apparatus, or no bathing facilities; also the food, though wholesome, is cheaper, and the diet monotonous. Regrettable as these deficiencies may be, they are less important than the lack of clean, airy quarters, or the lack of medical supervision. Large grounds can be dispensed with in the open country, provided that the place be free from dust and away from busy roads. In one flagrant instance, however, the patients had to walk about in a much-frequented highroad, and were left to their own devices without supervision. Such a place would be dear at any price. During the early stages of illness it is most important to be able to rest in bed in the open air; indeed, if there is marked fever, *absolute* rest is essential; but later on, in convalescence, it will do no harm if the patient has to dispense with servants and wait upon himself, so that in this way economies may safely be effected.

The choice of a sanatorium must, of course, be left to the medical adviser. The place which will suit one patient may be unsuitable for another; the climate which is advantageous to one may be not so good for another. As a rule, it is better to choose a sanatorium which is entirely devoted to the tuberculous, rather than one which is partly intended for ordinary pleasure-seekers, whose wants and wishes are often diametrically opposed to those of the tuberculous. Patients of my own have bitterly complained of the overheating and insufficient ventilation of some of these 'hotel sanatoria,' and of the ridicule poured on conscientious patients by other inmates for obeying the instructions of the medical adviser, even where he happens to be accredited to the hotel sanatorium itself. There are many such places in health resorts abroad, and although often comfortable, perhaps even luxurious, they should be avoided. It is also good policy to choose a sanatorium which has a sufficient staff, and whose medical officer does not undertake other work in addition to that of the institution, for the latter is sufficiently exacting if properly done.

CHAPTER VII

THE HOME AS A SANATORIUM

It may be necessary at times to make arrangements for treating the consumptive in his own home, or in some other place not intended for a sanatorium. This will happen more especially when he is too ill to be moved with safety, or when, after passing some time in a sanatorium, he is well enough to run the risk of less perfect arrangements in order to be with his own people.

In such a case we must first consider whether the house is suitable for the purpose, and, if so, what alterations will be necessary to adapt it to the open-air treatment.

It is seldom wise to attempt such treatment in a town, as the difficulties in getting pure air are almost insuperable.

The house should stand in a well-drained spot on the side of a hill, in a place where the air is pure. The top of a hill is not so good, unless there be plenty of shelter from cold winds by higher hills or by woodland. The trees should, however, not be near enough to prevent the circulation of air round the house. A distance of at least 15 feet is advisable. The greater the height above the surrounding country, the more is shelter necessary. In a low-lying situation airiness should be the first consideration. In an elevated spot the means of shelter should be specially considered. Failing natural protection, something may be done to protect the lower floors by the erection of walls and fences. The house should not be next to a much-used highway, because of the dust. There must be no offensive drains, decaying vegetation, manure-heaps, stables, dirty streets, neglected dustbins, or refuse-heaps near the house to spoil the purity of the air.

To insure a plentiful supply of fresh air in the house, there should be a free space, if possible, all round it, or at least in front and behind. A detached house is better than one in a terrace. Back-to-back houses, in which there is a blank party wall between two houses, are notoriously unhealthy, and a house with only a shut-in yard behind it is but little better. In the same way the neighbourhood of a high cliff, or overshadowing wall, or lofty building, is to be avoided. It will be a great advantage if there is a garden round the house.

The sanitary arrangements should be satisfactory, and the water-supply pure and abundant. There is usually no difficulty in obtaining information as to these matters, so that they need not be further discussed.

It is generally considered that to live in a damp house predisposes people to consumption. Although this is not quite certain, there is no reason for departing from the usual hygienic rules in this respect. A well-built house has a concrete foundation extending over the whole site, a damp-proof course in the walls, and ventilating gratings just below the floor-level. The object of the concrete foundation is to exclude moisture and ground air from the soil. When fires are lighted, a house acts like a leech on the soil on which it stands, sucking up the contained air, which is much less pure than that above ground. According to Boussingault and Lewy,* the ground air in sandy forest-land contains 24 parts in 10,000 of carbon dioxide, ordinary garden soil 364 parts, and recently manured fields from 221 to 974 parts in 10,000. Associated with this is an abundance of bacteria and other lowly organisms, many of which may be harmless, but are not the best things for a sick man to breathe. If the layer of concrete extends well outside the walls of the house and covers the whole site, the ground air cannot be drawn up into the house. Damp-proof foundations are also intended to prevent the rising of the moisture of the soil in the walls of a house. Bricks and other porous materials absorb moisture just like

* Quoted by W. N. Hartley, 'Air and its Relation to Life,' p. 127. London, 1875.

a lump of sugar ; but a double layer of slates bedded in concrete or asphalt, or even a good layer of well-tarred roofing felt placed in the walls above the ground-level, prevents this moisture from rising (Fig. 2). An ordinary brick is capable of sopping up as much as ¾ pint of water. Even a small house may consist of many thousand bricks, and in the process of building water is splashed on to the bricks if the weather is dry, so that a newly built brick house will necessarily contain an immense amount of water in its walls. Until this has been

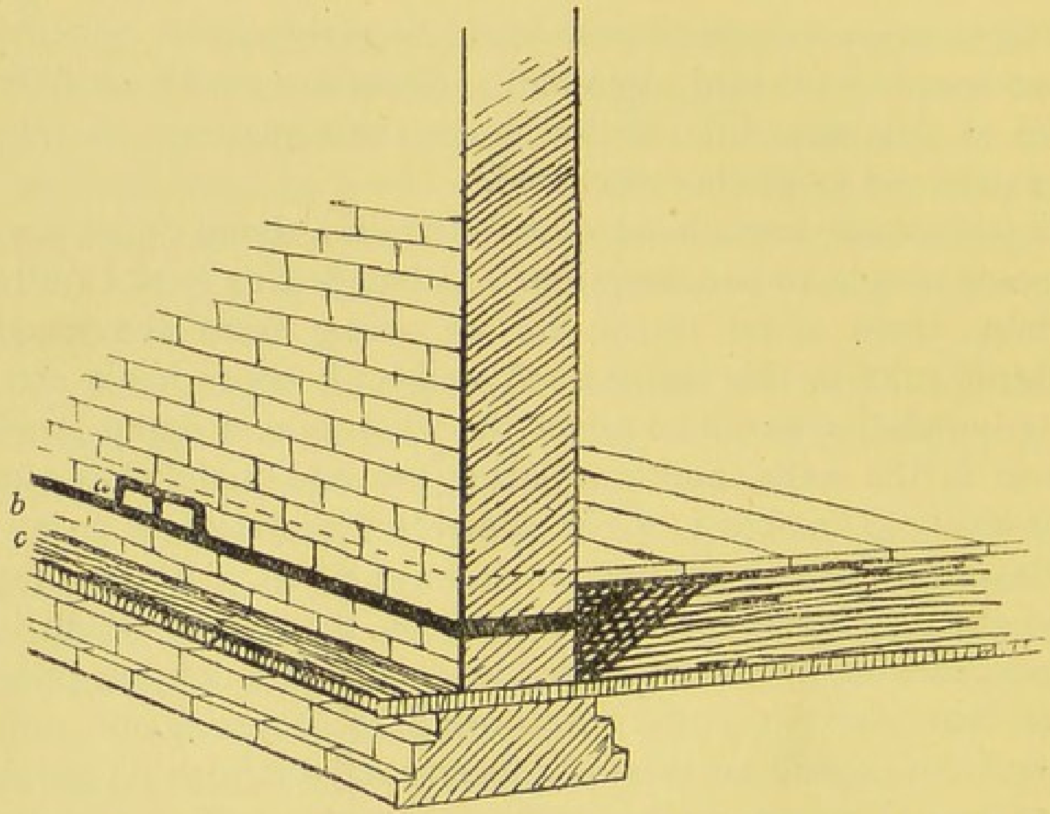

FIG. 2.—FOUNDATIONS OF A HOUSE, SHOWING VENTILATING GRATING (*a*), DAMP-PROOF COURSE (*b*), AND LAYER OF CONCRETE (*c*).

dried by fires and ventilation, the house will remain damp. A dry brick house allows the air to pass through its walls, but a wet wall stops the circulation of air. A dry brick house is a relatively warm house, because air is not a good conductor of heat, whereas water (like metal) is a good conductor, and feels colder than wood as a rule.

It is commonly supposed that a wooden house is cold in winter, hot in summer, but this is not necessarily the case. Wood is a much worse conductor of heat than brick or stone, and for equal thickness is much warmer in winter than other building materials.

In taking a house it is well to see that the earth does not touch the walls above the damp-proof course, and that the ventilating gratings are unobstructed. Otherwise the floor-boards will rot, and the walls remain damp.

The next point to consider is whether there are any suitable rooms for the open-air treatment. For an invalid or a feverish patient an airy, light bedroom should be chosen, with a sunny aspect, and means of securing cross-ventilation. A small room with abundant ventilation is preferable to a large room badly ventilated. In this climate a sunny room is preferable, but this is less important than the means of ventilation. Other things being equal, choose the larger room for the bedroom, as no sitting-room will be used continuously for so many hours as a bedroom. Light should enter the room freely. A dark room is apt to be a dirty room, and this is a great hindrance to recovery. Moreover, sunlight is one of Nature's disinfectants.[13] If there is a veranda in front of the bedroom, the latter must be regarded (and used) as merely a place for ablutions and the like, while the veranda is used for other purposes, unless the room is well lighted from another side (see Chapter VIII.). In hot summer weather a north or east room may be better than one on the south side.

There is an unfounded prejudice against a ground-floor bedroom. Provided that the house has dry foundations, there are distinct advantages for the consumptive invalid in a ground-floor bedroom, as it is easier to carry him thence into the open-air. It is still better if a room can be given him with French windows opening into the garden or on to a tiled terrace, for in this case the bed can be drawn out daily into the open air. Next best is an upper room near a lead flat or large balcony, where the bed can be placed in the daytime. It is convenient to have bedroom and sitting-room near together on the same floor, so that the patient can change his quarters without fatigue when he begins to move about. In this case the sunnier room should be chosen for the sitting-room. If there are no suitable rooms in the house for open-air treatment, a sleeping shelter may be thought of. I have also known of good arrangements being made in an unfurnished house near the home, patient and nurse being installed alone, with a little domestic help from outside.

The question of cross-ventilation is of great importance. It is more fully explained in Chapters IX., X., and XI.

CHAPTER VIII

VERANDAS, TENTS, AND SHELTERS

THESE are used for several distinct purposes, chief amongst which are protection against sun and against inclement weather. The best of them are admirable for open-air treatment, as they have many of the advantages of a room without some of the disadvantages.

Verandas are much used abroad, but those of the ordinary kind are of little use in this country. As usually placed, in front of a window, they darken the room behind, and interfere with its ventilation, unless there is an unobstructed window as well. Even a shallow veranda is enough to darken a room in this country, although in more sunny lands this may not be the case. For this reason, an awning which can be rolled up is usually preferable in this country. Some of these drawbacks, however, are avoided by making the veranda with an interrupted glass roof (Fig. 3). In hot weather a veranda is not suitable for open-air treatment (excepting, possibly, on the north or east side). The walls of a house absorb much heat in sunny weather, gradually giving it out again when the sun is no longer shining there. This may be pleasant in damp, chilly weather, but in hot weather is a decided drawback, as one loses the appetizing freshness of evening, and the freer ventilation of a more airy situation. It is exceptional to find any cross-ventilation in a veranda. A little help can be given by leaving the ends and the peak of the roof open (Fig. 4), but in the other direction the veranda is usually dependent upon the room behind it. For this reason, in hot weather it is better for the fresh-air patient to rest under the trees or in an airy shelter away from the house. If cross-ventilation can be secured, the best place for the veranda is against a blank wall or a well-lighted passage. Even as a protection against rain or snow, a veranda cannot be depended upon. Rain not infrequently drifts at

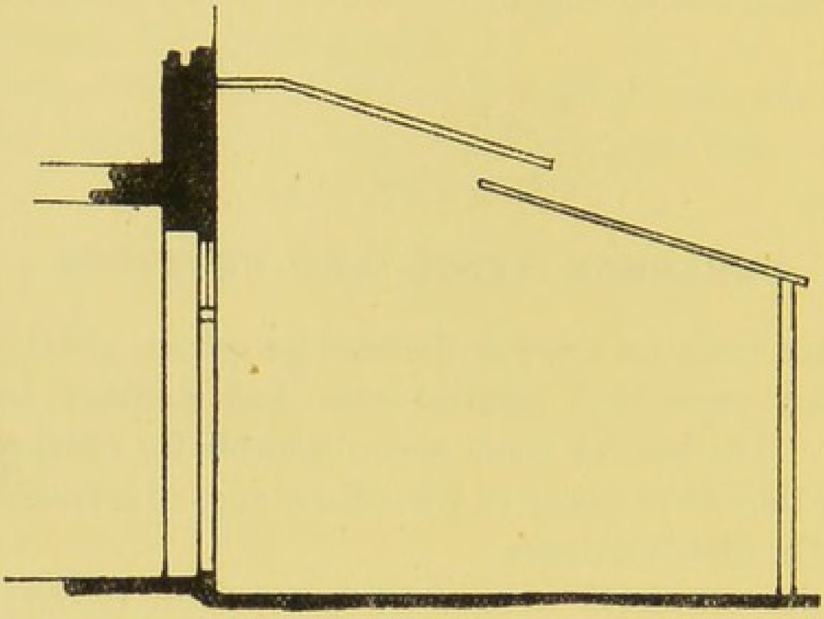

FIG. 3.—VERANDA, WITH INTERRUPTED GLASS ROOF.

an angle of 60 degrees, sometimes even at an angle of 45 degrees. If the veranda is as deep as it is high (a convenient proportion), and the rain is drifting directly at it, half the

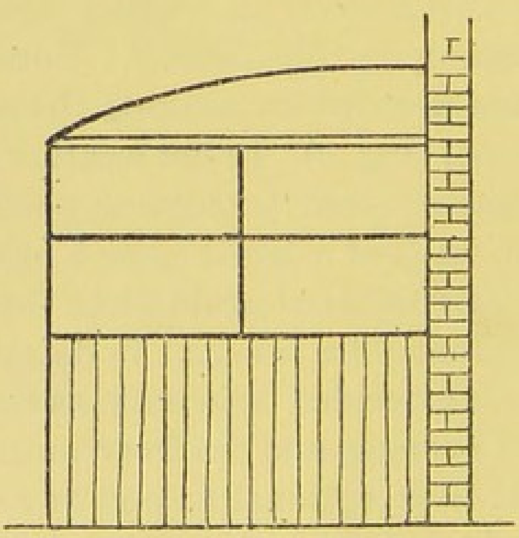

FIG. 4.—END OF VERANDA, SHOWING TRIANGULAR OPEN SPACE, WINDOW-PANES, AND WOODEN PANELLING.

floor-space will be wetted in the first case, the whole in the second case (Fig. 5), so that additional protection will be needed in stormy weather. With suitable screens or waterproof curtains, however, a veranda is a good place for rest in bad weather, and may even be used at night.

One of the American sanatoria was planned with the idea of treating patients in deep verandas, the space behind being merely used as a sort of dressing-box. A covered balcony leading out of a bedroom or bath-room also makes very suitable quarters. With the bed on the balcony, and a few screens or waterproof curtains, no better place could be found for a night's rest.

Most of the German sanatoria have lofty verandas, called 'Liegehallen,' where the patients spend their rest hours on cane lounges. These shelters are often arranged on either side

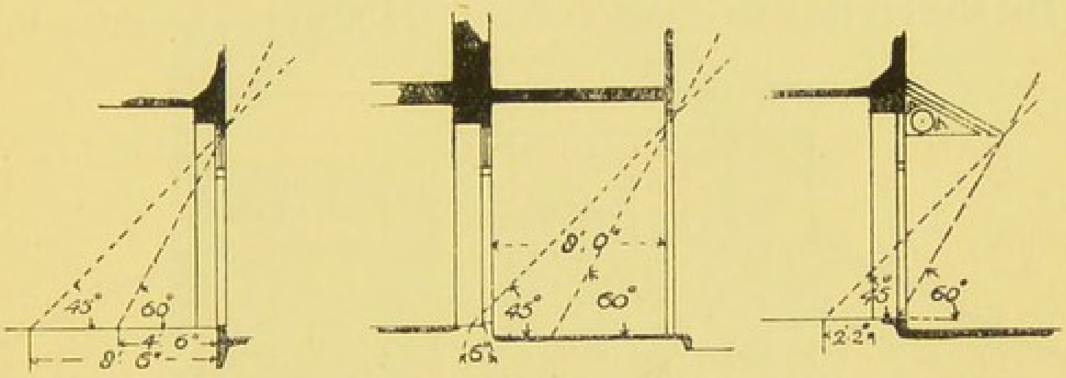

Fig. 5.—Verandas in Vertical Section, showing how Rain Wets the Floor at Angles of 45 Degrees or 60 Degrees respectively.

The first figure shows the effect on a room without a veranda, with window open.

of the main building at an angle, so as to give greater protection against wind (Fig. 6). The back of the veranda consists of a wooden partition, the upper part of which is either entirely open or provided with windows. The roof is often double pitched (like the roof of a house), so as to protect the open part against rain.

Summer-houses and shelters in the garden are almost indispensable for the convalescent from lung disease, and are very valuable for the invalid as well. The consumptive with a high temperature has probably an even better chance of recovery in a well-constructed shelter than in a more solidly built room. Such a shelter, unlike an ordinary room, can be ventilated at will from any desired quarter. For instance, if there is a strong north wind, the windows or openings can be closed on that side, those on east and west being left open. Such cross-ventilation is of the utmost importance in open-air treatment (see Chapter. X.). The chief drawback to a shelter for continuous use is that in wet weather you are exposed to the rain in going to dining-room, bath-room, or lavatory, and that hot food brought to the shelter may be chilled. Moreover, some people would be timid about sleeping in an isolated hut. To avoid such drawbacks, the shelter would have to be made complete in itself for all purposes, which is not usually convenient. A lavatory may be added, but cooking could not be done near the shelter without inconvenience. The shelter may be connected with the house by speaking-tube

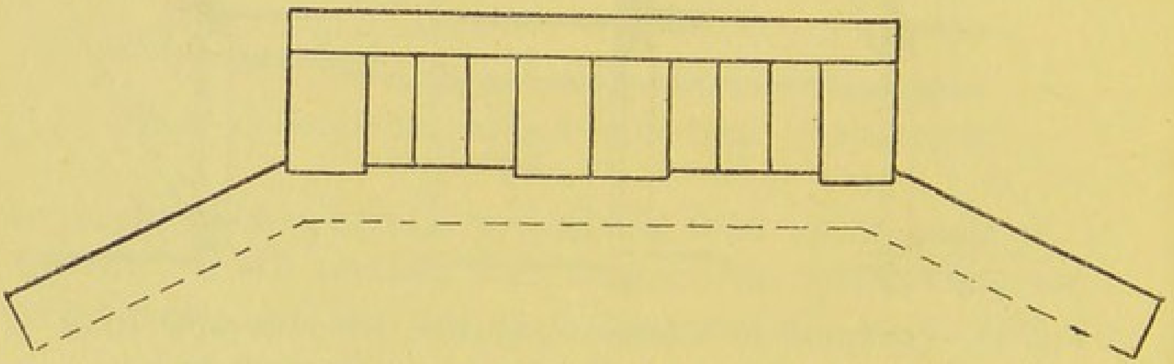

FIG. 6.—GROUND-PLAN OF PART OF SMALL SANATORIUM, WITH REST-SHELTERS TO SOUTH, PROJECTING ON EITHER SIDE AT AN ANGLE.

or telephone. A second room may be added for a nurse or attendant, or possibly a dog may give a greater sense of security. The question of warm food is discussed elsewhere.

Whenever there is the least doubt as to the suitability of rooms for open-air treatment, it is advisable to make provision for treatment out of doors. If there is no suitable veranda, a properly constructed shelter will have to be built or bought. For those to whom cost is no object, very good shelters are made by several firms in this country. Those usually supplied, however, are too small to be of practical value, while larger ones are expensive. There are two kinds in general use, in one of which cross-ventilation is secured by windows placed on all sides, the other kind being a revolving shelter. The ordinary revolving shelters are too small to be convenient in bad weather, and require special protection at such a time in the shape of screens or awnings. Moreover, they are usually made without any window or ventilator at the back, so that they are only fit for windy seaside places, for which they were probably originally designed. This lack of a window behind is a grave defect, which should always be remedied. Apart from this, a small shelter is inconvenient in rainy weather, and unfit for use in warm, still weather. However, at other times, and in windy places, a small revolving shelter may be extremely useful (Fig. 7).

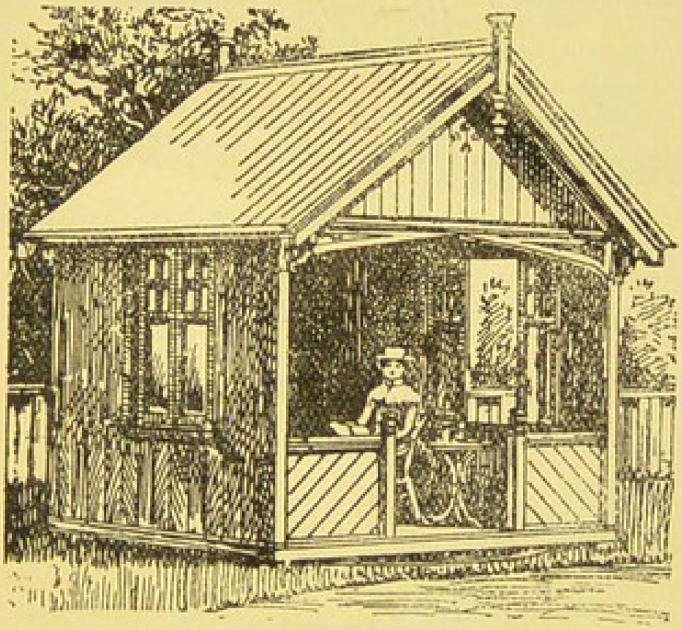

FIG. 7.—REVOLVING SHELTER.

A good shelter should be of reasonable size, have a dry floor, a roof big enough to keep off rain, ventilation on all sides, a free space round it, walls high enough to fend off wind, but low enough to allow anyone on a lounge-chair to see out easily. It should be made smooth inside, so that it may be easily kept clean. This refers especially to the parts within 3 feet of the floor. It should be fairly lasting, able to stand high wind, and provided with screens or curtains for privacy.

A convenient size for the floor is 12 feet by 10 feet for an undivided shelter, 18 feet by 10 feet for a double one. The floor should be raised 1 foot above the ground on piles or pillars; and if the soil be a damp one (clay, or loam, or alluvial soil), the surface may with advantage be covered with concrete to a distance of 3 feet outside the hut. On dry, sandy,

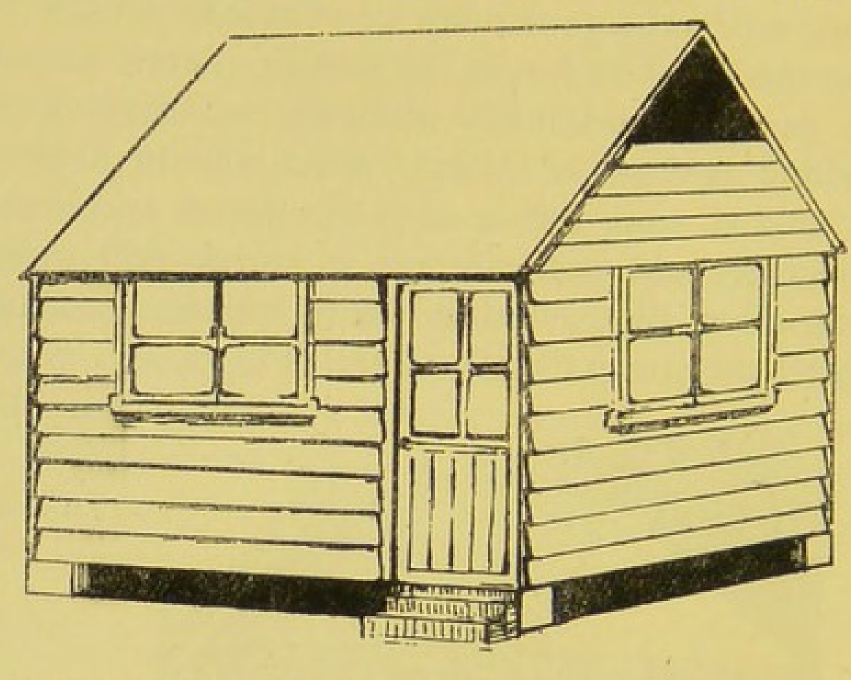

Fig. 8.—Shelter with Steep-pitched Roof—Front View.

or rocky soil this would not be necessary, nor if the shelter were placed on a rapid slope.

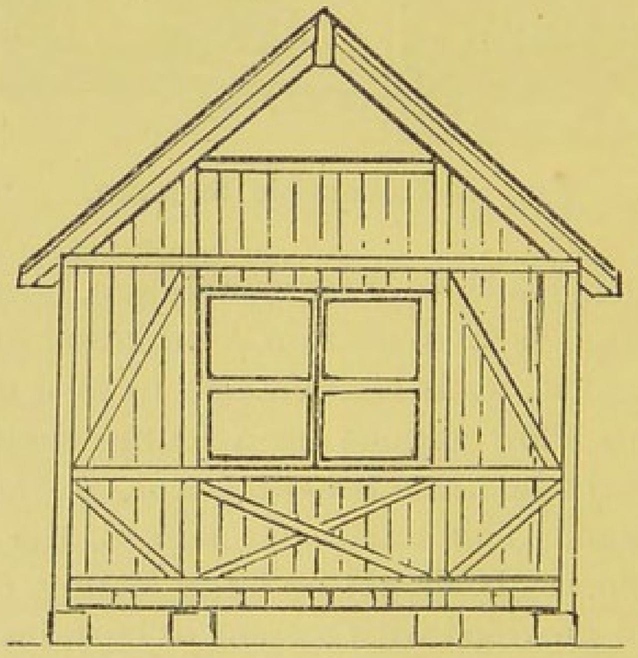

Fig. 9.—Shelter with Steep-pitched Roof—End View.

The height of the roof depends partly upon the kind adopted. A steep pitch throws off rain best, and therefore is likely to last longer; but it cannot be prolonged into wide eaves without blocking up the view and hindering access of air. Also, if windows are made to open outwards, they require head-room under the eaves. In one style of hut, therefore, you have a steeply pitched roof with almost no eaves, rain being kept out by awnings;* in another style there is a low-pitched roof, with wide eaves, awnings being unnecessary. In the first case a convenient height for the roof would be 6 feet 6 inches from the floor at the eaves, and 11 feet 6 inches at the gable, the roof projecting 4 inches beyond the walls

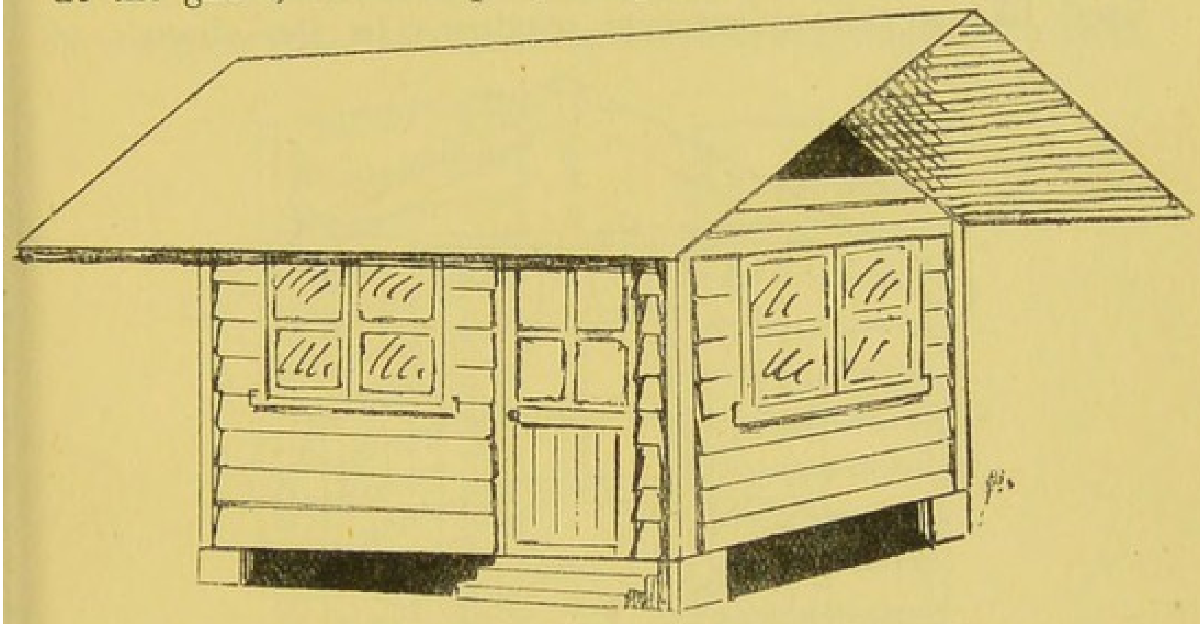

FIG. 10.—SHELTER WITH WIDE EAVES—FRONT VIEW.

(Figs. 8 and 9); in the second case, 7 feet from the ground at the lowest part of the eaves, 8 feet at the highest part of the eaves (7 feet from the floor), and 11 feet from the floor-level at the gable. In this case the eaves would project 3 feet from the walls on every side (Figs. 10 and 11).

The addition of a false roof or ceiling inside makes the shelter warmer in cold weather, cooler in summer.

In such a shelter as the above the door might be 6 feet 6 inches by 2 feet 6 inches, with the upper 4 feet glazed.

Four windows might be put in, each 4 feet 6 inches by 3 feet 6 inches, one on each side of the hut, placed 2 feet

* The windows cannot be depended upon to keep out rain, as they will usually be left open. The whole of every shelter window should be made to open.

6 inches from the floor. A ventilating space of 3 inches should be left all round next the roof, and a triangular open space at the ridge of the roof on each side.

Windows are not indispensable in a sleeping shelter, so long as there are window-spaces and protection against rain. If windows are put in they may be French casements, opening outwards or inwards; in the latter case a larger shelter is required, but the windows do not require cleaning so often. Another way is to have counterpoised casements which drop between the outer and inner parts of the walls, or similar ones fixed like a railway-carriage window. In the absence of

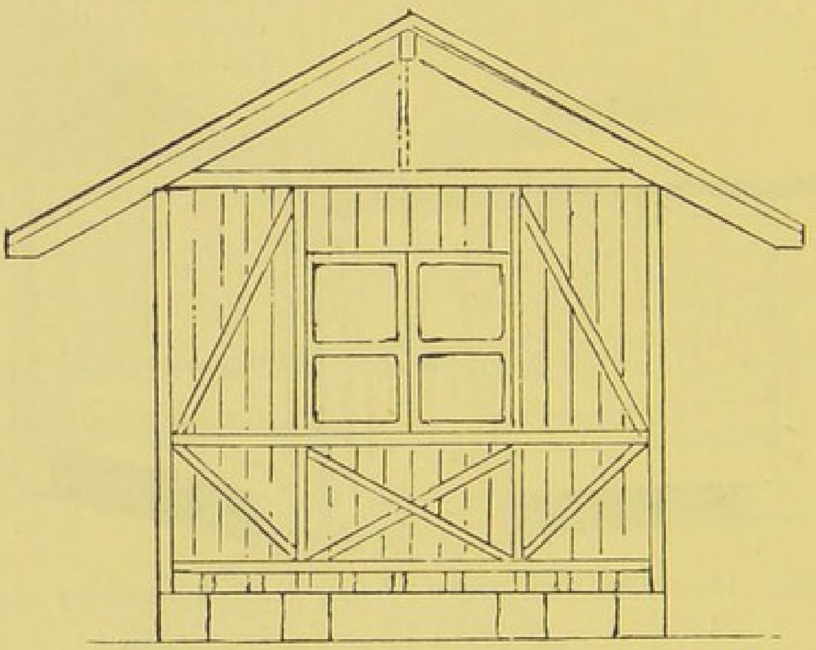

FIG. 11.—SHELTER WITH WIDE EAVES—END VIEW.

windows the spaces may be filled with louvred shutters at night (Fig. 12), or protected by blinds, curtains, or awnings of waterproof material, such as waggon-cloth. The same material serves well for awnings. It should be supported in such a way that rain does not collect on it in pools.

In the foregoing description it has been assumed that the shelter is to be made of wood. This may be covered outside with corrugated iron, tarred weather-boarding, plain boards tarred, asphalted, or painted,* well-painted floorcloth, Willesden paper on wooden frames, or painted canvas or waggon-

* It is an advantage to have the boards grooved and tongued, like a high-class floor.

cloth similarly supported. A more durable and fireproof material is uralite (or Kent slabs), which can be nailed on like ordinary boards. The same material or a modification may be used inside, or ordinary varnished match-boarding, or one of the other above-mentioned soft materials on frames. At the Crooksbury Sanatorium one large shelter has been made of uralite and Kent slabs, rough-casted outside for extra protection against the weather. Another useful material is a kind of terra-cotta made in hollow pieces to fit on to iron rods. This is cheaper than brickwork, and more quickly constructed. It has been used at the Workers' Sanatorium at Benenden, in Kent.

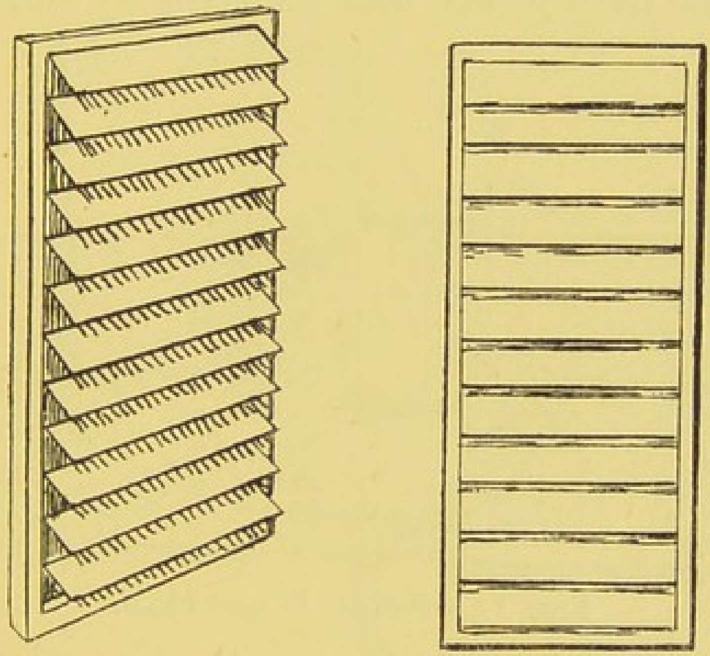

FIG. 12.—LOUVRED SHUTTERS—SIDE AND FRONT VIEW.

The Ducker Company make shelters of compressed paper. These have been extensively used in some German sanatoria, and also in England.

For roofing there is nothing better than good roofing felt placed over matchboarding or plain boards, well sanded and tarred, although corrugated-iron sheets are also used. The latter have the disadvantage of being good conductors of heat, and therefore make the shelter hot in summer and cold in winter; moreover, they are noisy when rain falls, but this can be partly remedied by a thick layer of felt underneath.

There is an unreasonable prejudice against wooden buildings and shelters. If carefully made, with an air-space between the inner and outer skins, they are as warm as more solid buildings, and much drier than newly built brick houses, or old ones with an insufficient ventilation. The chief drawback is the greater risk in case of fire, which is the reason why wooden structures are contrary to the building regulations in many places.

The furniture of the shelter should be such as will stand damp air. Metal fittings, bedsteads, etc., should be painted or enamelled, or they will rust. Bamboo, wood, and wicker-work are the most widely used materials for such furniture.

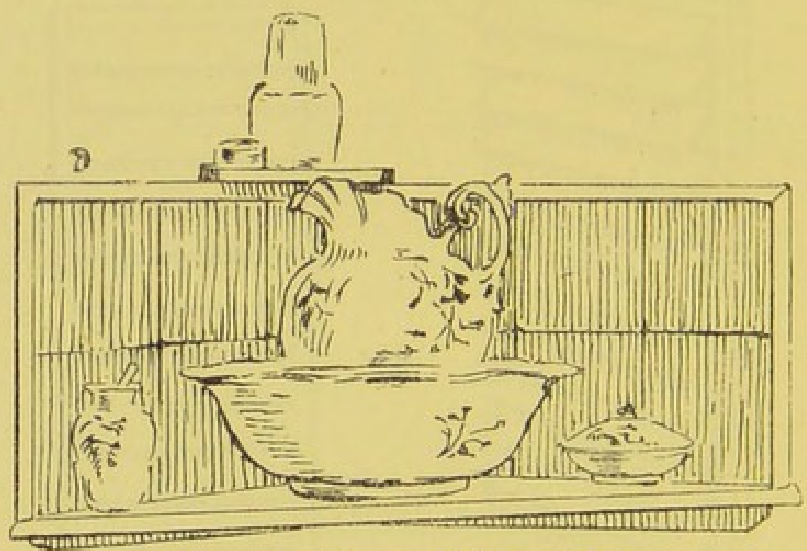

FIG. 13.—FIXED WASHSTAND.

It is convenient to have a table with a top which can be sloped at an angle, to serve as a reading-desk. In a sleeping shelter space must be economized just as in a cabin on board ship. A hinged slab at the side of the shelter will be useful. The addition of a stationary wash-basin will save some attendance (Fig. 13). In this country heating apparatus is not much needed in a sleeping chalet, but hot-water pipes may be added with an outside furnace, or a brick chimney with a fireplace may be built on. Where the flue-pipes pass near wooden structures there is some risk of fire. There should be at least 9 inches between the flue and the nearest woodwork of the building.

Lighting is best by electricity, as this is unaffected by wind.

If paraffin-lamps or candles are used they should be fixed, and the flame should not be left near the woodwork. One method of fixing portable lamps is to slip them into a ring at the end of a fixed bracket.

A good sleeping shelter may be constructed in the recess between two bow-windows, or in front of an ordinary sitting-room window, if the room itself has not to be used much. For this purpose a wooden platform should be erected a foot above the ground, a framework of stout (3 inches by 3 inches or 4 inches by 4 inches) timbers raised on this, with a sloping roof made with waggon-cloth or roofing-felt supported on battens

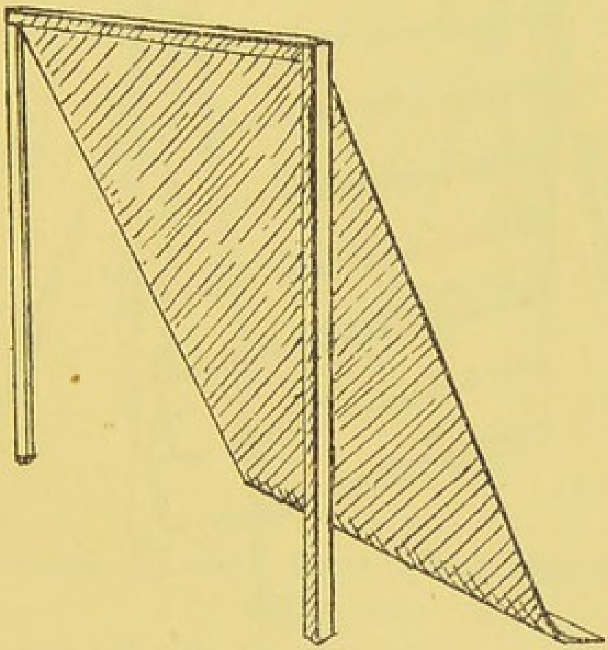

FIG. 14.—SUN-SCREEN.

4 inches apart, or of more lasting material. For the sake of privacy three or four curtains of waggon-cloth may be run on rods round the three outer sides of the shelter, but these curtains should usually be drawn aside to admit the fresh air.

In most of the better sanatoria summer-houses of various kinds are freely provided for rest out of doors. Those physicians, however, who model their practice strictly on that of Nordrach Colonie, in Germany, object to any kind of shelter, and expect their patients to rest under the open sky, or in their bedrooms. In fine weather rest should always be taken in the open, a shady spot being selected if there is hot sun. Rest in the bedroom is likely to be more absolute than in a common shelter, owing to the absence of talking. This is important in early stages of convalescence, much less so later on.

Tents are sometimes recommended for open-air treatment. An ordinary tent is, however, not at all airy, and cannot be recommended for the purpose. The chief fault is the lack of ventilating outlets above. To be satisfactory an outlet is needed almost the size of an ordinary window, which cannot easily be made rainproof. Moreover, in wet weather, if any-

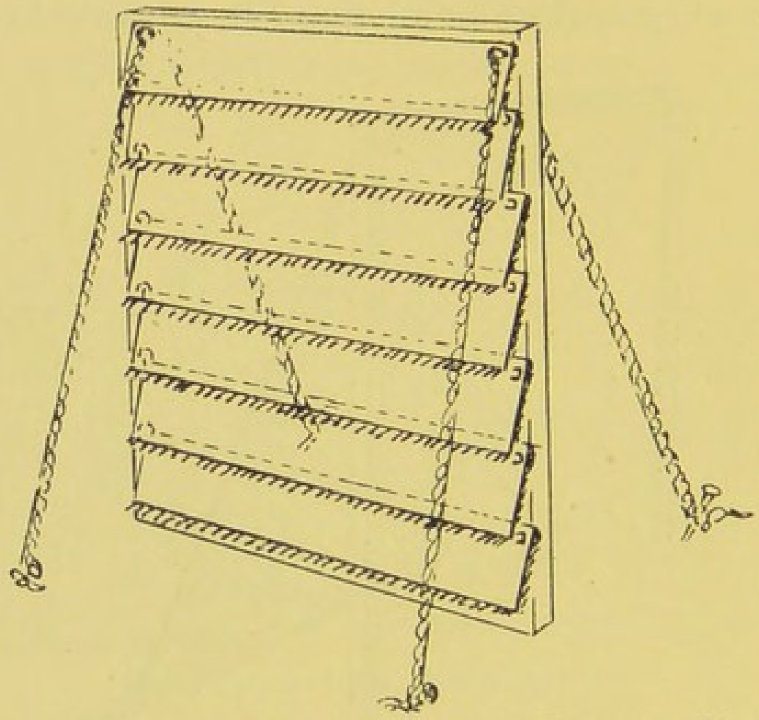

FIG. 15.—SHELTER WITH DETACHABLE BOARDS—BOARDS IN POSITION.

thing solid touches the canvas, the rain is apt to drip through at that place. There is no difficulty about the inlet, as a space can be left round the tent below, and in the daytime the door of the tent is sufficient.

A tent is usually hot in sunny weather, unless it has a double roof with a space between. In hot weather, if the house shadow cannot be used, and there are no trees, a tent with a double roof and all the sides left open gives very good shelter against the sun. In camping out a square or oblong waggon-cloth tent, with double-pitched roof, may be made both airy and rainproof by letting the roof project beyond two of the sides like eaves, and leaving a space open next the peak in front and behind.[44]

A good sun-screen may also be made with a slanting piece of canvas supported on poles 10 feet high, fixed with tent-cords, or else planted in the ground (Fig. 14).

For a wind-screen, make a stout framework of wood 5 feet to 8 feet high, with two upright and two horizontal bars, fixed

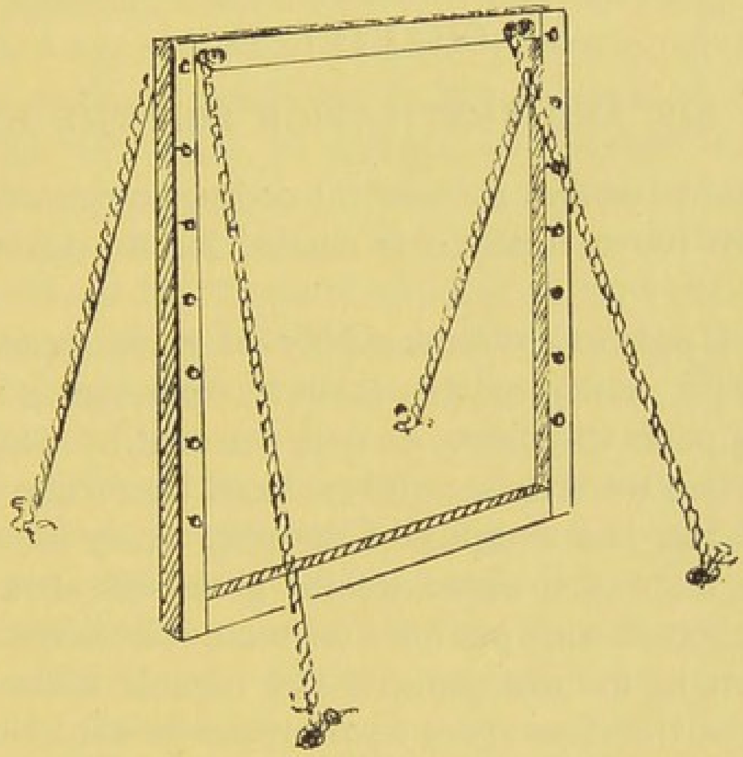

Fig. 16.—Shelter with Detachable Boards—Boards Removed.

with tent-cords. Along the uprights, at equal distances from the ground, drive in 3-inch nails, leaving $1\frac{1}{2}$ inches projecting. These nails should be 4 inches apart. Boards 5 inches wide, with holes to correspond with the nails, may then be slipped over them, overlapping each other (Figs. 15 and 16). A shelter on this principle was invented by Dr. Pott, of Bournemouth.

CHAPTER IX

FRESH AIR AND VENTILATION FOR THE HEALTHY

THOSE who have had no medical or hygienic training seldom realize how much fresh air is needed for the maintenance of health.

The atmosphere consists chiefly of three gases: nitrogen (about 79 per cent.), oxygen (about 21 per cent.), and carbon dioxide (4 parts in 10,000, or 0·04 per cent.). The oxygen is used up when we breathe, and replaced by carbon dioxide, so that the latter is a measure of the respiratory impurities in a room. A man of 9 stone weight gives off about $\frac{7}{10}$ cubic foot of carbon dioxide per hour (or more if he is working hard), in addition to minute quantities of organic matter, which is the cause of the close smell in an overcrowded room. Out of doors all these impurities escape so freely that even a crowd of people does not perceptibly change the composition of the air; but indoors it is different, so that without efficient ventilating arrangements the air of the room becomes close, and soon shows an excessive proportion of carbon dioxide and its attendant organic impurities. Later on, if the ventilation is bad, people get headaches, and begin to feel languid, and in extreme instances (as in the Black Hole of Calcutta) they may become very ill or die. Even slight impurity of the air, if persisted in day after day, is enough to cause pallor, loss of appetite, listlessness, and loss of strength, and 'rebreathed air' is a common cause of bronchitis and consumption.[42]

It is inconvenient to measure the impurity of the air in a room by means of the organic matter, because this exists in such minute proportions; so that, although carbon dioxide is not the only poison produced in breathing (or even perhaps the most powerful), respiratory impurity is usually measured by the proportion of carbon dioxide. It is found that when the proportion rises to 6 parts in 10,000 the air begins to smell close, so that in ordinary ventilation this has for many years been regarded as the proper standard of purity in a room. Yet few households will be found where even this standard of purity is observed. In a room 10 feet in every direction (1,000 cubic feet) with one occupant producing $\frac{7}{10}$ cubic foot of carbonic acid gas per hour, in the absence of ventilating openings, the air would be impure, or contain 6 parts per 10,000 of carbonic acid gas in less than twenty minutes—with two such occupants, in under ten minutes. What prevents this happening is the entrance of fresh air and the outflow of foul air, so that it is essential to health and life that there should be ventilating openings for these two purposes. The amount of fresh air which enters depends partly on the difference of temperature between the air inside and that outside the room, but with wide-open windows chiefly upon the wind.

The air out of doors even on a still day is perpetually in motion, so that with open windows and door the air of a room is quickly replaced. In addition to this, every gas tends to diffuse itself into the surrounding space, the thinner gases diffusing the most quickly, and this helps to mingle pure and impure air, and so dilute the impurities. Cold air which moves quickly is felt as a draught, so that as a rule people prefer the windows closed in cold weather, unless they have been through a course of open-air treatment, in which case they have a much greater longing for pure air. It may safely be said that in an average household or office it is exceptional to find the rooms ventilated even up to the very moderate standard laid down by hygienic authorities for the maintenance of health.

To keep the air moderately pure in a room, 3,000 cubic feet of fresh air must be introduced into it every hour for every individual in it, a corresponding amount of foul air being expelled. In addition to this, every ordinary gas-burner consuming 3 feet of gas per hour calls for a supply of 5,400 cubic feet of fresh air, for whenever anything containing carbon or charcoal (which includes every kind of fuel, candles, oil, or gas) is burnt, oxygen is used up, and carbon dioxide produced. From these data it is easy to reckon how much fresh air is required in any room, according to size and the number of people in it.

To give a few illustrations: an ordinary City dining-room, 40 feet long by 20 feet wide, and 15 feet high, might easily hold 108 customers and attendants at a time, and on a foggy day or in the evening would have perhaps sixteen gas-burners alight. To keep the air tolerably pure under these circumstances, 400,000 cubic feet of fresh air would require to be introduced every hour. It is found in practice that for ventilation any height above 12 feet has to be disregarded, so that the air in such a room would have to be changed nearly forty-four times every hour, and to do this without draught would require ventilating openings amounting to over 22 square feet, and other openings for the foul air to escape. We may safely say that nothing approaching this amount of open window or door is usual in cold weather, and yet this would only keep the air moderately pure. The conditions in a West End drawing-room at an evening party would often be just as bad. It is not uncommon in a City office to see a room of 14 by 12 feet, occupied by seven or eight people. When there is no artificial lighting in such a room, eight people would require a supply of 24,000 cubic feet of air per hour; and if draughts are to be avoided, this amount of air would have to enter at a pace of not more than 5 feet per second. To do so, the window or door would have to be left open permanently to the amount of 192 square inches, or $1\frac{1}{3}$ square feet, in addition to the outlets for foul air. As a rule, however, the window and door are kept closed. If there were no chinks through which air could get in, the air of such a room would be impure in about five minutes. Fortunately, even brick walls let a little fresh air through their interstices.

In a private room a practical rule would be to keep the windows open to the extent of 24 square inches for each individual present for the fresh air to come in, and a similar amount for the foul air to escape. This will not bring the room up to the standard required for open-air treatment, but will keep it up to that required for health. Practically the size of the room does not much affect the amount of opening required. A room of 3,000 cubic feet capacity, with four people in it, without ventilation, would be foul in a quarter of an hour; one double this size, without ventilation, would not be foul for half an hour; but in each case the same amount of fresh air would have to be introduced after its original stock of fresh air was exhausted.

CHAPTER X

VENTILATION FOR THE TUBERCULOUS

In a properly managed sanatorium the air is kept much purer than that of a room ventilated according to the hygienic standard described in the foregoing chapter. A few years ago I examined a room in the Crooksbury Sanatorium by a delicate chemical test,[42] choosing purposely a room which had been almost continuously occupied night and day for many weeks by a bedridden patient (Fig. 17). On comparing the air with that out of doors no perceptible difference could be discovered in its purity, showing that with proper ventilation as carried out in a sanatorium there is no need for the air ever to contain more than 4 parts in 10,000 of carbon dioxide. This room was not large; its capacity was about 1,200 cubic feet. The window-space was about 7 feet 6 inches by 4 feet, besides which there was a shaft of 96 square inches leading into the open air, and the door was usually kept ajar, so that the total ventilating openings amounted to about 39 square feet, permitting of an air-supply of 150,000 to 540,000 cubic feet per hour without draught (according to the direction of the incoming air).

This hyper-ventilation is necessary in order to destroy the poisons produced by the tubercle bacillus. The problem is not merely to keep people healthy, but to restore them to health, for which a more rigid standard is necessary.

All the better kinds of sanatoria for open-air treatment have been specially planned and constructed in such a way as to favour ventilation. To do this efficiently without draught, there must be inlets and outlets on opposite sides of the room large enough to allow a sufficient amount of air to enter quietly and constantly. Diminish the size of the openings, and either less air will enter or else it will travel faster and be felt as a draught. Moreover, the air will sometimes enter chiefly on one side, at others on the opposite side, according to the direction of the wind; so that for the open-air treatment the air coming in on one side of a room must be as pure as that coming in on the other. In all the best sanatoria there are either a number of chalets, which can be ventilated from any side at will, or a number of rooms in a single row (Fig. 6), with windows on one side and a free communication with the open air on the other,

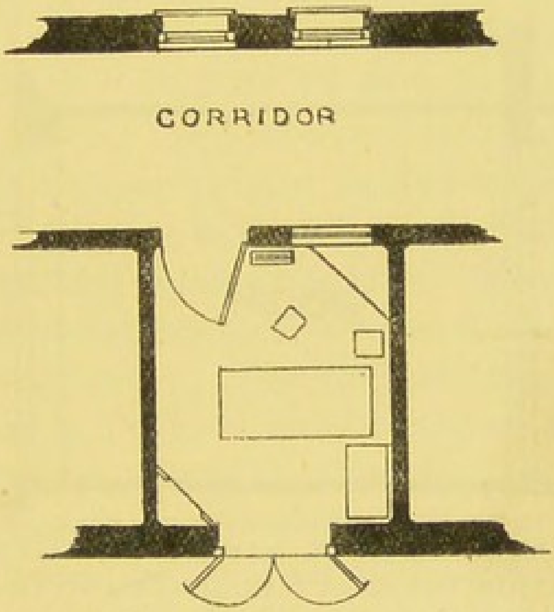

FIG. 17.—PLAN OF SANATORIUM BEDROOM, WITH CORRIDOR.

either through another window into the open air or through a very freely ventilated corridor. Sanatoria with less ventilation are not worthy of the name. A typical sanatorium bedroom has large French windows occupying most of the south side, each with a fanlight above it, reaching up to the ceiling. On the opposite side, over the door, is another similar fanlight, so that, even when door and window have to be shut, there are still ventilating openings on opposite sides of the room. In some Continental sanatoria double doors or double windows are provided, but it is difficult to see how these can be used without hindering the ventilation of the room. In a really good sanatorium the doors and windows are seldom shut.

At the Crooksbury Sanatorium patients are allowed to have the windows shut during ablutions, but in eight years' experience it has been the exception for them to ask for it, even in cold weather, and they are usually content with drawing the curtains over the open windows. In an exposed situation, when the wind blows, it may sometimes be necessary to close the windows (all but the fanlights) ; but, generally speaking, one cannot have too large or too wide open windows for the open-air treatment. This, however, is not enough, as there will be times when, with a different wind, the air must enter the room from the back. This is one of the drawbacks

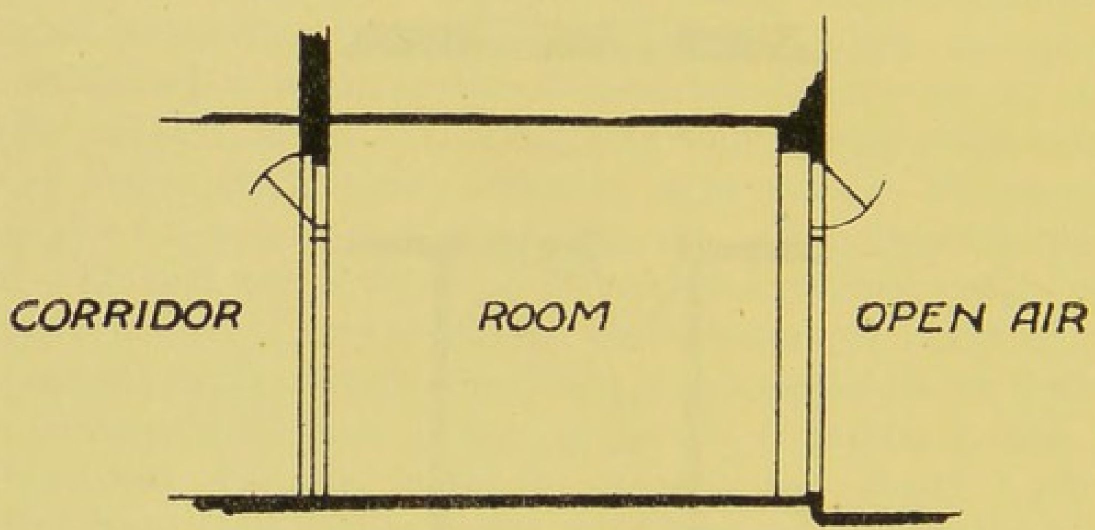

FIG. 18.—VERTICAL SECTION OF SANATORIUM BEDROOM, SHOWING CROSS-VENTILATION THROUGH FANLIGHTS AND OPEN WINDOW.

of an ordinary house for the open-air treatment. The diagram above of a room in a sanatorium will make this clear (Fig. 18).

Such cross-ventilation is one of the essentials in open-air treatment, more important than climate, aspect, or size of the room. Without it in still weather open-air treatment is impossible. No matter how large the open window-space on one side of the room, unless there be a sufficient outlet opposite communicating freely with the open air, the air of the room will at times be perceptibly less fresh than the air outside. In one of our consumption hospitals a lofty fresh-air ward was built, in which one whole side was replaced by a railing and an open space, which could be screened for the sake of privacy by pulling down a set of large blinds, but which was left unscreened all night. Notwithstanding the immense area open on one side, and the ample space allowed to each occupant, it was noticed that the air was distinctly stuffy in still weather, because no outlets had been provided behind the ward.

In a private house in which open-air treatment is to be attempted, the provision of cross-ventilation is one of the chief problems. This can be easily done where there are two rooms, separated by folding doors, and stretching from back to front of the house, as we have but to open the folding doors and the windows of both rooms. If there is a wall between two such rooms, it may be necessary to put in a large ventilating opening or fanlight (3 feet by 1½ feet) in the dividing wall. Sometimes, by leaving the bedroom door open and a window on the staircase, we may get the desired effect. When a fire is burning, the chimney acts as a very efficient outlet, but it cannot be depended upon as an inlet. Even when no fire is burning, all obstructions should be removed from the fireplace, and the register left open. The most practical opening at the back of the room is, however, usually the door, and the more directly the fresh air gets to the door from outside the room, the better. It should be remembered in ventilating an upper room in a tall house that the well of the staircase acts a little like an ordinary chimney, the foul air from basement and lower floors rising up to the top, unless an easier way out is provided. In a small house I have known a case where the patient's bed was placed on the top landing near an open staircase window, the fanlight over the front-door being kept constantly open, and curtains put next the stairs for privacy. In a breezy situation it may be possible to get good ventilation in a room with a front and a side window, although this is not so good as a room with big windows on opposite sides.

It is a good plan to take the door off its hinges, substituting a screen for privacy, or to wedge the door open. This is very frequently done in still weather, both in summer and in winter, at the Crooksbury Sanatorium. In another British sanatorium the doors are fixed open with bolts, a curtain being drawn across the gap ; elsewhere I have seen the door fixed by a hinged bar.

French windows have a great advantage over ordinary double-hung sash windows for the open-air treatment, as the whole space is available at once for ventilation in the former, and at most half the area in the latter. Another good form is the window pivoted on the centre line, either horizontally or vertically (Fig. 19). Casement windows may be made to lift off their hinges, and replaced at night by louvred shutters (like a fixed venetian blind), which let in the air, but exclude rain. The stays of casement windows should be made of stout material, the fixings such as cannot be unfastened by strong wind. In

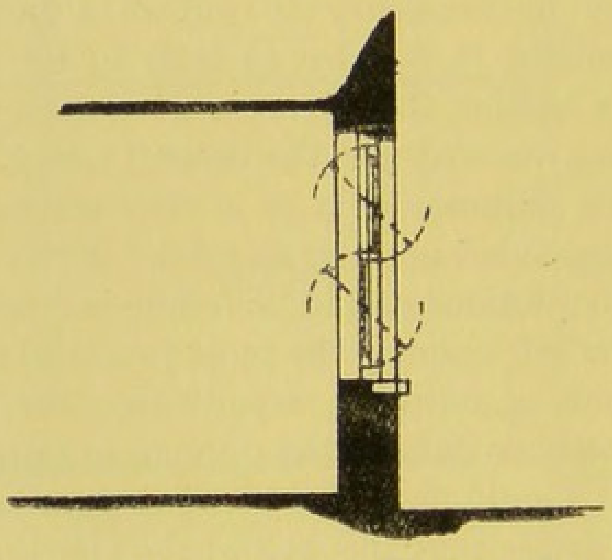

FIG. 19.—WINDOW WITH PIVOTED PANES.

windy weather there may be some noise from rattling of the fastenings, unless these are wedged in some way. A piece of stout rubber may be passed through the hinges for this purpose. No furniture of any kind should be placed in front of the window. As the window remains open in wet weather, any furniture near it may get wet ; and, apart from this, the free entrance of air would be hindered. If blinds are provided, they should be of glazed material, and fastened securely below, or they will be blown about by the wind. Curtains are banished from some sanatoria. If supplied, they should be of washable material (*e.g.*, drill), and hung from poles wider than the windows, so that they may be entirely drawn aside, to get the full benefit from the window-space. It is convenient to fix loops of tape near the lower edge of the curtains, in such a way that by stretching they will just slip over corresponding hooks. This prevents the wind from dislodging the curtains, and allows of privacy for ablutions without closing the window.

The window, whatever its kind, should be low enough for a patient lying down to be able to see out comfortably; otherwise he will have a very dull time. If the window is very small, it may be supplemented by a fanlight above it, or by a ventilator in the wall below the window.

Fanlights over the bedroom door usually act as outlets, and should be sloped accordingly (Fig. 18). If pivoted in the centre round a horizontal axis, the glass should be dulled, or it will act as a mirror and destroy the privacy of the room.

It is convenient to have one or two screens in the bedroom near the door, and sometimes near one of the windows. They should not be more than 5 feet high, and should either be heavy enough to be firm when the wind blows, or be fixed with hinges, stays, or bolts to the floor or window-frame, but always in such a manner that they can be folded out of the way when not wanted. A wind-screen may also be hinged to the window-sill inside the room (Fig. 20).

Ventilating gratings, Tobin's tubes, and the like, are seldom satisfactory, as they are usually made too small, and obstructed by bars and subdivisions. To be really useful, a ventilator should be at least 2 feet wide by 1 foot high, and in very small rooms a larger size may be required. There should be no grating or unnecessary subdivisions, and the surfaces should everywhere be smooth. The outer opening may be made smaller than the inner, as this diminishes the draught, the incoming air gradually slackening its pace as it enters the room.[43] A shield of some kind will be needed outside to prevent the entrance of rain. In towns where the air is dusty the inner opening may be covered with a screen of thin textile material (butter muslin, domet), which dips into a trough of water. This material must be detachable, so as to be renewed as often as it gets dirty. An arrangement similar to that adopted in straining the canvas or paper of an artist's picture will answer the purpose. Ventilating fans and extractors may be very useful in removing the foul air from a room in which the outlets are insufficient.

For a patient in bed the usual daily routine as regards ventilation would be as follows: Before or after breakfast the door would be shut for ablutions, and if the weather were cold or a strong wind blowing in, the windows would be shut, all but the fanlight; otherwise the curtains would be hooked down (see p. 65) over the still open window. After ablutions the patient would be wheeled in bed into the open air, under an awning or veranda, if necessary. He would remain out more or less until nightfall, and pass the night with windows wide open and (excepting in windy weather) the door wedged

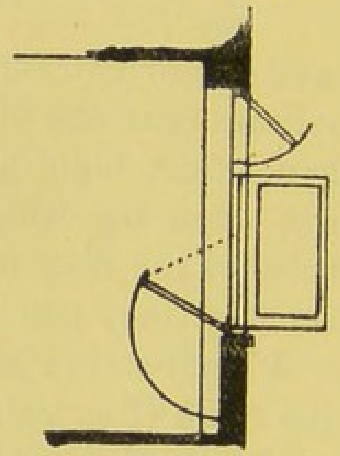

FIG. 20.—WINDOW WITH SCREEN HINGED TO SILL INSIDE.

partly open. While out of doors he would be put into a sheltered place if there were much wind. In case of rain, if the awning or veranda were insufficient protection, extra wraps would be thrown over exposed parts of the bed. If only part of the bed is covered by them, waterproof may be used; otherwise it is better to avoid using this material, as it confines the perspiration. In very cold weather a patient in bed may require in this country five or six blankets in all, but for most of the year three will be ample, and in the height of summer two. Hot bottles to the feet are apt to make them sensitive to the cold. These contrivances may, however, be used with advantage where the circulation is deficient and bed-socks or woollen foot-bags will not keep the patient warm.

In managing the ventilation of the consumptive's room, it should be remembered that just as much fresh air is needed in cold weather as in summer, so that the window should not be shut because the wind is cold. If a cold draught is felt by the patient, or there is much wind, a screen may be put up between the window and the bed, and more clothes put over the patient. If on a cold day the room be overheated and the window and door shut, there is sure to be a draught under the door. If the window is opened a chink, a strong draught will enter. If the room is cooled down or the window opened more widely, the draught will disappear, even though more fresh air enters the room. The fire, and to some extent the chimney without a fire, draws air into the room and up the chimney ; and the smaller the inlets, the faster the air has to travel, and the more it is felt as a draught. Windows may, however, have to be partly closed when a strong wind is blowing, and in this case it will also be useful to diminish the size of the outlets.

In exceptionally stormy weather the window may have to be entirely closed, and the fresh air left to enter by the opposite side ; but this will seldom be necessary in a place which is suitable for open-air treatment.

I have sometimes been asked whether windows should be closed in foggy weather. Country fogs are unlikely to do anyone harm, although they may call for a fire being lit. Town fogs, however (yellow fogs), are undoubtedly mischievous ; but nobody who is, or has been, consumptive should live in a place which ever has such fogs.

In damp weather with the windows open it is very common to get moisture condensed on the walls, and those unaccustomed to the open-air treatment may take this as a sign of a 'damp wall,' in which moisture creeps up from the ground. However, this is not the usual reason. As a rule, it is merely due to difference of temperature between the wall and the air, and such condensed moisture is absolutely harmless. If a glass of cold water is brought into a warm room, the outside of the glass will be quickly covered with drops of dew. In the same way, if the windows are open and the walls are cold, moisture is very apt to run down them, especially if they are solidly built of brick, stone, or cement, whereas this is less noticeable if the walls are porous, or flimsy, or built of wood. Such condensation of moisture can only be prevented in damp, cold weather by raising the temperature of the room to an undesirable extent.

On the other hand, a shut-up room, when full of people, is very apt to have its walls running with moisture from the condensed breath of the occupants, and this is undoubtedly injurious.

CHAPTER XI

HEATING AND LIGHTING

HEATING apparatus in a sanatorium or an improvised home sanatorium should not be used so much to warm the air as to warm the patient, either directly, or indirectly by warming the walls of the room. It is not possible to warm the air of a room with open windows to any great extent without spoiling the quality of the air. At a large chest hospital in Manchester the wards were at one time warmed by heating the incoming air, which was supplied in the proportion of 10,000 cubic feet per head per hour. It was, however, found that the patients did not get well as quickly as they should, and the place felt close, notwithstanding the abundant supply of air. So the system of heating and ventilation was altered, cool fresh air being admitted direct from outside through open windows, greatly to the comfort and advantage of the patients. It has been stated that heating fresh air destroys some of the contained ozone. Whether this be true or not, it undoubtedly spoils the freshness. Fortunately, it is quite unnecessary for the comfort of the patient to warm the air in this country.

A room occupied by a fresh-air patient should never be so heated as to feel distinctly warm on entering. In summer-time heating in this climate is never necessary, and the temperature will be almost the same as that outside. In winter, with wide-open windows, it is not possible to heat the room in this climate to higher than 40° or 50° F. without making it feel oppressive to those used to fresh air.

A temperature of 60° F. feels very pleasant, even perhaps cool, on a sunny summer day, but in winter it feels oppressive to anyone used to a fresh-air life.

Possibly the truth of the above statements may be doubted by those who are not accustomed to an open-air life, but only to the conditions of an ordinary closed room. It may be granted that anyone who in winter-time, without previous preparation, sits for hours in a room at below 55° or 60° F. will feel uncomfortably cold unless he properly protects his legs and feet, or raises them off the ground. But this is exactly what a sanatorium patient always does: he keeps his legs and feet off the ground, and wraps them up with rugs, and, so doing, does not feel cold. Moreover, once he is used to sanatorium conditions, he finds the atmosphere of an ordinary sitting-room oppressive and uncomfortable.

As a rule, the patient in bed will not feel the cold as much as his attendants, who should therefore be warmly clad. This is a matter in which nurses not accustomed to open-air treatment may be tempted to break the rules, as they jump to the conclusion that a room which is uncomfortably cold for them must also be too cold for the patient, and therefore shut the windows.

Some of my readers may be tempted to ask, after reading the foregoing, What is the use of any heating apparatus in the patient's rooms at a British sanatorium? As a matter of fact, some of the cheaper sanatoria dispense with heating apparatus, trusting entirely to clothing, hot bottles, rugs, and the like, to keep the patients warm. Still, there are times when a little warmth in the room itself is a great comfort, such as on returning after many hours out of doors on an autumn or winter day; and in damp weather it is pleasant to dry the air, even if it be not warmed many degrees.

At the Crooksbury Sanatorium the practice is to shut up and warm the unoccupied rooms towards nightfall in cold weather, so that the walls may retain some of the heat for the benefit of the returning patient. This is far better than attempting to warm the incoming air. When the patient returns, the windows are, of course, reopened. This manœuvre prevents the excessive condensation of moisture, and dries the air at a time when the patient is likely to be somewhat chilled by his sojourn out of doors. In the same way, if two rooms are available, they may be used alternately, each being warmed up during the absence of the patient; but care should be taken not to raise the temperature to that of an ordinary sitting-room. Sanatorium patients who are allowed to warm themselves up in cold weather in a warm room soon find that they become more sensitive to cold in this way, so that the offer no longer tempts them. Indeed, so long as a fresh-air patient can keep comfortably warm without using heating apparatus, the value of the latter is very problematical in open-air treatment.

Open fires are not much used in fresh-air sanatoria, although they are a great help to ventilation. They require careful stoking so as not to raise a dust; moreover, they heat the different parts of the room or shelter very unequally. People with weak lungs should never sit close to an open fire, as in this way one side of the body is overheated, while the other is chilled. The strongest current of cold air in a room usually travels along the floor towards the fireplace, and if a fire is burning, this current may travel so fast as to be felt as a most unpleasant draught. If, then, an open fire is used, the patient should keep at a respectful distance from it. Some of the best kinds of open fire are fed from below through a shoot above or at the side of the fireplace. The effect is that the half-burnt gases must pass through the hotter part of the fire on their way to the chimney, and in this way are completely burnt up. When fuel is completely burnt with an abundant supply of air, the resulting gases are less poisonous than in incomplete combustion, and are also freer from particles of soot.

Closed stoves are not, as a rule, to be recommended in a 'fresh-air' room. If used at all, they should be of a kind which does not allow the foul air to escape from the stove into the room. Hot iron allows some of the poisonous gases produced by burning coal or coke in a slow-combustion stove to pass through its thickness. There are some coke stoves which are made with a double coat or jacket, between which fresh air circulates, in order to prevent the escape of these gases from inside. The stoking door of most coke-stoves is so arranged that it is easier for the smoke to escape through it than to go up the chimney. Coke stoves, if used at all, should be stoked from outside the room. They are, of course, unobjectionable for heating the water in hot-water pipes, if, as is usual, only the hot-water pipes are inside the room. Gas stoves are not to be recommended in a ' fresh-air ' room. It is almost impossible to insure complete combustion of the gas and to prevent the escape of foul air into the room at times. Steam-pipes are chiefly found in large buildings, such as public libraries. They are apt to make the room smell very close, owing to the charring of dust particles on the hot pipes, and, owing to the ease with which the pipes can rapidly be heated up, nearly always encourage people to overheat the room. All the best sanatoria in this country are heated with hot-water pipes. The coils should be placed centrally in the room, not under the window (as is so frequently done). Such an arrangement is not only wasteful, but wrong in principle.

Lighting.

Electric lighting is supplied in all the better sanatoria, as this does not add to the impurities of the air. Should this method not be available, the choice lies between gas, oil-lamps, acetylene, and candles.

Notwithstanding their convenience, gas-lights are not to be recommended for the open-air treatment, as they increase the heat and foul gases to a much greater extent than oil-lamps or candles. This may not be the case for equal illumination, but in practice it is found to be so. Especially objectionable are gas-lights with a by-pass. If gas is permitted in the patient's rooms, a special flue should be provided above each burner to carry off the fumes.

The chief drawbacks to oil-lamps are their smell, when carelessly trimmed or cleaned, and the flickering caused by wind.

These may, however, be avoided with care. Protected candles, as used in carriage lamps, are also permissible.

A light will be useful in the veranda or shelter where the bed or couch stands during the day, as in the winter months the bed will not always be brought inside at sundown.

Acetylene is used in some of the sanatoria for the working classes. Unless carefully managed, it is apt to cause unpleasant smells, but the light is brilliant. Out of doors there can be little objection to it.

CHAPTER XII

DUSTLESS ROOMS

NEXT to abundant ventilation, one of the most important means of curing the consumptive is to banish dust as far as possible from the air he breathes. Household dust consists of a mixture of particles from clothes, furniture, food, the leavings of flies, the remains of dead insects, tiny particles from the human skin, dust blown or brought in from the roads, and myriads of bacteria. Many of these particles are capable of putrefying; others are irritating to the delicate mucous membranes; while yet others become saturated with the ill-smelling moisture from breath and perspiration, which is probably the chief cause of the stuffy smell of an ill-kept lodging-house, and possibly of the ill-health of those who live in it.

Of the many kinds of bacteria associated with this organic refuse, some are probably harmless; others help in putrefaction, and in this way act as scavengers; but many are the cause of various diseases, such as whitlows or bronchitis. There is no doubt that 'colds' are bacterial diseases, communicable from one to another through the air, although some people are more susceptible than others to the infection. People who live much out of doors are less liable to catch colds, which are especially common in dusty or overcrowded houses, and distinctly rare amongst the patients in a properly managed sanatorium.

One of the great dangers for the consumptive is to get what is called 'mixed infection,' by which is meant infection with other bacteria in addition to the tubercle bacillus. Just as inflammatory complications, 'blood-poisoning' and the like, were enormously diminished by protecting open wounds from the dust of a hospital ward or room, so in lung disease, where sore spots exist on the breathing tubes, a great danger is removed by allowing none but relatively dust-free air to reach the lungs. Nature has fortunately given a natural protection against dust in the tortuous moist passages of the nose, but even so there are some who cannot always breathe through the nose, and, in any case, it is well not to tax unreasonably the natural defences of the body. It is therefore worth while taking pains to reduce the dust in the patient's quarters as much as possible, by special ways of furnishing and decorating and special methods of cleaning.

It is surprising how many ledges and corners there are in

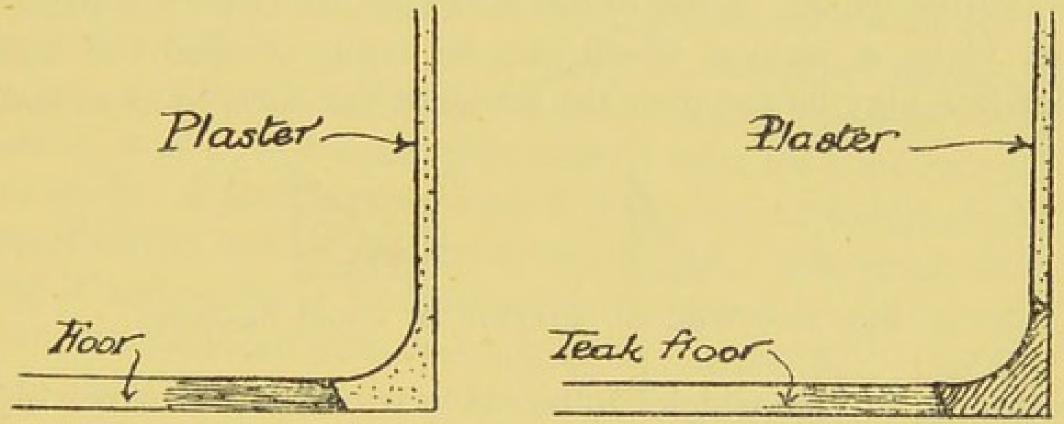

FIG. 21.—TWO METHODS OF FORMING ROUNDED CORNERS.

an ordinary house which cannot easily be kept clean. The consequence is that there is almost always dust there, ready to be dispersed with a breath of air, and so enter the lungs. There is, however, no necessity for this state of affairs, which is unknown in a good sanatorium, as well as in at least one house known to the author where similar methods are adopted.

In the best sanatoria all angles and ledges are avoided, being replaced by smooth surfaces and bold curves. The floors are laid without cracks, a bold curve being made at the junction with the walls, and another where one wall joins another and next the ceiling (Fig. 21). Frames of doors and windows are made without the usual projections, and there are no skirting-boards to catch the dust. Walls, floors, and ceiling are all alike smooth and washable, and the usual cornices and mouldings are omitted. The same principles are followed in constructing the furniture, which is made as plain and simple as possible.

Let us next consider how we may transform an ordinary room into a 'home sanatorium.'

If the floor is well made, it may be polished with Ronuk, which fills up the cracks. Otherwise, it may be covered with linoleum, laid, if possible, in one piece without joins, a fillet of wood being placed next the walls so as to fill up the corners. This fillet may be either concave or triangular in cross section, about 1½ inches thick (Fig. 22).

The walls should have all old paper stripped off, and may then be either whitewashed, colour-washed, or covered with washable paper. Some of the washable distempers, if painted on, leave a surface which can be freely washed. A small beading may be put over the frame of the door, so as to make

FIG. 22.—WOODEN FILLETS IN CROSS SECTION.

a sloping surface which can be easily wiped and on which dust does not readily collect. No carpet should be left in the room beyond small strips by the bedside and near the washstand. Cupboards should be treated like the walls, the angles being filled in with beading. Blinds and curtains have been already referred to on p. 64. All unnecessary furniture should be banished from the room, leaving in the bedroom just the bed, a few chairs, a commode or pedestal, washstand, screen, and two or three small tables. A wardrobe is unnecessary, as it is best to keep as few clothes as possible in the room, and any heavy article of furniture interferes with proper cleaning. At the Crooksbury Sanatorium wardrobes have been replaced by corner cupboards with sloping roofs and mirror fronts. Chests of drawers should be raised on feet, so that a wet cloth may be passed underneath. The most objectionable feature about an ordinary wardrobe is the 'dead space' on top, an irregular surface where any amount of dust may accumulate. Where exceptionally it is necessary to keep the wardrobe in the bedroom, the top should be closed in with smooth, well-fitting boards, preferably arranged in such a way that the dust may be wiped right off the top with a wet cloth.

For a washstand a single pattern is advisable, made of enamelled wood or iron. At the Crooksbury Sanatorium the washstand is replaced by a shelf of smooth-edged stained and varnished wood, placed in a corner and backed with tiles (Fig. 13), another smaller shelf being placed above for bottle and glass. Another good plan is to use a plain deal table, with a sheet of plate-glass on it, retained by a small band of leather at the corners. The glass should have the edges ground smooth. As a rule, stuffed furniture is avoided in a sanatorium. If it is used, there should be plain washable covers provided for each chair. The tables may be of polished wood or enamelled metal, or covered with American cloth, fastened under the edges with fillets of wood. A similar table may be used for a washstand, if desired. A comfortable bed is essential, as much of the patient's time will at first be spent in bed. The most comfortable and suitable kind is one with naked spiral springs, which has the merit of never sagging in the middle. The bed should not be too wide, as it makes nursing more difficult (3 feet 6 inches is a good width). It is possible to fit large rubber-tyred wheels to the legs of a bedstead, which makes it easier to wheel out into the open air. No valances or bed-curtains should be used. The mattress should have a double washable cover, so that if any soiling happens, the inner cover is likely to escape. The bolster and pillows should also have double cases. Instead of an ordinary counterpane, it is advisable to use a washable bedspread (*e.g.*, of drill). If an eiderdown quilt is used, it should have a washable cover. No boxes or other articles should be left under the bed. Bookshelves, ornaments, mats, and pictures are best removed from the bedroom. Only such things should be left as can be removed daily and cleaned outside the room.

The same principles should be adopted in decorating and furnishing a sitting-room for a tuberculous patient. The floor may, however, be covered in the middle with a loose square of carpet. Books should be kept in glass-fronted bookcases, and loose papers in boxes. Picture-frames should be of a kind which does not hold the dust; ornaments should be few and simple, and all unnecessary articles discarded.

Coming next to the methods of cleaning a sanatorium room, we find that the chief difference from those in ordinary use elsewhere is that in a sanatorium care is taken not to stir up the dust which has accumulated, but to remove it from the room. Every time a housemaid uses duster and broom in the usual way dust is stirred up into the air, and remains suspended for a long time afterwards, gradually subsiding on to the floor and articles of furniture. It is easy to convince oneself of the truth of this assertion by darkening the room and then admitting a beam of light, which will reveal the presence of countless millions of dust particles. Examine any ordinary inhabited room towards the end of the day, and every upper surface will be found to be coated with dust. In a good sanatorium, however, this will be far less noticeable. This is because a more systematic and rational method of dusting is in force. Every day the strips of carpet (if any) are rolled up and carefully carried out of doors, where they are shaken at some distance from the room. Every day the floor and adjoining part of the walls are wiped with wet cloths, to which the particles of dust adhere. The furniture is similarly treated, especially such parts as look upwards and receive the falling dust. An old sponge will be found useful for this purpose, and there is very little furniture which will not stand such treatment without harm. Provided all the dust is thoroughly removed by a wet cloth, sponge, or other similar article, there is no harm in drying the surfaces after with a dry *clean* duster, although it is not usually necessary, and may lead to the reintroduction of the pernicious method of dry dusting, which consists in wiping off some of the dust and distributing it in the air with a flick for the occupants to breathe. Taking into consideration the usual conservatism and lack of sense of the ordinary servant, the safest plan is to banish both broom and duster from the patient's quarters, and to persistently supervise the work until there is no longer any doubt of its being done the right way. In corridors and on landings, where the work of wiping with a wet cloth alone would be irksome, it is permissible to use a duster or cloth tied over an ordinary broom, and dip it repeatedly into a pail of water while the floor is being wiped down. Even carpets and rugs are none the worse for wiping with a wet cloth, and in my own house they are wiped this way far more often than they are swept, while wet dusting is employed for the furniture and floors. The consequence of this (and also of the greater purity of air in our country district) is that the annual house-cleaning is scarcely necessary, and differs *toto cœlo* in its revelations from that which most people experience.

It is usual in a sanatorium to employ some kind of antiseptic in wiping the rooms and furniture, but the really important point is to use water to remove all dust particles. Once a week it is useful to thoroughly clean the floors with soap and water, after which they will require repolishing with weak Ronuk or similar material. The turpentine used with this is an excellent purifier, and the alkali of the soap is antiseptic. Even painted or polished furniture may be safely washed with soap and water, provided that a second lot of clean water is used to wipe off the soap. At the same time the lower part of the wall to a height of 3 feet should be washed, as this is the part where dust particles are most likely to collect. Special care should be taken in cleaning floors to wash right into all corners, and under all large articles of furniture, which should be moved out from the walls so that every part may be cleaned.

CHAPTER XIII

TEMPERATURE OF THE BODY

THE temperature of the body is one of the most important guides in detecting and in treating tuberculosis, as well as in estimating the chances of recovery. Long before the patient is obviously ill a little fever will be found if sought for. The patient himself is often quite unconscious of being feverish, although sometimes he will feel hot or shivery some part of the afternoon or evening. The rise of temperature may, however, be detected by the clinical thermometer if properly used. There are several recognized ways of using it. An old-fashioned method still largely employed is to place the bulb of the thermometer in the armpit, between the naked arm and the naked chest, care being taken first to shake down the column of mercury to, say, 96° F. Another way is to put the bulb under the tongue, but the most reliable method is to introduce the bulb for about an inch into the rectum (or bowel). This is the method adopted at Nordrach and other German sanatoria, as well as in most of the good ones in this country. A reliable armpit (or axillary) temperature can only be taken with the patient in bed in a warm room, keeping the thermometer in place for a quarter of an hour or more. Even the mouth temperature is greatly affected by cool air, so that if the temperatures are taken this way slight degrees of fever may be altogether missed, and the wrong treatment adopted. Dr. Burton Fanning (an advocate of mouth temperatures) has shown that in order to get a reliable reading in this way the thermometer must be kept in place with the mouth closed for half an hour, at the same time preventing any cold air from blowing on to the face. Hot or cold food alters the tempera ture of the mouth for a long time after, so that it is usually recommended not to take mouth temperatures for three-quarters of an hour after taking food or medicine. Exposure of the mouth to cold air chills it in the same way, so that it must be kept shut (the patient neither coughing nor speaking) and the cheeks protected for at least half an hour to make a mouth temperature reliable. This is irrespective of the kind of thermometer used, and is as true of a 'half-minute thermometer' as of a slower one, since it is the mouth itself which has to be restored to the temperature of the body before an accurate observation can be made. On the other hand, a reliable rectal temperature can be taken in five minutes, so that the rectal method is both quicker and more accurate than taking temperatures by the mouth. There is another reason for preferring the rectal method, which is that it is a much better measure of the effects of exercise. In treating tuberculous patients the rise of temperature produced by exercise is an important guide to the amount of exercise necessary for the time being.

The temperature falls rapidly after exercise, so that within a quarter of an hour or less it may be already very much what it was before the walk. For this purpose, then, mouth temperatures are obviously of no value. Indeed, it is quite common to find that a walk raises the rectal temperature, while it lowers that of the mouth. It is true that if excessive exercise is taken, the mouth temperature will be higher some hours later, because feverishness has been excited; but we need some guide to give us timely warning, and prevent such mistakes. The rectal temperature taken immediately after exercise is just such a guide, and to do without it altogether is to deprive doctor and patient of a valuable indication for treatment. Many people suppose that the rectal temperature can be estimated from the mouth temperature by the addition of part or the whole of a degree. This, however, is not correct. In cold weather there will be a great but variable difference between the two methods, while in warm weather sometimes there will be no difference, at other times a decided difference. The minimum temperature (excepting in cold weather) taken by the two methods usually differs by at most from 0·2° to 0·4° F.; with slight fever the maximum temperature (taken at rest) will perhaps differ by a degree or more, while with high fever the difference will be less. I have known the difference to be 0·4° F. in the morning and 1·4° F. in the late afternoon on the same day in the same patient. The rectal temperature, therefore, gives more timely warning of the approach of fever (see Fig. 23).

Where there are hæmorrhoids or other bowel ailments which would make rectal thermometry painful this will, however, have to be abandoned for a time. Any inflamed spot is likely to raise the temperature near it. This is true of inflammatory conditions in the mouth and throat, such as a gumboil or a quinsy, as well as of a fistula or rectal abscess. The rectal temperature is usually lower after evacuation of the bowels. A clear half-hour should be allowed before the temperature is taken *per rectum*.

A hot bath may for a time raise the temperature of the body by a degree or more. This is a purely temporary disturbance, as a rule.

There are a few other methods of taking the temperature. In the Alpine health resorts it is customary to take the temperature in the stream of urine; but this cannot be an accurate way, as the stream is too small, and the time far too short. By warming the utensil beforehand to near blood-heat it is possible to get a fairly accurate temperature if the thermometer is put into the urine after it has been passed, but this is an inconvenient method. There is another way which answers well with patients in bed who are not too thin, consisting in placing the thermometer in the fold of the groin, with the thigh bent on to the front of the body, or between the thighs while they are close together. It cannot, however, be depended on when the patient is up.

My own directions to open-air patients who have no bowel complication are to carefully shake down the index of the thermometer to 95° or 96° F., to push the bulb gently into the bowel for about 1 or 1½ inches, leave it in for five minutes by the watch, then withdraw the thermometer carefully without shaking or jerking, placing it in a little stoneware pot containing some cotton-wool and a little disinfectant. The nurse usually reads the temperature and records it, and then shakes down the index ready for use. It is not necessary even for men to undress for this performance, which can quite well be done with clothes slightly unfastened, the patient resting on his bed with a rug over him, and the blinds drawn. Ladies under my care usually take mouth temperatures during menstruation.

The temperature of the body is taken in tuberculous patients and those suspected of tuberculosis for two chief purposes, to detect and measure the degree of fever, and to measure the effect of exercise. These two objects should be kept quite distinct, and temperatures taken after rest should not be confounded with other observations taken immediately after exercise.

The internal temperature in health varies slightly according to the individual. It is very slightly altered by external heat or cold, so that there is less than half a degree of difference in the rectal temperature of the healthy man, comparing winter observations with summer observations at the same hour of day. The temperature of the body is also raised by taking food, and notably by exercise, although in the healthy man the temperature rapidly falls again after exercise, and may have fallen to the standard of rest within half an hour. Apart from these circumstances, there is a daily rise and fall of temperature in health amounting to about $1\frac{1}{2}°$ F. in twenty-four hours, or a little less than 1° C. The lowest temperature is during the early morning, the highest usually about 6 or 8 p.m., varying a little according to the habits and constitution of the individual. A full meal may raise the temperature by 0·6° to 1° F.

The rectal temperature in health at its lowest is usually from 97·6° to 98° F., the highest reading at rest being usually 98·8° to 99·4° F., but allowance must be made for small individual differences.

After active exercise the temperature may rise from 1° to $3\frac{1}{2}°$ F., falling rapidly afterwards for a quarter or half an hour to the old figures.

In tuberculosis, just as in convalescence from a severe illness of any other kind, the temperature range may be increased, and may be 2° F., or even 4° or 5° F. In other cases, however, there is quite a small range.[30] It is much affected by trifling circumstances which have no effect in health. Thus the excitement of seeing a friend or receiving a disturbing letter, the exertion of coughing, or even of sitting up for the first time, will send up the temperature several degrees if the patient is weak—much less as he gets better.

In early tuberculosis of small extent the patient is usually slightly feverish some part of the day, especially as a rule from 4 to 6 p.m. The time of day when there is most fever varies in different cases. The fever may be very slight, and last but a short time daily, in which case it may be altogether missed if the temperature is not taken several times a day. In some cases it is necessary to take the temperature every two hours from midday onwards, in order to detect the feverishness, and in any doubtful case this should always be done. It is very common in women affected with tubercle to find some fever before or after the menstrual period, while it may be absent at other times. In other cases of tubercle there is no fever so long as the patient remains at rest, but this appears after exercise. Generally speaking, the consumptive gets a raised temperature after slighter exertion than the healthy man, and the higher temperature remains much longer than it would after severe exertion in health.

The amount of fever has a considerable bearing on the chances of recovery. The less fever there is and the more quickly it subsides when treatment is begun, the better the outlook for the patient. It is remarkable how quickly slight fever will often disappear when the patient is kept at rest in the open air. On the other hand, if the fever is high—say, 100° F. at the lowest and 103° F. at the highest point—it will take many months, as a rule, to get rid of it, and recovery is correspondingly difficult and imperfect. After bad attacks of tubercle, when the strength of the patient is beginning to fail, it is not uncommon for the fever to diminish; so that fever, although important as a guide, is only one criterion of the patient's chances.

Fever is not only caused by the poisons manufactured by the tubercle bacillus; other bacteria, such as those found in pneumonia and those present in a whitlow, have similar properties. By studying the type of fever and making a careful examination of the expectoration and blood the cause or causes of fever may be discovered, and treated in the appropriate ways.

Another cause for increased fever is the presence of complications. An attack of pleurisy or pneumonia or an inflamed fistula will raise the temperature considerably. Such causes should be looked for if a consumptive under treatment becomes more feverish. If no complications are discoverable, the increased fever usually shows that there has been an extension of disease in the lungs.

The usual hours for taking temperatures are 7 to 7.30 a.m., or on waking in the morning (preferably before the morning cough has started), before lunch, before dinner, and a clear ten minutes after getting into bed—say, 9.30 p.m. At the Crooksbury Sanatorium on some days in the week the second and third temperatures are taken immediately on returning from the prescribed walks—*i.e.*, at 11.30 a.m. and 5.30 p.m.; on other days they are taken half an hour later—12 and 6 p.m.—so as to show the temperatures at rest. In some respects 5 p.m. is a better hour than 6, but it interferes with walking exercise.

The bearing of temperatures on treatment is discussed in the next chapter.

CHAPTER XIV

THE FEBRILE TUBERCULOUS PATIENT

So long as there is even slight fever, the consumptive requires careful daily medical attention. Since the fever may spring from one or more of several causes, the physician has to find out which of these are likely to be causing the disturbance, and vary the treatment accordingly. Chief among these causes is absorption of poisons from the affected lung, or failure in the production of antibodies to these poisons. Occasionally, however, some fever arises from digestive disturbance ;* at other times complications of a non-tuberculous nature may raise the temperature. The appropriate treatment may therefore be either a remedy which increases the reserve of energy in the body, generally or specially, or one which helps to get rid of some of the poison, whether by increasing expectoration or in other ways, or which acts directly on the fever-producing bacteria. Apart from this, it is often necessary to counteract the effects of fever on the body by remedies which improve circulation or restore digestion.

The first and most essential remedy for the fever of tuberculosis is absolute rest in bed in the open air, or as near an approximation to it as possible.

One of the commonest mistakes made in pulmonary tubercle is to allow the patient to be up, and even taking exercise freely, while he is feverish. He has been told to go to the country or the seaside, and to live out of doors ; and, feeling fairly well, notwithstanding his lung disease, he spends the time in walking about. After a few weeks he begins to realize that he

* This is often disputed, but I am satisfied that fleeting feverishness may be caused in this way.

is getting weaker, and perhaps more distinctly short of breath than he was; and on examination he is found to be slightly feverish in the morning, and decidedly so in the afternoon or evening. Of course, he should have been *at rest* in the open air all this time, but, without precise directions, has done the wrong thing with the best of intentions.

Especially in early stages of tuberculous disease is it necessary to be cautious about exercise. At such a time there are patches of tubercle bacilli actively secreting poisons, and there has not yet been time for Nature to put a barrier of fibrous tissue round them. Consequently, whenever exercise is taken, the blood coursing near the damaged lung carries off a dose of poison to undermine the patient's health; whereas if he were at rest, he would absorb less poison and make better progress. If the patient is exposed night and day to the fresh air and kept strictly quiet in his bed, slight degrees of fever will promptly disappear, and more severe fever gradually subside in most instances, although it may take many weeks to get rid of the fever entirely. The higher the fever, the more imperative the need of fresh, cool air. The patient himself should be kept reasonably warm, but the air he breathes should be cool. There need be no fear of his catching cold, for this is caused by infection, not from exposure to fresh air. Neither country fog nor night air need be feared. The things to be afraid of are foul air and overheated rooms. Clothing in winter should be enough to keep the patient from feeling shivery; in summer it is often a good plan to reduce the bedclothes at times to a single sheet, and even to remove some of the bedgear. So long as this makes the patient feel comfortable, it is doing him good. If at any time he feels shivery, a little hot drink or a hot bottle, or an extra blanket thrown over him for a time, will usually be sufficient to make him comfortable again. In very feverish states the patient sometimes suffers from night-sweats. If this happens, he should have the skin carefully dried and a fresh nightdress put on, with as little exertion as possible. As a rule, however, night-sweats (or sleep-sweats, for they come on also after a nap in the daytime) are rare in a sanatorium, and are a sign either of dangerous weakness or of insufficient ventilation. The airiest situation available should therefore be chosen for the feverish consumptive, either in a suitable sleeping shelter out of doors or in the airiest room in the house. Place the bed between the open door and window, with a screen to protect the patient's head in breezy weather. I have seen feverish consumptives kept at the inner end of a deep, large bedroom with bow-windows open, but with no outlet for the air beyond the bed. With such an arrangement the air in the far end of the room scarcely gets changed, and the patient remains feverish. Move him thence into the bow-window, and he will at once begin to improve. This is, however, a more draughty situation than out of doors on a balcony or in a shelter, or in a properly constructed sanatorium room, and the patient may in consequence suffer from stiff neck and muscular pains in the shoulders and elsewhere. These are often due to the fever itself, but sometimes may be traced to draughts. The remedy, then, is to increase the opening through which the air comes, when it will travel more slowly and not cause a draught, or, if this be insufficient, to interpose a screen. Should a veranda be chosen for the bed, it will have to be protected against rain (see Chapter VIII.). The patient will suffer no harm from such an airy situation, provided that he is protected with enough bedclothes and in other ways already referred to. In this climate there is no hardship in sleeping in a good bed out of doors, provided that rain be kept off. There is never a degree of cold likely to do any mischief, excepting in exposed, windy places, which are not suitable for open-air treatment. In my experience, fever is more quickly reduced in cold weather than in warm. The continual bath of cool air acts in much the same way in reducing temperatures as the graduated bath of cool or tepid water so much used in some other kinds of fever.

Nor is a prolonged acclimatization needed: most of my patients have been able to stand the windows wide open at night within three days of their arrival, if not sooner. Our routine practice for feverish patients at the Crooksbury Sanatorium is to leave the window wide open the first night, with the curtain drawn and fastened; the second night to draw back the curtain; the third night (if the weather is still) the door will usually be wedged open a trifle, and the windows left wide open. In the daytime, directly after breakfast, the patient's bed is drawn half way out on to the terrace, with the awning down if there is strong sun or any rain, the patient's head and shoulders remaining inside the room. He is left like this more or less all day, coming in at nightfall, or in dry, quiet winter weather even later.

The best position for the bed in the room is with the head at least 6 inches from the nearest wall, and the foot of the bed projecting into the room. In this position it is easy to attend to the patient; he has free circulation of air around him, and far less draught than if the bed were pushed up against the wall. As a rule, in all but the hottest summer weather the patient's head is best kept out of the direct line between door and window, but it is not good to put the bed-head into a recess. Some people find it difficult to sleep facing the light. In this case the head of the bed may be turned towards the window and sheltered by a low screen.

The feverish patient should not only rest physically, but also mentally. A restful, unexciting time is very necessary to his recovery. He should have no worries, no domestic problems, no business cares to attend to. There should be no undue fussing over him, nor should he be unnecessarily disturbed in any way. Visitors at such a time should be denied, and conversation restricted to a little cheerful chatting. In one of the German sanatoria the exciting books in the library are starred, and forbidden to the feverish patients. On the other hand, it is often soothing to have an interesting but unexciting book read out during illness, and something of this kind will help to pass the time between meals and the other daily events.

It has already been said that a feverish patient should be assisted in his ablutions by the nurse, so as to avoid unnecessary fatigue; but some nurses are overanxious in this respect, and exhaust the patient's strength by unnecessary ablutions. Cleanliness is of great importance, but in marked fever rest is even more important (see also Chapter XVI.). Sponging with tepid water is sometimes useful in reducing the fever, so long as it can be done without tiring the patient. In German sanatoria a great point is made of hydrotherapy in various forms. The value of this remedy is perhaps underestimated in England, but professional opinion is not unanimous on this point.[45] If there is marked fever, the patient should use a commode in relieving himself. In extreme instances, when fever is high or there is great weakness, a bed-pan should be used. There are, however, patients who find it less exertion to use the commode than the bed-pan. In either case the motions should be kept soft, to avoid the need of straining.

In all prolonged fevers it is most important to keep the sheets smooth and free from crumbs. The skin is very apt to give way over prominent bony parts if this is neglected. If any redness appears, the part should be rubbed with methylated spirits or brandy in order to harden the skin, and at the same time the patient should be supported with cushions or pillows in such a way as to take the pressure off the threatened part. Although absolute rest is necessary, a change of position from time to time is useful. While the patient is on his back, the bedclothes should never be so tightly tucked up as to press on his toes or knees; but this need not prevent the coverings being tucked in at their edges. A draw-sheet should be used for every highly feverish patient, so that a fresh piece of sheet may be put under him without having to lift him up. His movements in bed should be assisted in the usual way. When the patient begins to sit up in bed, a pillow should be placed under the knees. Without this, much fatigue may be caused by such a change of position.

It is most important to feed the feverish patient suitably. This is discussed in Chapters XVII. to XIX.

How long should a patient be kept in bed? In early stages, until the temperature has been below 98·6° F. in the morning, and below 100° F. at its highest point, for seven consecutive days. Then he may usually be allowed out of bed for a short time daily, but it is still necessary to take into account the condition of the chest and circulation before any further exercise is permitted. Should there be any return of fever, it is wise to send him back to bed for a few days, at all events, although it is not necessary after a slight rise to insist upon a whole week of natural temperatures in the case of a patient who has been a long time under treatment, and who has usually been free from fever.

Sometimes the temperature keeps up for a long time without rising very high ; and if this cannot be accounted for by the extent of the disease in the lung, attention should be paid to the digestive system, as fermentation, or slight constipation, or an irritable state of the lower bowel, may be the cause.[65] If none of these conditions is present, and there is no evidence of any complication, it is sometimes good policy to allow the patient to get up with a temperature between 98·6° and 99° F. at lowest, and between 100° and 100·4° at highest. Experience alone will tell when such exceptional treatment is advisable.

Fever is sometimes kept up by the exertion of coughing, if this be out of proportion to the amount of secretion to be expelled. In such a case a relaxing expectorant or a bronchial sedative may do much good.[64]

Where there is a local inflammation, it is good practice to keep the part at rest. Thus, for a pleurisy the inflamed side may be kept quiet with strips of strapping plaster ; for a laryngeal complication strict silence will greatly help recovery.

Assuming that the patient is free from fever, he will gradually increase the length of time spent out of bed. At the Crooksbury Sanatorium we usually get him up first in the middle of the day. At this stage he spends his time on a cane lounge when not in bed, and puts on just enough clothing over his bed-garments to keep warm. Later on he is up from eleven till five ; then he dresses more completely, and also joins the others at lunch and tea. After this, in favourable cases, he may begin to take a short walk ; but if there is marked shortness of breath or a poor circulation, it is more usual to postpone all walks until the patient is able to be up the greater part of the day. In the summer-time a patient usually stays up to late dinner before he is allowed to get up for breakfast, but in winter the reverse is usually more convenient. Occasionally, however, we find that the exertion of dressing causes so much fatigue that it is wise to postpone getting up for breakfast until quite late in the course of treatment. On the other hand, there are some cases which remain feverish for a long time in the latter part of the day, but are free from fever in the morning. In this case it is best to give a little exercise early and send the patient to bed betimes.

CHAPTER XV

REST AND EXERCISE

APART from fever, a patient who is just beginning the open-air treatment during the colder months of the year should be kept in bed for a week or more, in order to accustom him to the new conditions as regards ventilation. In many sanatoria it is an invariable rule to keep the new-comer in bed for at least a week, whatever his condition.

Where there is great loss of weight, great weakness, marked shortness of breath, with feeble circulation, or marked dyspepsia, with subnormal weight, a prolonged stay in bed is advisable. It is also necessary to insist on rest in bed when there has been recent severe blood-spitting, or where a patch of lung is undergoing rapid softening. Apart from the latter condition, I am not in the habit of insisting on rest *in bed* for slight blood-spitting, which is usually easily controlled by other remedies.

It is a mistake to suppose that a patient with lung disease is very ill because he has been ordered to bed. This is merely a precautionary measure in many cases. Rest is a valuable remedy, and rest in bed is often more useful than rest out of bed.

It is an invariable rule in all good sanatoria for all patients to rest with their feet up during the hour preceding lunch and dinner. During this hour even conversation should be discouraged. Digestion is better performed if the patient be rested beforehand. Active exercise is best avoided after a meal, but strict rest is not so important then as before the meal. Indeed, I am in the habit of prescribing a short stroll after late dinner for any non-febrile patients who are able to take exercise freely. This accords with the old adage: 'After dinner rest awhile; after supper walk a mile.'

A patient who feels pretty well and is taking walking exercise should be definitely instructed when he is to rest and for how long. Loitering about is not the same thing as resting, and even sitting up in an ordinary chair involves more exertion than reclining on a couch with the legs supported. Rest should be taken in an easy position, with the body properly supported and the chest expansion unimpeded. It was formerly the custom at Nordrach, in Germany, to send the patients to take rest in a hammock in the woods. This, I think, is a mistake, as it is almost certain to contract the chest and throw the body into awkward attitudes which prevent proper chest expansion.

Much mischief is often done by not insisting on sufficient rest during open-air treatment. People imagine that an open-air life means exercise in the open air, whereas it may mean (and in some cases should mean) rest in the open air.

On the other hand, too prolonged rest is likely to cause undue accumulation of fat, muscular flabbiness, shortness of breath, and feeble circulation; so that it is just as important for the patient to take gradually increasing exercise when he is fit for it as for him to remain at absolute rest when he is not yet fit for exercise.

Every sanatorium patient goes to bed early. It is usual for everyone to go to bed not later than 9 or 9.30 p.m., while many retire much earlier in the day. This is an important means of restoring the strength.

Exercise in the open-air treatment fulfils a twofold purpose. On the one hand, it restores the muscles of the body (including the heart muscles) to a condition of health, and brings the other functions of the body—digestion, the action of the liver, and of the skin—up to the mark. On the other hand, exercise causes the absorption of bacterial poisons from the diseased parts of the lungs, and so provokes a reaction. This 'auto-inoculation' is equivalent to a series of tuberculin injections, and is one of the most important ways of increasing the special resistance of the body against tubercle, and so curing the patient. Active exercise may cause a larger absorption of bacterial poisons than a fair-sized injection of tuberculin, so that such exercise is to be regarded as a medical remedy just as much as a dose of medicine. Exercise to a greater amount than is warranted by the patient's condition may do just as much mischief as one of the excessive doses of tuberculin which were sometimes given before the proper use of Koch's remedy had been grasped by the profession. For instance, it may cause a feverish outbreak lasting several weeks, with headache, lassitude, and loss of weight, sometimes also pleuritic pains in the chest. It may, indeed, be the starting-point of a definite relapse, with extension of the mischief in the lungs. For instance, a forbidden toboggan ride caused a patient in Davos, who had been taking lighter exercise freely, to spend four months in bed, with high fever.

Another patient in England, who had probably been slightly tuberculous for some months without in any way suffering from it, became obviously ill, with slight fever, oscillating opsonic index, and other symptoms, as a consequence of an overlong walk.

In some patients a short walk raises the temperature as much as a longer one. In such cases there is probably excessive auto-inoculation. When the tuberculous patches have been isolated by a barrier of fibrous tissue from the circulation, the effect of exercise on temperature and on the opsonic index will be very slight. This is one reason why tuberculin treatment is often necessary to complete the recovery.[32, 84]

When the patient has for a week or more been up and dressed for several hours a day, he may begin to take a little walking exercise. In an average case I am in the habit of prescribing a walk of 30 yards on level ground as a beginning; very occasionally it is necessary to begin with half this distance. The distance is gradually increased until he is walking about a mile on more or less level ground. Then begins a series of walks, including a small upward slope, the patient returning downhill. After this come longer walks, involving steeper hills, until the patient is walking about five miles every morning, four miles in the afternoon, and one mile in the evening after dinner.

All this walking exercise is done at a slow pace, averaging about two and a half miles an hour, or the rate of a gentle stroll. The earlier walks are interrupted by frequent rests, the patient sitting down on a seat, or on a folded newspaper or other protection placed on the ground.

During exercise the head is to be held up, the mouth closed, the patient breathing through the nose. Exercise which causes breathlessness is usually too severe, and is forbidden in most sanatoria.

In certain cases it is advisable to begin hill-climbing from the first. Here the first walk would be one of five or ten yards, according to the steepness of the hill. Such treatment is appropriate if there has been a lesion of small extent, leaving the circulation good. After a time, when there is no breathlessness and the patient's condition and that of his chest are good, the pace may be increased to three miles an hour. This is contrary to the practice of some sanatoria, and should not be done without careful consideration; but I am satisfied that, with due care in selecting patients, it is quite safe, provided that there has not recently been blood-spitting or softening of a patch of lung, and the circulation is good.

The reason why it is advisable at first to walk slowly may be explained by the analogy of a theatre full of people. Just as the theatre can be more quickly emptied at a moderate, even pace, while a block is caused at the doors if people attempt to hurry the pace, so in the lungs a block will be produced in the circulation if the blood is hurried round too fast. In healthy lungs there is ample space for the blood-current, but after lung disease some of the bloodvessels have been blocked up, while the affected parts of the lung have been deprived of much of their elasticity. There will therefore be regions which cannot readily empty themselves of air, or expand to admit extra blood; and some of the air cells will be occupied by comparatively unyielding solid masses, preventing mutual accommodation between air and blood.

When recovery takes place, these mechanical difficulties will, to a great extent, disappear in favourable cases, but as long as they are present the capacity of the lung for blood and air should not be too severely taxed by exercise. The best warning is given by a feeling of breathlessness, causing the patient to breathe hurriedly through his mouth instead of quietly through his nose.

When convalescence is well established, games and more active exercises are permissible and advisable. Those, however, calling for the use of the arms should be attempted only with great caution. Exertion of the arms involves a pull upon the chest, which may be dangerous if cicatrization is incomplete or imperfect. So also exertion which requires the patient to hold his breath and fix his chest is unsuitable until convalescence is far advanced.

In early stages of treatment the chief guides to the sufficiency or otherwise of the exercise taken are the pulse-rate, the temperature, and the respiration-rate. Later on, when there is no fever and auto-inoculation is no longer a marked feature, an excessive amount or degree of exercise will show itself by headache, malaise, pains in the chest, and possibly a little fever. The opsonic index also is a useful guide, as excessive exercise leads to a marked drop in the index, which may or may not be followed by a rise. Where the pulse-rate at rest is habitually high (over 100 for an adult), extra caution is needed in taking exercise. If it is below 90 at rest, hill-climbing or a longer walk along the level may send it up to 120 or more. In early stages of treatment a pulse-rate over 120 on returning from the walk usually shows that the exercise has been too severe, unless the rate very promptly drops to a more natural figure on lying down. Later on a rise of pulse-rate after exercise to even 140, if strictly temporary and quickly subsiding, need not cause alarm, provided that examination of the lungs and heart shows no indication for extra caution.

Patients with a weakened heart, or with evidences of a small pulmonary aneurysm, or of extensive disease, with much fibrosis and cavitation, fall into a separate class. As regards breathlessness, this should never be extreme, and should subside promptly on resting. It can often be kept within bounds by increasing the number and duration of the rests by the way.

Thus, ten minutes' walking, with fifty minutes' rest per hour, on five or ten different seats, may be gradually increased until the whole hour (or more) is taken up by continuous walking exercise. The effect of walking or climbing exercise on temperature is twofold. On the one hand, it may cause a purely temporary rise, which may be of several degrees without harm in a convalescent with little disease; on the other hand, it may cause a rise in the next temperature taken at rest, which is more serious. I usually expect a rise after exercise (in all but the early stages) to a figure between 100° and 101° F. As a rule, 100·4° F. should not be exceeded. But whatever the rise immediately after exercise, if the next rest temperature is above the usual figures (*i.e.*, over 100° F. instead of below it), and still more, if next morning the temperature is raised (*e.g.*, 98·8° F. instead of 97·6° to 98·4° F.), the patient must be put to rest on his cane lounge for a day or two. If the rise in the morning temperature is to 99° F. or over, or if there is a slight increase in temperature from day to day, he should be sent back to bed. If the exercise temperature alone be over 101·5° F. (which should not happen), it will be wise to send the patient to bed without waiting for the rest temperature. Where an extension of disease results from excessive exercise, the full effect is not seen for several days, so that the *tendency* of the temperature (whether upward or not) should be taken into account quite as much as the actual figures. In this way the severity of the relapse may be reduced by persisting in rest at a critical time.

It should be remembered that walking exercise varies according to the conditions under which it is attempted. In windy or wet weather there is more exertion in taking a walk than on a fine, quiet day; also when there is a thick mist during spring or autumn, with a drop in temperature out of doors, some patients will feel a little more difficulty in exerting themselves.

It sometimes happens that the exercise taken has to be reduced because of loss of weight. Sometimes, however, the reverse occurs, and an increase in the amount of exercise helps to increase the weight. In the first case the amount of food taken has probably not been large, and the same amount of exercise may be taken if the patient can be induced to eat more. In the second case there is usually some sluggishness of the liver, which is relieved by exercise or by some other of the usual remedies.

It may be asked, Why should not a patient content himself with a tiny walk every day, so as just to keep his muscles fit for gentle exercise, without the risk of overexertion? The answer is that the walk is intended to increase the bodily resistance to tuberculosis by causing the absorption of a small dose of tubercle poison; and both theory and experience agree that this is best done by giving a dose just short of what will cause constitutional disturbance, and by gradually increasing the dose until the body can neutralize large doses of the poison. Too little exercise, in short, not only fails to train the patient's muscles, but also fails to cure him, leaving him in a state of invalidism in which he is neither well nor free from the danger of a relapse. Too much exercise makes him ill; too little fails to make him well.

For this reason, the walk must be prescribed by someone who has had experience of the system of treatment, and who understands the medical details. The treatment is (or should be) progressive, just as a course of tuberculin treatment is progressive, and for the same reasons.

In a sanatorium the amount of exercise is usually prescribed twice a day—at the doctor's visit before breakfast, and at the second one before lunch. In each case he knows what have been the temperatures, which are again inspected before dinner and, if necessary, at bedtime. These visits give the doctor an opportunity of seeing the effect of exercise on the patient, and of varying the amount according to need. It is difficult to see how any progressive treatment can be managed without such visits daily.

Generally speaking, the most active exercise should be taken in the first half of the day, which is the time when muscles are restored by sleep and the temperatures are usually lowest. In some cases, however, where the effort of dressing causes much fatigue, I have prescribed the daily walk at first in the afternoon between 3 and 4 p.m., the patient having had breakfast in bed and risen soon afterwards. Active exercise is best avoided immediately after a meal, and, as already mentioned, the hour before the chief meals should be spent in resting.

It is convenient to prescribe the early walks in yards or fractions of a mile. With an opisometer the distances can be measured on a large-scale ordnance map. A convenient scale for the room is 6 inches to 1 mile; for the pocket, 2 miles to 1 inch. Knowledge of the district is also necessary, as some walks will be more fatiguing than others, owing to steep gradients or to uninterruptedly rising ground.

The subject of recreation is deferred to another chapter (Chapter XXIII.); so also is the question of progressive exercises for the convalescent (Chapter XXV.).

CHAPTER XVI

CLOTHING, BATHS, AND ABLUTIONS

THE ordinary hygienic rules as regards clothing are applicable to the consumptive as well as to those in ordinary health. Clothing should be evenly distributed, and just enough to keep the patient warm. It should take up perspiration readily and part with it slowly, so as not to cool down the body too fast by evaporation. It should keep out rain to a reasonable extent, but not exclude air. Further, it should not hamper the muscles or the expansion of the chest, nor press upon the digestive organs.

The chief difference in the clothing of the consumptive arises from the facts that he will have to rest in the open air instead of in a warm room, and that he is particularly prone to perspire freely, so that he must be extra careful not to wear unnecessarily warm clothing. Moreover, as he is usually feverish for at least part of the day during the early weeks of treatment, he will need special modifications in order to combat the fever.

Overclothing is extremely common, and greatly adds to the risk of catching a chill. Moreover, too many or too warm clothes are fatiguing for those who are not strong, and prevent the bracing effects of cool air upon the skin. 'Chest-protectors' are a mistake, because they warm the front (and some also the back) of the body, while they leave the sides of the lungs unprotected, although it is here that Nature has put the least protection in the shape of muscles. Heavy coats worn open in front are not good, because they overheat the back, and the less protected parts are apt to perspire in sympathy. The warmth of clothing depends mainly upon the amount of air which it includes within its meshes. This is why finely woven wool is warmer than a coarsely woven material, and why several garments one over the other are warmer than the same thickness in one garment. But in this climate it is seldom necessary to wear a multiplicity of garments, and it is better, as a rule, to change for a thicker one when the weather turns colder. Additional garments should only be used in case of sudden and presumably temporary changes of weather.

As regards materials, woollen clothing is the most widely applicable in this climate, although in some sanatoria abroad it is objected to. An American physician (Dr. Pottenger) who has had practical experience in California objects to woollen garments in summer-time ; but in this climate the advantages outweigh the disadvantages, provided that thin enough material is used in warm weather. Woollen materials take up moisture readily, and part with it slowly. Moreover, the fibres are but little penetrated by the liquids absorbed, so that the clothing does not retain unpleasant odours so tenaciously as cotton or linen. The chief disadvantage of wool is that with some people it irritates the skin ; but this depends partly on the quality and the way in which the material has been woven. Where the skin is very irritable, silken undergarments may be tried, or even linen, with a thin woollen garment over it. In such a case, however, the linen should be changed whenever it becomes damp with perspiration. Most people find Aertex cellular (cotton) garments pleasant to wear. Cotton is in most respects intermediate in properties between linen and wool, being warmer and more absorbent than linen, but less so than wool. Leather garments are not to be recommended, as they are not porous and confine the perspiration.

For patients in bed, nuns' veiling is very suitable for ladies in warm weather, merino for men. Flannelette is warm, but very inflammable, unless the specially prepared 'non-inflammable' kind is used. It is a matter of indifference whether combinations, pyjamas, or nightgowns are used. If the latter, it will be necessary to protect the legs and feet in cold weather by bed-socks or stockings, or a foot-bag, or in some other way. If pyjamas are worn, care should be taken to protect the middle zone of the body, where the upper and lower garments meet. Patients in bed in the open air speedily become far less sensitive to cold than people under the usual conditions; still, there is no harm in adopting reasonable precautions against chill. Thus, it is usual to shut the windows for ablutions and whenever the patient is exposed to the air, especially if it be windy or really cold weather. If at any time a bed-patient perspires freely (which should not often happen with proper ventilation and a proper allowance of covering), care should be taken to dry the skin with a towel before exposure to cold air. Once people have become accustomed to a fresh-air régime, they soon resent any attempt to shut the windows in ordinary weather, and get no harm from free exposure to fresh air, even while washing or dressing. For this reason it is a great convenience to be able to secure privacy without shutting the window (see p. 64).

For those in bed it is convenient to use a bed-jacket to protect the shoulders while sitting up. If the wind blows unpleasantly on to the head, a 'Balaclava cap' may be worn, with flaps over the ears. However, in a very short time people get so used to the new conditions that they will prefer to be without such a cap.

The warmest clothing should be reserved for rest out of doors in cold weather. If the feet are on the ground, extra protection will be needed up to, or above, the knees. A large foot-bag, such as is used in the Alpine health resorts, made of fur or sheepskin lined with flannel, is convenient for sitting out of doors in cold weather. Most of the rest out of doors will, however, be taken with the feet up and the body semi-reclining on a cane lounge. Here it should be remembered that protection is needed underneath the body as well as over it. As a rule, one good rug under the body and another over it, tucked under the feet, is enough even in cold weather, but occasionally three rugs will be preferred.

Walking dress should not be heavy. While exercise is being taken less clothing is needed to keep the body warm.

Athletes usually recognize this fact, putting on extra wraps after a race ; but the principle applies equally to others. It is chiefly because in ordinary life people return from a walk to an artificially warm room, with windows shut, that they put on extra clothes out of doors and take them off on returning ; but for a sanatorium patient or a ' fresh-air fiend ' the conditions are quite different. Here the extra wraps are needed on returning, not while taking exercise. In rainy weather a thin overcoat or rain-cloak may be worn, but these must not be thick enough to overheat the body. It is more dangerous to get overheated than to get wet. Waterproofs in which the pores are stopped up are dangerous, as they confine the perspiration. If at any time a patient gets wet, he will take no harm so long as he keeps moving. On his return, there are two courses open to him : either to change into dry clothes, or else to lie down with enough coverings over him to allow of his slowly drying his clothes by the heat of the body. There is not the least danger in this, even for people who have been subject to cold-catching in ordinary life. The chief point is to keep warm if you have got wet ; so long as you feel warm you will not suffer.

In some of the best sanatoria ladies are strictly forbidden to wear corsets. It is a great mistake to wear tight clothing while undergoing open-air treatment, as it prevents the proper expansion of the lungs and limits artificially the quantity of food that can be taken with comfort. Still, it is, in the writer's opinion, an open question whether corsets should be entirely discarded. There are only two convenient ways of supporting the weight of ladies' clothing as regards the lower half of the body—by the hips or the shoulders. Any form of shoulder-strap (like men's braces) limits the movements of the chest, which suspension from the hips does not do. Men who indulge in active games usually abandon braces for the time ; and in ladies a form of low corset which is not rigid over the lower ribs and is nowhere tight will better support the skirts, and will be unobjectionable in other ways. It should be possible to put both hands inside the laced-up corset next the body. If this can be done, the corsets are harmless.

It should also be remembered that if people are below their proper weight and begin to gain, that of itself will help to make the clothes tight. An extra-loose suit of clothes should therefore be obtained for sanatorium treatment.

Evening dress is not permitted in a sanatorium, because it leaves part of the body exposed while other parts are more or less warmly clad.

For further remarks on bed-clothing, see Chapter XIV.

Bathing and Ablutions.

The ordinary rules in this respect apply to those with weak lungs. Cold baths and the like are bracing and stimulate circulation, digestion, and other processes, provided that there is a good reaction. If you are warm directly after a cold bath, it has done you good; if not, you should use slightly warmer water, or shorten the bathe. Some people can only get warm after a hot bath. Tepid baths are cleansing and soothing, but not tonic; but hot baths, if quite short and from 105° to 108° F., are stimulating. A good plan for those who find it difficult to get warm after a cold bath is to stand in warm water while they sponge themselves with cold. The more the water is divided up, the more stimulating and the less depressing it is. Consequently, a needle-bath is more bracing and more easily borne than a sponge-bath, and this than a plunge or swim. Swimming is only safe for those who are in a condition to take active exercise with the arms (see Chapters XXIII. and XXV.), and who have a good circulation; but, in any case, it is seldom wise to stay more than five, or at most ten, minutes in the water. And sea-bathing, it should be remembered, is more fatiguing than bathing in still water, although the salt water helps reaction more than fresh.

Those who get a proper reaction after cold water should use this daily for their ablutions, rather than warm water. Invalids can often stand cold water, and profit by it, if each part of the body is washed separately and dried before the next is washed.

For the sake of cleanliness, there is no objection to a weekly hot bath, provided it be not too prolonged. It is best taken at bedtime. Those, however, who are very feverish will have to dispense with baths altogether, substituting piecemeal washing by the nurse.

When a nurse washes a patient in bed, it is usual to wash the face and hands first. After this, the patient resting in a blanket, with nightgown partly or entirely removed, the arms and front of the body are washed. He is then rolled over while the back is done. Each part in succession is dried before the next is washed, the legs and feet being done last. In this way the whole body may be washed without undue fatigue of the patient. In highly feverish conditions, however, it is better to leave the patient at rest rather than to tire him with too prolonged ablutions. Provided there is no active perspiration and the sheets are kept quite smooth and free from rucks and crumbs, a quick daily sponging of dependent parts is enough. For a feverish patient half an hour a day should be ample for ablutions. More than this tires the patient and keeps him from the fresh air. If there is any incipient redness of bony points much pressed upon, a final rub with brandy, methylated spirits, or a suitable liniment, will be advisable.

In many sanatoria—*e.g.*, at Nordrach-upon-Mendip—patients are instructed not to dry themselves after a bath, but to get into bed with a bath-sheet round them, the reason being that the exertion of drying may easily send up their temperatures more than is advisable.

Medical opinion is divided as to the value of systematic hydrotherapy. At Nordrach Colonie patients used to take hot, cold, or tepid needle-baths, whichever they preferred, subject only to the rule about not actively drying themselves. At Görbersdorf and Falkenstein, the original homes of systematic sanatorium treatment in Germany, graduated hydrotherapy is universally applied, beginning with friction with a dry sheet or with spirit, going on to rubbing with the wet sheet, the wet pack, the needle-bath, and the douche, the length of application being prescribed by one of the doctors, who is also present to judge the effect. On the other hand, ordinary full baths are quite exceptional there. The writer regards it as a matter of comparative indifference whether such hydrotherapy is adopted, or the more usual British methods already described; but the underlying principles in each case are of importance, and should not be forgotten. At the Crooksbury Sanatorium needle-baths are provided in one of the blocks, and freely used by convalescent patients in warm weather.[45]

CHAPTER XVII

BODY-WEIGHT AND DIETETICS

THERE are few diseases in which a knowledge of the principles of dietetics is more needed than pulmonary tuberculosis. A wasting disease in which the digestive processes are disturbed from an early stage, and in which the instinctive promptings of appetite are usually lacking, above all others calls for a knowledge of the chemical changes in the living body and the chemistry and dietetic value of foods.

In health we are led by instinct (within limits) to eat the proper quantity of food, and in the right proportion, more or less, of its constituent food-stuffs; but in consumptives this instinctive appetite is wanting, so that we are compelled to fall back upon what is known as to the needs of the healthy body, and what has been experimentally determined to be best for the average consumptive.

Were the popular notion correct, that the consumptive must be compelled, as the price of recovery, to eat as much food as can be forced down his throat, we should have a rough guide to dietetic treatment in this disease; but, unfortunately, such indiscriminate stuffing is only possible in a minority of cases, while the great majority suffer speedily from digestive disturbances when it is attempted, and very soon begin to lose weight or to retrogress in other ways. There may still be doctors (in or out of a sanatorium) who are in the habit of treating their consumptive patients by the stuffing system, but, in order to get the best results, more moderate quantities and more careful attention to the proportions of the different food-stuffs are advisable. We will, however, return to this later on.

Consumption being a wasting disease, one of the first things we require to know is whether the patient in whom we are interested is below his proper weight, and if so, to what extent.

Even in an early stage most of those who require open-air treatment are below their proper weight, for the ill-nourished are specially liable to tuberculosis, and the disease itself still further reduces their weight. We may sometimes get clear evidence that the patient while in health had been heavier, but, failing this, we have to trust to the published tables of average weights according to height, age, and sex.[47] Some allowance may be made for family peculiarities, as there are some families with a tendency to light weight, while in others the tendency is to produce big men and women. Still, it is also possible that the patient has been attacked *because* he was a 'light-weight,' so that too much stress should not be laid upon the family tendency. Moreover, the chances are that he was tuberculous long before he knew it, which may have reduced his weight below the healthy standard. Remarkable transformations are often effected by feeding up those who have been 'light-weights' all their lives, with the best results as to health and energy.

In weighing a patient, certain precautions have to be observed. In order to get comparable results, we must weigh the patient at the same time of day and in the same clothes, or else weigh the clothes separately. Moreover, a considerable difference may be made by emptying the bladder and bowels, or by eating or drinking just before the time of weighing. Pains should therefore be taken to keep to the same conditions as regards food, drink, and evacuations every time the patient is weighed. The same scales should, if possible, be used each time, placed on a level spot, and carefully adjusted so as to hang true. If open-air treatment is attempted at home, it will be necessary to get a good weighing-machine, as there are likely to be times when the patient could not conveniently go elsewhere to be weighed.

People commonly fail to realize the weight of clothes worn, and the great differences there may be in weight between costumes which appear to be about the same. At some sanatoria it is the custom to weigh patients in their nightdress, but there may be as much as 2 pounds difference in the weight of ladies' or gentlemen's nightgear. The differences in walking-dress are still more considerable ; these may weigh as little as 5½ pounds or as much as 16 pounds. At the Crooksbury Sanatorium our rule is to weigh patients at the same hour on the same day of the week, cautioning them against the possible fallacies above mentioned, and then at night to weigh everything they had on. By deducting one from the other, we get an absolute net weight, which can be compared at any future time with other weights. New arrivals are similarly weighed, on the first convenient opportunity, at the same time of day.

What should be considered a satisfactory gain in weight ? Assuming that the patient is below standard weight for height, age, and sex, but has a good digestion and no fever, he should gain at least 1 pound a week. Many of my patients have gained an average of 2 pounds while taking plenty of exercise ; one gained 27 pounds in nine weeks ; another gained 18 pounds in three weeks ; a third gained 15 pounds in two and a half weeks ; another 7½ pounds in one week. By keeping patients long at rest, it is quite easy to make the majority gain 3 or 4 pounds a week steadily for some weeks ; also by a rigid system of stuffing this can be done while they are taking active exercise ; but the former is medically unadvisable, while the latter practice makes life a burden, and is very apt to cause dilatation of the stomach. Personally, I am in favour of such quantities of food as will insure a *steady* gain of 1 to 2 pounds per week in patients without fever, while they take as much exercise as their general condition and lung trouble show to be advisable. Provided there be a steady gain in this way extending over many weeks, there is less likelihood of a rapid loss afterwards than if the patient were to put on weight rapidly while at rest. It is quite common for patients during the early stages of treatment to gain in weight and also in bulk, while later on they lose their superfluous fat without losing weight. This, I think, is a good sign, and shows that the muscles have become better nourished.[48]

While fever lasts it is much more difficult to get a gain in weight, and we must be content with smaller gains—say, $\frac{1}{2}$ pound a week. We may be sure that the same quantity of food will promptly cause a gain in weight as soon as the fever is got rid of by natural means, so that the chief point is to insure this in whatever way may be possible.

Those who have recovered from severe attacks and have much damaged lungs or a weakened circulation should be careful not to attempt to gain rapidly in weight, but be content with steady gains of $\frac{1}{2}$ to $\frac{3}{4}$ pound a week. A more rapid gain is not free from danger, especially if there be a tendency to blood-spitting.

In dyspeptics, too, we have to be satisfied with small gains in weight, and great attention will have to be paid to the kind of food and to the medicinal treatment of their ailments. About half the patients who come to a sanatorium for treatment are more or less dyspeptic. It is especially in these cases that an exact knowledge of the composition and properties of different foods is of value. Very often this dyspepsia disappears under a well-chosen dietary. On the other hand, patients with pronounced dyspepsia which will not yield to treatment, and which prevents a progressive gain in weight, seldom do well. In such cases tuberculin treatment affords the best chance of recovery, and the beginning of improvement is shown by an improved digestion.

When a patient loses weight, the fault may be in the feeding, in the patient's own state of health, or in the mismanagement of some necessary detail of treatment, such as ventilation, rest, or exercise.

The food may be too much or too little in quantity, or the food-stuffs in wrong proportions. It may be given too often or too seldom, or the fault may be in the cooking, the quality, or the way in which it is served.

As regards the patient, the commonest cause is fever ; after this, dyspepsia in various forms ; but this may depend on easily preventable causes, such as imperfect mastication, washing down the food with drinks, or even unnecessary excitement from noisy conversation. It is an important part of the doctor's business to find the cause of any loss of weight, or of a stationary weight, where a gain is expected.

The state of the weather may have some influence over gains and losses of weight. When hot weather first sets in, a smaller gain in weight, or even a loss in weight, may show itself. This is partly because the appetite and digestion are less keen, and partly because of the increased perspiration. In the latter case the effect is quite temporary. On the other hand, when cold weather sets in, it is necessary to encourage the patient to eat more heartily of fatty and farinaceous foods, as more is used up in keeping the body warm. Presently the appetite becomes keener, and the difficulty is at an end.*

What shall we do with patients who are free from fever and up to standard in weight? These I think need not put on much flesh; but if they are to be gradually trained into a satisfactory muscular condition, they will need sufficient food to allow them to substitute hard muscle for soft muscle and fat. No loss in weight should be tolerated, but a gain is unnecessary. In some sanatoria—especially on the Continent—the doctors are so anxious to raise the weight of the patient to the highest possible figure that he is sometimes discharged fat, flabby, and breathless. In a few instances in my experience it has been necessary to reduce the quantity of food and alter its constituents, so as to reduce the weight of the patient to a more reasonable figure; and concomitantly he has become less short-winded and otherwise in better health.

How are we to estimate the quantity of food which is necessary in a given case? Two chief methods are adopted in fresh-air sanatoria, one of which consists in giving such helpings as would suffice for a man or woman doing active work, and increasing or diminishing the quantities according to results, the other method consisting in giving weighed

* In the Arctic regions the Eskimo children eat fat in much the same way as children in warmer climates eat sugar. The latter is a rapidly assimilable form of food, but has not the same value in the production of energy. Fats and oils have more than twice the caloric, or heat-forming, value of starches and sugars.

quantities based upon previous experimental work. The former is the method in vogue at most of the existing sanatoria, while the latter was introduced by Drs. Bardswell and Chapman at the Banchory and Mundesley Sanatoria.

Anyone with an elementary knowledge of dietetics who has had some experience at a sanatorium for tuberculous patients will know roughly what quantity of food is undoubtedly too little for a given patient, and what quantity is probably enough, but between these two extremes one would have to be guided by experience and by results. There is no difficulty in finding the right amount if the digestion is fairly good, but it is otherwise when we are dealing with patients of small appetites and impaired digestion. In such cases gain in weight can only be effected by regulating the proportion of food-stuffs, so as to give the most efficient combination in the least possible bulk. No food in ordinary use contains exactly the best proportions of food-stuffs, some containing too much proteid, while others are too starchy. Moreover, although fats and starches can to a large extent replace one another, the proportions in which they are taken is not a matter of indifference.

The food we eat is a mixture of 'food-stuffs,' each of which has a definite chemical composition. These food-stuffs may be naturally divided into those containing carbon, hydrogen, oxygen, and nitrogen (the most important being the *proteids*), and into those only containing carbon, hydrogen, and oxygen. Of the latter there are two classes—the *carbohydrates*, in which the hydrogen and oxygen are in the same proportions as in water, and the *fats*, in which there is less oxygen. Examples of proteids are—the greater part of meat, the casein of milk and cheese, more than half the bulk of an egg, the albuminous constituents of peas and beans, and of wheat, rice, and the like.

The carbohydrates are represented by starch and sugar, the fats by every kind of fatty or oily food. In addition to these three chief classes of food-stuffs, there are others which are only taken in small quantities—*e.g.*, mineral constituents, the gelatine group (which has nearly the same properties as proteids, but not entirely), and water. For practical purposes we need only take into consideration the quantities and proportions of proteids, fats, carbohydrates, and water.

There are three ways in which the food value of a dietary may be recorded—the amount of carbon and nitrogen may be given; or the amount of proteids, fats, and carbohydrates; or the caloric or energy value. The most important facts, however, may be summarized by stating the proteid value and the total caloric value. The latter is determined by measuring the amount of heat disengaged in burning a given quantity of the food-stuff, having regard to the proportion which can be digested and absorbed in the body, and the heat value of the excretions which finally represent the food-stuff. Since all energy is convertible, this heat accurately represents the energy which the food yields to the body. Such determinations agree well with the analyses of dietaries proved experimentally to be capable of sustaining life and health.[49]

Food is taken for three chief purposes—to provide for growing tissues; to repair the tissues as they wear out; and to provide for the various forms of energy given out by the body, such as heat and mental or mechanical work. Proteids are chiefly necessary for growth, repair, and development, although they may also be used as a store of energy. Fats and carbohydrates are chiefly of use in the latter respect, but are of unequal value, since fat yields more than twice the energy—weight for weight—yielded by carbohydrates. Fats, and to a smaller extent carbohydrates, are capable of being stored in the body, and are then available for a sudden demand, just as the coal in our cellars. If there is no such store, there is danger of the tissues themselves being reduced in bulk in order to yield the necessary energy for heat or mechanical work, whether of the heart or the voluntary muscles of the body. Children who are growing and developing need more food (weight for weight) than adults, especially proteid food. Moreover, as they have a relatively large surface from which heat is lost, they need more heat-formers (fats and carbohydrates). This is why healthy children are well padded with fat, which both protects them against unnecessary loss of heat and is a store of fuel, to be used in emergencies. The natural food of young children—milk—is an indication of their needs ; it is a more highly nitrogenous food (containing more proteid) than that of the ordinary adult. In the same way the consumptive, who often has a large amount of tissue to replace, and loses much energy through the febrile processes, needs an extra amount of food, and a relatively large proportion of proteids, even when at rest ; while the quantity of fats and carbohydrates (especially the former) must be increased when exercise is taken, in proportion to the amount of exercise. The consumptive's proper diet, therefore, approximates to that of the healthy growing child ; and more, not less, is needed when there is fever, as compared with the needs of the body at rest. This is one respect in which the old-fashioned treatment of consumptives was at fault, since the diet was formerly reduced for every kind of fever.[55]

Since fats yield more energy than carbohydrates, weight for weight, a diet rich in fat need not be so large as one containing little but starch and sugar (beyond the necessary proteid). Healthy men in cold countries can live quite well on nothing but proteid and fat, but in temperate, and still more in hot, climates such a diet would almost certainly cause ill-health, unless active exercise were very freely taken ; while, on the other hand, a diet consisting of proteid and carbohydrate, without any fat, would be even more unsuitable. Practically every healthy man combines all three classes of food-stuffs in his diet, the carbohydrates predominating in the poor man's diet, while the rich man takes a larger proportion of fat in some shape or other.

Most consumptives are inclined to take far too little fat, and there is good reason to believe that this habit increases the susceptibility to tuberculosis. This habit is commonly shown in a sanatorium by a disinclination to take the richer dishes, or any kind of sauce containing fat, butter, or oil ; and it is an important part of the doctor's business to combat such perverted instincts.

It has been shown that a very large amount of fatty food can quite well be assimilated by the average consumptive, while this is not equally true of carbohydrates. As it is usually important not to increase the total bulk of food to an unreasonable extent, there is a manifest advantage in increasing the proportion of fats as far as practicable.

People are not all alike in their efficiency as machines for converting food into energy, some making a better use of what they eat than others, just as some engines give out more energy than others with an equal consumption of fuel. For this reason we cannot lay down a hard-and-fast rule for every consumptive, but must to some extent be guided by actual results. Still, a knowledge of the dietetic value of foods and of the dietetic needs of the average consumptive is of great value as a guide to treatment.

Bardswell and Chapman* have given the results of a study of weighed diets in a large number of cases at sanatoria with which they were connected, and conclude that for those below standard weight the proteids should be increased by 30 per cent., and the total caloric value of the food by 30 per cent.[49, 50]

We may conclude this chapter by briefly summarizing the chief requirements as to diet for consumptives. The total quantity and the proportion of food-stuffs should be such as to allow the patient to reach his standard weight and restore his damaged tissues without overburdening the digestion. The food should be of good quality, not spoilt by overlong keeping. It should be palatable and attractive to the eye, with sufficient variety as regards the nature of the articles and the way they are cooked to make them attractive. It should be suited to the medical condition of the patient, and to the season and climate. Some of these points will be further considered in the next chapter.

It is one of the difficulties of an open-air life that food which is intended to be eaten hot is quickly cooled down. Something can be done to prevent this by using hot plates for the dishes, with spirit-lamps or other means of heat-

* 'Diets in Tuberculosis.' London, 1908.

ing underneath, or hot-water plates for the patient's own use.

Some of the Continental sanatoria have heated cupboards in the dining-room, connected with a lift from the kitchen. Jacketed jugs are sold, in which liquids will keep hot (or cold) a long time. If the meal has to be carried out to a shelter out of doors, a tin-plate box surrounded with felt covered with wood will be useful.

CHAPTER XVIII

WHAT TO EAT AND WHEN TO EAT IT

In the last chapter we discussed the quantities and uses of the various food-stuffs required in the treatment of tuberculosis. It now remains to consider the best way of giving these food-stuffs. Should we give little and often, or should we keep the patient strictly to meal-times at longer intervals? In most of the Continental sanatoria it is customary to provide five or six meals a day, including minor ones; whereas at Nordrach Colonie three heavy meals were given daily, with nothing between. The practice of most British sanatoria approximates rather to the Nordrach system than to the other, although in some the quantity of food is less, and forced feeding is discountenanced.

The objection to frequent meals is that they leave no rest-time for the digestive organs; so that, if the patient can eat enough at the three chief meals, it is far better to avoid giving him intermediate meals. The hour's rest before luncheon and dinner enables most patients to eat heartily at their chief meals, so that it is quite exceptional to find glasses of milk or beaten-up eggs and other additions necessary in between.

As everyone who is undergoing open-air treatment goes to bed early, and is the better for a long night's rest, a fairly early breakfast hour is advisable—say, 8 or 8.30 a.m., or for those accustomed to early rising 7.30. Luncheon may then be at 1 or 1.30, dinner at 7 or 7.30. Afternoon tea is usually an optional meal, and should be regarded as an opportunity for social intercourse rather than a proper meal. High-tea (by which is meant the combination of tea with dinner) is not to be recommended.

It is customary at most of the German sanatoria to provide a large number of courses at luncheon and dinner. This is good policy at an hotel *table d'hôte*, where people take or leave dishes as they please, but not at a sanatorium ; for the more courses are provided the more difficult it is to vary the meals from day to day. Indeed, it was found necessary for this reason to reduce the number of courses at one of the high-class German sanatoria. It is best to provide the consumptive with a limited number of courses to each meal, and get him to take a little of each course ; but this does not exclude the provision of alternative courses, which is to be recommended in a mixed company.

Variety is a great help to the appetite, so that it is not wise to provide exactly the same articles day after day at the same meals. Rather should we make a point of continually varying the menu, so that no two days have exactly the same. For a similar reason, food should be differently cooked on different days, and none excepting obviously unsuitable articles excluded. Many things commonly accounted indigestible are not so if properly cooked, and some of the most suitable dishes for the average consumptive are such as are indigestible if badly cooked, but perfectly harmless if properly prepared. There is no reason for excluding pork, veal, Irish stew, and the like, from the menu, unless there are special digestive difficulties, and these are more often believed to be present than proves to be the case on trial ; for many a dish which could not be properly digested during the stress of city life causes no inconvenience when people live out of doors. Twice-cooked meat is to be regarded with suspicion, but even this will be quite harmless to most if only it is prepared by a competent cook. There should, however, always be an alternative in the shape of fresh meat when ' made dishes ' are provided. Even some comparatively indigestible articles are good for those who can tolerate them—for instance, most vegetable foods contain some indigestible material, which is useful in separating the more digestible particles, and so favouring their digestion. For the same reason concentrated proprietary foods should never form the chief part of a patient's diet, but should be reserved for occasions when the ordinary menu has to be supplemented owing to weak digestion.

The different meals may with advantage be arranged as follows: *Breakfast* should consist of oatmeal porridge or bread and milk, followed by a meat dish of some kind, such as bacon, cold pork, sausages, or fish. A reasonable quantity of bread or toast and butter should also be taken, with jam or marmalade in addition if desired, and with these tea or coffee with ½ pint of milk. If tea and coffee disagree, cocoa may be substituted. *Lunch* should consist of not less than three courses—a meat course and a pudding course, followed by biscuit and butter, with cheese if desired. Half a pint of milk should be taken with the meal. The exceptions to this rule are mentioned later on, as also the part played by vegetables and fruit. The meat should be something substantial, of which the patient can eat heartily, and should be taken with a reasonable quantity of bread or toast and with the usual vegetables. This should be regarded as the chief meal of the day. The pudding course should also consist of the more substantial kinds—milk puddings or suet puddings—fancy dishes being reserved for second helps or else omitted. The object of a third course is to enable more butter to be eaten. A savoury may sometimes be substituted. *Dinner* should be much the same as lunch, but there should be a preliminary course of soup or fish. The less digestible meat dishes should be avoided, and smaller helpings of the meat provided may be given.

Every course in each meal should be taken by the patient, for each plays its own part, and cannot be usefully replaced by another. Where it is customary to supply sauces containing butter or bread sauce, these should be regarded as a necessary part of the meal. With poultry it is usual to take some bacon, because poultry is deficient in fat. Here also the addition should be scrupulously taken.

Soup, however, is not usually of much importance, although much depends on the way it is made. The chief object of soup is to help the digestion of the food which is next taken, so that a small helping of soup is enough.

In feeding the consumptive we must pay some attention to personal peculiarities. Cases are on record where the most harmless things, such as mutton, could not be digested, while there was no difficulty with beef, pork, etc. I have known cases in which pork fat was perfectly digested, whereas mutton fat disagreed, or where poultry was less easily digested than beef. If, however, any article has to be omitted, something else should be substituted which is dietetically similar—proteid for proteid, fat for fat, carbohydrate for carbohydrate.

Some people have a prejudice against animal food. It has been shown* that consumptives may be fed exclusively on vegetable food with successful results. Still, it is not usually good policy to attempt to do so.

Most of the more nourishing vegetable foods become more bulky when cooked, so that a vegetarian diet has to be more bulky in order to be as nourishing as a mixed diet containing a reasonable proportion of meat. Moreover, the chief sources of proteids in the vegetable kingdom are the leguminous foods (peas, beans, lentils, etc.), which many people find a difficulty in digesting in sufficient quantities.

Fruit and vegetables form a necessary part of every satisfactory dietary, but more for their contained salts than for the solid food-stuffs which they contain ; for these are only present in small amounts, if we except the dried fruits and some kinds of nuts. Fresh fruit and green vegetables are valuable in helping to prevent constipation, and in supplying some of the salts which are less abundant in meat. They are, however, watery foods, and in no way a substitute for meat or farinaceous foods. The potato occupies an intermediate position, as it contains about one-seventh part of starch ; but its place can be quite well taken by a smaller amount of bread, provided that fresh fruit or vegetables or raw meat juice is also taken. Green vegetables are usually provided at both of the chief meals at the Crooksbury Sanatorium.

Fruits act in the same way as green vegetables. The tuberculous patient should be encouraged to eat a reasonable

* Bardswell and Chapman, 'Diets in Tuberculosis.' 1908.

amount of fruit, but this should be taken as dessert, after a meal, rather than before the meal, when it may take away the appetite for the more essential food.

At the Crooksbury Sanatorium dessert is provided twice a week. Fresh-air patients who are taking a full allowance of solid food do not crave for more than this, and often wish to dispense with fruit when it is provided.

Dried fruits hold rather a different position from fresh ones, as they contain a large amount of sugar and starch (from 65 to 75 per cent.), so that they are valuable in supplementing the other carbohydrates in our food. Their chief drawback, if they are preserved with cane-sugar, consists in the fact that this kind of sugar taken in quantity is more liable to cause fermentation and dyspepsia than those contained in ripe fruit.

Water in some form is an essential in every dietary. We usually require not less than 50 ounces per diem, about half of which is present in the so-called solid food we eat. The remainder is taken in the form of beverages. Of these, plain water is the most universally useful, but in sanatorium treatment milk is usually given to the extent of 1½ to 3 pints a day at first, reducing this quantity to half the amount when some progress has been made, and enough solid food can be regularly taken. Milk is in a very real sense both food and drink, as it contains representatives of all three classes of food-stuffs —proteids, fats, and carbohydrates. Its chief drawback as the only food is its bulk, since each pint only contains about an ounce of each of these constituents, and over 8 pints a day would be needed on an average to keep up the body-weight.

Stimulants are not usually required during an out-of-door life. There are, however, cases where a well-chosen alcoholic stimulant greatly helps the digestion of food, and the patient's recovery can be hastened thereby. Excepting for emergencies, and for quite short periods of fever and weakness, not more than 1½ ounces of pure spirit should be taken per diem.*

* Spirits ordinarily contain 50 to 60 per cent. pure alcohol; the stronger wines, 15 to 25 per cent.; light wines, 10 to 15 per cent.; malt liquors, 3 to 7 per cent.

As a rule, it should be taken well diluted, with food rather than on an empty stomach. It should not be taken to keep people warm, for in the long-run it increases the loss of heat from the body. Where a stimulant is required to stave off a chill, hot soup or hot milk or cocoa is preferable.

There is good evidence tending to prove that habitual indulgence in alcohol diminishes the resistance of the body against tubercle.

Tea and coffee in moderation are usually unobjectionable. They should be taken with breakfast or in the shape of a very slight afternoon meal, as they distinctly hinder the digestion of most kinds of meat.* This is, indeed, the reason why strong coffee is taken after a dinner of many courses ; but it is a luxury rather than an essential for the tuberculous patient, who is not likely to take a really large meal excepting in one of the institutions where 'forced feeding' is the rule. At Nordrach Colonie, in Germany, tea was absolutely forbidden, as it was considered to be relaxing to the skin. Coffee possesses the great advantage that it can be taken with a large amount of milk. Some invalids can take tea made with hot milk instead of hot water with benefit, whereas the ordinary kind disagrees.

The practice of taking tea three or four times a day is most objectionable, and should be sternly forbidden. Such a habit spells ruin to the nervous and digestive systems. So, also, strong tea, in which the water is allowed to remain long on the leaves, is unwholesome.

Cocoa and chocolate may be taken more freely with meals than tea or coffee, provided that they suit the individual patient. Their chief drawback is the large proportion of contained cane-sugar, which is apt to ferment. Some kinds of cocoa contain a notable amount of fat and starch.

We will now pass in review the chief classes of dietetic articles.

Among nitrogenous foods, yielding proteids in abundance, are various kinds of meat, fish, game, and poultry, milk, cheese,

* The digestion of ham and bacon is least affected by tea and coffee (Sir William Roberts, 'Lectures on Dietetics and Dyspepsia.' London, 1886).

eggs, leguminous foods (peas, beans, lentils), and, to a smaller extent, various cereals (wheat, oats, maize, etc.).

Of the different kinds of meat, the most universally useful for our purpose are beef and mutton, although for the sake of variety it is advisable also to employ poultry, veal, and pork from time to time. Well-cooked pork of good quality is easily digested by most fresh-air patients, and the fat of ham, bacon, and boiled pork is a particularly useful item in their dietary. Poultry is deficient in fat and in red juices, and should not be used more than twice a week. Ducks and geese vary greatly in digestibility, according to breed and manner of feeding. Game, especially if high, is not to be recommended for ordinary use.

Amongst fish, salmon is rich and nourishing, but not always well digested. Herrings and their like are well supplied with fat, and should form a regular part of the sanatorium dietary, unless known to disagree. White fish of all kinds may be regarded as a rather watery meat, deficient in fat. These, as well as poultry and rabbits, should be served with melted butter. Five parts of white fish are about equivalent to four parts of lean meat as regards proteids, but white fish is deficient in fat. It is always good policy to provide a good quality of meat. As a rule, fat meat contains rather less water than lean meat. There is a strong prejudice in this country against the use of tinned meat and chilled meat from the colonies and the United States. This is partly because of the carelessness in preparation which was revealed by recent semi-official inquiries. There is, however, no objection to a good brand of tinned meat, apart from flavour. Bardswell and Chapman recommend the use of it at sanatoria, stating with truth that it has the advantage of being always tender, and therefore easily digested. It was largely used, I am informed, at Nordrach Colonie. Chilled colonial meat also, as they point out, is as good dietetically as the home-grown article, for which it is often substituted without customers' knowledge. At the Crooksbury Sanatorium, however, none but the best home-grown beef and mutton is supplied, and tinned meat (other than tongue) is never given.

Milk is an important item in the fresh-air patient's dietary, but should be used in addition to other more substantial things rather than as the staple food. Ordinary good milk contains 3½ per cent. of proteids, whereas cooked meat contains about 28 per cent., so that eight times as much milk as meat will be required to furnish the same quantity of proteids. It is usual to give the fresh-air patient from 1½ to 3 pints of milk per day at first, reducing this later on to half the quantity when substantial meals can be taken and the patient is steadily gaining weight. By giving the milk as a beverage the total bulk of food and drink may be reduced, which makes it easier for the patient.

There is so much difference in the quality of milk as supplied in this country that it is often worth while to have some of it analyzed. Good milk should contain not less than 12½ per cent. of total solids, of which about 4 per cent. would be fat and 5 per cent. milk-sugar. It is a common but not a commendable practice to add colouring matter to milk to disguise its poor quality. To insure the absence of bovine tubercle bacilli, the milk should be from a tuberculin-tested herd, or, at all events, from one which is under regular veterinary inspection.

Milk is a potent carrier of disease, such as enteric fever or scarlet fever, so that it is a common practice in institutions to subject the whole supply to sterilization by boiling or Pasteurization. Boiling somewhat alters the digestibility and flavour of the milk, so that many people do not care for boiled milk. Less change is made in these respects by Pasteurization. Dr. Newsholme* gives the following directions for domestic use: (1) Use a double milk saucepan. If, however, this cannot be obtained, put the milk into an ordinary covered saucepan, and place it inside a larger vessel containing water. (2) Let the water in the outer pan be cold when placed on the fire. (3) Bring the water up to the boil, and maintain it at this point for four minutes *without removing the lid* of the inner milk saucepan. (4) Cool the milk down quickly by placing the inner pan in one or two changes of cold water

* 'Prevention of Consumption,' p. 410. 1908.

without removing the lid. (5) When cooled down, aerate the milk by stirring well with a spoon. The above is a substitute for Pasteurization, which requires a special apparatus. Since milk is often contaminated with bacteria capable of starting putrefaction or souring, it is good policy to sterilize the milk-supply soon after it is received, and then to keep it covered, so as to prevent dust from falling into it.

Cheese is a most valuable source of proteids, if it can be digested (which is to a great extent a matter of individual experience). Healthy townsmen who cannot digest a bread-and-cheese lunch while on sedentary work often find that it suits them perfectly during a walking-tour ; and in the same way many consumptives can quite well digest cheese when they spend the whole of their time in the fresh air. The most digestible cheeses are cream-cheeses and the like, but these are more useful for the fat they contain than for their proteids. Poor cheeses are the richest in proteids, so that for this purpose Dutch and some American cheeses are preferable. A poor cheese on an average is one-third casein, one-half fat, one-sixteenth sugar ; a rich cheese, one-fourth casein, one-third fat. Grated cheese made of dry pieces is a particularly useful addition to soups, and should be used freely wherever the flavour of it is appropriate. Some of the most useful proprietary foods consist almost entirely of the casein (or chief proteid) of cheese or milk.

Eggs contain about $12\frac{1}{2}$ per cent. of albuminoids and 10 per cent. of fat, the latter being almost entirely in the yolk. There is no starch or sugar in an egg. Roughly speaking, an egg (which weighs on an average $1\frac{3}{4}$ ounces) contains $\frac{2}{9}$ ounce proteids (representing meat), so that to provide a sufficient daily ration of eggs alone about twenty would be needed. To supply a sufficiency of fat, about fifteen would suffice. Now, it is quite certain that anything like this number would speedily make anyone ill. Many people cannot take even two eggs daily without getting 'liverish,' although some can manage this number or a few more with impunity.

It is, in my opinion, a mistake for the consumptive to have one or two eggs daily as a matter of course. If they are supplied for breakfast twice a week, they are more likely to be well digested, and the dietary is less monotonous. An ordinary helping of fish contains more proteid than two small eggs, and is at least as useful. The chief reason why the contrary notion is so common is that more people can cook an egg properly than are able to cook fish properly for breakfast, and the egg, being protected by its shell, is less likely to be spoilt by keeping. It is quite possible to keep eggs for several months in such a way that they are indistinguishable from new-laid eggs. In a well-chosen dietary, then, eggs will take their place in turn with other proteid foods.

Leguminous foods—peas, beans, lentils—are the richest in proteid of all ordinary vegetable foods, and if they were more digestible, would be extremely useful as a staple food. They also have two other practical disadvantages as compared with meat—that in being cooked they absorb a large amount of water, with corresponding increase in bulk,* so that about three and a half times as much is required, and that they need very careful flavouring and cooking to make them palatable.

Cereals (wheat, oats, maize, barley, rice), and the various products prepared from them (bread, biscuits, flour, cornflour, etc.), are chiefly useful as sources of starch ; for their proteids do not amount to more than 8 to 16 per cent. in the uncooked state, and a good deal less when cooked. Bread contains almost half its weight of starch, and an eleventh part (or less) of proteids. It is deficient in fat, which is usually added in the shape of butter. Nearly three-fourths of flour consists of starch, and from one-eighth to one-ninth proteid. Oatmeal is two-thirds starch and nearly one-sixth proteid, and also contains an appreciable amount of fat ; so that it is a more nourishing food weight for weight than flour. Biscuits contain far less water than bread, so that they contain a larger proportion of food-stuffs, while at the same time

* Bardswell and Chapman (*loc. cit.*, p. 142) state that, whereas before being cooked the various leguminous foods contain, on an average, 23 per cent. proteids, afterwards they only contain an average of 8 per cent.

from their porous nature they are more digestible. About three-quarters of an ordinary biscuit consists of starch, and one-tenth proteid.

The chief sources of fat in our dietaries are butter, cream, milk, fat bacon and pork, lard and suet, dripping, and salad oil. There is another vegetable fat sold under the name of 'nuttine.' Butter is, roughly speaking, four-fifths fat; cream is a little less than half fat; milk contains from $3\frac{1}{2}$ to $5\frac{1}{2}$ per cent. of fat. Fat bacon or pork may be from one-fourth to one-half fat. Of the remaining fatty foods, the least digestible is usually suet. It is one of the commonest mistakes in the dietary of the consumptive to take an insufficient proportion of fat, and every opportunity should be taken to increase the allowance in various ways. Thus, bread and butter is a most valuable way of doing this. Cold boiled bacon should be often on the breakfast list. Oatmeal porridge should also be taken regularly, unless it disagrees. Puddings made with suet, lard, or dripping are also most useful; and in summer-time salads taken with an oily dressing should not be forgotten. Sauces containing melted butter should always be served whenever they are customary, and the patient should take pains not to leave these additions untouched, for the cumulative effect of these 'unconsidered trifles' is considerable.

The carbohydrates in our food are chiefly supplied in the shape of bread and flour. Some, however, are taken in oatmeal, sago, tapioca, arrowroot, cornflour, etc. It is too much the custom for people to look upon the pudding course, and sometimes also the bread, as an unessential part of the meal, only intended to remove the taste of the meat. Those who have even an elementary knowledge of dietetics will, however, not make this mistake. The customary piece of bread should always be eaten with the meat, and a small helping of bread and butter or biscuit and butter after the pudding course is also useful. Jellies should not be regarded as of equal value with the more solid puddings. As little as 1 per cent. of gelatine will make a jelly, and a much larger proportion, while it increases the nutritive value, also causes it to be indigestible.

Gelatine occupies an intermediate position between proteids and carbohydrates. Although it contains nitrogen, its chief value is to replace other non-nitrogenous food.

Vegetables, with the exception of potatoes (which contain about one-seventh part of starch), are of small value as foods, but most important for their contained mineral matter, and for their use in preventing constipation.

There are a number of things used in small quantities for flavouring and to increase the digestibility of our food. Under this heading come condiments and the like. As a general rule, the food for the consumptive should not be highly flavoured. Especially is it unwise to add much pepper or mustard if the patient's throat is in the least affected. Still, it is most important to make things palatable and nice, and to have them dished up in an attractive way. This may make all the difference in the quantity eaten, and even in the extent to which the food is digested.

For the composition of a number of dietetic articles in common use, see Part II., Section 50.

CHAPTER XIX

SPECIAL DIETS IN TUBERCULOSIS

In this chapter are given the diets recommended for various complications. The commonest of these is dyspepsia in one of its various forms. In the earlier stages of pulmonary tuberculosis the appetite is usually deficient, and there may be actual nausea at the sight of food. An ordinary full meal may cause decided discomfort, and there may be oppression or palpitation from distension of the stomach. The bowels are usually constipated. These symptoms are due to an ill-nourished condition, resulting in deficient power of movement. The secretions are not usually markedly deficient, and it is therefore advisable to give a fairly abundant diet, containing all the usual courses, excepting only such as are recognized to be difficult of digestion.[54-57] These are cases in which the quantity of food should be decided according to the doctor's judgment and the rules of dietetics rather than by the patient's appetite. Especially is it important to include a reasonable proportion of fats, and if these cannot be taken in the shape of food, such as butter and bacon, it will be necessary to give some form of cod-liver-oil, Virol, or pancreatic emulsion. The chief things which may be omitted in such cases are potatoes (if they disagree), pastry, and very sweet dishes, substituting an extra quantity of bread, toast, or biscuits, malt extract, and milk puddings. Owing to the tendency to constipation, green vegetables and fruit should not be discarded; but the less digestible (such as turnips, cabbage, and stone fruit) need not be insisted upon. In such cases one finds the advantage in getting vegetables fresh from the garden rather than from shops. Better progress is sometimes made when a full allowance of milk and eggs is given instead of the equivalent in other shapes ; but, as a rule, such a bulky diet is best avoided. Sanatogen is an excellent addition to the diet. A life spent out of doors is very useful in curing this form of dyspepsia.[63]

During the course of treatment, if but little exercise can be taken, it is common to get passing attacks of 'biliousness,' which usually disappear on taking a liver pill followed by a saline aperient. In such cases, if the patient has been gaining weight steadily, it is good policy to give light diet for twenty-four or forty-eight hours, toast and tea for breakfast, a little milk pudding at midday, a small helping of white fish in the evening, with just enough milk or bread and milk to prevent a starved feeling.

As a result of injudicious overfeeding for many weeks, we may get dilatation of the stomach, with symptoms of gastric catarrh and fermentation. This is not common if the diet is well chosen. The appropriate treatment is a nourishing diet of small bulk, excluding articles likely to ferment, such as jams, sweet fancy puddings, cake, or potatoes, as well as pastry, duck or goose, pork or veal, Irish stew, or other dishes in which the fat clings to the proteids or carbohydrates.

Well-marked gastric catarrh is not common in early stages of consumption. It may result from injudicious feeding, or from circulatory embarrassment due to the extent of the lung disease or to secondary cardiac disturbance. In the latter case it is often very difficult to treat with success, but remedies directed against the cardiac or pulmonary disorder are usually required. A bulky diet should be avoided when the heart is weak. If there is great difficulty in digesting sufficient quantities of digestible food, it is reasonable to give digestive ferments (pepsin, pancreatic extract, papain, and the like), although my own experience with these has been somewhat disappointing, probably because the constitution is often much damaged by the time that we get such gastric conditions. Wholly or partially predigested foods are also likely to be useful, and I have been in the habit of prescribing them.

In early tuberculous dyspeptic conditions these classes of remedies are very seldom necessary.[62]

Dyspepsia associated with vomiting may depend upon several distinct causes. If it is due to an irritable stomach a bland diet should be given composed chiefly of milk and farinaceous food, with a small allowance of fish or poultry. At other times the vomiting is entirely due to cough, and may be prevented by appropriate remedies without altering the diet. In other cases it may point to gastric catarrh, in which case the treatment should be that appropriate to such a condition. Where vomiting is the result of cough, it is good policy to give food again after a short interval.

Those who are suffering from diarrhœa are the better, as a rule, for a diet of milk and farinaceous food. In such cases meat, and still more meat-extracts and ordinary beef-tea, increase the intestinal disturbance. Cases with well-marked diarrhœa are usually difficult to treat with success.

Consumptives who are feverish should not be kept on a rigidly restricted diet like those who suffer from fevers of short duration. In early stages of tuberculous fever, beef and mutton can quite well be digested, and are far less bulky than the corresponding amount of milk. By pounding underdone meat in a mortar, or passing it several times through a mincing-machine, removing the indigestible fragments, and flavouring with salt and pepper, a soft food can be prepared which can be freely taken when there is a good deal of fever. Nor is it necessary to restrict the quantities of milk-pudding taken below the amounts required in fever-free resting conditions. The more digestible fruits (especially grapes) can also be taken regularly in fever, provided there be no tendency to diarrhœa. The chief difference between the diet of the febrile and that of the fever-free tuberculous patient is that in the former it is usually necessary to give smaller and more frequent meals, because the more liquid diet which is appropriate would be too bulky if only taken at three meals. Such cases require three pints of milk on an average, in addition to some farinaceous food, light jellies, and pounded meat.

After a time, if the fever lasts, the gastric juice usually becomes deficient in quantity or quality, so that adjuvants, such as hydrochloric acid, pepsin, and other ferments, are needed, as well as predigested foods. Among useful articles in such conditions may be mentioned junket and egg-flip. Some of the forms of meat-juice—home-made beef-tea prepared in the cold with a little acid, the expressed juice of beefsteak, Valentine's meat-juice, and similar preparations—may also be given (see next chapter).

Where the kidneys are damaged, it is advisable to reduce the quantity of meat and meat-extracts, and replace it with milk and farinaceous food.

In cases with severe hæmorrhage, if a milk diet, together with the usual medicinal remedies, fail to arrest the tendency to fresh bleeding, a semi-solid diet should be given, and the fluids restricted to 15 ounces per diem. It is believed by some that a raw-meat diet helps to prevent a recurrence of hæmorrhage.[58, 63]

Where there is laryngeal ulceration, a semi-solid diet is usually more easily swallowed than either solids or liquids, and pounded meat made up with white of egg may be given freely. In such cases very little pepper or other flavouring agents should be used. Sometimes food given while the patient is lying down is more easily swallowed than while he is upright.[59]

Whenever tuberculosis is complicated with diabetes, the diet should be that appropriate to the latter disease. These cases are unsatisfactory as a rule, but where there is only slight glycosuria and the patient middle-aged, the prognosis may be better.[60]

CHAPTER XX

SOME USEFUL RECIPES

Raw-Meat Sandwiches.

Take a thin slice of undercut of sirloin, free from fat. Scrape with a blunt knife across the fibres ; collect the scrapings ; flavour with a little Liebig's extract of meat or with warm Bovril or beef-tea, pepper and salt, and spread thickly between thin bread and butter. The meat will be spoilt if mixed with hot liquid. Some people like the addition of a little celery-salt. The meat extract may be replaced by a little well-done roast beef, the scrapings of which should be mixed with the raw meat.

For those who have an ulcerated throat the pepper and salt will have to be omitted.

Raw-Meat Balls.

Prepare 2 ounces scraped raw meat as in the preceding recipe. Mix with a beaten-up egg. This can often be taken by those who have difficulty in swallowing ordinary food owing to ulcerated throat.

Raw-Meat Pills.

Pass a piece of beef free from fat and gristle through the mincing machine. Make up into large pills, dusting with sugar or with cocoa-powder.

Where there is great aversion to food, owing to lack of appetite, a number of these pills can often be swallowed, amounting to as much as ¾ pound of meat per day. The patient should occupy himself in swallowing them singly at intervals of a few minutes.

Beef-Juice.

Mince a piece of rump-steak or of undercut of sirloin in a mincing machine. Cover it with half its weight of water containing 10 drops of hydrochloric acid to every 10 ounces. Allow it to stand for a few hours ; filter through muslin, and subject the solid residue to pressure in a press. The combined fluids will contain about 7 per cent. of meat proteid.

It should be remembered that the hydrochloric acid is corrosive. It may be kept in a stoppered bottle, diluted nine times, in which case 1½ fluid drachms (or small teaspoonfuls) may be added to every 10 ounces.

Scrambled Eggs.

Beat up 4 eggs with pepper and salt and a little milk. Pour this mixture on to ½ ounce of butter melted in a stewpan. Stir until it thickens, and serve on toast.

For those who have ulcerated throat omit the pepper and salt.

Bread and Milk.

One and a quarter ounces of bread broken up into pieces with nearly ½ pint of hot milk poured over it makes a breakfast-cupful of bread and milk. The food-value may be increased by the addition of 2 ounces of cream.

For patients with ulcerated throat the bread may be boiled with the milk for ten minutes and strained through fine muslin.

Oatmeal Porridge.

One breakfast-cupful of coarse Scotch oatmeal, weighing 12 ounces, will make 74½ ounces of porridge, of which 9½ ounces fills an ordinary soup-plate up to the brim. This is a proper helping for a sanatorium patient.

Sprinkle the oatmeal into 2 quarts of boiling water, stirring the while; then cook slowly for several hours in a double saucepan. If rolled oats (Quaker oats) are used, the time necessary is very much shorter; but the preparation has quite a different flavour, which is preferred by some, disliked by others. A large lump of clotted cream is a useful addition to porridge when served.

Rice Pudding.

Sprinkle enough rice (2 tablespoonfuls, or 3 ounces) into a pie-dish to cover the bottom. Wash thoroughly in several waters, pouring away the dirty water. Add 2 pints of cold milk, and sugar to taste. Cook very slowly for three or four hours in a slow oven.

Sago Pudding.

Sprinkle enough sago (2 tablespoonfuls) into a pie-dish to cover the bottom. Wash thoroughly in several waters, stirring well, to allow the dirt to float to the top, and pouring away the dirty water. Fill up again with clean water, and leave it to soak for an hour or more. Pour away the unabsorbed water, add sugar to taste, and pour on 2 pints of cold milk. Cook very slowly for two hours in a slow oven.

Sago soaked in water is lighter and more digestible than if soaked in milk.

Rocklaw Pudding.

Take 2 eggs and the same weight of butter and of flour. Beat the butter to a cream, add a tablespoonful of sugar, 2 tablespoonfuls of preserve of some kind, a small half-teaspoonful of carbonate of soda; mix in the eggs and flour, and boil or steam for an hour.

Eve's Pudding.

Take ¾ pound of finely chopped suet, 1 pound of fine breadcrumbs, 1 pound of sultana raisins, 1 pound of finely chopped apples, ¾ pound of Demerara sugar, the grated rind and juice of 2 lemons, and 4 eggs, well beaten up.

Mix all the dry ingredients ; then add the juice of lemons and the eggs. Grease a basin thoroughly with butter ; pour in the mixture ; coat with sugar ; cover with a greased paper, and steam for four to five hours.

Mixture for Plain Suet Puddings.

Take ½ pound of finely chopped suet, 14 ounces of flour, 2 ounces of bread-crumbs or rice-flour, and 1 teaspoonful of baking-powder. The above mixing will make any kind of suet pudding, with the addition of the special flavouring ingredient. For instance, a marmalade pudding may be made by adding a good tablespoonful of marmalade to the mixture. If prunes or figs are used with it, they must first be stewed.

Norfolk Pudding.

Take ½ pound of flour, ¼ pound of sugar, ¼ pound of dripping or butter, 2 eggs, ¼ pint of milk, 1 teaspoonful of baking-powder, 2 tablespoonfuls of jam, and a little salt.

Mix the sugar and dripping with the flour ; beat up the eggs ; add the milk to the eggs, and mix up all together, excepting the jam. The latter is put into the bottom of a pudding-basin, and the mixture poured on to it. Steam for two and a half hours.

Treacle Sponge.

Take ½ pound of flour, ½ teaspoonful of carbonate of soda, ¾ ounce of ground ginger, ¼ pound of suet, 1 egg, ¼ pint of treacle, and the same quantity of milk. Mix the dry ingredients, then the wet, then both together, and steam for two and a half hours.

Digestible Milk.

There are many ways in which milk can be made more digestible. The reason why some people have a difficulty in digesting milk is that it always clots soon after entering the stomach. If the curd which forms is in one big lump, the digestive juices can only attack it from outside; whereas if divided up into fine particles, there is no difficulty in digestion. Other people get indigestion after drinking milk because of its acidity.

There are four chief ways of making milk more digestible or less repellent for those who dislike it. One way is to add other materials so as to divide up the curd mechanically; another way is to add a peptonizing powder or liquid which will increase the rapidity of digestion or prevent the formation of a curd; or else alkalis may be added; or various flavouring agents.

To break up the Curd in Milk.

Add 2 tablespoonfuls of barley-water to each glass of milk, or dilute with an equal quantity of soda-water. The same result is obtained when farinaceous food of any kind is cooked with milk, as in making bread and milk, arrowroot, Benger's food, etc. Beaten-up eggs do not make a digestible mixture with milk, although a nourishing one for those who can digest it.

Peptonized Milk.

Peptonizing powders are sold which are convenient for digesting the curd of milk. They are usually added to warm milk, in order to partially digest it before it is taken. To prevent a bitter taste, the milk should be briskly boiled as soon as it is sufficiently predigested. This stops the action of the peptonizing powder. The same method may be adopted for arrowroot and the like.

Citrated Milk.

The addition of citrate of sodium (1 grain for each ounce) prevents the formation of curd. The citrate should be dissolved in a little water before being added to the milk.

Lime-Salts with Milk.

It is a common practice to add 2 teaspoonfuls of good lime-water to each glass of milk to correct the acidity. The lime-water will not keep well unless it is kept in a well corked or stoppered bottle.

The addition of a little solution of calcium chloride to milk is said to prevent its causing colic in fever. A tablespoonful of a 1 per cent. solution may be added to each quart of milk. The calcium chloride tends to thicken the blood, which is sometimes useful. Lime salts are usually a little binding to the bowels. Should there be constipation, soda-water would be a better material to add to the milk.

Flavouring Agents.

In cases where the flavour of milk is strongly objected to this can be altered by the addition of Bovril, meat extract, strong tea or coffee, orange-flower water, brandy, whisky, or rum. Spirits are, of course, not merely flavouring agents, but possess active medicinal properties, which may be useful or the reverse, according to circumstances. Excepting for definite reasons, it is a mistake to give spirits to a consumptive, as they help to prevent free oxidation of food. This does not apply to strictly limited quantities given under medical direction after due inquiry into all the circumstances.

Soured Milk.

In some forms of dyspepsia it has been found useful to give soured fermented milk. The chief ways of doing so are by using koumiss or kephir. Lactobacillin tablets have recently been introduced by Metchnikoff, with a view to hindering the growth of other kinds of bacteria in the digestive organs.

Home-made Casein.

Get some 'separated milk,' add pure dilute hydrochloric acid to it drop by drop, stirring with a glass rod, until the curd is thrown down as a sediment. Strain through fine muslin, and wash in several waters.

The curd may be redissolved in warm milk with the help of a pinch of bicarbonate of soda.

CHAPTER XXI

COUGH AND EXPECTORATION—BLOOD-SPITTING

It is commonly supposed that the progress made by the consumptive may be measured by the amount of cough and expectoration, but this is only true to a limited extent. If healing is to take place in the lungs, the antidotes manufactured by the body must be continuously passed through the affected parts, and the only way in which this can be done is by flushing out the breathing-tubes with mucus. If this is not brought up and expectorated, it stagnates and loses its curative properties, when it becomes an actual danger to the patient. Therefore, an improvement in the patient's condition may often correspond with an increase in the amount of expectoration, and *vice versa.* The first effect of the open-air treatment is often to increase the amount of sputum, a later effect to diminish it. Where the secretion is difficult to expel, relaxing expectorants will often be of great value. Where the difficulty consists mainly in retention because of the force of gravity, postural treatment is most useful. It will be found in such cases that in certain positions much more phlegm is coughed up than in others. These positions should be systematically assumed a few times every day, and maintained for half an hour at a time, unless they cause great discomfort. Dr. William Ewart* and Dr. Tucker Wise† have freely adopted this treatment, with the help of a special form of couch or support. Very often, when expectoration is insufficient, the

* 'The Treatment of Bronchiectasis by Posture and Respiratory Exercises,' *Lancet,* 1901, vol. ii., p. 70; 1908, vol. i., p. 1654.

† *British Journal of Tuberculosis,* October, 1908, vol. ii., No. 4, p. 268; *Lancet,* 1908, vol. i., p. 1546. See also Quincke, 'Zur Behandlung der Bronchitis,' *Berl. Klin. Woch.,* 1898, xxxv., 525.

patient becomes more feverish, and when he brings up more phlegm the fever goes down. The examination of the chest is often a guide in such circumstances. If the air-entry is deficient, and the lung choked with secretion, medicinal remedies, with or without postural treatment, by increasing the quantity expectorated, may give much relief to the patient. There is, however, another side to the question.

Cough may be quite out of proportion to the work done in bringing up phlegm, in which case it merely exhausts the patient. It is quite common to find such harassing cough ending in vomiting, in which case, unless the patient promptly has another meal (as with children suffering from whooping-cough), he loses his food as well as his strength. So, too, cough which disturbs the night's rest should be medicinally controlled. It is in such cases that the various sedative medicines are of value.[64] But it is bad policy to fly to paregoric lozenges and the like without sufficient reason. Cough is to a great extent subject to the will of the patient. Especially should cough be suppressed at meal-times. The entry of food into the stomach by stimulating the nerve which serves both lungs and stomach may excite useless cough ; but a sip of water and a determined effort will often stop the cough. A visitor to the late Dr. Dettweiler's sanatorium at Falkenstein remarked that, although there were 150 or more consumptives present at dinner, it was remarkable that there was no coughing. Dr. Dettweiler replied : 'They would not think of coughing. It is not the right time to cough.'

For obvious reasons, it is not advisable for a patient to indulge in a coughing-fit at table. If he is subject to such attacks at meal-times, he should have his meals alone, and for occasional fits of coughing it is usual for the patient to leave the table. Care should be taken not to swallow the expectoration. Such a practice may lead to infection of the bowel with tubercle.

Coughing should be done in such a way as not to infect surrounding objects. An explosive cough may scatter bacilli to a distance of several feet, unless a rag or handkerchief is held before the mouth. The sputum should, however, not be deposited in the handkerchief, but into a spit-cup or portable spit-flask, according to the place where the patient happens to be. A handkerchief may be used to wipe the lips, taking care to fold the soiled surface inwards, and to put the handkerchief in a washable linen or indiarubber bag rather than into the unprotected pocket. Such handkerchiefs should be burnt before the phlegm has had time to dry up. In a sanatorium it is usual to collect them daily and burn them. The same handkerchief should not be used to wipe the face and the lips.

To prevent the phlegm from clinging to the beard, a male consumptive should be clean-shaven. Even if no barber is available and the patient weak, a safety-razor is easily used. Ladies who are consumptive should not wear veils.

It is a great mistake to permit the use of spittoons on the floor, although this is done in some foreign sanatoria. The receptacles for the expectoration should be light and portable, easy to bring up to the mouth.

The patient who is kept in bed should not put his handkerchief under the pillow. A far better plan is to put it in a little waterproof bag (such as a sponge-bag) hanging from the bed or a chair near by. All his expectoration should be received into a spit-cup.

There are several kinds of spit-cup in common use. A perfectly satisfactory one consists of an ordinary china mug. To protect against flies (which are capable of carrying about infection), there should be a cover heavy enough not to be lifted by a puff of wind, and with a smooth, washable surface. A piece of plate-glass or of smooth metal forms a good cover. The funnel-shaped covers with a hole at the centre are not to be recommended. If the patient expectorates on to such a cover, the upper surface is soiled, and the sputum is no longer protected from flies. It is far better to have a cover which must be lifted before the cup is used. Paper linings are sold which fit into such a cup, and hold water. A little water (say, 1 ounce) should be poured into the bottom of the lining before use. A little disinfectant may be added to the water, either an equal bulk of 1 in 20 carbolic acid, or a drop of Zotal or

Cyllin, or a saltspoonful of lysol. The addition of a little soft-soap to the lysol dissolves the lumps of phlegm, and makes it less repulsive to took at. Corrosive sublimate (1 in 1,000) is also a satisfactory disinfectant for such purposes, but is very poisonous. Compressed discs (soloids) of corrosive sublimate are sold, which contain a little colouring matter as well, and which may be dissolved in water to make a stock solution.

Whatever disinfectant is used, it is advisable to destroy the sputum by heat, as explained in the next chapter. When the sputum is wanted for examination, a pellet should be received into a clean dry paper cup-lining, and at once put into a wide-mouthed bottle and securely corked and labelled. The bottle and cork should be boiled in water for ten minutes before it is used, and corked and turned upside down until it is used.

In order to measure the quantity of expectoration, marks may be made up the inside of a paper lining, showing how high measured quantities of water would rise.

Other forms of spit-cup are made of papier-mâché or of metal lined with paper. The former are often made too light, and are liable to be upset by a gust of wind.

There are many forms of spit-flask for use when walking about. The most used is probably Dettweiler's (sold in two sizes) and its modifications. A cheaper form is Liebe's modification. A still cheaper is the Ventnor Hospital form, or the Crossley Sanatorium form. A kind which is preferred by many is the 'Diskret,' a metal one, in which the opening is at the side.

Care should be taken never to soil the fingers with expectoration without at once thoroughly washing them; also, to prevent accidental soiling of the bedding, a piece of linen or waterproof should be placed over it near the patient in every case where there is any likelihood of such accidents. If any article is soiled with expectoration, it should at once be wiped up with a Japanese handkerchief or piece of rag (which can then be burnt) and the spot disinfected. In reading or writing, the pen or pencil should not be put into the mouth, nor should the pages be turned over with a moistened finger.

Blood-Spitting.

People are usually much alarmed if they cough up a streak of blood. There is, however, no need for such alarm, as really dangerous blood-spitting is quite exceptional. Even repeated hæmoptysis may happen in cases which eventually do very well. Many physicians hold that when blood-spitting is an early symptom, the outlook is especially favourable, probably because it leads to early discovery of the chest disease ; also, other things equal, there is a better chance of recovery if the blood gets freely to the affected parts. Still, it is wise to take reasonable precautions if more than a little blood is coughed up. The first is to lie down with the head and shoulders gently raised, and to remain quite quiet until the doctor arrives, without speaking or moving beyond what is absolutely necessary. Cough should be controlled at such a time as much as possible, and if the patient is taking any cough medicine to quiet the cough, it will be wise to take some of it.[64] If the bowels have not been freely open, an aperient pill should be taken at once, or some other kind of opening medicine.[67] The room and the patient should be kept as cool as possible, compatible with comfort. A single layer of bandage may be wound round the chest, or if the side is known from which the blood is coming, and there is strapping in the house (sheets of sticking-plaster), strips may be put on from the sound side behind to the sound side in front, each strip being about 2½ inches wide and overlapping the last by ½ inch. This, however, interferes with the doctor's examination, and should only be done in case he is unable to come for many hours. Where bleeding persists, a dry diet is advisable.[58] The most active remedies (amyl nitrite, nitroglycerine, morphine, calcium chloride, ergot) require watching, as they may do harm if injudiciously pushed.[65] After a severe attack of blood-spitting it is quite common to get an attack of fever ; but this need not cause alarm, provided that it be moderate, and the blood-spitting does not return.

CHAPTER XXII

DISINFECTION

Disinfection of the sputa and of any objects soiled by the sputa is of the first importance, both to the consumptive and to those around him. By disinfection of this kind the disease can, with few exceptions, be prevented from spreading, and by the same means the likelihood of repeated infection in the same individual, and therefore the risk of getting an overwhelming dose of tubercle bacilli, is greatly diminished.

The most efficient disinfectant, where it is applicable, is heat. If soiled articles can be burnt or boiled, there is no further need of disinfectants. Soiled handkerchiefs and rags can be quite easily treated in this way; so can sheets which have been soiled. Spoons and forks which have been used by a consumptive can be disinfected by dipping them into boiling water. Knives, after use, should be carefully wiped with paper (which can be burnt), and then dipped into boiling water up to their handles. If they are dipped in including their handles, the latter are loosened, unless they are of the kind which is made of metal, all in one piece. Woollen articles (such as blankets) which cannot be boiled without spoiling must be disinfected in a properly constructed steam disinfector, or by steeping for several hours in a disinfecting solution, such as 1 in 40 carbolic solution. It is, however, advisable to avoid the necessity of disinfecting such articles, as they are always more or less damaged thereby.

For soiled carpets and furniture 1 in 20 carbolic solution answers well. The room occupied by a consumptive should be disinfected from time to time, although it will not often be necessary if the precautions as to daily cleaning are thoroughly attended to. The most convenient way in a private house is, after moving the patient to another room, to carefully close all doors and windows, shut the register of the stove, open out all bedding and the like which is to be disinfected, hanging sheets, blankets, and garments from the backs of chairs, and opening cupboard doors ; then smear all metal-work with vaseline, and set light to a sulphur disinfecting candle or an Alformant lamp with formalin tablets on an old tray placed in the centre of the room. One of Kingzett's sulphur candles is sufficient to disinfect 1,000 cubic feet of room-space. Of the formalin tablets, ten suffice to disinfect a space of 1,000 cubic feet. They are more active in the presence of moisture, so that it is useful to vaporize a little water over a spirit-lamp before using the formalin. The latter rusts iron or steel, so that articles made of these materials should be greased or covered with vaseline.

One of the most efficient disinfectants for the walls of a room is solution of chloride of lime. It should, however, be remembered that the solution is likely to bleach coloured things.

For small articles which do not stand moist heat, a dry disinfector may be used, consisting of a square full-sized biscuit-tin, placed on its side over a lighted spirit-lamp. Inside can be put a wooden support to hold the articles, and a few bits of white paper. When the white paper begins to brown, the articles are probably disinfected.

Tubercle bacilli may be present in the urine and evacuations from the bowels. It is, however, doubtful whether any disinfectant need be added. In water-carried sewage the putrefactive bacteria are likely to kill the tubercle bacilli long before they can do any harm. Where the dry-earth system is used, sun and wind rapidly kill the tubercle bacilli, which are prevented from flying about by the growth of moulds and other fungi. If any disinfectant be added, it should be one like chloride of lime, which does not kill the nitrifying bacteria or prevent the transformation of the organic matter.

The disinfection of sputum-cups and flasks has been left to the end of this chapter, because more detailed directions are necessary. It is by far the most important of such duties. If sputum-cups are lined with linings or paper, some sawdust or balls of tissue paper may be thrown in, so as to soak up the liquid. The whole should then be lifted out with a pair of forceps or tongs, or with the fingers by a clean corner, and placed in the centre of a hot fire. Where this cannot be done, a special saucepan may be kept for such purposes over a spirit-lamp, and the cup-lining boiled for ten minutes briskly with a little water, and thrown down the closet with its contents. Another method consists in putting some strong lysol with soft-soap (1 fluid ounce of lysol to half a teaspoonful of soft-soap) into the cup-lining, just enough to cover the contents, shaking, and leaving to soak all night. When travelling, a more convenient method is to procure some corrosive sublimate soloids, dissolve one in a quart of water, and use enough of this solution to cover the contents of the spit-cup, mixing, and leaving all night as before, and then pouring down the closet.

Zotal and Cyllin are also efficient disinfectants if used in this way; but whenever a disinfectant solution is used, time must be allowed for it to soak into the sputum. The effect of soft-soap is to liquefy the sputum, and not only to diminish its unsightly appearance, but also to allow of its being more thoroughly mixed up with the disinfectant. It is therefore a very useful addition to most of these disinfectants.

Spit-flasks should be filled up with lysol and soft-soap, or some similar disinfectant, and after standing for several hours emptied into the closet. Once a week or more they should be taken to pieces and boiled briskly with water for ten minutes. If metal fittings are left surrounding glass flasks, the latter are very apt to be cracked by the unequal expansion; also, if hard tap-water is used, the flask will be dimmed by a deposit of lime-salts, so that for such purposes rain-water is best.

Each patient requires two spit-flasks for use when walking about, or two spit-cups if confined to couch or bed, so that one may be disinfected while the other is in use.

CHAPTER XXIII

RECREATION

So long as there is marked fever, the quieter the patient is kept the better. In such a condition not even reading should be allowed; at most a little quiet chatting with the nurse from time to time. When the fever is no longer marked, an occasional game of patience, draughts, or dominoes is permissible, and may prevent the patient from dwelling too much on his own condition and ailments.

For non-febrile patients who are obliged to rest there is a wide range of choice. In addition to reading, various card-games may be allowed, provided that no playing for money or other exciting feature is permitted, and no rise of temperature occurs after the game. In some foreign sanatoria card-games of every kind are forbidden, but I see no need for this, provided that the above-named conditions are loyally observed. No noisy or exciting games should be permitted, but quiet card-games played out of doors are an excellent way of passing the evening after dinner.

It is seldom advisable for the patient to play games during the hours preceding the chief meals. These should be made a complete rest, without even active conversation. For those with artistic tastes, the time may be pleasantly passed in sketching, or in modelling in clay or plasticine, or in the construction of models of chalets and the like out of cardboard. Many familiar objects in the country lend themselves to the decoration of Christmas and birthday cards, designs for pocket-books, calendars, blotters, etc.

For those confined to bed, it is convenient to have a sheet of millboard with elastic or other contrivances to hold paper, pencils, pen and ink. It is one of the minor troubles of an out-of-door sedentary life that papers are apt to blow away when a puff of wind arises, and any contrivance to prevent this will save loss of temper and mental irritation.

Good music is a great solace to the average mortal, and may help to prevent too much brooding over symptoms. In a sanatorium it is usually interesting to the patients still confined to their beds to watch the others at play on the lawns close by.

Ladies are forbidden to use their needle at some of the German sanatoria, but I see no objection to their doing a moderate amount of such work, provided that they are not very feverish or rendered feverish by the work. For men, netting is not to be despised as a means of passing the time. In a few sanatoria basket-making and the manufacture of fancy articles out of strips of cardboard are encouraged.

The time of enforced rest may also be made use of in learning languages or in mastering the details of various handicrafts. The time devoted to such work, so far as it involves close study, should be strictly limited, but to a reasonable extent it is to be encouraged. So, also, games requiring prolonged attention and thought—chess, halma, salta, etc.—should not be indulged in for many hours at a time.

When the patient begins to walk about, there are a number of other ways of passing the time, both in the way of games and in light occupations. Photography, for instance, is a delightful pursuit for those with any taste for it. With a daylight developing apparatus there is no need for a dark-room, but even with the ordinary apparatus a harmless dark-room may be made by hanging a thick rug over the open window towards evening. Those with scientific tastes will find much to occupy them in the shape of botany, entomology, geology, and when nearly well, branches of zoology which call for the use of a gun or the taxidermist's tools. Shooting is suitable for those who have not had extensive lung disease, and in whom the mischief has been quiescent for many months. It is not advisable when there has been recent pleurisy or softening of a patch of lung.

Among games may be mentioned those with a captive ball, deck-quoits, bull-board, shovel-board, putting, croquet, and later on bowls, golf, and lawn-tennis. The last three or four of these, since they involve active exertion of the arms, are only fit for such patients as have been convalescent for some time. Dr. Walther used to lay down the rule that for two years after leaving his sanatorium no active arm exercise should be indulged in. This is, perhaps, unnecessarily strict, as some patients with limited lesions which have apparently healed can undoubtedly indulge in such games with safety; but in case of doubt it is wise to err on the side of caution. I have satisfied myself that in carefully selected cases not only lawn-tennis, but even running and gymnastics, are free from danger.

In the Alpine health-resorts skating is one of the recognized amusements, and permitted to all who are able to walk about freely. The exertion involved in this and other sports depends greatly upon whether the patient is already expert in them. A beginner wastes a vast amount of misdirected energy in such matters until he has learnt the best way. Sleighing and tobogganing involve more sudden and violent exertion, and should be avoided until convalescence is far advanced. Where there is no ice available, horse exercise on a quiet horse is permissible and useful to the convalescent who is accustomed to it; also driving, if the horse is quiet and the lung trouble soundly healed.

A course of open-air treatment necessarily occupies many weeks or months, during which it is easy for the patient to fall into bad habits of idleness. It is, therefore, advisable for him to guard against this by spending a little time daily on some definite task as soon as he has got over the feverish stage.

Forms of recreation involving exposure to foul air or dust are not at all suitable for the consumptive or the convalescent from tubercle of the lungs. For this reason it is not wise for the convalescent to go to theatre, concert-room, or ball-room within two years of his illness. Of course, this restriction would not apply to an open-air concert or dramatic entertainment; but so long as our churches are so badly ventilated, it is to be feared that attendance at church service must be avoided, excepting where special arrangements are made for it in an airy place. At the King's Sanatorium a 'fresh-air' chapel has been erected.

CHAPTER XXIV

QUARTERS FOR THE CONVALESCENT

The convalescent consumptive who has recovered his health and strength need not be so rigidly bound down in his choice of a residence.

If unable to live in the country (which is best), he should choose the least populous suburb of a town with the most gardens and open spaces. If it be impossible for him to avoid work in a town, it will be worth his while to get out for at least part of the twenty-four hours, even at the risk of a daily tram or train journey. If he wishes to preserve his health, he must have a garden attached to his house where he may rest or exercise his muscles in the open air after business is over. A roof-garden is better than nothing for this purpose, although the neighbouring chimneys are a decided disadvantage.

Soil is a matter of less importance to the townsman than to the dweller in the country. Pavements dry the surface, so that they are convenient for walking, no matter what the soil or the weather. Although a dry soil is still preferable, a clay soil is permissible, provided there be a rapid slope where the house is situated. There is no difficulty in keeping a house dry on a damp soil if the foundations are satisfactory. There is a great difference between stagnant moisture and that which is freely flowing away. The former is much more unhealthy than the latter. In a badly built house on a damp site the moisture stagnates under the building, but this need not happen if the house is properly built (see p. 38).

Very bleak, exposed places are best avoided. When a windy day comes in such a situation, it will be difficult to rest out of doors.

Places in which the convalescent loses his appetite must be shunned. It is essential that he should continue to be well fed if he is to avoid further breakdowns.

Excepting for those who have been badly damaged by the disease, the elevation is a matter of comparative indifference. As a rule, a moderately elevated spot is better than a low-lying one, but any place which is not low enough to be water-logged will answer for the average cured consumptive.

Where the recovery has been incomplete, and the circulation is feeble, so that the cold of winter and spring in this country is keenly felt, it may be advisable for the convalescent to live in a drier climate. The choice will usually rest between the dry elevated regions of South Africa, Australia, or America (Colorado, California, New Mexico), and the lower-lying warm countries, such as the Riviera, some of the Pacific islands, Tasmania, or the warmer parts of New Zealand. It is in such cases as these that wintering abroad is often tried, since in summer-time this country is usually quite suitable.

Whenever change of climate is thought of, it is also important to pass in review the food and quarters available, and the chances of earning a living if the patient has not an independent income.

As regards the room, a top-floor will do just as well as a lower one for the bedroom, unless the convalescent has badly damaged lungs or heart, and is still short of breath. The air at the top of the house is often purer than that on the street-level. A quiet room should be chosen, on the side away from the road, if this is near, preferably overlooking the garden. There is no need for a southerly aspect, as this has no special advantage at night, excepting that it is sometimes warmer. As regards ventilation and in other respects, the room should be arranged as for the feverish patient (see Chapters VII.-XIV.). Although hyperventilation is no longer as important as during the illness, it is well not to relax the usual precautions more than can be helped. For a sitting-room, the ground-floor opening on to the garden is best. The sitting-room should be sunny and airy, as described on p. 41. The furniture should be as simple as convenient, the dead space over book-cases being filled in as described on p. 77 for wardrobes. The best book-cases are those with glass fronts. No accumulations of papers or loose books should be tolerated. All such things should be kept in boxes or covered shelves, where the dust will not accumulate on them. Ornaments should be reduced to a minimum, and pictures provided with plain washable frames. It is as well to have the walls colour-washed with washable enamel, or covered with washable paper. Any skirting or dado should be of washable material, such as lincrusta ; this should not have an intricate raised pattern. The daily cleaning should be done in the same way as for a patient's bedroom. There is far less likelihood of colds and relapses where these precautions are observed.

The convalescent should, however, spend very little time in any sitting-room, as a shelter in the garden is far better for him.

Quarters in a farm are often recommended. They have the advantage of being always in the country, and usually inexpensive. The drawbacks are likely to be the primitive sanitary arrangements, the accumulations in the farmyard, and the difficulties in the way of keeping the bedroom clean. Farms are seldom provided with ideal rooms. Very often they are full of ancient dirt of many kinds, and have irregular floors, and corners that cannot be kept free from dust (see Chapter XII.). If there is any doubt about farmhouse quarters, the proper thing to do will be to use a sleeping chalet, merely coming into the house for meals (Chapter VIII.). It will also be well to make sure that the water-supply is good and abundant.

CHAPTER XXV

OCCUPATIONS FOR THE CONVALESCENT

JUST as there are many degrees of strength and capacity for work in convalescents from lung disease, so there are many degrees of suitability in the work which is open to them; and although it is not always possible for such a convalescent to adopt the most healthy occupation, it is well for him to know what makes one kind more suitable than another, so that he can choose the best which is open to him, and diminish the evils associated with it, or counteract their effects on health by a wise use of his spare time.

Some occupations are bad for every weak-chested individual alike, whether he be muscularly strong or not; others are healthy enough for the strong, but would overtax the strength of the feeble. Among the former are those which involve exposure to a close, dusty, or overheated atmosphere. Occupations in which these evils are marked should be shunned by the convalescent, for only those with very good constitutions who have made a complete recovery from a slight attack are likely to stand them without a breakdown. Work inside a mill or factory is unsuitable for the convalescent from lung disease. Few such places are free from irritating dust, and many have to be overheated. A steamy atmosphere is debilitating, even though there be less dust.

Most places open to the public, such as warehouses, shops, courts of law, newspaper offices, railway-stations, theatres, are very dusty, and, owing to the use of broom and duster, this dust is stirred up and inhaled by the people frequenting such places. If wet cloths or abundance of water were used for the daily cleaning instead of dry brooms and dusters, there would be far less risk in this respect.

It is extremely difficult to insure proper ventilation in banks and other business offices where a number of people work together in the same room, because of the prejudices of the average man and the smuttiness of town air. Moreover, a sedentary occupation makes people sensitive to cold, so that they will prefer impure air with warmth to pure air in a chilly room. By using extraction-shafts or fans, together with large filtering-screens over the ventilating-inlets, much might be done to insure a sufficient air-supply without draughts or smuts. Another remedy would be the adoption of such a system as Glover-Lyon's, but this is more expensive.

The head of a business or of a department will find little difficulty, as a rule, in satisfactorily arranging such matters as cleaning and ventilation. To the professional man there will also usually be a way open, excepting, perhaps, for the barrister or solicitor, who must attend the courts of law.

The work of the clergyman is, on the whole, a healthy one. He spends a good deal of time out of doors, the hours of service are usually fairly short, and although churches are nearly always ill-ventilated, and there is some risk in visiting the sick, these drawbacks might be altered by attention to ventilation and other precautions.

For the doctor, the risks are somewhat similar, added to which are the disadvantages of irregular meals and often of disturbed nights. The consulting-room in a town might, however, be made healthy, and the hygienic conditions in patient's homes are very largely under the doctor's control. For those who are physically fit for the extra exertion, a country practice is preferable to one in a town.

The chemist, the architect, the surveyor and estate agent, the consulting engineer or electrician, can often choose a branch of work which may be made free from objection. The accountant and the auctioneer are more at the mercy of their surroundings, and, excepting in country places and in model premises, such occupations would not be suitable for the consumptive. Nor is the actor's life a suitable one for the convalescent consumptive.

For the employé who works with a number of others in the same room it is almost an impossibility to get satisfactory conditions while at work, so that, if his health suffer, he will have to take to a more suitable occupation. And here comes in the value of physical training, whereby the convalescent who is free from fever, but weak in muscle, may be gradually fitted to undertake heavy outdoor work. Dr. Paterson, at Frimley, has shown that it is possible to gradually train the artisan convalescent from lung disease until he is fit for such severe work as trenching, the use of the wheelbarrow, pick-axe, and shovel. Moreover, I have myself seen that in selected cases pretty severe physical exertion—*e.g.*, felling trees or trotting intermittently for as much as five miles a day—may be attempted without harm, provided the necessary training has been previously gone through.

Colonial life, which in some respects would be very good for the convalescent from lung disease, is almost impossible without some such graduated training under medical supervision, and the same is true of some ranks and branches in the army. On the other hand, the less trying kinds of outdoor work usually require special technical knowledge, so that both physical and technical training should be provided at every sanatorium not intended for the leisured classes.

Apart from dust and foul air, all sedentary occupations cramp the chest and soften the muscles. These tendencies will have to be counteracted by the convalescent spending some time after business hours in exercise, sport, or gymnastics in the open air.

It must, however, be remembered that 'the strength of a chain is that of its weakest link.' A man may be in fairly good muscular condition, and yet have an unprotected bloodvessel in his damaged lung, or his heart may have been greatly weakened by the disease. This is why the convalescent from consumption should never attempt any kind of severe exertion without a previous course of training and without medical sanction. Where unusual exertion cannot be avoided, the risk may be diminished by taking care not to fix the chest or hold the breath. This can be prevented by slowly counting or speaking during the time the effort is being made. But it should be distinctly understood that the wisest plan is to avoid all doubtful and unusual efforts.

It is unfortunate that farming, in many respects an ideal occupation for the middle-class consumptive, should be so unremunerative in this country. Probably, however, the introduction of better methods of culture—*e.g.*, the intensive system of market-gardening (which is taught at the Crooksbury Sanatorium and the East Anglian Sanatorium amongst other places)—will give a new opening to the man who wishes to take up outdoor work without losing money over it.

In some of the colonies transport riding appears to be a remunerative occupation open to the man who is not too much damaged by disease, and who can ride and shoot. The landscape artist also lives a very healthy life; but other branches of art (designing, portrait-painting, photography, enamelling, and metal-work), although they might be made healthy, are usually quite the reverse, owing to neglect of precautions already referred to.

CHAPTER XXVI

TRAVELLING

ALTHOUGH thousands of consumptives have been sent on a journey in search of health, it is becoming more and more recognized that (excepting for the fairly fit and the wealthy) such a proceeding has more dangers and drawbacks than it has advantages. There will, of course, be cases where it is worth while to risk a journey for the sake of some definite advantage to be obtained at the journey's end ; but, with the exceptions already mentioned, it is mistaken policy for the consumptive, even if convalescent, to go a long journey.

Probably the least objectionable way of touring for such a convalescent is motoring or yachting. In a motor-car the danger of chill may be avoided by suitable clothing. The journey need not be made long enough to fatigue, and in fine weather it is usually possible to rig up quarters in a portable tent, if none suitable can be found elsewhere. Still, it is difficult sometimes to avoid breathing more dust than is good for the weak-chested, and it may also be difficult at times to find quarters where ventilation and food are both satisfactory.

This is, in fact, the chief stumbling-block in almost all forms of travelling. Hotels are probably always unsuitable in a greater or lesser degree, even in a health resort, as the whole endeavour of the proprietor is to put as many people as possible under one roof, and to keep the rooms warm and stuffy in order to please his usual visitors.

Foreign fare is often a difficulty for the tourist with insular tastes, unless he goes provided with means of cooking the food for himself, or travels with a talented valet-cook. Were suitable fresh-air boarding-houses more common, the difficulty might be overcome ; but as things are, it is impossible to find really suitable quarters for the travelling consumptive.

For those who travel by rail, and who cannot afford a reserved compartment, there are similar difficulties. Few travellers unused to a fresh-air life care to open windows in a railway-carriage during a long journey, so that one who has been accustomed to such a life is at a serious disadvantage. It is a great pity that no fresh-air compartments are provided on the main lines here and abroad, to enable those who prefer pure air to travel in greater comfort. The difficulty is even greater than it used to be, owing to the introduction of steam-heating on some of the railways. There are nowadays a sufficient minority of ordinary travellers who would welcome such fresh-air compartments to make it worth while to set one apart in every long-distance train.

It is a question whether a convalescent from lung disease should ever travel in a sleeping compartment on the Continent. Owing to the poor quality of coal used, it is necessary to shut the window every time the train goes through a tunnel, so that unbroken sleep is impossible. As regards the length and speed of the journey, it will be found that most people have a limit beyond which they suffer from extreme and lasting fatigue. A convalescent who is aware of his former limit in this respect should take a rather shorter daily journey, unless there are urgent reasons for getting to his journey's end. As a rule, subject to this limitation, I think a quick non-stopping train will be found less tiring than a slow one.

It is doubtful whether a sudden change of climate—say, from winter to summer, or the reverse—is ever advisable, so that this may be a reason for breaking the journey if a suitable stopping-place can be found.

The invalid who takes a railway-journey should make sure that he gets proper meals at proper intervals, either by taking provisions with him or otherwise. A railway-journey in the cold season is very apt to chill the delicate passenger, so that plenty of wraps are necessary, especially around the legs and feet, as well as possibly hot bottles or foot-warmers ; but there is no advantage, but the reverse, in being compelled to breathe a warm atmosphere. As a rule, travelling through the open air is less tiring than in a railway-carriage, provided that enough coverings are used ; and, in the same way, travelling in a carriage with the window open is less fatiguing than with it shut.

On board ship it is easier to get plenty of fresh air, excepting at night and in the saloons. For those who can afford it, a deck-cabin is to be recommended. In bad weather the passenger may have to choose between too much and too little air, but in moderately good weather there is usually some place on board where the right amount may be secured. The chief difficulty is in the cabins, which are almost always worse ventilated than an ordinary room on shore. No convalescent should venture to take a long journey by sea who is not a good sailor, and capable of enjoying the fare provided. For the convalescent from lung disease it is advisable, if possible, to have his meals on deck rather than in the stuffy saloon. Needless to say, the dangers of staying in the smoking-saloon should be avoided. It is a familiar fact to every traveller that plenty of warm clothing is needed for a sea-voyage. Owing to the motion of the ship and the sea-breezes, the body is quickly chilled unless it is properly protected. Those who can afford a voyage in a luxurious yacht may, of course, arrange matters more satisfactorily for a voyage. Indeed, with a long purse most of the drawbacks of travelling, whether by land or by sea, may be avoided.

Short journeys to and from business stand in rather a different category from the above. Generally speaking, it is wise to choose the kind which is most airy, so that the top of a tram-car or omnibus is better than the inside ; but for a short journey and a really convalescent patient the kind of journey may often be safely decided on general grounds of convenience.

CHAPTER XXVII

FAMILY LIFE

A QUESTION of some importance for the convalescent consumptive is how far a fresh-air life is suitable for non-consumptive members of the household. Owing to the long course of treatment necessary for complete recovery from the disease, it is usually necessary to persevere in the chief features of sanatorium life for some time after departure from the sanatorium or the health-resort. Even where such prolonged courses of treatment have been undergone as are the rule at Alpine health-resorts,* the recovery is usually conditional on suitable conditions of life, which include proper ventilation at home, regular meals, and avoidance of the ordinary predisposing causes. When anybody catches measles, it merely means that he has not yet had the disease, and has been infected by another case. Here one attack confers more or less immunity for the future, and predisposition does not depend upon the neglect of hygienic rules. But in tuberculosis one attack does not protect against a second. Susceptibility is of more importance than contact with infection (unless prolonged or repeated), and this susceptibility depends to an enormous extent upon conditions of life.

Probably most of those who get a severe attack of tubercle are more susceptible than those who escape, and it is the object of sanatorium treatment to stop the disease by removing susceptibility ; but the tubercle bacillus is capable of entrenching itself behind its defences in out-of-the-way corners

* In the Alps even an early case is counselled to spend two winters and a summer in the health-resort ; in Colorado two years are prescribed ; in the Adirondacks at least a twelvemonth.

of the body, where the destructive juices of the human body cannot reach it, and may bide its time for years, to break out afresh if the general health is undermined. There is no doubt in my own mind that where a course of tuberculin (or its equivalent) is submitted to, a much larger proportion of bacilli will be killed instead of being left dormant ; but so long as only the minority agree to be treated in this way, and, moreover, many of those applying for relief have already neglected the most hopeful period for such treatment, we have to speak chiefly of those who have not had any course of specific treatment, and of such it must be emphatically stated that the maintenance of health is conditional upon their continuing to live a healthy life.

As far as hyperventilation is concerned, there is usually no difficulty in this country during the summer, or during the more genial days of other seasons ; but in cold or wet weather a ' fresh-air fiend ' puts a great strain on the loyalty of his friends, who are not willing to visit in a house where the sitting-room is 'draughty,' where the windows are never closed, and only a moderate fire is kept going. The convalescent consumptive must be prepared to do without the companionship of most of his friends so long as he is obliged for his own sake to live in really fresh air. Doubtless a time comes in many cases when these precautions may be relaxed, but this should not be until two years have elapsed from the time when the lung disease has become completely quiescent, which usually means at least three years from the commencement of sanatorium treatment, and sometimes more. It is not that a fresh-air life involves any hardship or discomfort to the person who has accustomed himself to it—far from it—but the average dweller in stuffy rooms will never look upon it in this light. He is used to depend on warm rooms to keep himself comfortable, instead of warm clothes and a properly trained circulation of blood ; and unless, or until, he himself undergoes a course of open-air treatment, he will not change his habits or his opinions on the subject.

Turning now to the actual members of the household, with a few exceptions it is advisable that they should become accustomed to at all events a modified form of fresh-air life. They should accustom themselves to live in an atmosphere of the purity recommended by recognized hygienic authorities, instead of the atmosphere of the average household. They should seldom, if ever, stay in a room without a window open (see Chapter IX.), especially at night, and should make a point of spending an hour or two out of doors every day, wet or fine. For this self-sacrifice (if such it be) they will have the reward of a degree of good health beyond the average, and will themselves be far less susceptible to tuberculous infection than the average mortal, as well as to ordinary cold-catching.

Another point of fundamental importance is to substitute cleaning with wet cloths and the like throughout the house for the irrational method of dry-dusting at present in vogue. This will not only improve the health of the household, but will greatly diminish the labour of daily and annual house-cleaning.

Where the convalescent is married, and already has children, it is his bounden duty to bring them up under at least modified fresh-air conditions, and to train them to eat a sufficiency of fat in some form or other. Fortunately, a fresh-air life is extremely healthy for even young children, diminishing the tendency to croup and convulsions in infancy, and to coughs and colds in later childhood, as well as to anæmia and 'strumous' complaints. My own children have all been brought up under such conditions, and I have seen no reason to doubt their value.

A distinguished Irish physician, Dr. Henry MacCormac, one of the pioneers of open-air treatment, wrote in the introduction to his book, 'Consumption and the Breath Rebreathed' (London, 1872, p. 7) : 'I would speak in especial of a chamber which I once entered, as I had often before entered it, early one winter's morn. It was the sleeping-closet of my son. His low trestle bed stood betwixt the severally widely open window and door, while the keen but exquisitely fresh, sweet atmosphere from wind-swept hills careered through the apartment ceaselessly. The hue of exuberant health mantled over the boy's every feature, while bordering the margin of the coverlet there extended a fringe of pure white snow, which the genius of the fragrant night had wafted in, all harmlessly, during the hours of my child's repose.'

With due precautions, there is no danger and much advantage in a fresh-air régime for delicate children. We must bear in mind, however, that as the surface of a child's body is larger in proportion to its bulk than in the adult, there is more need of warm clothing and of shelter against cold or strong winds. In my own household, even in winter-time, we have been accustomed to put the child within a week or two of birth (even in winter-time) in its perambulator in a sheltered corner of the garden, with a hot bottle among the folds of blanket if the weather is cold. If a shower of rain comes on, it is usually sufficient to raise the hood and put a shawl part-way over the opening. Older children who are warmly clad, according to the season, find no difficulty in a fresh-air life. Another point of importance in making children resistant to tubercle is to accustom them early to take plenty of fat in some form or other—fat of butcher's meat, or of ham or bacon, butter, dripping, creamy milk, or, failing these, cod-liver oil in some shape.

With old people it is a matter of greater difficulty to carry out a fresh-air life in the colder part of the year; and, as a rule, a compromise must be adopted. Sometimes an hour or two may be set aside during which the fresh-air folk might be with the older ones in a warm room, but, beyond this, it would be wise for each set to keep to their own quarters. The same thing applies to any delicate members of the household who have a very weak circulation. Another way out of the difficulty is emigration to a land where the climate is mild all the year round, such as Colorado, California, and some parts of Australia and New Zealand. In this case, however, it will often be necessary for the convalescent to engage in active work out of doors, which would only be possible if he has made a sound recovery, and has undergone a course of graduated outdoor work.[46]

In every case a reasonable amount of exercise out of doors, corresponding to the capacity of the individual, is necessary if he is to remain in good health. If the convalescent returns home before his recovery is assured, he will have to spend the greater part of his spare time in rest out of doors. In this case it is often wise to arrange for him to have his meals and pass the bulk of his time under a veranda or in an out-of-door shelter. If, however, he is well enough to return to business, it will depend on the nature of it as to what use he should make of his spare time. If the business is a sedentary one, he should spend several hours daily in exercise out of doors, including the time spent in the journey between his home and his place of business. If, on the other hand, his occupation is more active, some of his remaining time should be spent in rest out of doors or in a room ventilated sanatorium fashion.

The danger of attending crowded public rooms has already been referred to. Ventilation is always bad in such places, and often dangerously so; besides which, the excitement involved in attending such gatherings may be enough to break down the still feeble barriers between the dying (but not dead) bacilli and the rest of the body. In the same way, it is most unwise to undertake laborious work, or unaccustomed exertion in the way of games and sports, without having undergone a carefully graduated and progressive course of physical treatment, as many people date their illness or a bad relapse from such indiscretions. A case is on record of a patient at Davos who was fast recovering, and able to take long walks with impunity, who paid for an unauthorized tobogganing expedition with four months in bed, and had a struggle for his life. The late Dr. Dettweiler has stated that he has seen infinitely more harm arise from too much exercise than too little, and, but for the necessity of fitting convalescents for some kind of active work, and the danger of prolonged invalidism which so often results from the outdoor rest-cure alone, one might well be contented with such treatment.

Apart from exertion, excitement or intemperance of any kind is dangerous for the convalescent from lung disease. Married couples will have seriously to consider their mutual relations in other respects. For some time after convalescence it is wise for them to occupy separate bedrooms, or at least separate beds, as it is not safe to run the risk of any debilitating influence. Marital relations should be avoided by those who are not robust, and only indulged in most sparingly after complete recovery. Any form of intemperance greatly diminishes the chances of restoration to health. The risks of the married state are even more serious for consumptive women than for phthisical men. Pregnancy may temporarily arrest the progress of tuberculous disease, but in the end it enormously increases the risks. Dubois has said: 'If a woman threatened with phthisis marries, she may bear the first accouchement well, a second with difficulty, a third never.'* Indeed, it is not uncommon to find that a patient's chance of recovery has been entirely thrown away by the trials of maternity. For this reason, a girl who has been attacked with tubercle of the lungs will be well advised to abstain from marriage until she has been in perfect health and without any evidence of lung disease for at least two years. If, however, the disease has been strictly localized, the physique is good, the lung expansion is satisfactory, and there is no marked inherited tendency to the disease, marriage is permissible to those who can live under favourable conditions. The danger to the offspring of becoming consumptive is usually a negligible quantity, if recovery in the parents is fairly perfect, no bacilli are any longer expectorated, and the children are sensibly reared under suitable conditions of life; but the danger to the tuberculous mother is a more serious one. Probably when it is too late to avoid pregnancy it will be advisable for the mother not to nurse her child, both in the child's interest and her own. Where a mother is in good health, lactation is a duty which should not lightly be set aside; but it is otherwise where she runs the risk of materially shortening her life, and possibly of doing irreparable damage to the health of her child.

It is wise to have the children of tuberculous parents

* Quoted by Osler, 'Principles and Practice of Medicine,' sixth edition, p. 351. 1906.

examined from time to time, and to have them regularly weighed once a quarter. If there has been no gain in weight, or, still more, a loss, the child should be fed up with plenty of milk, allowed to stop school-work for a time, and spend the time out of doors in some country or seaside place. It is in such cases where cod-liver oil and similar remedies are especially useful. It has already been pointed out that in the first instance tubercle often causes no definite signs of tuberculous disease, but that it may remain latent for years, to break out when the constitution has been undermined by some other illness or by unfavourable conditions of life. Such consequences can, however, be prevented by timely attention, and there is no reason why the children of consumptive parents should not grow up strong and healthy, if only they are kept away from infection and brought up under favourable conditions. Foremost among such conditions are attention to ventilation, clothing, and food; the prompt treatment of minor ailments; and avoidance as far as possible of infectious diseases, such as measles, whooping-cough, and scarlatina. For a more detailed account, the reader is referred to previous chapters in this book.

PART II

I.—BACTERIOLOGY

In this section will be found notes on the collection and examination of sputum, including various staining methods. For the distinctive characters of the bovine and human varieties, see also Section 6.

§ 1. The Examination of Sputum for Tubercle Bacilli.

Carbol-Fuchsin Method.

The following method is the one employed at the Crooksbury Sanatorium :

Collect the sputum coughed up before breakfast in a clean paper lining or sterilized spit-cup or wide-mouthed bottle, and protect against dust and other impurities after collection. With a sterilized needle or fine pair of forceps take a number of opaque or gummy particles from different parts of the specimen, and smear on to a clean glass slide (previously scratched with No. 00 emery-paper), rubbing in all directions until a *very* thin smear has dried over a large part of the slide. Fix by passing slowly and repeatedly through the flame of a spirit-lamp, or by holding above it. Test the heat from time to time while doing this by touching the back of the hand with the warm slide : it should not be allowed to get uncomfortably hot.

An alternative method of fixing the smear, which is less destructive to the cells, is to place the slide for five minutes in a mixture of absolute alcohol, 50 c.c. ; pure ether, 50 c.c. ; saturated solution of mercuric chloride in absolute alcohol, 1 c.c. Rinse thoroughly under the tap, and allow the slide to drain and dry.

Warm some carbol-fuchsin solution over a spirit-lamp until steam just begins to rise. Pour it over the slide, and keep in a warm place for ten minutes. (If several slides are prepared at the same time, they may be placed in a photographic dish, which should previously be warmed.) Rinse the slide under the tap. Decolorize by steeping in solution of sulphuric acid until all the pink colour is discharged and the film is pale yellow or almost colourless. Rinse thoroughly under the tap.

Counterstain with methylene-blue solution. (The length of time this requires depends on the freshness of the solution, its strength, alkalinity, and the brand of pigment used. It may be well stained in one minute, or require as much as ten.) Rinse rapidly, and put to drain. The slide should be transparent, *very* faintly blue, and when dry of a faint French grey.

Formula for Carbol-Fuchsin Solution.

Solution of phenol (1 in 20)	100 c.c.
Fuchsin powder	1 gramme.
Absolute alcohol	10 c.c.

Dissolve the fuchsin in the absolute alcohol, and add the carbolic solution. Just before using, warm over a spirit-lamp and filter. This should never be neglected.

Formula for Decolorizing Solution.

Strong sulphuric acid	1 c.c. (or 12 drachms).
Distilled water	10 c.c. (or 15 ounces).

Drop the sulphuric acid little by little into the water, stirring the while with a glass rod.

Formula for Methylene-Blue Solution.

Caustic potash solution (1 in 10,000) ..	100 c.c.
Concentrated alcoholic solution of methylene blue	30 c.c.
Distilled water	30 c.c.

This solution does not keep well, and gradually loses its alkalinity with use, so that more potash should be added from time to time, and a longer time allowed for staining if necessary.

The advantages of doing the carbol-fuchsin test in this way are the large surface which can be examined and the certainty that tubercle bacilli, if present, will not fail to be properly stained and recognizable. When the more rapid method is adopted, some bacilli may be missed through insufficient staining. I am indebted to Dr. C. G. Higginson for some of the details of this method, which is founded on the one used by the late Dr. Stevenson at the London Open-Air Sanatorium.

Tubercle bacilli may also be stained without heat with the carbol-fuchsin, leaving the solution in contact with the slide for twenty-four hours. Plenty of solution should be used, and a stoppered bottle used to hold the slide and carbol-fuchsin, or evaporation may cause the deposit of particles of pigment, which rather spoils the preparation.

Aniline-Water-Fuchsin Method.

Another method of staining tubercle bacilli in common use is by Ehrlich's aniline-water-fuchsin stain. After making the slide preparation as before, stain with warm aniline-fuchsin solution; rinse, decolorize with 3 per cent. HCl in alcohol, or $7\frac{1}{2}$ per cent. H_2SO_4 solution in water. Wash thoroughly with water, and counterstain with alkaline methylene blue as before. This method is stated by Sir A. E. Wright to be less destructive to the phagocytes and other cells. Bacilli stained by either of these methods are often beaded, with clear spots at intervals.

Formula for Aniline-Water.

To 98 c.c. distilled water add 2 c.c. (or an excess) of aniline oil. Shake up in a test-tube, and filter into a beaker through moistened filter-paper until the filtrate is quite clear. This solution keeps well.

Formula for Aniline-Fuchsin Solution.

To 100 c.c. of aniline-water add 1 gramme of basic fuchsin which has been ground fine and moistened with about 6 or 7 c.c. alcohol. Mix well, and the stain is ready for use. This solution should be warmed over a spirit-lamp until steam begins to rise, then filtered and used at once. To stain slides satisfactorily with this solution in a photographic dish or a beaker from fifteen to twenty-five minutes will be required, according to the freshness of the stain. It should be filtered every time it is used. It does not keep more than a few weeks.

SPENGLER'S HÜLLENMETHODE.

Spengler* introduced a method which is stated to enable one to distinguish between the bovine and human varieties of tubercle bacilli.

Rub a 1 per cent. solution of sodium or potassium hydrate with an *öse* thoroughly over the slide preparation. Dry it by warming very cautiously, without raising the temperature high enough to injure the waxy envelope of the bacillus. Cover with Löffler's methylene-blue solution, to form a ground-stain; then stain with carbol-fuchsin, warming very cautiously. Wash with water. Counterstain for a few seconds with methylene-blue solution, to which is added a drop or two of 15 per cent. nitric or sulphuric acid. Wash off with water, and dry cautiously between blotting-paper or with the aid of very little heat.

Stained by this method, the human bacilli are stated to appear thinner than the bovine, because the envelope of the former escapes the stain. The method fails if the bacilli have been dried up, because drying damages the waxy coat. The method is also unreliable for bovine bacilli from the human subject, because the human body is able to damage the coats of bovine bacilli.

* *Deut. Med. Woch.*, 1905, No. 31; 1907, No. 9.

Spengler's Picric Acid Method.*

This method is stated by Spengler (and also by Pottenger)† to stain bacilli deprived of their waxy coats when the usual methods (Ziehl-Neelsen, etc.) fail to demonstrate them. After staining with warm carbol-fuchsin, carefully avoiding overheating, pour off the excess of stain without washing the slide. Then pour on picric-acid alcohol, leaving for two to three seconds. Wash with 60 per cent. alcohol. Treat with 15 per cent. nitric acid until a faint yellow colour is produced (a few seconds). Wash off the solutions with 60 per cent. alcohol. Counterstain with picric-acid alcohol until there is a faint yellow tinge. Wash with distilled water, and dry carefully without overheating. In examining the slide, use a low power to look for yellow islands. The bacilli can then be seen in these by the oil-immersion lens, appearing red on the yellow ground. Spengler's 'splitter' forms are also sometimes to be seen (see farther on). To prepare the picric-acid alcohol solution, add 50 c.c. of saturated watery solution of picric acid to 50 c.c. of absolute alcohol.

Spengler points out that bacilli from sputum which do not take the Ziehl-Neelsen stain may, nevertheless, be able to grow and multiply, and, if cultivated, may develop into typical bacilli, staining in the usual way. For this purpose from 5 to 7½ per cent. of glycerine should be added to the culture medium, which should consist either of blood-serum or of agar, with 2½ grammes sodium carbonate per litre.

Double Staining without Acid.

Spengler has described a third method, which depends on the fact that acid-fast bacilli, if stained with carbol-fuchsin, and then treated with another stain (such as methylene blue), do not take up the latter, whereas other kinds of bacteria do. The smegma bacillus, the Timothy grass bacillus, the perl-

* *Deut. Med. Woch.*, February 28, 1907, No. 9.

† 'Diagnosis and Treatment of Pulmonary Tuberculosis.' London, 1908.

sucht (or bovine tubercle) bacillus, and the bacillus of avian tuberculosis, stain much better with this than with the decolorization method, since they are very easily affected by acids. Tubercle bacilli of the human variety, on the other hand, show best when stained by the Ziehl-Neelsen and similar methods. Spengler recommends staining with carbol-fuchsin, warming very carefully until a very little trace of steam begins to rise, then washing with 60 per cent. alcohol, and counterstaining with Löffler's blue stain. The smegma bacillus stains well by all the methods, excepting the picric acid method, by which it comes out very pale.

Staining of Spores and Sporoids.

Spengler* has described some minute bodies in tuberculous sputum and cultures which he regards as either spores or related to them.

In order to demonstrate them, the film preparation should be rubbed with caustic soda or potash, as described in the 'Hüllenmethode.' Spengler believes that in the bovine variety they are true spores, because he finds them to be more resistant to destructive influences than the bacilli with which they are associated, the reverse being true of those derived from the human variety. By other observers they have usually been regarded as particles of precipitated stain.

Degenerative Forms.

It is not uncommon to find branching or clubbed forms of the tubercle bacillus in old cultures, and these are occasionally seen in sputum. The swellings are usually regarded as pseudo-spores, and they appear when the life conditions are unfavourable to the growth of the bacilli. The branched forms suggest a relationship to actinomycosis.

Separation of Bacilli from Mucus.

When tubercle bacilli are few in number, it is convenient to adopt some method of separating them from the containing

* *Wien. Med. Woch.*, 1902, No. 14; *Zeitschr. f. Hyg. und Infectionskr.*, Bd. xlix., 1905.

mucus or muco-pus. Ribbert's method (which is like what was formerly called Fenwick's) is as follows: Add to the sputum an equal quantity of 2 per cent. solution of caustic potash, and boil the mixture. Stir with a glass rod, adding an equal bulk of water, and collect the bacilli by subsidence in a conical glass during twenty-four hours, or by the centrifuge.

Other methods depend upon the digestion of the mucus with papain, pepsin, etc.

§ 2. The Collection of Sputum for Examination.

There is usually no difficulty in obtaining a specimen of sputum for examination. That which is first expectorated on waking is usually the most suitable. It should be received into a sterile (or at all events strictly clean) sputum-cup, without the addition of any antiseptic. If slide preparations are made without delay, the staining and examination can be safely postponed to a convenient time.

There are, however, patients from whom it is difficult to obtain any sputum. In this case a wet pack may be put round the chest overnight, followed in the morning by rubbing with a cold wet sheet. This method often leads to the expectoration of sufficient material for diagnosis.*

In young children and infants expectoration may be provoked by applying a piece of sterilized muslin to the fauces with artery forceps.† Another method consists in inverting the child, as for removal of a foreign body, catching the sputum in a cup.

§ 3. Examination for Mixed Infection.

Special precautions are necessary to determine the existence of mixed infection. The following method is recommended by Schröder:‡ The patient thoroughly washes out his mouth in

* Möller: 'Zur Auswahl geeigneter Fälle von Tuberkulose für die Heilstättenbehandlung,' *Zeitschr. f. Tuberk. u. Heilst.*, Bd. i., p. 109.

† Holt: 'Tuberculosis in Childhood,' p. 99, ed. Kelynack. London, 1908.

‡ Schröder and Blumenfeld: 'Handbuch der Therapie der chronischen Lungenschwindsucht,' p. 598. Leipzig, 1904.

the early morning with a disinfecting solution, then coughs up and spits out the first mouthful of sputum into a sterilized glass beaker 3½ centimetres in diameter, and about the height of a test-tube, the wadding cover being quickly lifted and replaced. In the glass beaker is put about 30 c.c. of sterilized salt solution; the contents are thoroughly shaken up; the sputum lump is fished out with a sterile platinum needle, placed in another beaker with more salt solution, again shaken, fished out and placed in a third beaker, and so on up to the sixth. The washings from the later beakers in the list are found to be sterile when cultures are made with them. The sputum is now used in the ordinary way to make cultures with. Schröder found no difficulty in procedure. Out of thirty cases examined in this way, he found twenty-nine times streptococci, seventeen times staphylococci, fifteen times both together, once streptococcus with tetragonus. By injection into animals it was found that these organisms had a feeble toxicity. Schröder also hardened sputa in formalin, and made sections, to show the distribution of tubercle bacilli and associated organisms.

II.—MODES OF INFECTION

Disregarding the rarer modes of infection, such as through inoculation, the chief ways are by inhalation and by ingestion.

§ 4. Infection by Inhalation.

It is generally believed that pulmonary tuberculosis is chiefly spread by the inhalation of particles coughed up by a tuberculous patient. There are two chief ways in which this may happen, the relative importance of which is still under discussion. In one of these the sputum dries, and is inhaled in the shape of dust; in the other droplets are coughed out, together with bacilli, in a moist state. The latter is believed to be the most important way of distribution by Flügge, Baumgarten, Fränkel, and Heymann; but Cornet has criticized their views, pointing out that on Fränkel's own authority the number of bacilli present in a pellet of phthisical sputum is infinitely greater than the number expelled by coughing, apart from expectoration. According to Heller there may be 300,000,000 tubercle bacilli in a single pellet of sputum, so that if the patient expectorates once an hour, he may bring up 7,200,000,000 in a day; whereas Fränkel only obtained 2,600 bacilli from 219 face-masks in thirty-two days. Newsholme* believes that dust infection is the more important in industrial life, while droplet infection is chiefly a feature of domestic life, although the relative importance is uncertain.

Infection through the Tonsil.

Dr. Walsham has shown† that infection through the tonsils is not uncommon. In one of my cases, sent by Dr. V. Harris and Dr. G. S. Woodhead, there was clear evidence of such infection. Enlargement of cervical glands on the affected side has been fairly common in the cases under my care. StClair Thomson and Hewlett ‡ have shown that the nasal mucus is capable of killing many kinds of bacteria, so that the nasal passages to a large extent sterilize the air we breathe, unless there is atrophic rhinitis or any other condition hindering the secretion of healthy mucus.

§ 5. Infection through the Alimentary Canal.

It has been somewhat rashly assumed that the tubercle bacillus only infects the lung by being carried thither with the air that is breathed. We now know that in some cases the invasion may be through the alimentary canal, and thence to the lungs by the lymphatic stream. Sir William Whitla, in his Cavendish Lecture on the 'Etiology of Pulmonary Tuber-

* 'The Prevention of Tuberculosis,' p. 97. London, 1908. See also *British Medical Journal*, January 16, 1909, p. 169.

† 'The Channels of Infection in Tuberculosis,' Weber-Parkes Prize Essay. London, 1904.

‡ *Journal of Laryngology*, vol. ix., 1895.

culosis,'* quoted experiments in which an animal was fed with China ink, water, and oil, through a stomach-tube, and the pigment particles were subsequently found in the lungs. In other experiments one bronchus was blocked, while the animal was exposed to the fumes of burning turpentine. The lung exposed to the fumes was found to be almost free from carbon particles, whereas the one connected with the blocked bronchus was highly pigmented. It is reasonable to conclude that if tubercle bacilli find their way through the intestinal walls, and are carried thence by the lymphatic stream, any block in a bronchiole will help to produce a tuberculous infection of the corresponding part of the lung. Cornet holds the view that infection is usually by inhalation; Ribbert, Aufrecht and others believe rather in infection through the digestive canal. Von Behring believes that infection is always through the digestive canal in childhood, remaining latent in lymphatic glands and other structures until puberty or later, but this view is not generally accepted (see also p. 196).

§ 6. **Infection from the Cow and other Animals.**

Bovine and Human Tubercle Bacilli.

There are good reasons for regarding the tubercle bacilli found in birds, cows, and other mammals as varieties of the same species. The difference between avian tubercle bacilli and the other kinds is, however, much greater than that between the human and bovine varieties, and it is doubtful whether birds can be infected from human or bovine sources, or *vice versâ*. Human beings are clearly susceptible to both the human and the bovine varieties, although the latter, as a rule, produces a different type of disease, affecting the lymphatic glands, bones, and joints, rather than the lungs. Koch holds that the bovine bacilli have nothing to do with pulmonary tuberculosis in man, and are of very little importance to humanity. On the other hand, Von Behring

* *British Medical Journal*, July 11, 1908, p. 61.

believes that the bulk of human tuberculosis is acquired in early life from bovine sources, remaining latent for years, and then developing under predisposing conditions into phthisis or tubercle of bones, joints, and glands respectively. Koch argues that, if the milk of tuberculous cows were an important cause of human tubercle, primary intestinal tuberculosis should be common; but it has been clearly shown that the tubercle bacillus may pass through the intestinal mucosa without causing any local damage, so that his argument is less conclusive than it appears.

The Interim Reports of the Royal Commission on Tuberculosis (1907) show that two different kinds of tubercle bacilli are obtainable from the sputum in human pulmonary tuberculosis, of which one kind, when injected into animals, produces results indistinguishable from the inoculation of bacilli from bovine sources, whereas the other kind only produces mild and localized lesions. A third kind, with somewhat special characters, was obtained from two cases of lupus. Inoculation of another susceptible animal with material from the above-mentioned localized lesions was, however, capable of starting a more virulent form of bovine disease. This appears to prove that two or more varieties of tubercle bacillus are found in human tuberculosis, one of which may possibly be identical with that of bovine tuberculosis. The differences between the two kinds of tubercle bacillus (bovine and human) are not so great as to prevent us from regarding them as varieties of the same species, produced by long sojourn in a special host; but there is no evidence to support the idea that such a transformation can take place in one human being.

It is usually held that the bovine variety, when it infects human beings, shows very little, if any, tendency to invade the lungs. Spengler, however, claims to have shown by his special staining methods (see p. 172) that it is very common to find both varieties together in the sputum of human pulmonary tuberculosis, and founds thereon a special method of treatment (see p. 297). Newsholme* provisionally esti-

* *Loc. cit.*, p. 134.

mates that from 5 to 10 per cent. of the mortality from tuberculosis is caused by the bovine type of bacillus.

The chief differences between the two varieties are as follows: (1) As a rule, bovine tubercle bacilli, when grown on glycerine broth, cause it to lose its acidity and turn feebly alkaline (as tested by phenolphthalein), while human tubercle bacilli usually only slightly diminish the acidity of this culture medium (Theobald Smith).* (2) Tuberculin made from bovine tubercle bacilli is alkaline, whereas from human tubercle bacilli it is usually acid. (3) The bovine tubercle bacilli in cultures are usually shorter and straighter and thicker than human tubercle bacilli, and grow less luxuriantly in glycerinized broth. (4) Bovine tubercle bacilli are usually more virulent than human for the rabbit and other animals. (5) Spengler adds that the bovine tubercle bacilli have thicker envelopes, which, however, are easily destroyed by heat, by desiccation, and by the acid in the carbol-fuchsin test; (6) that bovine tubercle bacilli form spores, while human tubercle bacilli only form pseudo-spores; (7) that in pure cultures they are differently agglutinated, what agglutinates one leaving the other unaffected, but that serum from human tuberculosis usually agglutinates both; (8) that the corresponding kind of tuberculin produces a greater reaction in the human tuberculous subject than the other kind; and (9) that human tubercle bacilli are more aerobic, and are therefore more abundant in positions well supplied with air. (10) This would explain the usual localization of the two varieties respectively.

Tuberculosis in Cattle.

The proportion of tuberculous cows in this country is estimated at from 20 to 31 per cent. in carefully managed dairy-farms, and much more in others—sometimes as much as three-fourths. It has been shown that the milk may be infected with tubercle even in cases showing no obvious disease of the udder, although the danger is greater where

* Quoted by Park, 'Bacteriology,' p. 309. London, 1906.

this can be detected. Probably it often happens that the milk is infected during milking by contamination with the fæcal matter from diseased cows. Cream, butter, cheese, and other products made from tuberculous milk, are also likely to be tuberculous. In Denmark all cows affected with tubercle of the udder are killed, the diagnosis being effected by microscopical examination of the milk. Dr. Bang reported at the British Congress on Tuberculosis (1901) that this method was quite reliable in the vast majority of cases. As, however, tubercle of the udder, when it once appears, progresses very rapidly, frequent inspection of dairy-farms is necessary.

The tuberculin test is reliable in cattle when the disease is still in an early stage. When the amount of disease is considerable, a doubtful reaction may be obtained, because the animal has become accustomed to the absorption of the tubercle toxines. The tuberculin used for the purpose is usually Koch's old tuberculin, of a strength capable of killing tuberculous guinea-pigs which are from six to eight weeks old in five to eight hours, when the dose is 20 to 30 centigrammes. It is diluted for use with $\frac{1}{2}$ per cent. aqueous carbolic solution. The usual dose for cows is 0·5 c.c., and for calves 0·1 c.c.; and a typical reaction consists of a rise of 2° to 4° C., the maximum occurring about the seventeenth hour, and the fever ceasing on the twenty-fourth hour or thereabouts. A sudden rise of temperature is not diagnostic. The correct curve is in the form of a wave.

III.—PREDISPOSING CAUSES

The predisposing causes of pulmonary tuberculosis are of two kinds: those which favour infection, and those which favour the spread of tuberculous disease after infection, or help in producing noticeable symptoms. Some of the predisposing causes, however, might logically be placed under both of these heads.

§ 7. Association with Infected Persons.

Those who suffer from closed tuberculosis are naturally incapable of transmitting the disease; but having regard to the large proportion of 'early cases' in which tubercle bacilli are found in the sputum, open tuberculosis is probably commoner than some people realize.

Open tuberculosis, however, is not necessarily a danger to others, if only adequate precautions are taken; and as this is quite easy in all but a few, there is no reason why consumptives should be segregated like lepers or scarlet-fever patients. The only real danger arises when people are helpless from advanced disease, or very careless, or unable to observe precautions because of tender years or feeble intellect.

§ 8. Frequenting Infected Places.

Here, also, the danger lies in the absence of adequate precautions, rather than in the presence of consumptives on the spot. People often fancy that chest hospitals and sanatoria are likely places in which to acquire tuberculosis, but such is not the case.

It is always difficult to prove with certainty where a disease like tuberculosis has been acquired. If there has been a clear source of infection, there may still have been others at a different time, since the disease is very common, and its latent period variable and often prolonged.

However, there is abundant evidence tending to show that it is most unusual to acquire the disease in a chest hospital or sanatorium.

Chest Hospitals.

Careful inquiries were made at the Brompton Hospital by the late Dr. Cotton and Dr. Theodore Williams, extending over a period of thirty-seven years.* During this time there

* Pollock: *Practitioner*, June, 1898; Wilson Fox: 'Diseases of the Lungs and Pleuræ.' London, 1891.

was no evidence of the disease ever having spread from one patient to another. None of the resident medical officers, matrons, gallery-maids, porters, or secretaries and clerks, had become phthisical, although most of them were brought into frequent contact with the patients. Out of about 150 house physicians, only one appeared to have contracted the disease in the hospital; and out of 101 nurses only three died from consumption after leaving the institution, and only one showed the disease while still in the hospital.

At the hospital of Magdeburg-Altstadt, Aufrecht* states that in seventeen and a quarter years 34,560 patients were received, of whom 3,820 were phthisical, mostly in an advanced (and therefore specially infectious) stage; but none of the other patients and none of the large nursing staff became consumptive.

Sanatoria.

Römpler investigated the death-rate from consumption from 1790 to 1889 in the village of Görbersdorf, in Silesia, which is close to several large sanatoria, with an aggregate of 500 to 600 beds. Before the establishment of the oldest sanatorium the deaths from consumption in the village were at the rate of 0·83 per annum; whereas since that time the death-rate was 0·47, although the population had doubled in twenty-five years; and in forty years something like 25,000 consumptives had been under treatment.†

In the same way, at Falkenstein, near Frankfort, where there is a large sanatorium, with over 106 beds, Nahm found the mortality had fallen in the village from 4 per 1,000 before the sanatorium was opened to 2·4 per 1,000 since it was opened.

Other evidence of a similar character is quoted in my book, 'Sanatoria for Consumptives,'‡ and in Bulstrode's Report

* 'Zur Verhütung und Heilung der chronischen Lungenschwindsucht.' Vienna, 1898.

† 'Beiträge zur Lehre von der chronischen Lungenschwindsucht.' Berlin, 1892.

‡ Third edition, p. 60 *et seq.* London, 1905.

of the Medical Officer of the Local Government Board.* The facts are rather more detailed in the latter publication.

Comparing these results with those in some convents and foreign prisons, and the ill-ventilated and often ill-cleansed rooms of the poor, we find a remarkable difference, so that it is quite true to say that tubercle is less likely to be acquired in a sanatorium or chest hospital than in most other places.

§ 9. Incomplete Expansion of the Lungs.

Incomplete expansion of the lungs predisposes to consumption, as the tubercle bacillus is more likely to take root where there is stagnation of the air and secretions. The parts of the lungs usually first involved in tubercle are those in which conflicting currents of air cause a local eddy or incomplete expulsion of the contents.

Sedentary Pursuits.

Those who are engaged in sedentary pursuits, and who do not properly expand the chest, are especially liable to tubercle of the lungs.

An analysis of death-rates made by the late Dr. A. Guy, presented to the Statistical Society of London in 1843, shows that 'The ratio of cases of pulmonary consumption to those of all other diseases is highest where the amount of exertion is least, and lowest where it is greatest ; and the intermediate degree of exertion presents an intermediate ratio. The age at which pulmonary consumption makes its attack is earlier in employments requiring little exertion than in those requiring more, and in those requiring moderate exertion than in those demanding great effort.'

There is, however, a possible fallacy, since those who are weak, and therefore prone to become consumptive, or possibly already infected with tubercle, are less likely to adopt any occupation requiring great exertion.

Children who are in the habit of sitting in cramped positions should be discouraged from doing so.

* Thirty-fifth Annual Report, 1905-1906, pp. 49-62.

Impeded Respiration.

It is acknowledged that adenoids and other causes of nasal obstruction are disproportionately common in those who suffer from tubercle. Such conditions, by interfering with the free entry of air into the lungs, lead to stagnation of the secretions and of the contained air. Moreover, by encouraging mouth-breathing, they prevent the arrest of dust particles by the nose. Collapse or compression of the lungs from lateral curvature or other causes, pleuritic effusions and adhesions, also predispose to consumption. So does injury or disease of the neuro-muscular mechanism of respiration. In one of my cases pulmonary tubercle was preceded by progressive muscular atrophy.

§ 10. Non-Tuberculous Diseases or Injuries

also favour the production of tubercle, both in the lungs and in other parts of the body. Just as gout attacks an injured joint, so also will tubercle attack a part which has already been weakened by disease.

It is not uncommon to find tuberculous enlargements of the tonsil,* and although it may conceivably attack a healthy tonsil—the bacilli harbouring in one of the crypts—it is more likely to be preceded by non-tuberculous enlargement or ulceration. Tubercle is very commonly grafted upon chronic bronchitis, and after infectious fevers which are associated with catarrh, such as measles, whooping-cough, or influenza. Therefore, children and adults who are convalescing from such ailments should, if possible, spend some time in a pure, healthy atmosphere. Denudation of the mucous membrane doubtless favours an attack of tubercle by removing the cilia. In the case of bronchiectasis, the dilatation itself hinders the complete removal of secretion, and emphysema has much the same effect. Pleurisy is often itself a tuberculous disease, but, apart from this, the effusion provides a suitable culture fluid for the tubercle bacillus,

* See Walsham, 'The Channels of Infection in Tuberculosis.' 1904.

while respiratory movement is hindered in various ways, and the subjacent lung also suffers.[28]

As regards injuries, in one of my own cases tubercle attacked the side injured in a fall on the ground ; in another case, a young naval officer who fell from aloft and broke his ribs afterwards developed tubercle on the injured side. Another patient dates her attack of tubercle from a carriage accident, which severely bruised the chest. Tuberculous diseases of bones and joints very commonly develop after accidental injuries.

Dusty Occupations.

Occupations which involve exposure to irritating forms of dust, such as that of the knife-grinder or stone-mason, often end in phthisis. Since an incised surface is an unprotected surface, operations on the throat and nose in the predisposed should be performed in a pure atmosphere.

In Dr. Newsholme's book on 'The Prevention of Tuberculosis' (p. 158) is a table in which the comparative mortality figure from phthisis is given according to occupation. In 1900-1902 the mortality figure as regards phthisis was 175 in all occupied males ; 838 among tin-miners ; 516 in cutlers and scissors-makers ; 501 in copper-miners ; 375 in file-makers.

A table is given by Dr. Huber in his book 'Consumption and Civilization' (p. 114) in which the relative mortality from phthisis in the United States is graphically represented according to occupation. Those who head the list are marble and stone cutters, cigar-makers and tobacco-workers, plasterers and whitewashers, compositors, printers and pressmen, in this order. Most of the above (perhaps all) work in dusty places.

§ 11. Exhaustion.

Physical, and possibly mental, exhaustion from prolonged or unusual exertion, overwork, worry, irregular hours, insomnia, or grief, are recognized causes of consumption. I have many instances among my notes in which overexertion preceded the outbreak of disease.

§ 12. Intemperance.

Intemperance of any kind increases the tendency to consumption, and diminishes the chance of recovery. Among my own cases the intemperate who have been attacked with tubercle have usually done badly.

The late Professor Brouardel held that alcoholism was the most powerful factor in the propagation of tuberculosis. Alcoholic indulgence weakens the bodily resistance to disease, and also leads to carelessness and neglect of the ordinary rules of health. The mortality from tuberculosis amongst publicans is much above the average. Probably they are more exposed to infection than the majority, since a disproportionate number of the careless and ill-nourished would frequent their establishments. If money is spent on drink, there is less left for wholesome food and other necessaries.

§ 13. Unsuitable Rooms.

Overcrowded, ill-ventilated, dark, dirty, or overheated rooms favour the development of consumption.

Overcrowding.

Some interesting figures are given of the proportion of CO_2 in various overcrowded places by W. N. Hartley,* who also quotes some analyses by Dr. Angus Smith. From these it appears that in a theatre during the performances the proportion of CO_2 may sometimes rise to as much as 32 parts in 10,000, or eight times the usual proportion out of doors. According to Angus Smith, the air in a closed room in Chancery Court contained 20·3 parts of CO_2 in 10,000 three feet from the ground, and nearly as much at seven feet from the ground.

Prolonged sojourn in a much less impure atmosphere will, however, have lasting ill-effects upon health. A healthy man breathes more than 23,000 times in twenty-four hours, so that the cumulative effect of breathing an impure air day

* 'Air and its Relation to Life,' p. 120. London, 1875.

after day may be enormous—fully sufficient to account for the ill-health of those in the habit of doing so.

Apart from the influence of impure air in lowering the general health, there is more danger of getting tuberculous disease in overcrowded rooms, because of the longer survival of tubercle bacilli in such places. Ransome* has succeeded in growing tubercle bacilli on filter-paper saturated with the organic moisture from the breath, and also on wall-paper with the same, at ordinary room temperatures; and although these are not the most favourable conditions for their growth, it was shown that this was possible.

Ransome† states that he has never seen a case of tuberculous infection in an ordinarily well-ventilated house in this country.

Overcrowding acts in two ways—by lowering personal resistance and by increasing the chances of infection (and re-infection) if a consumptive is, or has been, present. Alone, overcrowding is incapable of producing tuberculosis; still, Newsholme‡ speaks of it as the most mischievous factor of town-life.

Dirt.

Dirty rooms favour the spread of tuberculous disease if the tubercle bacillus is deposited in them, because the dirt hinders the disinfectant action of sunlight, and may even act as a culture medium, and allow the bacilli to multiply, if the room is warm and damp. Dirt is also mischievous because of the other bacteria which it harbours, some of which are the cause of mixed infection.[3]

Dirt alone is insufficient to breed tuberculosis: the bacillus is also a necessary factor. This almost self-evident proposition was illustrated by the results obtained by Coates§ in an

* 'Researches on Tuberculosis,' p. 27. Weber-Parkes Prize Essay. London, 1898.

† 'The Treatment of Phthisis,' p. 31. London, 1896.

‡ *Loc. cit.*, p. 224.

§ 'An Investigation into the Presence of Infective Material in Dwellings occupied by Consumptive Persons.' Transactions of the British Congress of Tuberculosis, vol. ii., p. 88.

examination of the dust from various kinds of rooms. Those rooms which were dirty and had been occupied by consumptives who were careless about expectoration were infected in about two-thirds of their number. Those in a clean condition, but occupied by consumptives who were careless (as in the previous group), were infected in half the number. Those which were very dirty, but had not been occupied by consumptives for years, were found to be free from infection.

Overheated Rooms.

Consumption is very common among sugar-bakers, probably because of the debilitating effect of heat. Bakers, who are also very subject to respiratory diseases, have to endure the additional drawbacks of night-work and a dusty atmosphere. Operatives in cotton-mills suffer from heat and moisture, which increases the tendency to consumption.

Lack of Sunlight.

There is no evidence that the absence of bright sunshine causes a predisposition to tubercle, but there is no doubt that lack of sunlight may do so, both by its effect on the health of the subject and by its action on the bacillus itself. Air and sunlight combined are able to kill the tubercle bacillus in a comparatively short time. Moreover, a dark room is usually a dirty room, so that it should never be used as a dwelling-room. Ransome and Delépine made some experiments on this subject, published in the Proceedings of the Royal Society, vols. xlix. and lvi. Sputum exposed to the air in a poor cottage in Ancoats remained virulent for two or three months, whereas the same sputum freely exposed to the air and light lost the power of rendering guinea-pigs tuberculous when inoculated with it. Dried sputum reduced to dust remained virulent in the dark for thirty-five days; whereas the same exposed to light for two days, or to bright sunshine for one hour, became harmless.

In Koch's experiments the tubercle bacillus exposed to light, but not to direct sunshine, lost its virulence in five to seven days, and in bright sunshine in a few minutes or hours (International Congress at Berlin, 1890). Straus ('La Tuberculose et son Bacille,' p. 220; Paris, 1895) states that cultures in glycerinated bouillon were killed by exposure to two hours' summer sunshine.

The results depend partly upon the thickness of the layer of sputum and partly on the amount of protection given by dust and other opaque substances.

According to Park * dried sputum protected from abundant light has occasionally been found to contain virulent tubercle bacilli for as long as ten months.

§ 14. Dietetic Errors.

Tuberculosis is exceptionally common among the half-starved poor. Insufficient food, irregular meals, and an injudicious proportion of food-stuffs, especially too small a proportion of fat, are the chief contributory causes under this head. We may also add overindulgence in alcoholic drinks, which paves the way for tuberculosis by ruining the digestion.

§ 15. Some General Diseases.

Diabetics, it is well known, are specially prone to consumption. Moreover, influenza, enteric fever, and some other infectious diseases, appear to favour its appearance. This may sometimes be due to the catarrh excited in the bronchial tubes, but the bodily resistance is also probably lowered. Since the recent influenza epidemics a large proportion of phthisical patients appear to date their illness from an attack of influenza; but it may be that in some cases what was taken to be influenza was really itself tuberculous fever. Some of the worst cases of tubercle of the lungs are those in which there is 'mixed infection,' pneumococci, streptococci, staphylococci, etc., being present together with the tubercle bacillus. Phthisis appears to be specially common amongst the insane. Whether this is due to lack of intelligence in combating the disease, or to some other cause, is not certain.

* 'Bacteriology in Medicine and Surgery,' p. 290. London, 1906.

The late Dr. Solly* was of opinion that the intelligent had a better chance of recovery from tubercle than the stupid, and I am myself under the impression that a courageous disposition helps recovery. Syphilis appears to be associated both with some very favourable and some very unfavourable attacks of tubercle, so that it is difficult to estimate its importance as a predisposing cause of tubercle.

§ 16. Loss of Blood.

After profuse hæmoptysis there is commonly an extension of tuberculous lung disease. This is probably due to auto-inoculation with an excessively large dose, but the loss of blood would also help by lowering the bodily resistance. It is very common to find a history of profuse menstruation in those who are suffering from tubercle; and although this may have been to some extent a result of the disease in an early stage, it probably also contributes to the breakdown.

§ 17. Maternity.

Frequent child-bearing and prolonged lactation are common causes of consumption. Moreover, they are capable of converting a slight attack into a very serious one.

§ 18. Hot Climates.

Hot climates, especially hot damp climates, lower the resistance to tubercle. Pulmonary tubercle appears to be more virulent in Italy and other places with a warm climate than in cooler temperate climates. Excepting where houses are overheated, it is rare in cold climates. Some of the least promising cases I have had have been invalided home from the West Coast of Africa, Burmah, and India.

Dr. A. Ransome† has shown that the tubercle bacillus will grow at ordinary room temperatures (21° C.), but it grows more freely on all media at 35° C. Consequently there is far

* 'Medical Climatology,' p. 124. London, 1897.

† 'Researches on Tuberculosis,' p. 28. Weber-Parkes Prize Essay. London, 1898.

more danger of bacilli remaining active in a warm than in a cool room, and in a hot than in a cold climate. Reinfection is therefore more likely to happen under the former conditions.

Apart from this, a warm climate has a debilitating influence on Europeans, and diminishes the self-protective powers of the body.

§ 19. Chills.

Notwithstanding the fact that consumption is commonly attributed to a chill, it is very doubtful whether it be often a contributory cause. The effect of exposure to cold is difficult to trace, because it so often happens that the early feverish stage of tubercle is mistaken for a chill. A gentleman under my care who had a large tuberculous glandular enlargement in the neck dated this from falling into a river on a very cold day, after which he was unable for hours to change his clothes. In this case the chill may have made him susceptible to infection, or to spread of disease from a pre-existing focus. The danger of chill is necessarily greater for those who live in overheated rooms, because (like hothouse plants) they feel the contrast in temperature on going out of doors. This is an additional reason why hot rooms should be avoided by the delicate.

§ 20. A Delicate Constitution

undoubtedly creates a predisposition to tubercle; but the expression is vague, and is covered by many conditions already mentioned. Many people who are delicate, but not actually ailing, owe their delicacy of constitution to the existence of more or less latent tubercle within them.

French physicians have long believed in the existence of a special delicacy of constitution predisposing to tubercle, and give it the name of 'pretuberculosis.' A. Robin and M. Binet, who have made a special study of metabolism in the tuberculous, find that even in very early stages there is more oxygen consumed, more retained in the system, and more carbon dioxide given out, than in robust health. Similar alterations in metabolism have been found in some who were nearly related to tuberculous subjects, and a few of these are known to have later on themselves become consumptive, so that Robin regards this respiratory behaviour as the mark of a tuberculous tendency.*

§ 21. Inheritance.

There is one fallacy which should be borne in mind whenever the subject of inheritance of tubercle is considered. It does not at all follow because parent and child are both tuberculous that the child inherited the disease; for one may have caught it from the other, or both may have received the infection from a common source. This may sometimes be a common friend who is phthisical, at other times an infected place—house of residence or workshop—which both parent and child inhabited. The inheritance of consumption is an exceedingly rare thing—so rare, indeed, that the instances on record have been much disputed. What *is* inherited in some cases is the *tendency* to the disease, although even this is not so common as infection from a common source. Léon Petit states that the children of tuberculous parents, if removed from Paris to suitable country conditions, grow up stronger than the average city population, and with a smaller proportion of tuberculous subjects. Still, we do meet with instances in which a delicacy of constitution has been inherited, so that parent and child are more than usually liable to certain diseases, such as tubercle, and to suffer severely from them if infected. Where several sons in one family fall ill with tuberculosis about the same age in different parts of the world it is extremely probable that there was an inherited tendency to the disease. A striking instance of this happened within my own experience, where a gentleman who had entered a sanatorium heard that his brother (whom he had not seen for years) was crossing the Atlantic because of a breakdown in health, which presently proved to be also pulmonary tubercle; and soon after news came that a third brother who had lived in quite another part of the world had also had to enter a sanatorium for consumption.

* *Academie de Médecine*, Paris, 1901.

The late Dr. Hermann Brehmer was of opinion that the later-born members of a family were more liable to consumption than the older ones, probably because the mother's constitution is apt to be exhausted by the trials of repeated maternity.

Dr. J. E. Squire estimates the proportion who become tuberculous as about 33 per cent. among the children of consumptive parents, against about 24 per cent. among the children of non-tuberculous parents.*

Probably the only authority who believes tuberculosis to be usually directly inherited from the parents is Baumgarten.

IV.—SYMPTOMS AND DIAGNOSIS

This section includes notes on the clinical course of pulmonary disease, on latency, the chief symptoms, the physical signs, the various forms of the tuberculin test, and the opsonic test.

§ 22. The Clinical Course of Pulmonary Tuberculosis.

Pulmonary tubercle may begin insidiously or suddenly. The symptoms may follow some other illness, such as influenza, pneumonia, pleurisy, or bronchitis, or after accouchement. In such cases convalescence is incomplete, and after a while positive evidence of tuberculosis is obtained. In other cases the disease may apparently date from some overexertion, overstrain, or injury. In yet other cases—fortunately, a minority—the disease begins in an acute form with high fever and rapidly progressing lesions in the chest. These are the cases of acute caseous pneumonia and of acute miliary tuberculosis, popularly grouped together as 'galloping consumption.'

Most cases probably begin insidiously, remain slightly febrile for weeks or months, without marked constitutional deteriora-

* 'Hygienic Prevention of Consumption,' p. 34. 1893. See also Transactions of the Royal Medical and Chirurgical Society, 1895; *American Journal of Medical Sciences*, November, 1897; Proceedings of the Royal Society of Medicine, 1908; and *Lancet*, November 28, 1908.

tion, and are recognized as tuberculous when the disease is already advanced. These cases might be completely arrested without material damage to the lungs if rigidly treated from the beginning. It is to be hoped that the public will more and more realize the importance of strict treatment from an early stage, since later on recovery is only possible with permanent damage to the lungs.

In seeking for the possible date of infection, it is not uncommon to find it a long time before the breakdown in health, suggesting a long period of latency, during which the disease produced no symptoms. Very often there have been repeated slight breakdowns, each of them possibly tuberculous, though this cannot always be proved, and each successive attack is a little more serious or a little less completely recovered from than the previous one.

Among those who do not come under medical supervision, excepting for some intercurrent ailment of a different nature, the constitution is often sufficiently good to gradually overcome the tuberculous disease, in which case there is 'spontaneous arrest.' This is probably exceedingly common.

§ 23. Spontaneous Arrest of Tuberculosis.

The evidence for this consists in the discovery of cicatrized and calcified tuberculous lesions after death from disease or accident. Knopf gives an interesting chapter in his book ('Prophylaxis and Treatment of Pulmonary Tuberculosis,' p. 31; Philadelphia, 1899), with statistics and personal statements from various authorities. The statistics of healed tuberculous lesions vary from over 90 per cent. to under 15 per cent., doubtless because of a difference in the material dealt with and the carefulness of the search. Heitler, of Vienna, gives a proportion of about 4·76 per cent. in 16,562 autopsies; J. Kingston Fowler about 9 per cent. in nearly 2,400 autopsies.* Taking all the cases together, there appears to be about 8 per cent. Dr. Brouardel, of Paris, is quoted by

* Fowler and Godlee: 'Diseases of the Lungs,' p. 379. London, 1898.

Knopf as saying: 'There is hardly any autopsy performed at the Morgue on persons having died an unnatural death where healed tuberculous lesions, cicatrized and calcified, are not found, especially if the individual has lived more than ten years in Paris.'

Dr. Fowler mentions the case of a lady* in whom there was a cavity in the left lung, almost certainly formed fifty years before. The writer has seen a case in which a cavity was present in the right lung, apparently dating back to thirty-four years before the consultation, when the patient had severe hæmoptysis, and was told to expect the worst. However, he recovered his health, and remained well for years.

§ 24. Latency of Tuberculosis.

Von Behring is of opinion that people who become consumptive have invariably been infected in childhood, but remain free from symptoms of disease until the constitution is weakened by rapid development at puberty or by some other circumstance. While few authorities accept this extreme view, there seems good reason to believe that infection is not usually at once followed by symptoms of pulmonary disease, but that these appear some time—sometimes several years—after. Thus, I have in my case-book instances where the patients had suffered from hæmoptysis or pleurisy or enlarged glands in the neck four, five, seven, nine, eleven, and thirteen and a half years before disease in the lungs began to produce any noticeable symptoms. In one case a gentleman aged forty-three had had a solitary attack of hæmoptysis eleven years before the lung disease was discovered. In another case a gentleman had tuberculous glands at the age of twelve, but remained in good health after this until at the age of twenty-eight he had pleurisy, and at the age of forty-seven slight signs and symptoms of pulmonary tubercle were discovered.

Dr. Pottenger† mentions the case of a lady whose father died of phthisis when she was two years old. Her mother died when the patient was eight years old. The latter showed

* *Loc. cit.*, p. 380. † *Loc. cit.*, p. 2.

no special symptoms until the age of seventeen, when she had slight evidence of tubercle. She had other attacks at the age of thirty, after a confinement, and at the age of fifty-eight and a half after whooping-cough, having remained in good health the greater part of the intervening periods.

Hamburger,* of Vienna, states that 90 per cent. of a number of apparently healthy children reacted to tuberculin at the age of puberty, and that 75 per cent. of the post-mortem examinations of children at puberty revealed the existence of tuberculosis. From this it appears that few children escape tuberculous infection in Vienna by the age of puberty, but that in many it remains latent.

Dr. Newsholme† mentions cases in which there was a latent period of twenty to twenty-seven years. Out of 100 cases which were carefully analyzed, twenty had a definite history of infection ceasing at a known date, and of these one-half had a latent period of over ten years.

§ 25. **Acute Tuberculosis.**

Two chief forms of acute pulmonary tuberculosis are met with, in one of which there is widespread miliary tubercle, in the other pneumonic or bronchopneumonic patches, which become rapidly caseous. The possible reasons for an acute outbreak are partly differences in the virulence of the bacilli, partly differences of dose and distribution, partly also differences in constitution. Sometimes, however, the acuteness of the attack depends chiefly upon neglect of proper treatment in early stages. Just as 'ambulant typhoid' has a bad prognosis, so with 'ambulant acute tuberculosis.' Many patients who are highly febrile when first seen by a medical man have previously had slight fever from the same cause, which would have responded without difficulty to appropriate measures. The slighter degrees of fever in tuberculosis are not easily recognizable by the sensations of the patient; and if in every case of obstinate dyspepsia, or catarrh, or debility, the thermometer were invariably used a few times in the afternoon, there

* *Münch. Med. Woch.*, December 29, 1908. † *Loc. cit.*, p. 73.

would be fewer instances of unmanageable tuberculosis. Any laryngeal or bronchial catarrh which lasts more than a month calls for careful investigation, as many such cases are no doubt tuberculous. While there is only a slight degree of fever it is comparatively easy to arrest the disease, and the permanent damage to the lungs is less in proportion to the earliness of treatment; but later on, if the fever is allowed to become high, it is often impossible to save the patient.

Whenever well-marked fever is present, absolute rest in bed, with hyperaeration and suitable diet, are of the greatest importance, and to these tuberculin in suitable doses may be a most valuable addition. The rest should be as absolute as for a typhoid patient or Weir-Mitchell case, and low diet should be most carefully avoided. To carry out such treatment with success good sanatorium-trained nurses are necessary both day and night, and the precautions and conditions usual in a sanatorium should be most rigidly enforced.

Even when the patient's strength is almost unimpaired, and the fever is only moderate, strict precautions are of great importance from the earliest possible moment. Whenever there is evidence (however obscure) of multiple lesions in the lungs, extra care is advisable. It often happens that tuberculous deposit is widespread, without at first producing much constitutional disturbance. This comes later on, when softening allows of free auto-inoculations; but the mischief has really been done previously, so that a little 'intelligent anticipation' might save many a patient.

The investigations of the Royal Commission on Tuberculosis show that the dose of bacilli has a great influence upon the nature of the subsequent attack. Small doses are easily overcome by a reasonably good constitution, when larger ones overwhelm it. It has also been shown that bacilli of low virulence cause slight local fibrosis; whereas those of high virulence cause widespread caseous changes, with but little evidence of repair. But these are matters which cannot be affected by treatment, and but little by prophylaxis; whereas the strict enforcement of suitable measures of treatment should always be possible with pecuniary help.

§ 26. The Early Diagnosis of Pulmonary Tubercle.

Since tubercle bacilli are not usually discharged from the lungs until softening has taken place, and even then may not appear in the sputum, examination of the latter cannot be depended upon for the discovery of pulmonary tuberculosis in its earliest stages. In such cases the diagnosis rests upon—(1) a history of prolonged or repeated exposure to tuberculous infection, or (2) of suspicious breakdowns in health in the past. We may sometimes obtain cumulative evidence from

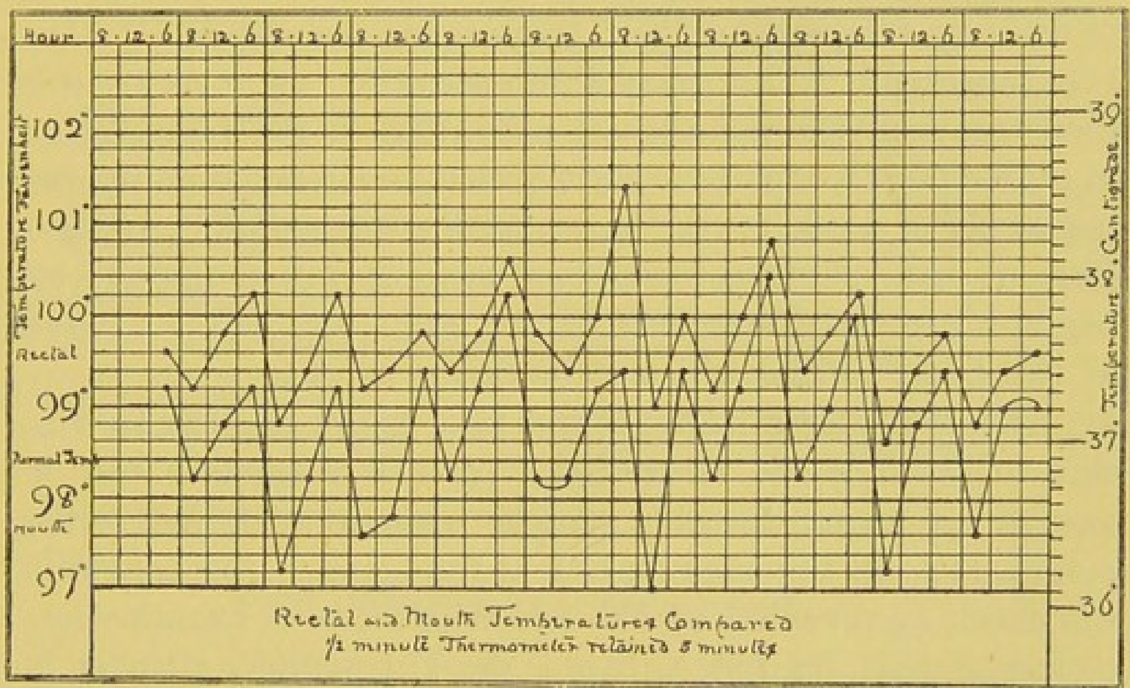

FIG. 23.—TEMPERATURES IN PULMONARY TUBERCULOSIS. RECTAL AND MOUTH TEMPERATURES COMPARED.

slight alterations in health, which may singly be none of them conclusive, but are not otherwise explicable. Under this heading come slight debility or loss of flesh, dyspepsia, or anæmia. A young lady came under my observation with advanced disease of both lungs and high temperatures. She was supposed to have been ailing slightly for three months, but cross-examination revealed the fact that there had been four previous slight breakdowns in health, extending over five years, each a little less perfectly recovered from than the previous one. When first seen by me, the condition was most unfavourable. Had the earlier attacks been more carefully investigated, her life might have been saved. (3) A raised body - temperature in the afternoon or early evening, or after exertion or excitement, or preceding menstruation. Careless investigation of the body - temperature is the cause of many early tuberculous cases being missed. It should be remembered that the temperature is often normal (or even subnormal) part of the day when there is advanced lung disease, and that a half-minute thermometer inserted in the axilla or under the tongue for the usual time will often fail to reveal slight degrees of fever. Braine Hartnell* has shown that there may be two or three degrees difference between mouth or axillary temperatures and those taken *per rectum*. I have also repeatedly found great differences (Fig. 23). As regards menstruation, the commonest alteration in the temperature of tuberculous women is a rise of both maximum and minimum, beginning a week or ten days before the period. Another form of disturbance consists in a wave of high temperatures, beginning soon after menstruation, and culminating a week or two later. Cases which show this type of fever are in my experience rather obstinate, and take many months to subside under hygienic treatment. (4) The tuberculin test in one of its many forms. (5) The opsonic test, and other evidences form the examination of the blood. (6) Changes in the chest, as revealed by the usual methods of examination, including that by the X rays. (7) Tuberculous changes in other parts of the body. (8) A family history of tuberculosis.

In investigating the family history, if several near relatives have died from, or suffered from, phthisis, without any possibility of one being infected by another, the presumption is that the patient also will have more than average susceptibility to the disease. A heavy infantile mortality often conceals deaths from tuberculosis, as also do deaths from brain fever, atrophy, or marasmus, or in childbirth. All deaths in early adult life or about puberty are suspicious, unless clearly explicable by other causes than tubercle.

If the medical history of the patient includes pleurisy, in the absence of rheumatic fever, pneumonia, or Bright's disease, this

* Transactions of the Tuberculosis Congress. London, 1901.

was probably tuberculous. If the patient dislikes fat or butter or is exposed to any of the usual predisposing causes of consumption, this would strengthen the probability of tuberculosis.

§ 27. Diagnosis of Tuberculous Anæmia from Chlorosis.

As anæmia is often an early feature of tuberculosis, at a time when the diagnosis is difficult, the following distinguishing characters may be usefully remembered :

In Early Tuberculous Anæmia.	*In Chlorosis.*
Slight fever is usual.	Fever is absent or ill-marked.
Loss of flesh is the rule, especially on the chest.	There is no loss of flesh, the breasts being firm.
Insomnia is common.	Sleepiness is usual.
Menstruation is not usually arrested at first; it may be excessive.	Menstruation is irregular, and may be deficient or absent.
There is often perspiration on slight exertion, often unilateral in the axilla.	No special tendency to perspiration.
Vascular tension is normal or low.	Vascular tension is usually high.
Pulse-rate is increased.	Pulse-rate not increased.
No marked blood-changes at first.	Deficiency in hæmoglobin more than in red corpuscles.
Œdema of ankles unusual.	Œdema of ankles common.
Loss of strength is common.	Usually no loss of strength.

Other distinctive features have been referred to elsewhere.

§ 28. Pleurisy and Tuberculosis.

At the British Tuberculosis Congress in 1901, Koch stated that 73·2 per cent. of pleurisies with effusion in his experience reacted to tuberculin, and were presumably tuberculous. Excluding pleurisies from rheumatic fever and from pleuro-pneumonia (pneumococcic), the vast majority are almost certainly tuberculous. Finkler* states that of 256 cases seen in his clinic, 22·3 per cent. were certainly tuberculous, and another 33·6 per cent. probably tuberculous. West† concludes that at least 50 per cent., and possibly 75 per cent., of pleuritic cases are caused by tubercle. Dry pleurisy is so frequent in chronic pulmonary tuberculosis that it is exceptional to find a case without it, if under observation for a few

* Schröder and Blumenfeld, *loc. cit.*, p. 655.

† 'Diseases of the Organs of Respiration,' vol. ii., p. 652. London, 1902.

months. Pleurisy which does not cause distinct lasting dulness or adhesions after removal of the effusion has little influence on the progress of a phthisical case.

§ 29. Examination of Pleural Exudate.

The Search for Bacilli.

For this purpose Jousset's method is to be recommended. The fluid is allowed to clot, artificial gastric juice added in sufficient quantity to digest the fibrin, the liquefied exudate centrifuged, and the sediment used for making cover-glass preparations. The clot entangles all bacteria as well as other particles, but the digestion does not affect the tubercle bacilli.

Cytodiagnosis.

We have in *cytodiagnosis* a special method of distinguishing the nature of pleuritic effusion. If the fluid drawn off from a pleurisy with effusion be centrifuged, and film preparations made with the sediment and examined, the cells will be found in primary tuberculous pleurisy to consist almost entirely of lymphocytes. In pleurisy secondary to disease in the lung mixed infection is very common, so that polynuclears may also be found, although there will usually be a large proportion of lymphocytes. In pleurisy caused by the pneumococcus, streptococcus, and other pyogenic bacteria, it is usual to have an excess of polynuclear leucocytes. In rheumatic pleurisy it is stated that endothelial cells are predominant (just as in passive exudation), all forms of leucocytes being scarce; moreover, in such cases cultivation would usually give a negative result. Effusion of red blood cells is not uncommon in both tuberculous pleurisy and that due to malignant disease. It is sometimes (but not always) possible to detect the tubercle bacillus in pleuritic exudations. The absence of such bacilli is no argument against the tuberculous nature of the case.

Where the fluid has coagulated before cytodiagnosis could be attempted, the clot may be broken up by shaking in a sterile bottle with glass beads, rejecting the coarser sediment, and centrifuging the remainder of the fluid. If the fluid has to be kept any length of time before examination, a crystal of thymol added to the exudate will prevent decomposition.

The sediment may be examined by the wet or the dry method. In the former a drop of methylene-blue solution (p. 170) may be added to the edge of the cover-slip, and allowed to creep in and mix with the drop of fluid to be examined. Emery recommends cementing the cover-glass to the slide with melted paraffin applied with a hot iron rod, to prevent lifting of the cover-glass when the oil-immersion lens is used.* By the dry method of examination, a film preparation is made and allowed to dry, then flooded with Jenner's stain for one and a half to three minutes, distilled water added, and the film again dried and examined in the usual way. The lymphocytes appear blue, as well as all nuclei; the eosinophile leucocytes appear red, the basophile granules violet, red corpuscles pale red, polynuclear leucocytes pale red, with blue nuclei.

§ 30. Types of Fever in Pulmonary Tuberculosis.

Several types of fever are to be met with in the course of pulmonary tuberculosis. Kingston Fowler† has pointed out that during advancing tuberculosis there is marked pyrexia, quite apart from secondary infection; that there are only small daily remissions in miliary tuberculosis, and remissions of 2° F. or more in caseous tuberculosis, which tend to increase when failure of vital powers is threatened (Figs. 24 and 25).

In chronic tuberculosis, on the other hand, the temperatures are moderate, with a small remission. An inverted type, in which the morning temperatures are high and the evening temperatures low, is commonest in miliary tuberculosis, and denotes a severe attack. In severe disease it is common to get waves of temperature, which are probably caused by large auto-inoculations, with extension of disease during the negative phase. Such waves often last from two to three weeks, and in favourable cases the first improvement is shown

* 'Clinical Bacteriology and Hæmatology,' p. 224. London, 1906.

† Fowler and Godlee: 'Diseases of the Lungs,' p. 323. 1898.

by a lower acme in succeeding waves. In women auto-inoculation commonly takes place especially before or after

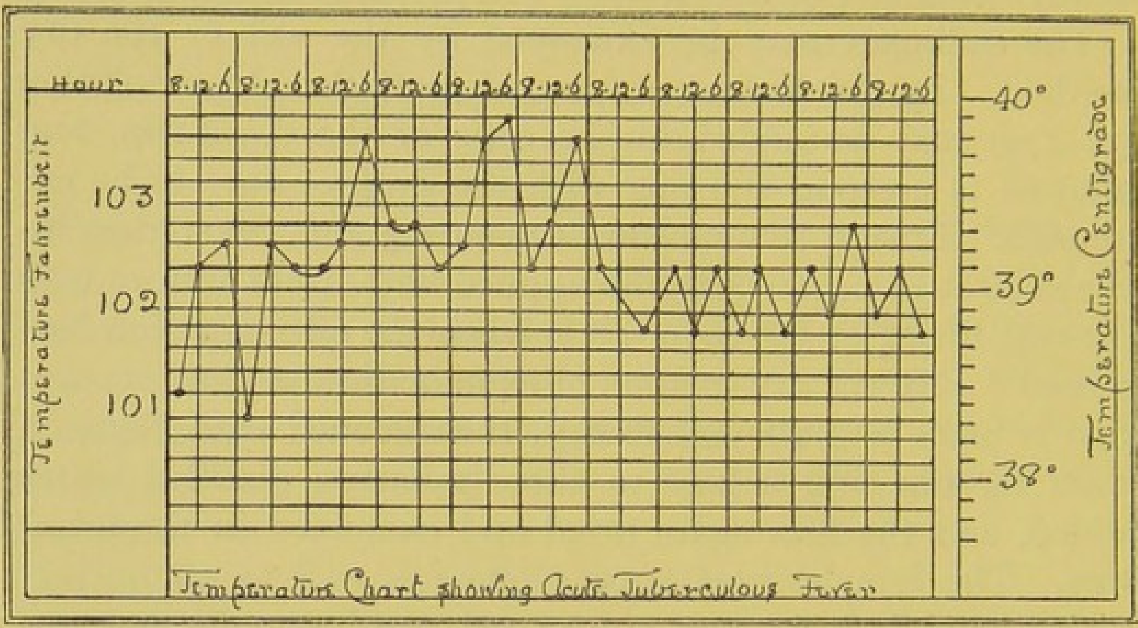

FIG. 24.—TEMPERATURES IN PULMONARY TUBERCULOSIS.

the menstrual period. In either sex violent cough or exertion of any kind may cause auto-inoculations ; and these are apt

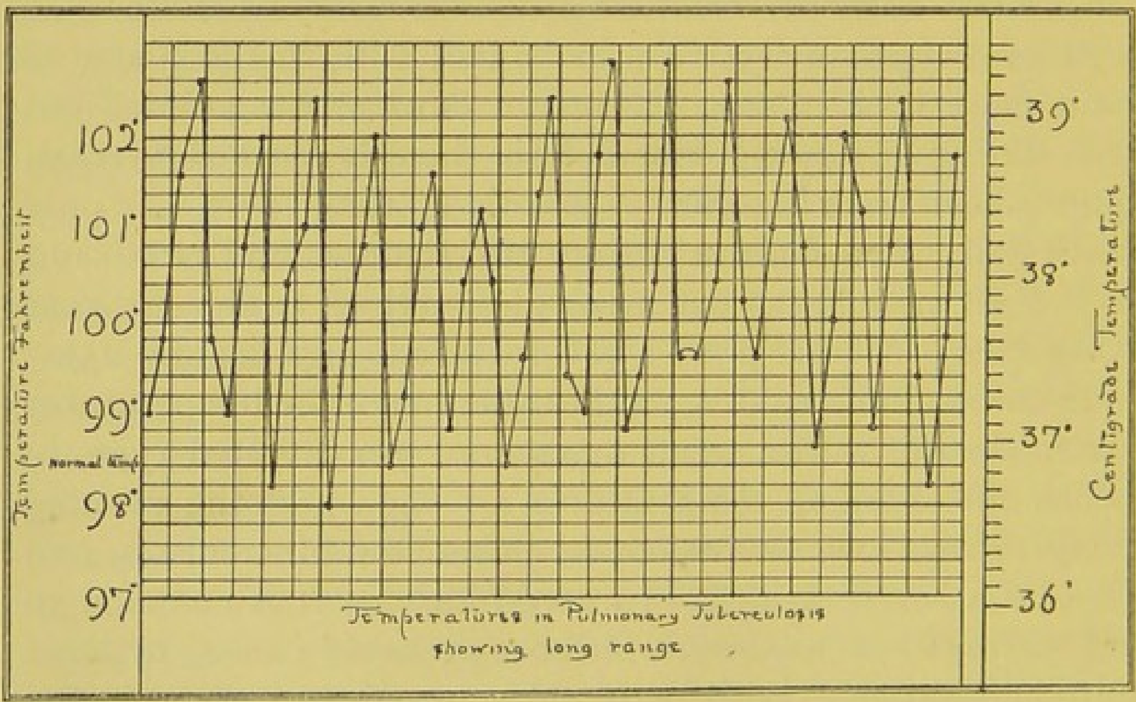

FIG. 25.—TEMPERATURES IN PULMONARY TUBERCULOSIS WITH CASEATION.

to be much greater during acute stages of the disease than those produced by customary doses of tuberculin.

Temperature in tuberculosis may be classified for clinical purposes into *high temperatures*, with small range, large range, or inversion, each subdivided into those with a long wave, a short wave, or an irregular form of wave ; *low temperature* cases into those with a large range or a small range, regular or irregular.

The most favourable cases are those with very little fever, small range (1·5° F. or less), and regular intermissions, not much disturbed by exercise.

Suitable treatment reduces the height of the fever (Fig. 26),

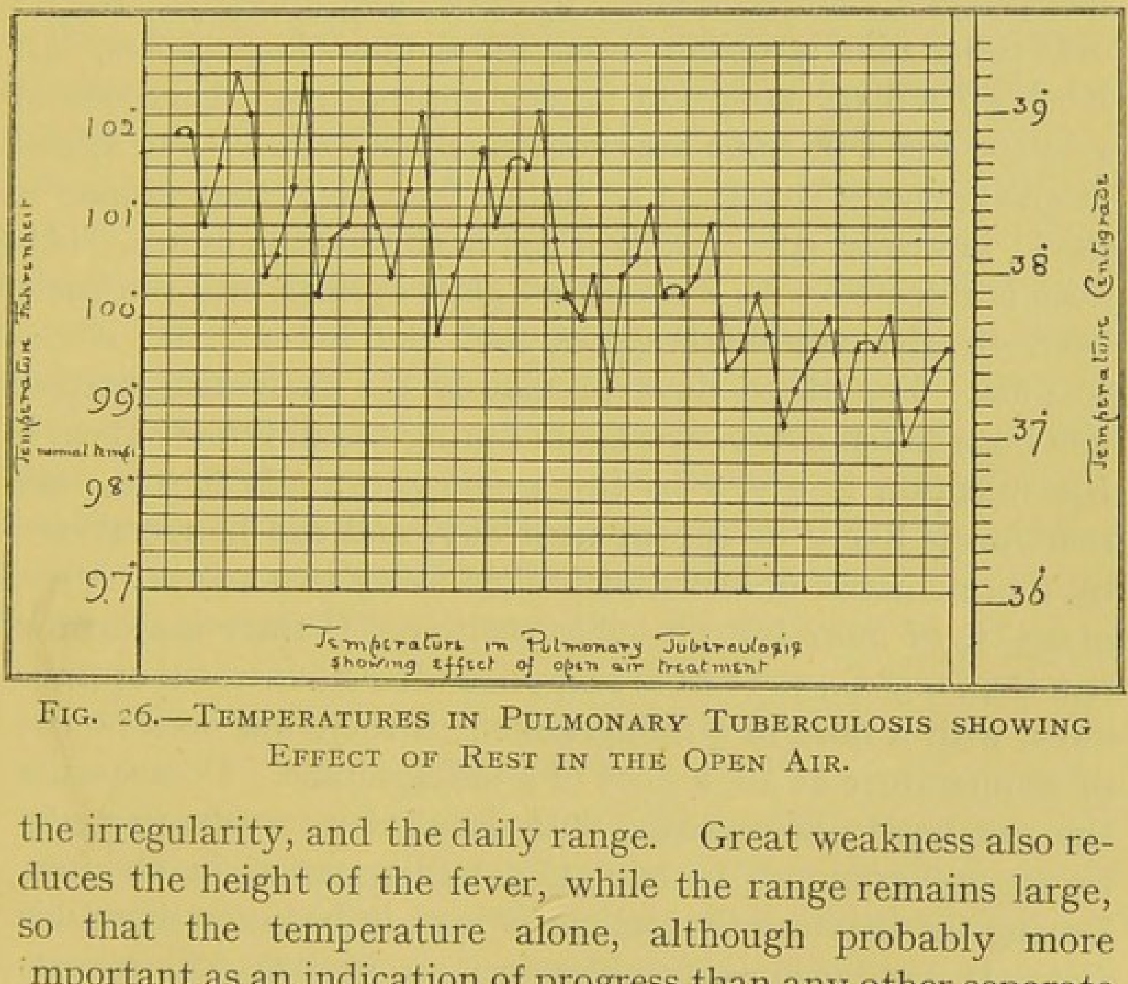

FIG. 26.—TEMPERATURES IN PULMONARY TUBERCULOSIS SHOWING EFFECT OF REST IN THE OPEN AIR.

the irregularity, and the daily range. Great weakness also reduces the height of the fever, while the range remains large, so that the temperature alone, although probably more important as an indication of progress than any other separate symptom, should not alone be taken into account. Where the morning temperature is higher than the evening (inversion), the case is usually a serious one. If there is not marked improvement in the temperature within a few weeks, or in high fever within ten days, supplementary treatment is necessary if a satisfactory result is to be obtained. Hygienic treatment has its limits, and is insufficient to cure a well-marked case with high fever and widespread lesions In such cases, which are always difficult to deal with, specific and medicinal remedies are needed.

§ 31. The Tuberculin Test.

This test is usually applied in afebrile cases in which the diagnosis is in doubt. If used at all in febrile cases, the greatest caution should be observed, and a very much smaller dose employed.

Möller * mentions as other contraindications recent hæmoptysis, cardiac lesions, hysteria, and epilepsy. Koch's old tuberculin is chiefly used for diagnostic purposes, but Koch's bacillary emulsion is also appropriate. Dilutions of 1 in 100 and 1 in 1,000 are successively prepared. For adults in good general condition an initial dose of $\frac{1}{5}$ milligramme is used; in weaker subjects, $\frac{1}{10}$ or $\frac{1}{20}$; in children, $\frac{1}{20}$ or less. This dose is injected with a sterilized glass syringe into the back, between the vertebral spines and the lower part of the scapula. For three days previously the body temperature has been taken every two hours during the daytime; then, if the injection is given in the evening towards 8 p.m., the reaction is likely to appear next day, and can be recognized by thermometric observations taken every two hours. A rise of 0·5° C. or more is regarded as positive. If there is a smaller rise than 0·5° C., the test is reapplied after an interval of three days, with a dose of $\frac{1}{5}$ milligramme; if there has been no rise of temperature at all, a dose of $\frac{1}{2}$ milligramme. Occasionally the test has to be repeated with doses at intervals, rising up to 10 milligrammes in adults, 5 milligrammes in children. During the reaction the patient is kept in bed on a digestible diet. If headache is troublesome, an ice-bag will relieve. It is common to have a local reaction in the form of râles appearing where there had been, perhaps, merely rough breathing; and this suffices for diagnosis, even where no febrile reaction takes place.

In very recent disease the reaction is usually relatively great, as after a time, owing to auto-inoculations, a certain

* Schröder and Blumenfeld, *loc. cit.*, p. 253.

degree of tolerance is established. Formerly a single dose of 5 to 10 milligrammes used to be given, but this may give rise to very severe constitutional disturbance, and has, therefore, been abandoned for the above method by repeated smaller doses. Provided there is no fever and no well-marked evidence of disease in the chest, the above method has been shown by an extended experience to be quite safe and reliable. It has the further advantage of exerting a curative influence over the disease.

Von Pirquet's Method.*

This modification is very useful in the case of young children, but is less reliable later in life. The method is as follows: After disinfecting the skin of the arm with ether, 2 drops of a special tuberculin solution are dropped on to the skin in two places, about 2 inches apart. With a lancet the skin is slightly abraded at these places. After cleaning the lancet, a third abrasion is made between the two, without any tuberculin solution. If the child is tuberculous, the inoculated spots show a red papular eruption within twenty-four hours, the control being little, if at all, affected. The solution consists of 1 part of old tuberculin, 1 part of 5 per cent. carbolic acid solution with glycerine, and 2 parts of normal saline solution, making a 25 per cent. solution.

The Calmette or Wolff-Eisner Ophthalmo-Reaction.

For this a 1 per cent. solution of old tuberculin is employed, 1 drop being put on to the conjunctiva of one eye. In a day or two slight or severe conjunctivitis shows itself in tuberculous patients in the treated eye, the other remaining normal. Calmette avoids the use of glycerine in preparing the solution, believing that the glycerine would irritate the eye. It appears, however,† that a 2 per cent. solution of glycerine does not usually do so. Calmette's method of preparation

* 'Ueber Tuberkulin-impfung,' *Deut. Med. Woch.*, 1907, xxxiii., p. 865.

† Eppenstein: *Med. Klinik*, 1907, No. 36.

is to precipitate the albuminous matter of the tuberculin with alcohol, making a sterilized watery solution from the precipitate. The solution is placed on the inner canthus, the eyelids closed for a moment, and all rubbing of the eye strictly forbidden. It is not wise to apply the test to an eye that is in the least inclined to be inflamed, as, apart from vitiating the test, it might give rise to violent conjunctivitis. Even without this precaution, this mishap has followed in a few instances, although it seems unusual for any real damage to be done by the test. If no reaction follows, the test may be repeated on the other eye after from one to six weeks (Cohn). Sometimes the test fails in undoubtedly tuberculous individuals. This may be because toleration has been produced by auto-inoculations of much larger quantities of tubercle toxins, and is chiefly noticed in advanced cases. The same thing happens at times with all forms of the tuberculin test. Apparently some cases of enteric fever have reacted positively to the test in the absence of tuberculosis,* which Schröder explains by sensitiveness to any form of bacterial proteid material caused by the typhoid toxins.

It does not appear as if any conclusion can be drawn from the test as to the chances of recovery or the severity of the attack. One would expect theoretically that in a very early stage of the disease where the body had not become accustomed to the toxins, a violent response would be produced by a moderate test dose, whereas in advanced disease the usual test dose might fail to produce any reaction; but in widespread early disease there might be very little auto-inoculation, with a considerable reaction to a test dose, so that the latter is of little value in prognosis.

Moro's Method.

consists in the application of a small quantity ($\frac{1}{10}$ gramme) of a tuberculin ointment over an area of about 4 square inches on the chest or abdomen, rubbing in for half a minute, and

* See Schröder and Kaufmann, *Münch. Med. Woch.*, 1908, No. 2, for a discussion of the value of the test, and for references.

then leaving for absorption to take place. If on the second day (or earlier) small papules appear over the treated area, the reaction is regarded as positive. In some cases there is also diffuse erythema. The eruption disappears in a few days. The ointment consists of equal parts of old tuberculin (T.) and lanolin.*

§ 32. The Opsonic Index in Tuberculosis.

In spite of the adverse criticism to which the opsonic index of Sir Almroth Wright has been subjected, it is a very useful means of diagnosis, and a useful guide to specific treatment, although it is no more infallible than any other symptom, sign, or test. One may say that the only absolutely conclusive evidence of the presence of tuberculosis is the demonstration of the tubercle bacillus in material obtained from the excreta or tissues of the body ; but tubercle bacilli are absent from the sputum in closed tuberculosis of the lungs, exactly when systematic treatment is of most value. It is here that the value of the opsonic index is seen. It has been shown that the tuberculo-opsonic index fluctuates in health between 0·8 and 1·2. Many apparently healthy persons have an index outside these limits, just as some apparently healthy persons react to the tuberculin test; but since we know that most people in civilized countries carry some tubercle about in their bodies, quiescent or otherwise, the probability is that an abnormal tuberculo-opsonic index usually shows the existence of tubercle somewhere in the body, though this may at the time be perfectly harmless. The opsonic power of blood-serum against one kind of bacteria may be reduced by great demands made by the presence of another kind of pathogenic bacteria, or possibly by other circumstances, as there is reason to believe that special opsonins are derived from a common pre-opsonin. For this reason the tuberculo-opsonic index may occasionally be lowered by non-tuberculous disease. Still, an abnormal tuberculo-opsonic index is presumptive evidence of the existence of tubercle in the serum-giver, to be confirmed or otherwise by other methods of

* See *Münch. Med. Woch.*, September 29, 1908.

investigation. On the other hand, a normal tuberculo-opsonic index is no evidence of the absence of tubercle, any more than a normal temperature would be. Those who are obviously phthisical quite commonly show a normal index if they are doing fairly well, and have had no marked auto-inoculations nor any specific treatment. As a rule, in quiescent tubercle the index is somewhat subnormal; in active tubercle it fluctuates considerably, being at one time subnormal, at another high; and these fluctuations may happen in the course of the same day. Opsonic indices which are steadily and moderately high are usually found in those in whom the disease is subsiding. When the powers are becoming exhausted at the end of a severe illness, the indices may be normal or subnormal.

RATIONALE OF THE TEST.

The phagocytes or scavenger blood-corpuscles are unable to engulf and carry off pathogenic bacteria unless these are acted upon by substances called opsonins, present in variable quantities in the serum and blood-plasma. Healthy blood-corpuscles appear to have little or no power over tubercle bacilli (and other bacteria with similar properties), excepting in presence of these opsonins. A subcutaneous injection of tuberculin in suitable dose causes an increase in the average number of bacilli engulfed by each phagocyte, and the same thing happens where exercise or other agencies lead to absorption of toxins from a tuberculous focus in the body. In localized tuberculosis, where, presumably, auto-inoculation does not freely occur, the degree of phagocytosis is usually below normal. In pulmonary disease of a kind where the toxins presumably freely pass into the blood-stream, fluctuations are observed in the degree of phagocytosis which remind us of the effects of injection of tuberculin. In proportion as the disease becomes localized the degree of phagocytosis declines towards normal, and the fluctuations diminish. A correspondence has been observed in many cases between the degree of phagocytosis and other forms of antibacterial action, such as agglutination and bacteriolysis. It is, therefore, assumed that the degree of phagocytosis may be taken as a measure of the antibacterial power of the blood.

Recently Wright's theory of opsonins and the opsonic test have been fiercely assailed, especially in the German Pathological Society.* Baumgarten, who led the attack, declared that only dead tubercle bacilli were carried off by the phagocytes, and phagocytosis was only a subsidiary process analogous to carrying off the corpses of the slain in battle. Furthermore, he stated that in immunized animals bacteriolysis takes place in the serum, not in the phagocytes, and that just as abundant cultures could be obtained from bacilli treated with serum and leucocytes as with those treated with serum alone. In his opinion, it is only cholera vibrios and other specially vulnerable bacteria which are killed by phagocytosis.

On the other hand, A. Latham and A. C. Inman have shown † that the opsonic index (or relative amount of phagocytosis) varies inversely with the temperature in phthisis; while Wright has shown that the effect of serum in promoting such phagocytosis agrees with what would be expected from the source of the serum—being least in the centre of an abscess, most at the periphery or in remote parts of the body. Even if only the dead bacilli are swallowed up, the number of dead bacilli would still be probably proportional to the bactericidal power of the serum, so that the phagocytic test could be taken as a measure of its activity. Baumgarten's test of making a culture was probably not of sufficient delicacy to decide the matter one way or the other; and as we have concordant evidence from many quarters that the opsonic index rises and falls with the rise and fall of antibacterial activity, there is no reason to doubt the value of the test. Treatment based upon Wright's theory has been successful in curing or improving diseased conditions to a remarkable extent, while the theory explains many facts which are otherwise inexplicable.

* 'Untersuchungen über Opsonine,' *Verh. d. Deutschen Pathol. Gesellsch.*, 1908, p. 254.

† Proceedings of the Royal Society of Medicine, April, 1908; *Lancet*, October 31, 1908, and January 25, 1908.

Technique of the Test.

To apply the test, we require freshly drawn blood-corpuscles deprived of the blood-plasma, blood-serum from healthy blood deprived of its fibrin and corpuscles, the same from the patient to be examined, and suspension of tubercle bacilli of suitable strength.

The blood-corpuscles are obtained by dropping blood into a solution of sodium citrate and chloride, mixing, centrifuging, removing the liquid, washing in normal sodium chloride solution, and again removing the liquid after centrifuging.

The blood-serum is obtained by allowing blood to clot in a sterile glass tube, and centrifuging it.

The bacillary suspension may be obtained by rubbing down a small portion of a culture in a little strong saline solution; or the residue from the manufacture of tuberculin may be similarly mixed with saline solution.

Equal quantities are then drawn up of the corpuscles, the suspension, and the serum, into a glass pipette drawn out into a capillary tube, the three being separated from one another by bubbles of air. They are then mixed, and placed in the sealed tube in an incubator at blood-heat for fifteen minutes, after which a very thin film preparation is made on a glass slide, stained and counterstained, to show the bacilli and blood-corpuscles. The number of bacilli engulfed in 50 or 100 phagocytes is counted in each specimen with a $\frac{1}{12}$-inch oil-immersion lens. The number in the specimen with healthy serum is used as a divisor, that in the other specimen as the dividend; the quotient is called the opsonic index.

If the test has been properly carried out, there should be an average of from one to ten bacilli per phagocyte. Three or four are convenient averages. The comparison should by rights be made with the average of several healthy specimens, in order to avoid the fallacies resulting from fluctuations in the normal sera; otherwise there may easily be an error of 50 per cent. In the hands of those familiar with the test the error is usually not more than 5 to 10 per cent., estimated by the difference between two counts of slides with the same serum. Very often the counts are almost or quite identical.

To Collect the Blood.

The blood specimens should be taken at the same hour in every case, otherwise as great discrepancies may be found as in the comparison of the maximum temperature of one person with the minimum temperature of another. It is a good rule to draw off the blood in the morning—say at 9 a.m. —before there has been much exertion or exercise. In many cases a coughing fit or the exertion of dressing will affect the opsonic index.

If an ambiguous result is obtained from the blood taken at rest, a comparison may be made between specimens taken before and after exercise, or before and after massage or passive motion in the case of local tuberculosis.

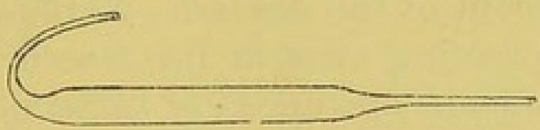

Fig. 27.—Glass Capsule for collecting Blood for the Opsonic Test.

The blood may be taken from the lobule of the ear, but it is more convenient to prick the finger with a glass pricker made out of a capillary tube, or with the needle supplied with a hæmocytometer. Either the pad of the finger or the dorsum of the last phalanx may be pricked. In the latter case, by bending the phalanx the blood-flow may be increased. Before and after pricking the finger the pricker should be sterilized (in the case of the glass one, freshly drawn to a point). A little lysol may be rubbed on to the spot chosen for puncture before and after pricking it. In cold weather it is wise to warm the hand first. Too much squeezing is not advisable, since the interstitial fluid often has a higher opsonic index than the blood. Taking a curved glass capsule (Fig. 27), the hooked end is made to touch the drop of blood in such a way that capillary attraction draws the latter in to the far side of the hook. Then, by gently warming the empty body of the capsule in a spirit-lamp flame, and sealing the straight end by contact with the flame, a partial vacuum is produced, which draws the blood well into the capsule. The hooked end can then be sealed with sealing-wax. In such a capsule the blood will keep for several days, and may be sent through the post to a laboratory.

The Heated Serum Test.

A modification of Wright's test consists in estimating the difference between the opsonic indices of heated and unheated sera. The serum of tuberculous and inoculated persons loses about nine-tenths of its opsonic power by being heated for ten minutes at 60° C., whereas that of normal blood only loses about one-half.

The practitioner who wishes to learn the technique of the test is referred to a book by R. W. Allen,* which contains a trustworthy account of the method. Nothing, however, will replace actual practice, even in the case of those who are expert in the ordinary operations of bacteriology and microscopy. This has been strikingly illustrated by some of the recent criticisms of the test, notably that by the Committee for the Study of Special Diseases,† in which it was shown that most discordant results were arrived at in certain laboratories. At St. Mary's Hospital Pathological Laboratory the discrepancies between the results of different workers seldom amount to more than 10 per cent., and are usually much less;‡ and if we except instances in which there was an obvious failure of technique, recognized at the time, the same has been true at the Crooksbury Sanatorium, where the writer has used the test regularly for over three years. If in some laboratories the test is found to be consistent in its results, in other laboratories erratic, the conclusion is obvious.

* 'Vaccine Therapy and the Opsonic Method of Treatment.' London, 1908.

† M. P. Fitzgerald, R. J. Whiteman, and T. S. P. Strangeways: 'An Inquiry into the Value of the Opsonic Index,' Bulletin of the Committee for the Study of Special Diseases, Cambridge, 1909.

‡ See *Practitioner*, May, 1908.

The Inoculation Curve.

Injection of a dose of vaccine has a characteristic effect upon the opsonic index, which may be shown by daily observations, and by plotting the indices in the form of a curve. The effect of a very small dose is to raise the index (prenegative rise), which, after a variable (but usually a short) time, gradually drops to a position a little higher than, or identical with, the one at the time of inoculation. A slightly larger dose first causes a fall (negative phase), sometimes

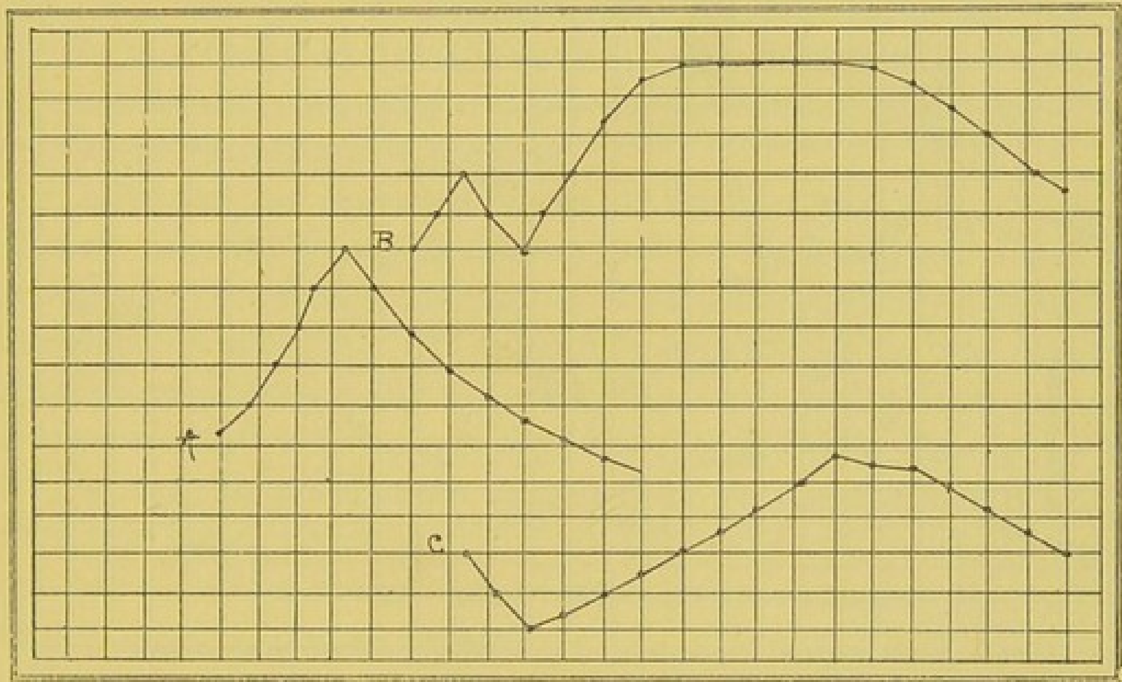

Fig. 28.—Opsonic Curves showing Effects of Inoculation of Tuberculosis in Various Doses.

preceded by a slight prenegative rise, followed by a rise (positive phase), which lasts longer, and then gradually declines as before (Fig. 28). An excessive dose causes a negative phase, which may last some time without a rise. The length of time occupied by these different phases is very variable: the negative phase may last a few hours or many days, the positive phase lasting from a day or less to several weeks. It is during the positive phase that healing takes place in abscesses and the like. When the index begins to decline, healing often ceases until a fresh inoculation is given. Auto-inoculations produce a similar series of events, but more irregular, owing to the superposition of wave upon wave. The effect of large repeated doses of tuberculin is to intensify the negative phase, while the positive phase is long in coming, and ill-marked. Auto-inoculations often cause more disturbance than injections of tuberculin (Fig. 29). An excessive dose of vaccine, or a large auto-inoculation, causes a 'reaction' in the shape of fever and malaise, during which the opsonic index varies inversely as the fever. There is no need for this, and inoculations of each kind should be so proportioned and

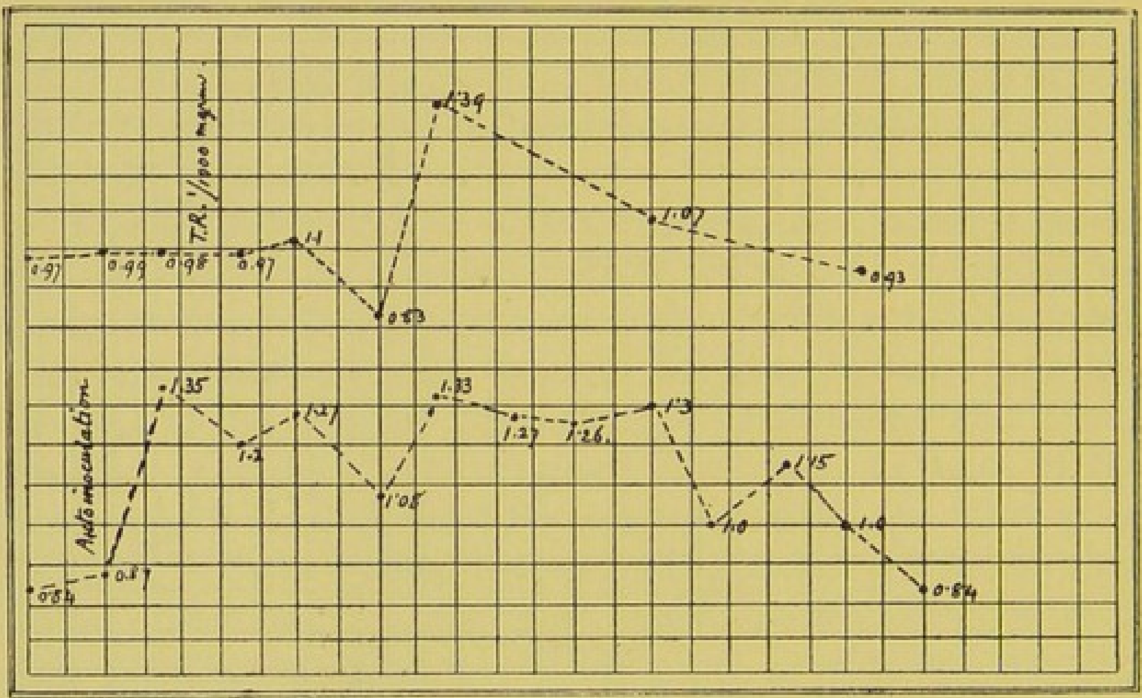

FIG. 29.—OPSONIC CURVES FROM INOCULATION AND AUTO-INOCULATION RESPECTIVELY.

given at such a time as to produce no febriie disturbance. From cases published by A. Latham it appears that doses may be appropriate in various cases, ranging from $\frac{1}{100000}$ milligramme to $\frac{1}{10}$ milligramme TR; but I am informed that some doctors have given initial doses of as little as $\frac{1}{1000000}$ milligramme with advantage;* whereas in Germany it is usual to increase the doses gradually until 10 milligrammes are being given. It is doubtful whether these large doses are ever necessary, even if they do no harm (see p. 288).

* These may, however, refer to Spengler's preparations.

§ 33. Examination of the Chest.

There are no physical signs absolutely pathognomonic of tubercle. The diagnosis rests chiefly upon the position in which they are found, their persistence, the succession of changes at the same spot, and evidence obtained in other ways, such as from the examination of the sputum and the effect on the general health.

It is quite common to find subcrepitant or cogwheel respiration in those who have never suffered from tubercle, and who do not develop the disease. It is just as common to hear râles and rhonchi, which might equally well be caused by simple bronchitis as by tubercle. Tuberculosis may begin with a condition indistinguishable from ordinary pneumonia, or from non-tuberculous pleurisy.

If, however, the abnormal signs are located in places where tubercle commonly begins, if they persist for a week or more in one spot, or if they undergo changes attributable to those commonly undergone by tuberculous infiltrations, we are justified in provisionally regarding the case as tuberculous. If on auscultation the signs are very slight and uncharacteristic, we may be aided in our diagnosis by the use of tuberculin, since this has a selective action on tuberculous deposits, and may cause a rapid though temporary alteration in the physical signs if they are due to tubercle.

In examining the chest, we have to distinguish between early quiescent tubercle, disease which is actively progressing, and conditions which are merely the result of previous disease. Each of these has a bearing on prognosis as well as on diagnosis. We must be prepared to find evidence of changes of all degrees, from a scarcely detectable abnormality to extensive destruction.

It has been shown experimentally* that tubercle bacilli of very low virulence may produce lesions resembling cirrhosis, whereas ordinarily they lead to the formation of a granulation tissue of low vitality, tending to decay with production of cavities, or to an overgrowth of cells which undergo casea-

* Störk : Transactions of the Tuberculosis Congress. Vienna, 1907.

tion in more wholesale fashion. Creighton* has brought forward evidence tending to show that giant cells and epithelioid overgrowth depend upon capillary thrombosis, which provides a pabulum for the active growth of these cells; and has apparently proved that a similar process takes place physiologically in the placenta. Bacillary infection very commonly gives rise to capillary thrombosis, so that this theory is not incompatible with our other knowledge of tuberculosis. However this may be, caseous infiltration points to a more virulent form of infection or a lower vitality in the subject, and shows itself in more rapid consolidation and breaking down of the affected parts. Generally speaking, the more favourable the case, the more the tendency to fibrosis and calcareous changes, the less to caseation.

Early diagnosis is, however, at least as important as extent or virulence of the disease, since the disease is far more amenable to treatment in an early stage. It has been said with some truth that pulmonary disease is no longer in an early stage when it causes definite physical signs; and it is especially whilst the physical signs are somewhat indefinite that recovery will almost certainly result from systematic treatment on sanatorium lines.

The earliest signs in the chest are those dependent upon slight obstruction to the entry of air, slight irritation of the air-tubes, or slight loss of elasticity in the lung. Later on come those which are caused by more extensive infiltration or commencing softening. The signs of irritation are those of a very localized patch of bronchial catarrh, fine and medium crepitations, or a single mucous râle, heard at the end of inspiration. At first these are not heard in quiet breathing, but are elicited by a cough, followed by a deep inspiration. I have known many cases where adventitious sounds were entirely absent during quiet deep breathing, but widespread and marked after cough. These soft crepitations may be present even when there is no expectoration, and may be absent at some examinations and present at others, returning

* 'Contributions to the Physiological Theory of Tuberculosis.' London, 1908.

to the same spots. Later on, with increased secretion, we may hear the crepitations without cough, and with both expiration and inspiration. They are not consonating until there is a fair amount of consolidation, so that consonating râles are a sign of well-marked disease. Unlike pneumonia, it is not usual to find them replaced by bronchial or tubular breathing; but they may gradually become coarser in character and associated with something like bronchial breathing.

There are some cases in which the vesicular murmur is rough and almost crepitating in character, without any other evidence of lung disease. If this change is widespread, equal on both sides, fading gradually into the ordinary type of respiration at the bases, and unaccompanied by alterations in the temperature or general health, it may be regarded as probably a variation within the bounds of health. This conclusion is confirmed if no change is noticeable after several weeks or months. If the changes are localized to one of the parts usually affected in pulmonary tubercle, without impairment of the health, they may be regarded as probably due to quiescent or spontaneously cured tubercle; so that beyond counselling a healthy life, as in the case of one predisposed to tubercle, no special measures are necessary.

Obstruction to the air-tubes is shown by feebleness of the vesicular murmur when one part is compared with another. Deep inspirations should be insisted upon during examination, performed with the mouth open, and as noiselessly as possible. A slightly louder respiratory murmur may be heard at the left apex in perfectly healthy people, probably because of the unsymmetrical arrangement of the bronchial tubes on the two sides. If, then, weak breathing is found over the right apex, not abruptly confined to a limited area, and unaccompanied by other abnormality, it may be disregarded. Further evidence of pathological obstruction may be present in the shape of interrupted inspiration (cogwheel breathing), or prolonged expiration, the latter being also a sign of loss of elasticity. These are among the commonest early signs of tubercle, and if persistent, are almost always the result of present or past disease.

In dense infiltration of a patch of lung there may be deficient breath-sounds on deep inspiration, causing a click, like the separation of two sticky surfaces. In such a case there is always some alteration in the percussion sound.

It is most important in diagnosing the extent of lung mischief to note the area over which natural breathing is absent as well as that over which abnormal signs are present. Without this precaution, the extent of disease may be greatly under-estimated.

Puerile respiration over one lung, or over the bases of the lungs, or other more circumscribed area, points to dense infiltration in other parts (if pleuritic effusion be absent), so that the extent of the damage may be partly estimated by altered breath-sounds in the relatively healthy parts of the lungs.

The same applies to hyper-resonance on percussion. In early infiltration the pitch of the percussion note is usually raised, so that it may not be actually dull over the affected part. Marked dulness (as of a pleuritic effusion) is never found in early tuberculous infiltration; the most that should be expected is a slight dulness on light percussion. If there is more than this, the disease is already somewhat advanced. Slight degrees of dulness may be intensified by using a good door as a support for the patient's back (Habershon). The heart-sounds may be unusually audible over a consolidated patch.

Commencing softening is usually shown by abundant medium or mixed râles after cough on deep breathing, accompanying both inspiration and expiration, together with well-marked signs of infiltration or consolidation. In such a case there will be diminished movement of the affected part; the upper lobe may perhaps be shown to be shrunken on careful percussion; there will be distinct impairment in the percussion note, decided lack of vesicular murmur, or else fairly abundant adventitious sounds over the softening patch; and the vocal resonance will be altered in quality over the affected area. If there be much fibrosis around the softening patch, the respiration may be blowing in character, like bronchial breathing, but without the usual interval between inspiration and expiration (Higginson). In such cases it is common to get friction-sounds, either over the apex or above the mamma or in the postero-lateral regions of the lung, near the scapula. Unless consolidation is well marked and widespread, it is unusual to be able to detect alterations in the vocal fremitus. The presence of tubercle bacilli or elastic tissue in the sputum is evidence of softening in the lung.

The evidence of cavitation is always rather ambiguous, because the physical signs are often the same as for a patch of consolidation involving a bronchus. If cracked-pot sound is obtained, this is usually good evidence of the existence of a superficial cavity. The percussion note may be either dull or tympanitic over a deeper-placed cavity, according as the surrounding fibrosis or consolidation is well marked or not. A small cavity surrounded by normal lung may give a perfectly natural percussion note. Bronchial breathing is not diagnostic, though suspicious unless there be marked dulness. Amphoric breathing is conclusive evidence of a cavity, though this may be a dilated bronchus. Adventitious sounds may be almost or entirely absent if the entrance to the cavity is sufficiently obstructed, in which case the appearance of râles may herald an improvement. If after cough there be heard a succession of well-marked râles, this is usually evidence of the existence of a cavity. Large gurgling râles are also suggestive. The position of the patient sometimes affects the appearance or non-appearance of râles.

Amphoric vocal resonance is usually the sign of a cavity ; whispering pectoriloquy is a little less conclusive.

When contraction of the cavity occurs, there may be displacement of other viscera, such as the heart ; and the chest-wall may be distorted, and its movements restricted by adhesions.

Cavitation is not necessarily evidence of extensive disease. In a case sent to me by Sir Douglas Powell there was good evidence of the existence of a cavity at one apex, with elastic tissue and tubercle bacilli in the sputum, but the lesion was of small extent. The patient remained free from fever, and made a perfect recovery.

§ 34. Distribution of Tubercle in the Lungs.

In chronic tuberculosis of insidious onset the parts of the lungs most frequently affected are those in which the air is most likely to stagnate. In the upper lobes* the commonest position is at a point 1 to $1\frac{1}{2}$ inches below the summit, towards the posterior and external aspect, spreading in the first instance backwards, so that the earliest evidence is often to be found in the supraspinous fossa. Anteriorly this corresponds with the supraclavicular fossa or to a spot below the centre of the clavicle. Another common line of extension is downwards and outwards along the front of the upper lobe.

A less common starting-point is opposite the first or second interspace, below the outer third of the clavicle. Excepting in cases which begin with pneumonic or caseous consolidation, the middle and lower lobes are usually only secondarily affected. In the lower lobe the earliest sign is usually at a spot opposite the fifth dorsal spine, midway between the scapula and vertebral spines. The disease may appear at this spot on the same side as the original lesion, or at times on the opposite side. Extension takes place obliquely downwards and outwards along a line corresponding with the border of the scapula when the hand is placed over the opposite shoulder. Extension towards the base usually occurs in groups of spots, probably from extension through the bronchi. Secondary infection of the upper lobe may attack it just above the middle of the interlobar septum, spreading thence in all directions. It is quite common to find secondary infection in the axillary regions, which should, therefore, always be carefully examined.

Where pulmonary tuberculosis starts with a pneumonic attack, the first signs may be in the lower lobes, the upper lobes being secondarily affected. Excepting in such cases, the disease spreads according to gravitation, from above downwards, and (if the patient be in bed) from the front

* J. Kingston Fowler and R. J. Godlee: 'The Diseases of the Lungs,' p. 350. London. 1898.

towards the back, or towards the side on which he usually sleeps.

If the first evidence is a pleuritic attack, friction-sounds may be heard over the upper lobes, very commonly near their lower limits.

Lawson has shown that there is one form of pulmonary tubercle in which extension follows the chief bronchi and their subdivisions. This is most easily diagnosed by the X rays.

§ 35. Compensatory Hypertrophy and Emphysema.

It is extremely common to have a progressive enlargement of the healthy lung in unilateral tuberculous disease. As a rule, this is merely emphysematous; but most authorities believe that true compensatory hypertrophy may take place if the destructive processes are limited and the general nutrition remains good.

The presence of much emphysema is very apt to mask the associated tubercle, so that it is unsafe to estimate the extent of the affected area by the distribution of dulness on percussion or of adventitious sounds. Since the breath-sounds are diminished in emphysema, there may be large areas of disseminated tubercle which do not even reveal their presence by such signs. It is safer to estimate the extent of the disease by the area over which good normal breathing is clearly audible, and to regard the rest of the lung as suspect. The degree of breathlessness may also help, if we take account of the state of the circulation; but it is always difficult to arrive at a reliable conclusion in such cases.

§ 36. Röntgen-Ray Examination of the Chest.

Early evidence of pulmonary disease may be obtained by means of the X rays, although it is disputed whether this method or the ordinary methods of physical examination are the more likely to detect early disease. Probably it depends on the examiner. The chief points to be noticed in an examination of the chest by the X rays are alterations in transparency and in movement. An infiltrated patch usually gives a denser shadow than normal lung, and fails to light up with deep inspiration. A cavity usually shows a clear space surrounded by a denser area. In chronic fibroid lung disease one usually sees mottled areas. The mobility of the diaphragm is often seen to be restricted, and the ribs are not as much separated in breathing as in health.

§ 37. Changes in other Organs.

It is foreign to the purpose of this book to give an exhaustive account of all the indirect consequences of pulmonary tuberculosis or of the associated changes in other organs ; it will be sufficient to refer here to a few of them.

Cardio-vascular Changes in Tuberculosis.

In early tuberculosis there is stated to be usually reduced vascular tension, together with the alterations associated with secondary anæmia. The heart is usually small in such conditions, and its muscular substance may be feeble. Sometimes, however, there may be signs of dilatation. The tachycardia of consumptives is to be explained by the action of tubercle toxins on the central nervous system, as well as on the heart itself. The alterations in this stage chiefly affect the left side of the heart. After a while, owing to obstruction in the lungs, the right side of the heart often becomes overworked, causing dilatation of the right ventricle. Many of the fatal cases of pulmonary tuberculosis die in consequence of a rapidly induced cardiac insufficiency.

In addition to these two classes of cardiac changes there are others, which result from mechanical displacement or pressure due to destruction of lung tissues, compensatory emphysema, and contraction of fibrous tissue. These are very apt to cause uncomfortable palpitation after cough or exertion, or during gastric digestion.

It is scarcely necessary to remind the practitioner of the frequency of aneurysmal dilatations in the lung after severe and protracted tuberculous disease. Excessive conduction of heart-sounds to parts of the chest should arouse suspicion of tuberculous consolidation in doubtful cases. A see-saw murmur persisting in one spot over a damaged lung is suggestive of aneurysm, and in such a case the diet and manner of life should be modified in such a way as to diminish the risk of hæmorrhage. I have known one case of fatal hæmorrhage apparently precipitated after virtual recovery from tubercle by persistence in a large diet after the need for it had gone.

It is common to get dilatation of the veins over the chest in pulmonary tuberculosis. There may be a regular festoon of such vessels right across the chest in front or behind.

§ 38. **Laryngeal Disease.**

It is extremely common to get disturbance of some kind in the larynx in the course of pulmonary tubercle, although many of these ailments are not actually tuberculous, but due to the effect of coughing or other non-specific causes. Actual laryngeal disease has been shown by Habershon especially to attack the parts of the larynx supplied with squamous epithelium, where there are no cilia to move off the sputum. Thus the arytenoid and interarytenoid region suffer disproportionately, together with adjacent folds of mucous membrane and the part of the true vocal cords nearest to the arytenoids, these parts being inoculated by the expectorated matters. Less commonly infiltration occurs from within, the infection travelling up along the lymphatics. Primary laryngeal disease is far less common than that secondary to lung disease. The commonest forms of laryngeal tubercle are swelling of the arytenoids, vocal processes and interarytenoid fold, swelling and ulceration of the epiglottis, swelling and ulceration of the vocal cords and ventricular bands. There may also be paralysis of the vocal cords, either toxic or inflammatory.

The symptoms in an early stage are aphonia, huskiness or hoarseness, with perhaps sore throat and pain in the ear, palate, or larynx itself. Later on dysphagia is very common, the chief difficulty being in swallowing liquids, while soft solids give the least trouble.

As many laryngeal complications are in the first instance not tuberculous, and fairly easily cured, it is wise to attend promptly to any subjective sensations referred to the larynx. Actual tuberculous disease of the larynx adds very greatly to the danger in cases of pulmonary tubercle.

§ 39. Cutaneous Changes in Tuberculosis.

The skin and mucous membranes may suffer in various ways from tuberculosis. Fairly numerous instances are on record in which tuberculosis has been inoculated from without, with the formation of tuberculous new growths in the skin, lips, etc. Under this heading come tuberculosis cutis verrucosa, tuberculosis cutis necrogenica, cases in which lupus vulgaris has been implanted upon a cracked or ulcerated or eczematous surface, cases of tuberculosis from infection by broken spit-cups, in milking tuberculous cows, etc. In other cases the skin or mucosa has been affected secondarily to some tuberculous affection of lymph glands or other organs. Under this heading may be placed cases of scrofuloderma. A third group consists of tuberculous lesions in which the infection comes by way of the blood-circulation. Probably cases of lichen scrofulosorum, erythema induratum of Bazin, perhaps acne cachecticorum, as well as the rare diseases tuberculosis cutis miliaris and erythrodermia exfoliativa universalis (Bruusgaard), belong here. In a fourth group are found lesions which are the consequence of dissemination of tubercle toxins rather than of bacilli. The extent of this group is still uncertain, but it probably includes cases of erythema multiforme, erythema pernio, falling and nutritive alterations in the hair of the head and dorsum of hands, excessive development of hair on the chest, and pityriasis tabescentium. Some of the ailments in this group are not absolutely specific. Pityriasis tabescentium is found in other wasting diseases, and pityriasis versicolor, although more often found in tuberculous persons than others, is a parasitic disease implanted upon a skin surface too freely bathed in perspiration. Chilblains are not a tuberculous affection, although they appear to be specially common in tuberculous patients with a feeble circulation. Clubbed fingers and the disease called pulmonary hypertrophic osteo-arthropathy are also common but non-specific results of usually long-standing lung disease.

Alterations in function are very common in the skin of the consumptive. Unilateral sweating, limited to one side of the chest, one hand, or one axilla, is frequently met with. There is often a peculiar and characteristic odour about the tuberculous, which may be noticed in quite early cases where the evidence of tuberculosis is still feeble. I have known two cases in which this was one of the earliest signs, but it is obviously of no value excepting to the medical man of experience, as a smell cannot be accurately described.

Pain and tenderness are common in early tuberculosis, especially over the seat of disease in the lungs, and may help to confirm the diagnosis in a doubtful case. Muscular irritability on percussion is common in well-marked tuberculous cases; rare, as far as my experience goes, in early cases.

V.—CLIMATIC TREATMENT

§ 40. Alpine Resorts.

Most early cases of tubercle with little constitutional disturbance do well in the Alps, as also those who are merely threatened with the disease. In addition to climatic advantages, which make a life out of doors attractive, there is the further advantage that people who are recommended to go to Switzerland are more likely to consent to a prolonged course than those who go to a British sanatorium or health resort. This makes any comparison between the results in the two countries misleading, as in the one case a year or two is commonly devoted to the pursuit of health, in the other only a few months. Moreover, the very ill are, by the nature of the case, more likely to remain in England than to go abroad.

Dr. Ewart, who has lately been recommending a stay in Switzerland for at least a month or six weeks as a preliminary to further treatment elsewhere, mentions the following as unsuitable for treatment in the Alps: All advanced cases in terminal stages, with severe visceral complications, whether cardiac, vascular, renal, gastro-intestinal, hepatic, nervous, or alcoholic; or with specially adverse respiratory affections, such as catarrhal bronchitis, asthma, bronchiectasis, emphysema, or late laryngeal tuberculosis. Relatively early cases are also excluded by him if they show much pneumonia, active tuberculization (as evidenced by persistent pyrexia, wasting, rapid pulse-rate, or much dyspnœa), considerable tendency to hæmoptysis, or any of the pulmonary or visceral complications already mentioned.* It is a mistake to send people to the Alps who are very sensitive to cold, or who have a bad circulation, or brittle arteries, or a small respiratory surface. Apart from these conditions, there are some who find a difficulty in sleeping properly at a great height. It is rather remarkable that the class of case recommended by Dr. Ewart for Alpine treatment is exactly the class which does well in a British sanatorium.

The late Dr. Solly† endeavoured to analyze the results of treatment in 7,795 cases of pulmonary tubercle, from which it appears that treatment in high altitudes is much more useful than treatment (outside a sanatorium)

* 'Alpine or Home Climates for Early Tuberculosis,' *British Medical Journal*, January 16, 1909.

† 'Medical Climatology,' chapter viii. London, 1897.

at low levels; but sanatoria appear to get better results than the Alps in early cases, and slightly worse results in Turban's second and third stages. His figures are as under:

	Percentage of Benefit.		
	All Stages.	First Stage.	Second and Third Stages.
Lowland climates ..	58	71	28
Sanatoria	63	95	58
High climates	76	89	63

As most of the existing sanatoria are in places of little or moderate elevation, this shows (what would have been expected) that better results can be obtained by treatment in an institution specially equipped for the purpose than in an ordinary house. Assuming that the sanatorium doctor is on the average as competent as the non-sanatorium practitioner, the advantages are bound to be in favour of the former in dealing with a disease which requires special hygienic conditions, special experience in the application of remedies, and much time and perseverance on the part of both doctor and patient.

§ 41. Sea-Voyages.

As regards the value of sea-voyages there is little to add to what has been said elsewhere. Solly* tabulated the results of sea-voyages in comparison with those of treatment inland in high and low altitudes respectively, from which it appears that sea-voyages are not nearly so useful as treatment on land. There does not seem to be any special reason why less favourable cases should be sent for a sea-voyage than are treated on land, so that the statistics are probably reliable on this point. The exposure to wind, dependence

* *Loc. cit.*

on weather, and foul air of cabins and saloons, are great drawbacks to marine treatment. Solly's figures are as under:

	Percentage of Benefit.		
	All Stages.	First Stage.	Second and Third Stages.
Sea climates	57	71	38
Inland climates	63	92	57
Climates of high altitude	76	89	63

VI.—HYGIENIC TREATMENT

As this subject has been fully treated in another part of this book, it is unnecessary to say much here about it. Dietetics are referred to in the next section.

§ 42. Tests for Purity of the Air.

Air vitiated by respiration owes its noxious qualities partly to the carbon dioxide it contains, partly to living and inanimate organic materials, to a small extent to the exhaustion of oxygen and ozone. The most convenient tests for its purity are, however, the educated nose and some of the chemical tests for carbon dioxide. One of the simplest is

DR. ANGUS SMITH'S HOUSEHOLD METHOD,

in which ½ ounce of lime-water containing 0·0195 gramme of lime is shaken up with a bottleful of air. If the air contains not more than 0·03 per cent. of CO_2, a pint bottle of air with this amount of lime-water should give no precipitate. The bottle should previously be sterilized, and filled with distilled water, which is poured out in the room to be examined, and the lime-water put in instead. Any greater degree of impurity is unsatisfactory for open-air treatment.

Lunge and Zeckendorf's Method

is more delicate, but requires special apparatus. To perform it, a 100 c.c. bottle is required, with a rubber stopper perforated for two glass tubes, one of which just penetrates the cork, while the other reaches nearly to the bottom, and is connected above with a rubber tube provided with a rubber ball and a valve. Ten c.c. of $\frac{N}{500}$ sodium carbonate solution in distilled water neutral to test-paper and containing 1 gramme per 1,000 c.c. of phenolphthalein, is put into the bottle. The latter has been previously exposed to the air of the room, but the solution must be used fresh, and kept from contact with the air. The rubber ball is repeatedly squeezed in the room to be tested, and the number of squeezes sufficient to decolorize the solution shows the proportion of CO_2. Two squeezes would represent 30 parts per 10,000; 20 squeezes, 6·2 parts per 10,000; 30 squeezes, 4·8 parts per 10,000; 40 squeezes, 3·8 parts per 10,000, representing good open air. A table is supplied with the apparatus, showing intermediate proportions.

Pettenkofer's Test.

A 2-litre bottle is filled with air from the room to be tested, with the help of bellows; 60 c.c. of pure lime-water or baryta-water are added. The bottle is stoppered and well shaken. The causticity of the lime or baryta is estimated by a solution of oxalic acid, the point of neutralization being determined by turmeric-paper. The bottle is allowed to stand for a few hours, and the causticity of the contained alkali is again estimated, the difference representing the number of milligrammes of alkali which have combined with the CO_2 in the bottle.

§ 43. Ventilating Contrivances.

Conical Ventilation Inlets.

At the Parkes Museum, Margaret Street, W., there is a model showing that a puff of air directed through the wide end of a glass funnel will extinguish a candle, whereas it will fail to do so if directed through the narrow end. Ellison's air-bricks are made on this principle, but the openings are too small to be of service for open-air treatment. In fixing open a French window which opens outwards, it is not advisable to put the two halves slanting towards the outside walls of the house, as this reproduces the same features as the conical inlet with the narrow end pointing inwards, and is likely to cause a draught. Placed at right angles or flat against the walls, there is no such danger.

§ 44. Tents for Open-Air Treatment.

Dr. Huber, in his book (' Consumption and Civilization'; Philadelphia, 1906), describes several tents which have been extensively used in America for the treatment of consumptives. The simplest and cheapest—the Ulrich Sanatory Tent—consists of a ridge-tent with a fly outside, forming in section two parallel inverted **V**'s, with usually open ends, and a raised platform, which supports the framework.

§ 45. Hydrotherapy in Tuberculosis.

In German sanatoria, while the ordinary forms of bath (hot and cold) are but little used, the patient is submitted to an ascending scale of hydrotherapy, beginning with rubbing with spirit, going on through rubbing with a cold wet sheet to the cold subdivided or unsubdivided douche. The objects are stated to be to accustom the skin to stand cold air and to get it into a healthy condition; but in this country no difficulty is experienced in effecting this without hydrotherapy. I have found a needle-bath popular in summer-time, but do not regard it as indispensable. The more finely subdivided the stream of water, and (within certain limits) the greater the force of impact, the more stimulating it is to the skin, the circulation, respiration, and digestion—in fact, the more 'tonic' it is. A great point is made in sanatoria which model their practice upon that of Nordrach, in Germany, of avoiding active drying of the skin, the patient after a bath getting into bed with a blanket or bath-sheet round him. This practice avoids undue raising of the temperature in susceptible patients, so that those with but slight fever can have a bath in this way without suffering from it.

Hydrotherapy is useful for three other purposes—to lower excessive temperature, to promote expectoration, and to reduce inflammation. For the former purpose sponging with tepid water is best, great care being taken not to allow the patient to exert himself at all. The application is unnecessary, excepting with temperatures rising above 103° F. The sponging may be repeated every half-hour, lasting five minutes each time. With longer applications, the patient sooner or later complains of fatigue. As a rule the face and arms should be sponged first, then the pyjamas or night-dress may be opened, the sides packed with towels, and the chest and abdomen quickly sponged. The skin may be quickly dried, and the patient covered up with just enough covering to prevent his feeling chilly. In warm weather there is no need to dry the skin, which may even be left exposed for a few minutes to the air.

On the Continent wet-packs are commonly used to reduce fever, but they are as fatiguing as the sheet-bath, and less efficient. To give a sheet-bath, remove the sheets and bed-garments; place a blanket under the patient, with a rubber sheet under it; wring out a sheet in water at 70° F.; wind one side round the patient's body, while the arms are lifted; then wind the other side round arms and body together, tucking up over the shoulders, and introducing a fold between the legs. Rub the extremities, grasped through the sheet, so as to keep up the circulation. If the heat of the body dries the sheet, water at 60° F. may be splashed on to it. Remove the sheet if the patient feels chilly; it should not be left on until a rigor occurs. This application cannot safely be repeated on the same day.

To promote expectoration, a cold or tepid wet compress may be left on all night, with plenty of woollen protection outside.

For reducing inflammation, hot wet cloths covered with flannel and frequently renewed may sometimes be temporarily useful, but in hyperaerated rooms such a procedure cannot conveniently be long continued.

§ 46. Graduated Work.

The treatment of consumption amongst the working classes has until recently had one great drawback. Rest is usually essential for a long time, and for still longer active exertion is dangerous to the convalescent, as it may easily precipitate a relapse. The consequence is that the consumptive working man, when he recovers, is unable to continue any laborious occupation, and sooner or later drifts into less profitable employments. To some extent this also affects those belonging to other ranks of society, and it is highly desirable that the means of escape now provided for the working man should be extended to his more cultured fellow-citizen.

Thinking over this problem, Dr. Paterson was led to experiment at the Frimley Sanatorium as to the possibility of gradually increasing the laboriousness of exercise taken by convalescents, which resulted in the institution of a new and extremely useful programme of graduated labour. Graduated exercise of the ordinary kind, as prescribed by Brehmer, Walther, and other German pioneers, consists entirely of walking and hill-climbing; and Walther was in the habit of forbidding his patients, when they left him, to use their arms for any purpose involving exertion for at least two years. In this way certain very real risks are avoided, but the muscles of the arms and trunk do not get into a healthy hardened condition like those employed in walking. By a careful selection of cases it is, however, possible to enable many to use their arms from a comparatively early stage in such a way as to fit them for hard work later on. A wonderful amount of really hard work has been accomplished at the Frimley Sanatorium by the convalescent patients, who consist of selected cases from the Brompton Hospital. A similar system has been introduced into the Benenden Sanatorium for the Working Classes, the Crossley Sanatorium, and other provincial British sanatoria. To some extent it was anticipated at the Royal Victoria Hospital for Consumption at Edinburgh, and may now be regarded as a recognized feature in British working-class sanatoria.

At Frimley a reservoir 108 feet long, 54 feet wide, and 12 feet deep with walls 4 feet thick at the base, and 1½ feet thick at the top, has been made entirely by the patients. Five thousand tons of sand have been moved 300 feet; 1,000 tons of concrete have been mixed and laid; 900 tons of mould, sand, and gravel carried a distance of 200 yards; and 3¼ acres of land brought into cultivation; while the place has been kept in firewood, the boots of the staff and patients kept repaired, and the whole of the patients' block painted—all by the labour of the patients themselves.

The following description is based upon Dr. Paterson's own published statements :*

Selection of Cases.

No patient who looks ill, is much wasted, or poorly developed is fit for graduated labour; nor should it be attempted so long as the mouth temperature is 99° F. or over in the case of men, 99·6° F. or over in the case of women. The general condition is of much more importance in selection than the extent and nature of the lung disease, although this also must be taken into account. Those with extensive or spreading lesions are not fit for exertion, but if a patient has continued at laborious work with an extensive lesion without provoking fever or otherwise undermining his general health, the chances are that he will soon be fit for some hard work. Recent hæmoptysis is a bar to active exertion; so is a softening patch.

* Trans. Med. Soc., London, vol. xxxi., p. 131.

Preparatory Measures.

When there is no longer fever, the patient may be put on to light work which employs the fingers, such as mat-making, sewing, basket-making, and the like. This is followed by graduated walking exercise, beginning with half a mile a day up to ten miles daily. This stage of treatment corresponds with what has been described elsewhere (p. 93).

Basket-Work.

This is considered by Dr. Paterson to be one of the most important grades of work. At first 12 pounds of earth are carried in a basket 50 yards up an incline of 1 in 10·7 (or a 14-foot rise), eighty such loads being carried daily. Next, the load is increased to 18 pounds a time, and finally 24 pounds a time. A definite object for this work is provided to make it more attractive.

Spade, Shovel, and Pickaxe.

In the next grade digging and the like are attempted, beginning with a small child's spade (a coal-scoop on a long handle), ending with full-sized tools and pickaxe. In spade-work earth or sand is dug, and raised 7 feet into a cart to the amounts of 2 tons, 4 tons, and 6 tons successively per day. The hardest work consists in using the pickaxe to unbroken ground, and finally in mixing 10 tons of concrete per diem. This, being continuous and incapable of interruption, is more severe than work which may be stopped at any moment. When a man has been able to do this work for six hours a day, he is put to his own trade for three weeks previous to discharge.

Danger-Signals.

A rise of temperature to 99° F. in men or 99·6° F. in women (by the mouth), together with a slight headache, are signs that the exertion has been excessive. In this case the patient is again put to bed for a day or two until all disturbance has ceased, when he takes up the work at the point where he left it. If these danger-signals are disregarded, pains in limbs, back, and joints are likely to be felt, or an attack of pleurisy may set in.

Other Kinds of Work.

It is obvious that many kinds of work may be similarly graded. Hoeing and chopping wood are considered to be equivalent to using a small spade, sawing equal to work with a large spade; planing is the equivalent of pickaxe work. The women at Frimley Sanatorium are put to scrubbing floors in the final grade, and both men and women are expected to do many of the lighter domestic tasks.

Patients of all classes may be treated by graduated games, but these have the drawback that they are more exciting, and therefore more disturbing to the temperature, out of proportion to the exertion involved. Such disturbance, however, is largely an individual matter, and does not affect some people at all.

VII.—BODY-WEIGHT AND DIETETICS

§ 47. Standard Weights.

The following tables may be taken as an approximate guide to the proper weight of the body :*

Men (Height and Weight).

Age.	5 Feet to 5 Feet 3 Inches.	5 Feet 4 Inches to 5 Feet 6 Inches.	5 Feet 7 Inches to 5 Feet 9 Inches.	5 Feet 10 Inches to 6 Feet.
	st. lb.	st. lb.	st. lb.	st. lb.
21 to 25	8 6	9 7	10 8	11 9
26 to 30	8 9	9 10	10 11	11 12
31 to 35	8 12	10 0	11 2	12 4
36 to 40	9 1	10 3	11 5	12 7

* Modified from tables by Roberts, Bowditch, and others.

WOMEN (HEIGHT AND WEIGHT).

4 Feet 10 Inches to 5 Feet.	5 Feet 1 Inch to 5 Feet 3 Inches.	5 Feet 4 Inches to 5 Feet 6 Inches.	5 Feet 7 Inches to 5 Feet 8 Inches.
st. lb.	st. lb.	st. lb.	st. lb.
7 0	8 2	9 9	11 0

Age.	Boys and Youths.		Girls and Maidens.	
	Height.	Weight.	Height.	Weight.
	ft. in.	st. lb.	ft. in.	st. lb.
1	2 5½	1 4½	2 3½	1 4
3	2 11	2 6	2 10	2 3½
5	3 4	2 12	3 3	2 11
7	3 10	3 7¾	3 8	3 5½
9	4 1¾	4 4½	4 0¾	3 13½
11	4 5½	5 2	4 5	4 12
13	4 9	5 12½	4 9¾	6 3
15	5 2¼	7 4¾	5 1	7 8¼
17	5 6¼	9 5	5 2½	8 3½
19	5 7¼	9 13½	5 2¾	8 10
21	5 7½	10 5	5 3	8 12

§ 48. The Specific Gravity of the Body.

It is a familiar experience that a man in hard muscular condition often weighs more than would be expected from his size.

Dr. Jaeger,* of Stuttgart, has shown that there are surprising differences in the specific gravity of the bodies of healthy men, according to their 'hardness' and muscularity.

The bulk and weight of a number of soldiers were measured, and out of sixty-five, one weighed 764 grammes per litre, another 1,060 grammes per litre, corresponding to a difference of nearly 40 per cent. in weight for equal bulks. To put this in another way, of two equally bulky men, one might weigh

* 'Problems of Nature.' London, 1897.

118 pounds, the other 159½ pounds. Still greater differences undoubtedly exist in ill-health. When the tissues are deficient in weight, the reason may be an excess of water or of fat in the body. Dr. Jaeger states that thorough ventilation, exercise out of doors, and the adoption of woollen clothing, help to harden the body, and raise its specific gravity, while they at the same time improve the health. This agrees with the effect of sanatorium treatment on convalescents from pulmonary tubercle, although in this case other factors have to be considered.

§ 49. The Standard Diet in Health.

In order to construct a scientific dietary for a consumptive, we ought to know the most suitable dietary for him in health. Standard dietaries may be constructed in one of several ways: by chemical analyses of the food of large numbers of people under similar conditions, by accurate observations on individuals, and by experiments on animals. The latter are not of much value in estimating the quantities of the different food-stuffs required, but they throw some light on the part played by these food-stuffs. A diet low in proteids appears to be incapable of keeping animals in health. Even herbivora become unhealthy if their food contains too little proteid. Conclusions drawn from the study of carnivora cannot well be applied to man; those from the study of an omnivorous animal (such as the pig) are of more value for our purpose. Both cows and pigs who are fed on a diet poor in proteids show a gradual deterioration in general health after a time, and when slaughtered a poorer quality of meat.

Analysis of dietaries of institutions, such as barracks, prisons, and hospitals, or of special bodies of men, such as rowing clubs and football teams, show that a considerable latitude in the proportion of proteids is compatible with health, as protein is broken up in the system, and its constituents either built up again into the tissues or the non-nitrogenous portion used up as a store of energy. With heavy muscular work, diets containing from 150 to 226 grammes of protein, 177 to 365 grammes of fat, 440 to

1,150 grammes of carbohydrate, appear to be assimilable without gain in weight.* On the other hand, large numbers of working men and women live on diets containing from 50 to 150 grammes of proteid; and Chittenden has proved that for limited periods a man may remain healthy on a diet containing 55 grammes of proteid, and a caloric value of 2,600.† It does not, however, follow that health can be long maintained on such small quantities of proteid; and Rowntree‡ assumes that 125 grammes of proteid and a total energy value of 3,500 calories are necessary for the average working man.

Benedict § summarizes the results of various analyses as under:

Subjects.	Protein in Food.	Caloric Value.
People doing severe muscular work: lumbermen, etc.	175	5,500
People doing ordinary muscular work: carpenters, labourers, etc.	115	3,300
People doing light muscular work: business men, etc.	100	2,700

Bardswell and Chapman|| accept 120 grammes as the average healthy man's proteid requirements, with a total caloric value of 3,500; or on light sedentary work, 2,540 calories. They give the following table for the needs of a healthy man of average weight (say 140 pounds):

	Calories.
Doing no muscular work—*e.g.*, a clerk	2,500 to 2,700
On light work—*e.g.*, a house-painter	3,000 to 3,500
On moderate work—*e.g.*, a carpenter	3,500 to 4,000
On heavy work—*e.g.*, a navvy..	4,000 to 5,000

* Atwater: *Bulletins* 98 (1901) and 149 (1904). Office of Experiment Stations of the United States Department of Agriculture.

† 'Physiological Economy in Nutrition, with Special Reference to the Minimal Proteid Requirements of the Healthy Man.'

‡ 'Poverty: a Study of Town Life.'

§ Quoted by Spriggs: 'A System of Diet and Dietetics,' edited by G. A. Sutherland, p. 147. 1908.

|| 'Diets in Tuberculosis,' p. 24. London, 1908.

In experimental work on individuals some guidance may be obtained by measuring the excretion of nitrogenous bodies in the urine. Up to a certain point, the more we increase the proteids in the food, the more nitrogen is excreted in the urine. When the nitrogen of the food and that of the urine are equal, the addition of more proteid is balanced up to a certain point by the excretion of more nitrogen in the urine, so that it is possible to have nitrogenous equilibrium at various levels, and the level which answers best is a matter of individual experience.* This accounts for the various amounts of proteid in the diets consumed by different people.

During growth and development, during convalescence from illness, and generally wherever great demands are made upon the bodily machinery, it would be most unwise to be satisfied with a low level of nitrogenous equilibrium. The quantities of fats and carbohydrates required are largely dependent upon the exercise taken, and are conveniently estimated by the caloric value.

Rübner's results as to caloric value of different food-stuffs are generally accepted. He measured experimentally the heat evolved by the combustion of 1 gramme of the food-stuff and the proportion absorbed in ordinary digestion, correcting the former by the latter. He estimates that 1 gramme of protein yields 4·1 calories; 1 gramme of fat, 9·3 calories; 1 gramme of carbohydrate, 4·1 calories. The heat value of vegetable protein is about 3·9 calories; that of animal protein 4·2 calories.† In the above statements the calorie (kilocalorie, or large calorie) is referred to, meaning thereby the quantity of heat which will raise 1 kilogramme of water 1° C.

Taking the average requirements at 3,500 calories, and assuming that 120 grammes of proteid are necessary, these by Rübner's figures would yield 492 calories, leaving the remainder of the 3,500 calories to be supplied by fats and carbohydrates. If fats alone were added, 324 grammes would be necessary; if carbohydrates alone, 734 grammes.

In cold countries fats are preferred to carbohydrates. They

* Bardswell and Chapman, *loc. cit.*

† Spriggs, *loc. cit.*, p. 121.

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are, however, not so rapidly converted into energy as sugar and starch, and many people have an invincible dislike to much fat in their food, so that practically a mixture of the two kinds of food-stuffs is advisable. But it should be remembered that a high proportion of fat allows us to reduce the general bulk of the food, which is of importance where (as with consumptives) a highly nourishing diet is required. In pregnancy and lactation the diet should be increased, both in proteids and in the other constituents.

During the later months of pregnancy we may add with advantage 3 grammes of proteids and 3½ of fats.

During lactation from 500 to 1,000 calories are given out daily in the shape of milk.* This might be replaced by from 25 to 50 grammes of proteid, 27 to 55 of fats, 35 to 70 of carbohydrates.

Bardswell and Chapman adopt the following as the standard diet of the healthy man of 10 stone weight doing clerk's work :

120	grammes	proteid	Caloric value, 2,540.
110	,,	fats	
250	,,	carbohydrates	

They recommend an increase of 30 per cent. in proteid value and 30 per cent. in caloric value for consumptives, basing the estimate upon the results obtained in sanatorium patients.

If, then, the standard weight of the patient while in health is known, the necessary diet can be readily calculated.

§ 50. Diet Tables.

In the following tables the approximate composition and caloric value are given for a number of articles in common use as food, calculated for quantities likely to be wanted. They are grouped according to the meals for which they are appropriate, and should be used in conjunction with the dietaries which follow. The figures are based upon analyses

* Spriggs, *loc. cit.*

ARTICLES FOR BREAKFAST.

Identifying Number.	Articles.	Ounces (Avoird.).	Grammes.	Remarks.	Food Value in Grammes. Proteids.	Fats.	Carbo-hydrates.	Calories.
A 1	Oatmeal porridge	9	255	Soup-plate full	6½	3	27½	165
	,, ,, with milk (add.)	4	114	—	4	4½	6	82
2	Bread and milk	9	255	Large breakfast-cup full ..	10	9½	28	242
B 1	Bacon, lean	2	57	—	9	24	—	260
2	,, ...	1	28	—	4½	12	—	130
	,, with eggs (add.)	2	57	1 egg	6	4½	—	67
3	Sausages	2	57	—	7½	25	½	265
4	Ham	2	57	—	9	22	—	242
5	Tongue	2	57	—	11	13	—	167
6	Kidneys	1	28	—	9	2	—	55
	,, with bacon (add.)	1	28	—	4¼	12	—	130
7	Herring, smoked	2	57	—	21	9	—	170
8	,, fresh	4	114	—	22	8	—	172
9	White fish	2	57	—	9	—	—	37
	followed by sardines (add.)	1	28	—	5½	5½	—	74
	or cold fat bacon (add.)	1	28	—	1	11	—	107
10	Eggs, plain	3½	100	2 eggs	12	9	—	135
11	,, scrambled	3½	100	2 eggs, ¼ oz. butter ..	11	14	—	175
C 1	Bread	3	85	1½ rounds, thick	8	1	45	220
2	Toast	2½	71	—	8	1	43	213
3	Butter	½	14	—	—	12	—	112
4	Milk, with tea or coffee ..	16	456	—	15	18½	23	325
5	Sugar	¼	7	At will	—	—	7	27
6	Syrup	½	14	,, ...	—	—	10½	45
7	Honey	½	14	,, ...	—	—	11	47
8	Jam	½	14	,, ...	½	—	8	34
9	Cream	1	28	,, ...	1½	12½	—	120
10	,, clotted	½	14	,, ...	¾	8½	—	80

ARTICLES FOR LUNCH OR MIDDAY DINNER.

Identifying Number.	Article.	Ounces (Avoird.).	Grammes.	Remarks.	Food Value in Grammes. Proteids.	Fats.	Carbo-hydrates.	Calories.
D 1	Beef, roast	3	85	—	19	24	—	303
2	,, boiled	3	85	—	19	22	—	283
3	Mutton, roast	3	85	—	21	19	—	265
4	,, boiled	3	85	—	21	17	—	248
5	Pork, lean (roast or boiled)	3	85	—	21	7	—	151
	,, with pease pudding (add.)	2	57	—	4½	—	11½	64
6	Turkey	3	85	—	23½	15½	—	243
7	Capon	3	85	—	23	10	—	187
	,, with fat bacon (add.)	½	14	—	—	12	—	112
8	Pheasant	3	85	—	21½	1½	—	102
	,, with fat bacon (add.)	½	14	—	—	12	—	112
9	Duck	3	85	—	14	19½	—	236
10	Goose	3	85	—	14	19½	—	236
11	Hare or rabbit	3	85	—	21½	1½	—	102
	,, ,, with fat bacon (add.) ..	½	14	—	—	12	—	112
E 1	Potatoes, boiled	3	85	—	2	—	17½	80
2	,, mashed	3	85	—	2	2½	15	94
3	[,, fried]	2	57	Avoid if dyspeptic ..	4	23	26	236
4	Beetroot	2	57	If desired	1	—	5½	23
5	Parsnips	2	57	,, ...	1	—	8	35
6	Carrots	2	57	,, ...	½	—	5	24
7	Turnips	2	57	,, ...	¾	—	4½	21
8	Green peas	2	57	,, ...	4	—	9½	54

Identifying Number.	Article.	Ounces (Avoird.).	Grammes.	Remarks.	Food Value in Grammes.			Calories.
					Proteids.	Fats.	Carbo-hydrates.	
E 9	Cabbage	2	57	If desired	—	3	16	
10	Cauliflower	2	57	,, ...	1	—	3	16
1	Milk pudding	4	114	—	5	5	16	130
2	Suet pudding	3	85	—	5	11	42	296
3	Custard pudding	5	142	—	6½	6½	19½	167
4	Macaroni, cooked	4	114	—	3	1½	18	102
5	Batter pudding	5	142	—	7	12½	10½	190
6	Cabinet pudding	4	114	—	5½	5¾	13	130
7	Rocklaw pudding	3	85	—	5	23½	26½	348
8	Apple pudding	5	142	—	3¼	13¾	39½	300
9	Blancmange	5	142	—	3	3½	8	75
10	Jelly	5	142	—	4¾	1	18	101
11	[Fruit tart]	..	..	Only for second helpings	—	—	—	—
12	[Stewed fruit]	..	..	,, ,,	—	—	—	—
G 1	Bread	1½	42	Three-quarters round, thick	4	½	22½	110
2	Biscuit	1	28	—	3	1½	20	105
3	Butter	½	14	Size of walnut	—	12	—	112
4	Milk	8	228	—	7½	9	11½	162
5	Cheese, Cheddar	½	14	If desired	4	5	½	67
6	,, Dutch	½	14	,, ...	5	2½	—	45
7	,, cream ..	1	28	,, ...	¾	15½	—	148
	For dessert, see M.							

ARTICLES FOR SUPPER OR EVENING DINNER.

Identifying Number.	Article.	Ounces (Avoird.)	Grammes.	Remarks.	Food Value in Grammes.			Calories.
					Proteids.	Fats.	Carbo-hydrates.	
H 1	White fish	2	57	With melted butter ..	9	½	—	39
2	[Mackerel]	2	57	—	8	14½	—	169
3	[Salmon]	2	57	—	12	7½	—	119
I 1	Beef, roast	2½	71	—	16	20	—	253
2	,, boiled	2½	71	—	16	18	—	235
3	,, corned	2½	71	—	18	13	—	201
4	,, steak	2½	71	—	16	20	—	253
5	Mutton, roast	2½	71	—	17½	16	—	222
6	,, boiled	2½	71	—	17½	14	—	206
7	,, chops	2½	71	Without the bone	17½	16	—	222
8	,, cutlets	2½	71	,, ...	17½	16	—	222
9	Lamb, roast	2½	71	—	15½	21½	—	263
10	,, chops	2½	71	Without the bone	15½	21½	—	263
11	Turkey, roast or boiled ..	2½	71	,, ...	19½	13	—	203
12	Capon	2½	71	,, ...	19	8½	—	156
	,, with fat bacon (add.)	½	14	—	—	12	—	112
13	Pheasant	2½	71	,, ...	18	1	—	85
	,, with fat bacon (add.)	½	14	—	—	12	—	112
14	Hare or rabbit	2½	71	—	18	1	—	85
	,, ,, with fat bacon (add.) ..	½	14	—	—	12	—	112
15	Sweetbreads	2½	71	—	12	8½	—	126

ARTICLES FOR SUPPER OR EVENING DINNER—*continued.*

Identifying Number.	Article.	Ounces (Avoird.).	Grammes.	Remarks.	Food Value in Grammes.			Calories.
					Proteids.	Fats.	Carbo-hydrates.	
J	Vegetables as under E	—	—	—	—	—	—	—
K	Puddings as under F	—	—	—	—	—	—	—
L	Sundries as under G	—	—	—	—	—	—	—
M 1	Apples or pears	2	57	If desired	¼	¼	8	36
2	Bananas	2	57	,, ...	¾	⅓	12½	57
3	Grapes	2	57	,, ...	¾	1	11	56
4	Oranges	2	57	,, ...	½	—	6½	30
5	Plums	2	57	,, ...	⅔	—	11½	49
6	Currants (grocer's) ..	2	57	,, ...	1⅓	1	42	187
7	Raisins	2	57	,, ...	1½	1¾	43	201
8	Dates	2	57	,, ...	1	1½	44½	208
9	Figs (dried)..	2	57	,, ...	2½	—	42	184
10	Prunes	2	57	,, ...	1	—	42	175
11	Almonds	1	28	,, ...	6	15	5	189
12	Chestnuts (dried)	1	28	,, ...	3	2	21	117
N 1	Cake	1	28	At tea-time	1	2	12	122
2	Milk	8	228	Tea-time, or 11 a.m. ..	7½	9	11½	162

given by Atwater,* Bardswell and Chapman,† Cautley,‡ Church,§ Parkes,|| Spriggs,¶, and Von Ziemssen,**, supplemented by private data. They are only intended to be a rough guide to the quantities required, so that small fractions have been omitted. Directions have been given in Chapter XX. (p. 134) for the preparation of some of the dishes.

§ 51. Dietary for One Day.

Breakfast.—Porridge, 9 oz.; or bread and milk, 9 oz. Meat (B 1 to 11): one or more items in the quantities indicated. Bread (3 oz.) or toast ($2\frac{1}{2}$ oz.), with not less than $\frac{1}{2}$ oz. butter. Tea, coffee, or cocoa, as desired, with 1 pint of milk, part, if desired, being added to the porridge. Marmalade, jam, or honey, if desired.

Lunch.—Meat (D 1 to 11): one or more of the items in the quantities indicated. Vegetables (E 1 to 10): one or more of these is necessary for health; and, as a rule, potatoes should be taken if they do not disagree. If they do, more bread will be necessary, and one of the more digestible green vegetables, such as cauliflower. Pudding (F 1 to 10): at least one of the items in the quantities indicated. It is good practice to take helpings of two different kinds—*e.g.*, milk pudding and suet pudding—where several are provided. At the Crooksbury Sanatorium two or three milk puddings and some different kind of pudding are always provided. Fruit is not the equivalent of a milk or suet pudding, and should always be regarded as an extra, proper helpings of the more substantial puddings being first given; and the same applies to fruit tarts, in which the chief nutritive value is in the crust. Of sundries (G 1 to 7), bread, butter, and milk, in the quantities indicated, are necessary. The rest are a matter of choice.

* 'Composition of American Food Materials,' *loc. cit.*

† 'Diets in Tuberculosis.' London, 1908.

‡ Spriggs, *loc. cit.*

§ 'Food' ('South Kensington Museum Science Handbook,' 1889).

|| 'Practical Hygiene,' ed. De Chaumont.

¶ *Loc. cit.*

** 'Handbook of General Therapeutics,' trans. Willoughby, 1885.

The milk may, however, be dispensed with when substantial helpings are taken and there is steady gain in weight. Dessert is unimportant, provided that vegetables are always taken with the meat courses. In summer-time salad is a useful addition to cold meat. An oil dressing should always be taken with it.

Tea.—An unimportant meal, chiefly useful in its social aspects. If there is a difficulty in getting through enough milk or farinaceous food, these may be taken at tea-time, provided that this does not interfere with the dinner appetite (which is a matter of individual experience).

Dinner should be a lighter and more digestible meal than lunch. Soup or fish (H 1 to 3) may be taken to begin with. The soup is useful in promoting the flow of digestive fluids. It varies enormously in food value, which is usually small. Then should come a meat course (I 1 to 15): one or more of the items in the quantities given. Vegetables, puddings, and sundries are required much as for lunch. Dessert according to taste.

The average proteid value of the above is 140 grammes; 3,420 calories.

As food is required in proportion to body-weight, a reduction may be made in the quantities for women, and an addition should be made for those of either sex who are very tall. For children the full reduction for weight should not be made, as growth and development have to be provided for, in addition to the replacement of diseased tissues.

§ 52. Dietary for One Week.

I have given here a dietary for one week in winter and one week in summer, taken from the menus of Crooksbury Sanatorium, to illustrate the kind of fare which is suitable for an average case of consumption. It will be noticed that there is considerable variety, and that it is not at all the invalid's dietary of popular fancy. When a dish is provided which is not digestible for some of the company, a plainer alternative is always provided. Beyond this no attempt is made to

WINTER MENU.

	Sunday.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
BREAKFAST	Porridge and milk or Bread and milk	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
	Kidneys and bacon Boiled eggs Ham	Bacon Sardines Tongue or ham	Bacon and tomatoes Ham	Bacon Bloaters or kippers Ham	Sausages Scrambled eggs Tongue or ham	Bacon Fish-pie or fish-cakes Ham	Liver and bacon Ham
	Bread or toast Butter Jam, honey, or marmalade Milk Tea or coffee	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
LUNCH ..	Roast chickens Boiled chickens Bread sauce	Roast mutton	Roast sirloin	Roast or boiled pork Apple sauce Boiled mutton	Beefsteak pudding or pie	Roast sirloin	Irish stew
	Potatoes Stewed celery	Potatoes Spanish onions	Potatoes Cauliflower	Potatoes Turnips	Potatoes Cabbage	Potatoes Boiled beetroot White sauce	Potatoes Carrots
	Two or three kinds of milk puddings	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
	Baroness pudding	Apple pudding	Eve's pudding	Bread-and-butter pudding	Baked corn-flour pudding	Apple tart	Roly-poly pudding
	Milk Bread Butter Biscuits Cheese	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
	Dessert	—	—	Dessert	—	—	—

TEA ..	Tea Bread and butter Cake Biscuits Jam Milk	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
DINNER ..	Soup Cold sirloin Spiced beef Cold chicken	Soup Grilled steak Chicken croquettes	Fish Mutton cutlets Curry	Soup Roast pheasants Bread sauce Cold beef	Fish Fricassee of rabbit Mince	Soup Stewed oxtail Cold beef Shepherd's pie	Fish Roast fillet of beef Rissoles
	Potatoes Beetroot Pickles, etc. Salad	Potatoes Spinach	Potatoes Baked tomatoes	Potatoes Brussels sprouts	Potatoes Salsify	Potatoes Haricot beans	Potatoes Stewed endive
	Two or three kinds of milk pudding	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
	Charlotte russe Jellies	French pancakes	Apple charlotte	Banana fritters	Treacle tart	Cabinet pudding	Macaroni cheese
	Milk Bread Butter Biscuits Cheese	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*

EXTRA: Milk at 11 a.m. and at 9 p.m., where necessary.

SUMMER MENU.

	Sunday.	*Monday.*	*Tuesday.*	*Wednesday.*	*Thursday.*	*Friday.*	*Saturday.*
BREAKFAST	Porridge and milk or Bread and milk	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
	Bacon Omelette Cold tongue	Liver and bacon Sardines Ham	Bacon Haddock Ham	Bacon Anchovies on toast Ham	Bacon Buttered eggs Ham	Bacon Kedjeree Ham	Bacon Boiled eggs Ham
	Bread or toast Butter Jam, honey, or marmalade Milk Tea or coffee	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
LUNCH ..	Roast duck Roast chicken Bread sauce Bacon	Boiled beef Dumplings	Roast lamb Red-currant jelly Mint sauce	Roast sirloin	Roast veal, stuffing, and bacon Boiled mutton	Roast mutton	Roast sirloin Yorkshire pudding
	Potatoes Green peas	Potatoes Mashed turnips	Potatoes French beans	Potatoes Cabbage	Potatoes Cauliflower	Potatoes Boiled cucumber	Potatoes Green peas
	Two or three kinds of milk pudding	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
	Red currant and raspberry tart	Rocklaw pudding	Boiled batter pudding	Chocolate pudding	Cherry pudding	Queen pudding	Sponge pudding Jam sauce
	Milk Bread Butter Biscuits Cheese	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
	Dessert	—	—	Dessert	—	—	—

TEA ..	Tea Bread and butter Cake Biscuits Jam Milk	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
DINNER..	Soup Cold sirloin	Soup Roast loin of mutton	Fish Grilled steak	Soup Roast chicken	Fish Grilled chops	Soup Calves' head	Fish Roast lamb
	Dressed crab	Cold beef	Cold lamb	Bread sauce	Hindoo sauce	Brain sauce	Mint sauce
	Spiced beef	—	—	Rissoles bacon	Mayonnaise of beef	Tournedos of beef	Minced veal
	Potatoes Salad, pickles, etc.	Potatoes Spinach	Potatoes Tomatoes	Potatoes Vegetable marrow	Potatoes Salad	Potatoes Spinach	Potatoes Curly kale
	Two or three kinds of milk pudding	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*
	Trifle	Pressed pudding	Custard	Junket	Blancmange	Castle puddings	Jam tarts
	Coffee cream	—	Stewed fruit	Pineapple chunks	Baked apples	Lemon sauce	Cheese cakes
	Milk Bread Butter Biscuits Cheese	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*	*Ibid.*

EXTRA: Milk at 11 a.m. and at 9 p.m., where necessary.

exclude any dish which would be approved of by a healthy man leading an out-of-door life. For those who cannot digest such fare some of the dietaries which follow will be suitable.

§ 53. Dietaries for Dyspeptic Patients.

The chief difficulty in the case of tuberculous patients is to provide a dietary which is sufficiently nourishing and yet small enough to be eaten when there is no appetite. The majority of afebrile patients can eat the foregoing diet ; but if the appetite is very poor, a specially concentrated diet must be provided, which is also easy to take. In other cases less difficulty is experienced if the food is given mostly in a liquid form ; but as this necessitates many meals a day, it should not be continued longer than is absolutely necessary, for fear of overtaxing the digestive organs, which require times of rest as much as other parts of the body. Several forms of dietary are given here, from which a choice may be made.

§ 54. Diet for Anorexia.

Breakfast.—Bread and milk, 4½ oz., with ½ oz. clotted cream ; ham, 1 oz. ; tea or coffee, made with milk, 8 oz. ; toast, 1 oz., with ½ oz. butter.

11 *a.m.*—An egg beaten up with 8 oz. milk.

Lunch.—Fish, 2 oz. ; meat, 2 oz. ; pudding, 2 oz., made with ½ oz. casumen ; 1 oz. toast, with ½ oz. butter ; 8 oz. milk, with 1 oz. cream.

Tea.—Milk tea, 8 oz., with 1 oz. cream ; bread, 1 oz., with butter, ½ oz.

Dinner.—Soup, thickened, ¼ pint ; or fish, 2 oz. ; meat, 2 oz. ; pudding, 2 oz., with casumen, ½ oz. ; toast, 1 oz., with butter, ½ oz. ; milk, 8 oz., with cream, 1 oz.

9 *p.m.*—Benger's Food, ½ pint.

The above dietary has a proteid value of 154 grammes, a caloric value of 3,530. It consists of 23 oz. of solids and semi-solids, with 55 oz. of liquid food, or 25 oz. of solids and semi-solids, with 50 oz. of liquid food, according as it includes soup or fish at dinner-time. In the ordinary dietary there would be 43 oz. or more of solids, 32 oz. or more of liquid food.

§ 55. Diet for Anorexia with Fever.

7 *a.m.*—Milk, 10 oz., with 1 oz. cream.

9 *a.m.*—Bread and milk, 3 oz., with clotted cream, ½ oz.; toast and butter, 1½ oz.; milk tea, 16 oz.

11 *a.m.*—Milk, 10 oz., with an egg.

1 *p.m.*—Fish, 2 oz.; scraped meat sandwich, 2½ oz., made with toast and butter; Benger's Food, 10 oz.; grapes, *ad lib.*

4 *p.m.*—Milk tea, 10 oz., with 1 oz. cream.

7 *p.m.*—Soup, 5 oz., thickened with farinaceous material and 1 oz. casumen; scraped meat sandwich, 2½ oz.; pudding, 2 oz., with ½ oz. cream; milk, 10 oz.

9 *p.m.*—Benger's Food, 10 oz.

Quantities: 14½ oz. solids, 80 oz. liquid food. Proteid value, 157 grammes; caloric value, 3,420.

§ 56. Liquid Diet in Fever.

7 *a.m.*—Milk, 8 oz., with cream, ½ oz.

9 *a.m.*—Milk tea, 8 oz., with cream, ½ oz., and 1 egg.

11 *a.m.*—Benger's Food, 10 oz., with cream, ½ oz.

1 *p.m.*—Milk arrowroot, 8 oz., with cream, ½ oz.; meat-juice, 3 oz.

3 *p.m.*—Milk tea, 6 oz., with cream, ½ oz., and 1 egg.

5 *p.m.*—Milk, 6 oz., with cream, ½ oz.; meat-juice, 2 oz.

7 *p.m.*—Milk arrowroot, 8 oz., with cream, ½ oz.; meat-juice, 3 oz.

9 *p.m.*—Benger's Food, 10 oz., with cream, ½ oz.

1 *a.m.*—Milk, 6 oz., with cream, ½ oz.; jelly, 5 oz.

4 *a.m.*—Benger's Food, 10 oz.

Proteid value of the above, 144 grammes; caloric value, 3,060. The arrowroot may, if necessary, be peptonized by the addition of ½ drachm of liq. pancreaticus.

§ 57. Concentrated Diet without Extra Milk.

Breakfast.—Porridge, 4½ oz., with clotted cream, 1 oz.; ham, 1½ oz.; toast, 2 oz.; butter, ½ oz.

11 *a.m.*—Benger's Food, ½ pint, with casumen, ½ oz.

Lunch.—Soup (thickened), 5 oz., with casumen, ½ oz.; chicken dariole, 2 oz., with mashed potatoes, 1 oz.; pudding 4 oz., made with an extra egg; add cream, ½ oz.

Tea.—Bread and butter, 1½ oz.; cake or biscuits, 1 oz.; cream with the tea, ½ oz.

Dinner.—Fish, 2 oz.; scraped meat sandwiches, 3 oz.; pudding, 3 oz., with casumen, ½ oz., and cream, ½ oz.

9 *p.m.*—Benger's Food, ½ pint, with cream, 1 oz.

This dietary, which may be useful where milk is disliked, consists of 57 oz. food, most of which is solid or semi-solid. The proteid value is 157; the caloric value, 3,116.

§ 58. Concentrated Diet for Severe Hæmoptysis.

Breakfast.—Porridge, 9 oz., with casein, ½ oz.; ham or other meat dish, 3 oz.; bread, 3 oz., with butter, ½ oz.; milk tea, 4 oz.

Lunch.—Pounded or scraped meat, 4 oz.; mashed potatoes, 3 oz.; bread, 2 oz.; pudding, 4 oz.; biscuit, 1 oz.; butter, ½ oz.; casein with the pudding, ½ oz. For drink, 4 oz. water.

Tea.—Milk tea, 4 oz.; bread, 2 oz.; butter, ½ oz.

Dinner.—Fish, 2 oz.; pounded or scraped meat, 4 oz.; mashed potatoes, 3 oz.; bread, 2 oz.; pudding, 4 oz.; biscuit, 1 oz.; butter, ½ oz.; casein with the pudding, ½ oz. For drink, 4 oz. water. Thirst may be also relieved by sucking a strictly limited amount of ice.

This dietary contains 165 grammes of proteid, and has a caloric value of 3,454.

§ 59. Diet in Laryngeal Disease.

In this condition, if there is dysphagia, semi-solid food usually causes less discomfort, and is more easily swallowed than liquids. If the disease is unilateral, food may often be swallowed without discomfort in the Norris-Wolfenden position, the patient lying on the sound side, with the head low down. Benger's Food, arrowroot, and the like, may be made of suitable consistency by preparing them with twice the usual proportion of the farina, or with the addition of a little gelatin. Milk is more easily taken if 2 per cent. of gelatin is dissolved in it. Junket is another useful preparation, if carefully drained of the superfluous whey. Scraped raw meat may be made up without salt, and with the addition of a raw egg to every 4 oz. Scrambled eggs, gelatin blancmanges, and 'typhoid bread and milk,' are also well taken as a rule. A number of useful recipes are given by Dr. Bardswell in his article on 'Diet in Tuberculosis' ('A System of Diet and Dietetics,' ed. Sutherland), to which the writer is indebted for some of the foregoing details.

§ 60. **Diet in Diabetes.**

The combination of diabetes with tuberculosis is a very difficult one to treat satisfactorily. The measures required to combat the glycosuria are very apt to cause loss of weight, owing to the patient's distaste for the permissible foods. Especially trying is the partial deprivation of bread, potatoes, and milk, which are ill replaced by the recognized substitutes. It is generally admitted that in uncomplicated diabetes a strict antiglycosuric diet is likely to defeat its own objects and to increase the danger of acetone poisoning; and in diabetes complicated with pulmonary tubercle a compromise in respect of food is still more necessary.

Diabetes includes two different types of disease, in one of which the sugar excreted is less in quantity than the equivalent of starch in the food taken; whereas in the other and graver type more sugar is excreted than can be so accounted for, some being derived from the disintegration of tissue proteins.

In the slighter group it is usually safe to give as much carbohydrate food as corresponds with the difference between ingested and excreted carbohydrate, estimated with an ordinary dietary. According to Von Noorden, it is seldom advisable to reduce the quantity of carbohydrate in the food below 50 grammes a day in a patient of average weight. To provide sufficient calories with a restricted ration of carbohydrates it is necessary to increase the amounts given of fats and oils or of meat. If the fats and oils are largely increased, there is some risk of acetonæmia, so that the urine should be regularly tested with the ferric chloride test. The disintegration of proteins helps to neutralize the acidity; but if more meat is given than can be dealt with, the tendency to acidity is increased. For this reason it is not advisable to increase the daily ration of meat beyond 11 or 12 oz. (310 to 340 grammes). In some cases the free administration of alkalis will help to diminish this difficulty.

Whenever diabetes is associated with marked wasting, it is necessary to give a sufficiently abundant diet to prevent the disintegration of tissues. This is especially the case in the graver form of diabetes, in which the sugar in the urine is more than can be accounted for by the carbohydrates taken in the food. Pulmonary tuberculosis associated with diabetes is stated to be usually of a mild type, with little fever, but there are exceptions to this rule. In every case it must be decided by the physician whether the glycosuria or the pulmonary mischief is for the time the more important, and the diet varied accordingly. Diabetics with lung trouble usually require treatment in a mild climate, as they are very sensitive to cold.

The following dietary may be suggested for an average case, but it should be modified in accordance with urinary analyses and gain or loss in weight.:

Meat, 8 to 12 oz.; cheese, 1½ to 4 oz.; milk, 10 oz.; bread, 2 oz.; butter or other fat, 4 oz.; eggs, 2 to 6; and the equivalent of 200 to 300 calories in the shape of admissible vegetables and special diabetic foods.

This would supply from 2,500 to 3,500 calories, with a proteid value of 120 to 190 grammes.

The most useful vegetables are spinach, cooked lettuce, cabbage, Brussels sprouts, cauliflower, asparagus, stewed celery, cooked tomato, leeks, and ordinary salads. Cooking vegetables deprives them of some of their carbohydrates. The butter (which may be replaced in part by salad oil if desired) may be partly used up in cooking the vegetables.

Among the special foods may be mentioned almond meal, gluten bread, bran biscuits, almond biscuits, soya bread, Aleuronat, Graham flour, and Graham bread. It should not be assumed that these preparations are all quite free from starch, as some contain a notable proportion. Full particulars should be obtained from the firms who specially deal in such articles, and checked by private analyses.

According to Von Noorden, oatmeal may be given in large quantities (7 to 9 oz. per diem) to the sufferers from the severer forms of diabetes. He recommends that it be made up in the shape of porridge, mixed with butter and eggs.

§ 61. Diet for Intestinal Tuberculosis.

Here it is necessary to give food which is digested in the first part of the alimentary canal, without leaving much insoluble residue. Raw meat and meat-juice fulfil this requirement ; milk is best given in predigested form, so as to avoid the production of dense curd in large masses. Eggs, butter, and cream agree well. Cheese is only suitable if the acid is previously neutralized. Most of the puddings made with a gelatin basis may be given. Oatmeal, green vegetables, and fruit, and the various casein preparations, are better dispensed with, as they are apt to cause irritation and diarrhœa. Excessive dilution of the food is also to be avoided.

The following diet may be given :

Breakfast.—Fish, 2 oz. ; toast, 2 oz. ; butter, ½ oz. ; milk coffee, 10 oz.

11 *a.m.*—Meat-juice, 4 oz.

Lunch.—Meat, 3 oz. ; toast, 1½ oz. ; pudding, 4 oz. ; biscuit, 1 oz. ; butter, ½ oz. ; peptonized or citrated milk, 8 oz.

Tea.—Milk tea, 10 oz. ; 1 egg ; bread and butter, 1 oz.

Dinner.—Fish, 2 oz. ; meat, 3 oz. ; toast, 1½ oz. ; pudding, 4 oz. ; biscuit, 1 oz. ; butter, ½ oz. ; peptonized or citrated milk, 8 oz.

9 *p.m.*—Benger's Food, ½ pint.

Proteid value, 160 grammes ; caloric value, 3,360.

§ 62. Predigested Foods.

There is no need for artificial digestion of foods in the treatment of ordinary cases of tuberculosis, for the digestive powers are usually preserved even where the appetite has failed, and the administration of ordinary medicinal remedies is sufficient to stimulate the natural forces. In high degrees of fever, however, or moderate but prolonged fever, the digestion is apt to fail, in which case digestive ferments and predigested foods may be of use.

Among carbohydrate foods which are partially or wholly predigested may be mentioned Allenbury Foods, Benger's Food, Horlick's Malted Milk, Loeflund's Cream Emulsion, and Mellin's Food. Various meat-foods are also made, in which the proteids are partially or wholly peptonized, such as Antweiler's Peptone, Darby's Fluid Meat, Denaeyer's Peptone, Kemmerich's Meat Peptone, Koch's Meat Peptone, Liebig's Peptone, Mosquera Beef-meal, and Somatose. There are a number of other peptonized preparations in which the proportion of peptone is quite small. Carnrick's Peptonoids contain sugar and starch in addition to peptones.

By the use of digestive ferments, such as peptonizing powders, liquor pancreaticus, etc., the food prepared from ordinary sources may be partially or wholly predigested.

§ 63. Concentrated Foods.

There are a number of concentrated foods sold, some of which are derived from meat, others from milk, yet others from cereals of various kinds.

Sugar is practically a concentrated carbohydrate food; grated cheese a concentrated proteid food.

Most of the meat extracts are loaded with extractives, and contain only a small proportion of proteids. Used in small quantities, well diluted, some of them are useful in stimulating appetite and secretion of digestive juices, in the same way as soup, but they should not be relied upon for their nutritive properties. Meat-juices are, however, of real nutritive value, although for the most part much more expensive than home-made substitutes.

Somatose (containing 60 to 80 per cent. proteids) has been much recommended for the hygienic treatment of consumptives. Mosquera Beef-meal is stated to be a meat preparation partially digested by pineapple ferment, and, according to Cautley,* contains 77 per cent. proteids and 13 per cent. fat. Leube-Rosenthal Meat Solution is recommended by Bardswell,† It is meat which has been partially digested by HCl, pounded in a mortar, neutralized by alkali, and mixed with water to form a thin paste. It is stated by Cautley to contain 11 per cent. albumin, 6·5 per cent. peptone, and 6 per cent. fat. Meatox is said to be a powdered beef, free from preservatives, containing nearly 74 per cent. proteids and 12 per cent. fat. Among preparations made from milk may be mentioned Biogene, Casumen, Plasmon, Protene, and Tilia. These consist chiefly of casein, of which they contain from 76 to 86 per cent. Lacvitum contains approximately equal quantities of casein, milk-fat, and milk-sugar. Sanatogen is a combination of casein with glycerophosphates. Desiccated milk powders are also sold, under the names of Glaxo and Lacumen. Another protein preparation, made from cereals, is called Roborat. A similar substance obtained from wheat is called Aleurone.‡

VIII.—SYMPTOMATIC TREATMENT

§ 64. Remedies for Cough.

There are two points of importance about the cough of a tuberculous patient which have always to be considered. Is the cough excessive, or is it duly proportional to the work of expectoration? If excessive or ill-timed, what is its exciting cause? A slight cough, especially if it only comes on when

* 'A System of Diet and Dietetics,' ed. Sutherland. London, 1908.

† *Loc. cit.*

‡ Cautley, *loc. cit.*

there is sputum to bring up, may be disregarded; but excessive cough may disturb the night's rest or cause vomiting, or, without these effects, may exhaust the patient's strength, and cause excessive auto-inoculation. It is in these cases especially important to trace the cause. This may be an irritation in the pharynx, naso-pharynx, or larynx, trachea and bronchi, lungs, pleuræ, or occasionally in the ear. Moreover, slight irritability in any of these parts may be intensified by gastric disturbance, so that the digestive functions need also to be taken into account.

Cough may be started by exertion, by laughing or talking, or by sudden change of temperature, as in going from a warm room into a cold one—an additional argument for reasonably cool rooms. Even contact with cold sheets may start the cough, or a change of position.

If the cough begins directly the patient lies down, it may be due to elongated uvula, which is a mechanical consequence of perpetual cough from any cause, and is very common in phthisis (see p. 272).

Cough due to granular pharyngitis may be subdued by painting the affected part with a solution of iodine (5 to 10 grains), with iodide of potassium (20 to 40 grains), in glycerine (1 ounce), to which may be added a few drops of oil of peppermint. Pharyngeal coughs are also improved by sedative inhalations (equal parts of creosote and ether, or creosote and chloroform), or by astringent sprays (alum or tannin, 5 to 10 grains in an ounce of water, used with a Siegle's spray), or by painting with glycerine and tannin. The compound menthol lozenges are useful if the cough comes on at meal-times, or the tannic-acid lozenges.

Laryngeal coughs are also improved by sedative inhalations, as well as by local treatment directed against the particular condition (inflammation, ulceration) which may be present. Both laryngeal and pharyngeal coughs may be improved by using a 5 per cent. solution of benzoate of soda in an atomizer.

The cough of tracheitis is said by A. Latham to be relieved by bicarbonate of soda with hydrocyanic acid and syrup of

Virginian prune.* Intratracheal injections of gomenol (1 in 10 of oil) are much used for the same purpose by French physicians.† This is a volatile liquid obtained from a species of myrtaceous plant, containing a form of turpentine, eucalyptol, and other substances, but almost free from aldehydes, and is stated to be neither caustic nor toxic (see p. 286).

If bronchial catarrh be prominent, the choice of remedies depends greatly upon the quantity and nature of the secretion. If tenacious and scanty, a relaxing expectorant should be given for a few days, such as ipecacuanha with iodide of potassium, or ammonium chloride in 10-grain doses, with extract of liquorice. Antimonial wine in small doses may be given if the circulation is reasonably good. Small doses of heroin or paregoric may be added to these remedies.

If, on the other hand, the secretion is too abundant, it is better to administer creosote or one of its compounds (see p. 282), or one of the turpentine group. The best of these, according to Lépine, is terpene, as it does not upset the stomach like turpentine. It may be given in 2 to 5 grain doses, dissolved in a little spirit, with glycerine and peppermint-water. Terpheroin is another useful remedy in such cases. It has been shown that the members of the turpentine group diminish congestion, while they increase secretion, if given in minimal doses. Terpene may also be used for inhalation. Atropine diminishes bronchial secretion, but is seldom convenient for use, as it dries the throat.

In cases with abundant secretion Coghill recommends inhalations of turpentine, iodine, or eucalyptus. Ransome recommends a pill containing 1 grain of zinc sulphate, $\frac{1}{2}$ grain of codein, and 2 grains of extract of hyoscyamus, taken after meals.‡

It is not certain how far counter-irritation affects the cough or the secretion from the lungs and bronchi. Painting

* 'The Diagnosis and Modern Treatment of Pulmonary Consumption,' p. 185. London, 1905.

† See Barbary, 'La Grande Faucheuse,' p. 121. Paris, 1907.

‡ 'The Treatment of Phthisis,' p. 203. London, 1896.

with iodine is a recognized routine treatment in many places, but excepting for the relief of pain or of pleuritic complications, I have never obtained any striking results from it. A more convenient remedy is the acetic liniment of turpentine or the compound camphor liniment, neither of which leaves the skin as sore as repeated iodine painting.

Much of the bronchial irritation met with in tubercle is in the form of congested areas surrounding the tubercular deposit. This might possibly be reduced by persistent jacket poultices or hot fomentations, but such remedies are out of place in a sanatorium, owing to the risk of chill. One of the remedies which has a reputation for relieving congestion is ichthyol, which is much used by French physicians (see p. 284). In unilateral mischief it is useful to immobilize the chest, as for pleurisy.

Sedatives should be used with great caution in pulmonary tuberculosis, as they often upset the digestion, on which so much depends. The most suitable forms known to me are heroin hydrochloride ($\frac{1}{10}$ grain), syrup of codein, and chlorodyne, with or without syrup of Tolu. These remedies should be reserved for excessive nocturnal cough.

The cough of early morning is best relieved by sodium bicarbonate (15 grains) in hot milk.

Very persistent cough may be caused by pleuritic irritation. This may be considerably relieved by flying blisters, stimulating liniments, or mechanical restraint from strapping or a bandage. For pleuritic pain the most efficient remedy is said to be the application of leeches, but in sanatorium treatment belladonna plaster is more convenient.

Much paroxysmal cough may be caused by accumulation in cavities of the lungs. When secretion trickles into the more healthy air-tubes, cough is set up, which may last a long time. In this case postural treatment is of great value. The patient should be placed at convenient times during the day in positions favouring the gravitation of secretion towards the mouth. This should not be done just before a meal or during active digestion. Dr. Tucker Wise and Dr. Ewart have both described special forms of support for this purpose.

I have myself been for some years in the habit of recommending the same procedure, with the help of a low chair by the bedside or by means of the knee-elbow position (see p. 140).

Inhalation Methods.

Many remedies have been used for consumption by way of inhalation. Foremost among these are creosote, iodine, carbolic acid, turpentine, formalin, the essential oils, and eucalyptol. Such inhalations were much used by the late Dr. Coghill, of Ventnor.

Judging by my own observations, they sometimes allay irritable cough and favourably influence laryngeal catarrh. I am unable to say positively whether they have any effect on the associated pulmonary condition. Burney Yeo recommends inhalation of a spray of 5 or 10 per cent. solution of benzoate of soda in catarrhal conditions. The following are some of Coghill's formulæ :

℞ Eucalyptol, Chloroform pur.	āā ʒi.
Phenol absol., Creosoti	āā ʒii.
℞ Tinct. iodi ætherealis, Acid carbol.	āā ʒii.
Spir. vini rect.	ad ℥i.

In each case a small piece of lint is wetted with the solution and placed in an oro-nasal respirator.

Another convenient method is to use Olberg's inhalation-pipe, which is made entirely of glass and can be completely sterilized.

Intratracheal Injections.

The advantage of this method is that, if somewhat tenacious solutions are used, they coat and stick to the exposed surfaces of the larynx every time the patient coughs, and protect them from secondary inoculation. Possibly some portion of the remedy may be absorbed and exert an effect elsewhere. The remedies which have chiefly been used for this purpose are solutions of menthol, guaiacol, thymol, eucalyptus, naphthalene, or Izal, in olive oil, almond oil, glycerine, or paroleine.

The only form of which I have had any experience is the naphthalene and cinnamic acid solution recommended by Lake,* which is decidedly useful in slight ulceration or congestion of the larynx. I have used this with a Lake's laryngeal syringe; it is not even necessary to introduce the nozzle within the larynx if the patient is trained to inhale suddenly at the right moment.

With Izal, 2 per cent. Izal and 5 per cent. lanoline may be used with paroleine. Colin Campbell† recommends thymol ʒi., salol ʒii., menthol ʒi., glycerine pure ℥v., dissolved in a water-bath; from ʒii. to ʒxii. injected daily at 140° F. Also Izal ʒiii., menthol ʒii., glycerine ℥v., as above. Bowie uses 50 per cent. thymol, 8 per cent. menthol, 3 per cent. guaiacol, 0·125 per cent. iodine in sterilized almond oil.‡

§ 65. Remedies for Hæmoptysis.

Slight hæmoptysis requires no special treatment beyond rest. It is not dangerous, and does not increase the gravity of the case. On the contrary, many physicians consider that where slight hæmoptysis is one of the early symptoms the outlook is specially favourable. No doubt this is partly because, thanks to the hæmoptysis, the condition is discovered in good time.

Brisk hæmoptysis which is insufficient to threaten life requires more active measures, because if it recurs it may weaken the patient and cause extension of the disease by mechanically carrying the bacilli into fresh parts of the lungs, together with a suitable culture medium. There is nearly always a rise of temperature after brisk hæmorrhage into the lungs. If this is not due to extension of disease, the temperature subsides within a fortnight or three weeks. Hæmoptysis is very apt to cause excessive auto-inoculation, owing to the

* Naphthalene, 3 per cent.; ol. cinnamomi, 0·5 per cent.; ol. petrolei, or sterilized almond oil, to 100 per cent., used at a temperature of 80° F. R. Lake, 'Laryngeal Phthisis.' London, 1901.

† *British Medical Journal*, June 7, 1902.

‡ *Lancet*, October 31, 1903. See also Mendel, 'Tracheal Injection' (*Lancet*, July 15, 1905).

lowered vascular tension. The chief indications for treatment are to insure physiological rest for the affected part, to reduce local congestion if present, to increase the coagulability of the blood, and to reduce vascular tension if this is excessive. Theoretically one should also constrict the bleeding vessels, but in practice this is not easy.

Vascular tension may be reduced by keeping the skin warm and the bowels open by calomel and saline aperients. Those which contain calcium and magnesium salts have the additional advantage of increasing the coagulability of the blood. Among the most valuable remedies at the time of the hæmorrhage are amyl nitrite inhalations, sodium nitrite, and nitroglycerine. Another method of reducing the vascular tension consists in restricting the quantity of liquids in the diet. This is very efficacious in recurring hæmorrhage.[58] Ergot has been recommended in hæmoptysis, but I have myself found it disappointing. Dr. Jane Walker strongly recommends inhalations of spirits of turpentine. I have no experience of this method. Given internally it has been of little, if any, good; but in small doses it is known to reduce congestion, so that it should often be useful.

To increase the coagulability of the blood calcium chloride may be given, at first in large doses. Thirty or forty grains may be given at first every two or three hours; after the first three doses (or sooner if the hæmorrhage shows signs of abating) the dose should be reduced and the intervals lengthened. After a few days the remedy should be dropped, and resumed if necessary after an interval. I have found it useful to estimate the coagulability of the blood by Wright's method. Calcium lactate is much nicer to take than the chloride, but less efficacious.

To reduce local congestion external warmth (such as poultices) may be useful, but it is not a convenient remedy in open-air treatment. I have little experience of the ice-bag for such cases; when I have tried it the effect was not evident. Cool air to breathe is undoubtedly useful, unless it excites cough. The position is of importance in stopping capillary hæmorrhage. When a slight hæmoptysis persists the patient should be well propped up with pillows, a box being placed at the end of the bed to give purchase for the feet and insure rest. Although the pulse-rate is increased in sitting up, it subsides again if the patient keeps perfectly quiet.

Physiological rest may be insured by strapping the affected side with resin plaster, or less perfectly by a bandage. Subcutaneous injections of morphine or heroin are commonly used, but they have grave drawbacks, causing obstinate constipation, preventing the expectoration of stale and possibly fermenting blood, and upsetting the digestion. Rigid rest in bed is important in all well-marked cases of hæmoptysis. The bed-slipper should be used for the evacuations, and straining prevented as far as possible by the use of aperients and enemata if necessary. Ablutions should be reduced to the necessary minimum. If the sheets are kept very smooth the patient need scarcely be moved for several days at first.

In very profuse hæmorrhage which immediately threatens the life of the patient it is important to prevent the blood from collecting in sound parts of the lung and suffocating the patient. In these cases the position should be such as will allow the blood to drain away freely. The head and chest should be promptly placed in a semidependent position, with the help of a chair by the bedside. If there is syncope it may be necessary to apply artificial respiration. Such conditions are necessarily grave, and many would hesitate about any active measures; but Dr. Neild* argues that it is more important to free the lungs from blood than to keep them quiet, and measures like those adopted for the drowning are more likely to help than those usual in less severe hæmorrhage. He also points out the great danger of using morphine in severe hæmorrhage, as accumulations of blood may then happen in dependent parts of the lungs during narcotic sleep.

As regards the after-treatment, it is most important not to give an insufficient diet, or in any way to further reduce the patient's strength. To give a liquid diet of insufficient nutritive quality is a grave mistake; the proper diet after severe hæmoptysis is a dry, concentrated, and highly nourish-

* *Bristol Medico-chirurgical Journal,* June, 1908.

ing one.[57] It may also be advisable to give tuberculin or other remedy to provide against the extension of disease which usually follows after severe hæmorrhage.

PROPHYLAXIS.

Where there is a tendency to repeated hæmoptysis it is common to find the arterial tension above normal. This may be due to digestive disturbance, to the use of remedies, or to fever. Sometimes, however, the reason is not obvious. Hyperalimentation should be carefully avoided in such conditions, and dyspepsia carefully treated. The functions of the liver should be regulated, and the bowels kept open with saline aperients. Such a patient should keep regular hours, and avoid excitement and overexertion. While vascular tension is high it is not advisable to use creosote in any form, or arsenical medication. It has been shown by Huchard and others that some tuberculous subjects are liable to attacks of high arterial tension, while in others the condition is more permanent, and only disappears under a special régime. Subnormal tension may, however, alternate with normal or high tension, especially in ladies, in whom such a rhythmical alteration is within limits a natural process. High arterial tension appears to be specially common in both sexes at puberty, and in women at the menopause, and this should be taken into consideration in treating tuberculous subjects.

§ 66. Antipyretics in Pulmonary Tuberculosis.

Apart from the use of tepid or cold water, or of exposure to cool air, the question often arises in the course of severe pulmonary disease whether antipyretics should be used. There are a number of such remedies which undoubtedly reduce the temperature, including antifebrin, antipyrin, phenacetin, pyramidon, and cryogenin. The last is a favourite with French physicians, while pyramidon is much used in Germany. The drawbacks to the use of most antipyretics are that they do not appear to attack the cause of the fever so much as the actual rise of temperature, and that they nearly always depress the strength and spirits after a few doses have been given, while the effect is not lasting. Cryogenin, however, appears to be an exception. Two other remedies commonly used in England—viz., quinine in 5 to 10 grain doses, and effervescing carbonate of ammonia mixture—are less depressing, and may for a time be useful. None of these remedies, however, attack the cause—*i.e.*, the absorption of toxins—and measures directed against this are more likely to be of permanent value.

Fever is sometimes reduced by remedies which act upon the alimentary canal and its contents, as much toxin is found there whenever digestion is impaired. Here we have an indication for the use of creosote and its numerous compounds, guaiacol, duotal, creosotal, creosote benzoate, styracol, etc. Cultures of lactic bacilli are also of use, as well as aperients, bismuth, and other familiar digestive remedies.

The chief source of toxins is, however, the affected lung, and to diminish absorption we may either give remedies or adopt measures which help to get rid of some of the retained secretion (on the principle of draining an abscess), or give calcium lactate to thicken the blood and diminish absorption in this way.

Physiological rest is also indicated, so that pulmonary sedatives, absolute rest, strapping applied to the chest wall, and general sedatives to make the patient a trifle drowsy and reduce the sensitiveness of his nerve centres, may all be of use.

Probably some of the recoveries on record from acute phthisis treated with quinine, opium, and digitalis may be accounted for in this way. Whenever this line of treatment is adopted, measures should be taken to clear out the accumulated secretions periodically by expectorants with change of position, while the effect on the temperature is carefully watched. Sometimes free expectoration is more efficacious than to keep the chest quiet; sometimes the reverse is the case.

Another method of treatment is that by very minute doses of tuberculin given subcutaneously or by the mouth (see pp. 288 to 302). Specific treatment of this kind increases the formation of antibodies if there is still a reserve of constitutional strength, and so antagonizes the toxins which cause the fever.

A number of antibacillary remedies have been recommended at different times, some of which are probably useful within limits. This is a rational method of counteracting the fever, but, unfortunately, in severe attacks it is not usually to be depended upon (see pp. 278 to 288).

In all cases hyperaeration must be insisted upon, the patient being kept reasonably warm, and as much easily assimilable food given as can be digested. Remedies will also be necessary to maintain the nutrition of the heart, which always suffers in prolonged pyrexia.

Fever is often increased by complications, whether tuberculous (such as fistula, laryngitis, or pleurisy) or non-tuberculous. In one such case I found a staphylococcal vaccine invaluable, bringing down the temperature to quite moderate figures.[94] In another, surgical treatment of a fistula-in-ano brought down the temperature. Sometimes catarrhs (whether influenzal or other) cause great rise of temperature, and in such cases it may be possible to adopt vaccine treatment after the pathogenic organism has been identified. In some of these cases quinine, or arsenic, or antipyrin appear to counteract the catarrhal organisms ; and if a nasal accumulation is present, a nasal douche with a little antiseptic added, or a cyllin inhalator, is likely to be useful.

§ 67. The Digestive System.

Probably at least half of those who come for treatment to a sanatorium have some digestive disturbance on admission, so that open-air treatment will often have to be supplemented with medicinal help. A fresh-air life quickly improves both appetite and digestion in all slight attacks of tubercle, but in many cases the appetite is not equal to the digestive power, and the latter is often unequal to the demands made upon it. Those who are attacked with tubercle belong, for the most part, to the ill-nourished members of society, and it takes time and trouble if they are to be taught to eat more heartily.

Patients belonging to the working classes usually benefit much more quickly by the change of diet than others from the cultured classes who are equally hard hit, because there is necessarily a greater difference in the hospital class between the food they had at home and that provided under treatment.

The teeth should always be seen to early in the course of treatment, as imperfect mastication is a great drawback to efficient digestion. However, all serious dental operations, and all minor operations of doubtful urgency, should be postponed, since they may lead to an increase of fever or an extension of the lung disease. With this exception, carious teeth should be promptly attended to, as they increase the probability of fermentative changes in the stomach, and may possibly help to produce secondary infection.

The use of an antiseptic or astringent mouth-wash is often useful. A half-saturated solution of boric acid may be employed, or a solution of resorcin and menthol in alcohol and paroleine used with a nebulizer. Formamint lozenges are also convenient. If the uvula is elongated, and there is little or no expectoration, it may safely be shortened, an antiseptic wash being regularly used after expectoration. If, however, there is much expectoration, cutting operations are best avoided.

For similar reasons it is not advisable to remove enlarged tonsils in tuberculous patients, unless there is good reason to believe the tonsils to be tuberculous, in which case judgment must be exercised. Tuberculous ulceration of the palate and pharynx is notoriously fatal.

Atonic dyspepsia is very common in tuberculous patients. The most useful medicinal combinations in such cases are alkalis with bitter tonics, acids with strychnine, bismuth with alkalis and bitters, alkalis with carminatives, and gastric antiseptics, including the recently introduced lactic acid cultures or lacto-bacillin. Barbary* praises the persulphates for increasing the appetite. These were specially studied by Rigot

* *Loc. cit.*, p. 107.

(*Thèse de Lyon*, 1901), and are referred to by A. Robin as the best existing laxative digestive tonics. They may be prescribed in the form of persodine tablets (Lumière). Being unstable, less concentrated forms do not keep well. Orexin tannate in 4-grain tablets has also been recommended.

Dilated stomach is sometimes found in those who have been injudiciously overfed at a sanatorium or elsewhere. It is distinctly uncommon in a sanatorium where the dietary is well chosen. The best remedies are a more concentrated diet with less liquids, saline aperients, and alkaline mineral waters, gastric antiseptics, and muscular tonics, such as strychnine and the formates. Electrical treatment is said to be beneficial in such cases. Where the functions of the stomach are much impaired, with hypochlorhydria and fermentation, dilute hydrochloric acid after meals, with or without pepsine, will answer better than alkalis. In such cases partially predigested foods will be useful (see Section 62). To remove the accumulation of mucus a full dose of Vichy water taken hot on an empty stomach is useful. Patients in this country do not take kindly to lavage of the stomach.

For hyperchlorhydria and gastralgia, which are common in early stages of tuberculosis, the alkaline earths and bismuth are useful, with or without hydrocyanic acid or compound tincture of chloroform.

Constipation.

Laxatives are frequently required in sanatorium treatment. especially for those who are confined to bed. The prolonged rest which is necessary in febrile stages is not conducive to regular evacuations, and patients who have to eat full quantities of the more nourishing kinds of food are disinclined to take much fruit or green vegetables. Sometimes, however, it is useful to prescribe a fruit breakfast, including plenty of figs and other dried fruits, which are both laxative and nourishing. As regards drugs, ordinary cholagogues are well borne, as a rule. Other useful remedies are cascara tabloids or liquid extract, purgen tablets, 'Californian syrup of figs,' compound liquorice powder, and Apenta water.

Fistula in Ano.

As fistula in ano is a common complication of pulmonary tubercle, it may be necessary to decide as to an operation. The same considerations apply as in the case of dental operations. Where the discomfort is small, and there is no retention of pus, an operation is best postponed. The use of laxatives and local applications of olive oil or vaseline, introduced with the finger inside the sphincter, before and after action of the bowels, may prevent the necessity of an operation. If, however, the chest is but little affected, and the constitution unimpaired, it will be wise to have the fistula thoroughly attended to, as a large proportion of the diseased structures may in such a case be removable. Before any operation is attempted the opsonic index should be raised by a few doses of tuberculin. This will diminish the risk of extension of the disease after the operation.

Diarrhœa.

Persistent diarrhœa is of ill omen in tuberculous affections, because it usually implies the existence of tubercle of the bowels or of profound poisoning with bacterial products. While the constitution is still unimpaired, however, there is no reason to feel depressed about an attack of diarrhœa, which may be of quite a simple nature.

An over-large allowance of food is often corrected by nature by an attack of diarrhœa, so that a more concentrated diet may be needed if the tendency continues. Milk puddings and other unirritating farinaceous foods may be taken freely, but meat and meat-juice must be used cautiously, as they often increase the diarrhœa. Fruit and green vegetables are best avoided. Bread and milk is more suitable than oatmeal-porridge.[61] As regards drugs, the usual method may be followed of giving an aperient to remove irritant particles, followed by astringents. Among the latter, tannigen is useful. Full doses of bismuth are also of use in such cases. Severe diarrhœa, however, cannot be cured by astringents. In such cases an evacuant and antiseptic treatment is more likely to succeed. Mild saline aperients may be given, with naphthol and bismuth salicylate. Burton Fanning advises supplying the patient at lunch and dinner with a level teaspoonful of the pure powder of bismuth salicylate, a small quantity to be eaten with each mouthful of food like salt.* Salol may also be given.

Recently methylene blue has been strongly recommended by Dr. Renon. It may be administered twice to four times daily in cachets in doses of 15 to 20 centigrammes mixed with sugar of milk.†

De Renzi recommends 2 grammes of iodoform, 4 grammes of tannin, to make ten powders—one to be taken from twice to four times daily.‡

§ 68. Tonics and Cardiac Remedies.

One of the great dangers from long-continued fever lies in the weakening of the heart and other muscles of the body. It is a common experience that people who have had a severe attack of pulmonary tubercle, even if they recover under a suitable régime, are laid low by an attack of heart failure when some ordinarily trifling complication arises. It is, therefore, advisable to anticipate such failure, both by putting as little strain as possible on the heart, and by prescribing cardiac and general tonics while yet there is power of responding.

Rest in bed is one of the most important of these measures, which in high fever should be as absolute as it can be made, but without deprivation of fresh air in abundance. Incessant cough throws a severe strain upon the heart, and should be kept in check by suitable remedies.[64] Straining at stool should also be avoided, and all unnecessary exertion.

Disturbed sleep is also weakening. As a hypnotic, veronal in 7 to 15 grain doses is very useful; so also is trional in 10-grain doses; while some of the other hypnotics —such as chloral hydrate and bromide of ammonium—

* 'The Open-Air Treatment of Pulmonary Tuberculosis,' p. 124. London, 1905.

† *La Presse Médicale*, 1903, No. 49.

‡ *Riforma Medica*, December 23, 1899.

may be given from time to time. The latter is especially useful where there is general restlessness and irritability, leading the patient to spend his strength unreasonably over trifles. Some of the antispasmodics are useful for the same purpose—such as valerian, tincture of sumbul, and musk.

Palpitation and cardiac discomfort are more often due to digestive disturbance than to any other cause. After this, probably mechanical causes, such as excavation and fibrosis, leading to displacement of the heart, are the commonest reason for such discomfort in phthisical cases. The diet should, therefore, be seen to.[57] If displacement is the reason, something may be done by careful avoidance of any pressure on the heart from the garments, especially after meals. Ladies should avoid the least approach to tightness in their garments, and should never sacrifice comfort to appearances.

Among the drugs most useful in this form of cardiac debility are strychnine and quinine. The dose must be proportioned to the individual, but should be as much as can be borne without disturbance. If the pulse is too frequent and of low tension, digitalis is indicated. Strophanthus is also sometimes useful as a substitute for digitalis. Possibly syrup of formates would be useful.

Hæmatinics may be prescribed where the colour does not promptly improve with open-air treatment, but such cases are, in my experience, often disappointing. Trousseau warned against the use of iron in phthisical patients, but I have seen no ill-effects from a reasonable course of iron tonic, with or without arsenic, in cases free from increased arterial tension. Still, the need for such treatment is probably exceptional, whereas in anæmia from other causes an iron tonic is the first thing to be thought of.

§ 69. Remedies for Dyspnœa.

Dyspnœa in phthisical cases may be due to removable or to irremovable causes. On the one hand, there is dyspnœa from debility and anæmia, or from catarrhal and congestive processes, which will eventually clear up, or from pleural effusion ;

on the other hand, there may be dyspnœa from extensive destruction of lung tissue, or from cardiac debility consequent upon a prolonged attack of the disease. In the one case much improvement may be looked for, possibly a complete removal of the shortness of breath ; in the other the patient will have to put up with it as the price of any kind of recovery.

When dyspnœa arises suddenly, one of the most useful remedies is oxygen inhalation. In this case the cylinders are usually the most convenient, and the least quantity should be given which can be set free. There is considerable danger in some cases of the establishment of a craving for oxygen, comparable to the craving for strong drink in dipsomaniacs, and for a time equally distressing and difficult to eradicate, since the removal of dyspnœa by reparative processes is necessarily slow and gradual.

Dyspnœa from obstruction in the circulation through the lungs may sometimes be promptly relieved by venesection, provided that the patient be in a fairly vigorous state. The remedy is applicable in overfulness of the venous system, without impairment of the left side of the heart.

Another valuable remedy for dyspnœa is strychnine *sub cute.* Sometimes hot fomentations over the chest give comfort, or amyl nitrite if the pulse be hard.

It must be borne in mind that dyspnœa may arise from secondary renal mischief, in which case the best remedies are likely to be diuretics with digitalis ; but such cases are only fit for a warm room or a warm climate.

§ 70. The Treatment for Night-Sweats.

Many remedies have been recommended for night-sweats, and these are still referred to in British and foreign textbooks. In this climate I have never found the need for them if open-air treatment is properly carried out. The symptoms may be troublesome in moribund cases, but in such it is useless to give a special remedy. Hot food and stimulants, tepid sponging, and remedies directed against the general debility and the fever, are more likely to be of use than zinc oxide and atropine, tellurate of sodium, or agaric.

Do not know of terminal dyspnoea

IX.—GENERAL REMEDIES

A number of drugs have been recommended by well-known physicians as remedies for tuberculosis. Those which are not intended to relieve symptoms either act on the metabolism of the body or possess antibacterial properties. Some of these remedies are undoubtedly useful, and will be still more so when the indications for their use are more generally and precisely known. Some light has been thrown upon the subject by the investigations of physicians in France and Germany, amongst whom Robin, Bouchard, Gimbert, Gautier, Huchard, Gumpert, Landerer, and Cohn are prominent.

§ 71. Arsenical Remedies.

Arsenic has long been used in tuberculosis as a tonic without any very precise idea as to its action. Its value apparently depends chiefly upon the power it possesses of restraining metabolism, which is known to be excessive in tuberculosis. It has been shown by Robin and Binet* that there is in tuberculosis an increased elimination of carbon dioxide and an increased consumption of oxygen, of which an abnormal proportion is retained in the system, more than can be accounted for by the carbon dioxide eliminated. Hariel and Daremberg have shown that there is a close connection between tuberculosis and phosphaturia, so that the tuberculous subject may be regarded as one in whom there is excessive destructive metabolism and excessive elimination of phosphates or (to change the expression) progressive demineralization. It appears, however, that these destructive changes are reduced by arsenic, which diminishes the carrying capacity of the blood-corpuscles, and, in consequence, the oxidative processes and the abnormal demand for oxygen. The indirect consequence of this is to increase the corpuscles and the albuminous

* Robin and Binet, *Arch. Gén. de Médecine*, May and June, 1894, and April, 1895; *Acad. de Médecine*, March, 1901. Barbary, 'La Grande Faucheuse,' p. 53. Paris, 1907.

constituents of the blood, and later on those of the tissues. French physicians, who use arsenic largely in phthisis, insist upon the importance of only administering it intermittently and in cases where the vascular tension is subnormal or normal.

Owing to the irritating effects of arsenic upon the alimentary canal, organic compounds have been introduced which are less toxic and which can be administered by subcutaneous injection. The chief of these are cacodylic acid, cacodylate of soda, and arrhenal. Cacodylate of guaiacol has also been introduced by Barbary, combining the properties of arsenic and of creosote.*

Cacodylate of soda is given subcutaneously in doses of 5 to 10 centigrammes daily for a week, followed by a week's rest, and repeated. Arrhenal, which is a methylarsenate of soda, is less toxic, and can be given *sub cute* or by the mouth. For the latter purpose granules of 1 centigramme may be used, or a solution of 4 per cent. It is useless to give more than 2 centigrammes in one day. Cacodylate of guaiacol (which may be a mixture or a true chemical compound) is a white salt soluble in water, alcohol, glycerine, or oil. It may be injected very slowly into the gluteal region in oily or watery solution. The usual dose is 1 milligramme every other day for ten doses, followed by a rest. The injection is stated to be painless ; the effect is said to be to reduce fever if this is present, to reduce expectoration, improve sleep, and increase the appetite if there is no fever.

§ 72. The Phosphorus Group.

The late Dr. Churchill was chiefly instrumental in introducing calcium hypophosphite as a remedy for phthisis, in which he was followed by Thorowgood and other well-known physicians. It was stated by Churchill to produce an almost immediate improvement in many cases.

Dr. Sturges† found it to be very useful in children suffering

* *Académie de Médecine*, 1900. See also Barbary, 'La Grande Faucheuse.' Paris, 1907.

† *Westminster Hospital Reports*, vol. i., 1885.

from presumably tuberculous affections of the glands, for which he gave from 6 to 10 grain doses. In some cases treated in this way fever promptly disappeared, and the general nutrition began to be improve soon after the drug was given· It is supposed to be chiefly of use before softening has begun.

The glycero-phosphates are also largely prescribed in France. They appear to improve the nutrition of the nervous system, which always suffers in tuberculosis.* A preparation called Sanatogen, consisting of a combination of casein with glycero-phosphate of soda, has been shown to have the property of increasing the assimilation of other kinds of food.† Lecithin, which is a phosphorated organic compound existing in the nervous system, the yolk of an egg, and other highly organized materials, has been used in France by subcutaneous injection in doses of 5 centigrammes. It is stated to diminish the elimination of phosphates and to increase the absorption of nitrogen, to increase the appetite and the weight, and generally to improve the state of nutrition.

§ 73. Calcium Salts.

Dr. Ferrier has introduced a method of treating consumptives,‡ the object of which is to promote the retention of calcium salts in the body. In addition to prescribing these medicinally, he forbids the use of any food which is believed to increase their elimination, such as alcohol in any form, butter, fat, oils, or acids. He allows very little sugar and little or no pastry, and only a limited amount of bread.

Apart from this method, lime salts have long been recognized as useful in the treatment of consumptives for their effects on the digestive system and on the heart.

The action of lime salts in restraining auto-inoculation and hæmorrhage is referred to elsewhere (Sections 65 and 66).

* Gumpert, *Mediz. Klinik*, 1905, No. 41.

† Tunnicliffe, *Arch. Intern. de Pharmacodynamie et de Thérapie*, vol. xvi., fasc. 1 and 2.

‡ *Soc. Méd. des Hôpitaux*, March 30, 1906.

§ 74. The Sulphur Group.

Sulphuretted mineral waters have long had a reputation in France for the treatment of tuberculous and non-tuberculous catarrhal conditions. They appear to increase the fluidity, and eventually to reduce the quantity, of expectoration.

Calcium sulphide has long had a reputation for the cure of enlarged tuberculous glands.

Ichthyol (Section 79), which has an undoubted influence on pulmonary tuberculosis, contains organic sulphur as well as phosphorus.

§ 75. The Iodine Group.

Tincture of iodine has been used by Coghill and others for inhalation in phthisis, and is stated to have a useful effect on the cough and expectoration (see Section 64). Given by the mouth, the iodides are very useful in increasing the fluidity of the sputa. They reduce vascular tension.

Iodoform.

Shingleton Smith and others strongly recommend iodoform in pills for pulmonary tuberculosis. Dewar* appears to have obtained good results from the intravenous injection of iodoform dissolved in ether.

Iodipin.

Iodipin is said to cause less disturbance than iodine. It may be given in 1 to 2 drachm doses of a 10 per cent. solution with a little oil of peppermint.

§ 76. Mercurial Salts.

Since corrosive sublimate is known to be very poisonous to the tubercle bacillus, attempts have been made to cure tuberculosis by means of injections of mercurial salts. In some cases these have appeared to be beneficial, but the condition may not have been one of unmixed tuberculosis.

Oleate of mercury (10 per cent.) rubbed into the skin appears to be useful in tuberculous peritonitis and tuberculous glands.

* *British Medical Journal*, November 21, 1903.

§ 77. Formalin.

Formaldehyde is a useful disinfectant for tuberculous expectoration. It has therefore been employed as a remedy for tuberculosis, chiefly by inhalation. I have myself tried this method, but could not satisfy myself as to its value.

Maguire* introduced a method of injecting formalin into the veins, concerning which most discordant opinions are held.

Urotropin, which is converted into formaldehyde in the body, is a very useful remedy for tuberculosis of the urinary organs.

Formamint lozenges appear to have a decided antiseptic power in intercurrent inflammations of the pharynx.

§ 78. The Creosote Group.

Creosote appears to possess some antiseptic power against the tubercle bacillus, since it prevents its development in glycerinated broth. Originally introduced as a remedy for consumption by Reichenbach in 1830, it has been much used by Bouchard, Gimbert, Sommerbrodt, and a number of other distinguished physicians, who regard it as of great value. Its effect in reducing the expectoration in phthisical patients is undoubted, and but for its irritating action on the digestive canal, its apparent tendency to promote hæmoptysis, and its uncertainty of action, it would probably be more largely employed than it is. Cases are not uncommon in which it appears to do no good. Now and then it seems to do actual harm. These variable results may be partly explained by a variable dosage on the one hand, and by the variable state of the patient on the other. Burlureaux† and others have shown that there are greater individual differences in the reaction to creosote than to any other commonly used drug, so that a medium dose may be well tolerated by one, but actively poisonous to another. It appears also that while creosote and its compounds are useful in a condition of low vascular

* *British Medical Journal*, December 15, 1900.

† 'La Pratique de l'Antisepsie.' Paris, 1892.

tension, they are mischievous if the tension is above normal. I have myself largely used this group of remedies in several ways, and while at times they have been obviously useful, in other cases they have been disappointing. Burlureaux cautions against their use in fever, excepting in very small doses, although, on the other hand, they have been used in France, Italy, and Germany as antipyretics. They are not, however, to be recommended for this purpose, as they are apt to cause symptoms of collapse.

There is some difference of opinion as to the mode of action of creosote in the body, some believing that it makes the tissues a bad culture medium for the bacillus, while others attribute the good results to antifermentative action or to neutralization of toxins. In small doses it is useful both for the reduction of expectoration, where this is abundant, and for the correction of intestinal fermentation.

Burlureaux* treated some chronic cases from the French Army with large doses of creosoted oil *sub cute*, applied by the help of a special apparatus working by atmospheric pressure. The results appear to have been very good. I have myself tried the same method where no sanatorium treatment was available, and my impression is that the method was useful.

The French and German physicians who have used creosote in this way or by the mouth insist on the importance of using pure beech-wood creosote, which contains chiefly guaiacol, without the more irritating cressols. Given by the mouth, it appears to be partly eliminated by the lungs, and acts upon the bronchial tubes on its way out. It can be given in perles or capsules after meals, or in a formula suggested by Burney Yeo,† which I have myself used extensively, and have found to be well borne.

* *Loc. cit.*

† 'A Manual of Medical Treatment,' vol. ii., p. 25. London, 1894.

℞ Creosoti pur.	♏xlviii.
Glycerini	℥ii.
Tinct. aurant.	ad ℥iii.

Ft. mist. One teaspoonful in a large wineglassful of milk and water three or four times a day soon after food.

Creosote and its compounds have a distinct effect in diminishing secretion where there is a good deal of secondary catarrh, but I am unable to say whether the cases in which it acts in this way are instances of double infection or of simple tuberculous mischief. Some patients can tolerate very large doses (up to 2 drachms of pure creosote suitably diluted) without any disturbance. On the other hand, some people are very intolerant of it, and taste it all day after a single small dose of 2 to 3 minims, or suffer from vomiting and shivering. Creosote carbonate and guaiacol carbonate are less open to this drawback, since they pass unchanged through the stomach, and are decomposed and absorbed in the small intestine. Styraco (guaiacol cinnamate) partakes of the nature of guaiacol and of cinnamic acid combined. Probably the benzoate acts in much the same way. Both are well borne in 10-grain doses, and I continue to prescribe them ; but I have met with no really unpromising case in which they were of use. Creosote is also used by inhalation.

Dr. Kaatzer, of Rehburg, prescribes creosoted coffee in conditions where creosote is indicated. It is made by infusing beech-wood creosote with a double quantity of extract of coffee (20 centigrammes of the creosote with 40 centigrammes extract of coffee make 10 grammes of coffee). Patients take from 60 to 100 grammes per day.*

§ 79. Ichthyol.

This has been extensively used in France and Germany since its introduction by Unna in 1881. Among the earliest to recommend it for tuberculosis were Mauritz Cohn and H. Fränkel. It appears to have a decided antiseptic effect on several pathogenic bacteria, including the tubercle bacillus, besides which it is stated to have the property of reducing congestion in mucous membranes, liquefying expectoration, and after a time reducing the quantity. It is said to be well borne in febrile conditions and in cases with high arterial tension. It may be given in cachets or palatinoids, or in

* Kuthy, 'A Tüdövész.' Budapest, 1897.

20 to 40 drop doses in a glass of peppermint-water before meals. It is stated by Barbary* to reduce fever in phthisis, and to prevent the extension of inflamed areas in the lungs.

ICHTHYOSOL.

A compound of ichthyol with guaiacol has been introduced in France, which combines the action of these two remedies, and can, like ichthyol, be given to febrile patients. The dose is 12 drops twice a day in a glass of water, increased to 40 drops, then gradually diminished (Barbary, *loc. cit.*).

§ 80. **The Balsamic Group.**

A number of drugs related to benzoic acid have been used as remedies for tuberculosis. Many of them have antiseptic and antipyretic qualities ; some of them increase the production of leucocytes, which are usually deficient in tuberculosis. Both benzoic and salicylic acids have been much used to combat the fever of tubercle. A spray of benzoate of soda is said to be a good remedy for some forms of tuberculous cough. Balsam of Tolu is a recognized ingredient in cough-mixtures. Balsam of Peru and cinnamic acid have been given subcutaneously or by intravenous injection for their action on the blood, and indirectly on tuberculous foci.

CINNAMIC ACID TREATMENT.

Landerer introduced a method of intravenous injection of cinnamic acid which was stated to reduce the true tuberculous fever, to increase leucocytosis, and induce sclerotic changes in the affected parts of the lungs. The solution used consists of finely powdered synthetic hetol (or cinnamic acid) in distilled water or 0·7 per cent. sodium chloride solution. Two strengths are employed, containing respectively 1 per cent. and 5 per cent. It should be neutral or slightly alkaline in reaction, recently filtered, and sterilized each time before use by being boiled for five minutes in a water-bath. The skin should be rubbed

* *Loc. cit.*

with ether, and a piece of plaster fixed on the arm above the chosen spot, the injection being made into the cephalic vein with a sterilized glass syringe. The doses are gradually increased from 1 milligramme (in a 1 per cent. solution) to 15 or 20 milligrammes (in a 5 per cent. solution) for men, 10 or 15 milligrammes for women, being given about every second day if there is no disturbance. Should fever follow, the dose must be reduced. In case of hæmoptysis, no injection should be given for at least a fortnight. The treatment is suitable for early cases only.* According to Bullock, hetol increases the formation of antibodies.

Cinnamate of Soda.

This has been injected subcutaneously in a 10 per cent. solution in glycerine by Dr. Lovell Drage with apparently useful results.†

§ 81. Camphor and its Allies.

Camphor has been given to control night-sweats. It is also stated to have some influence over the fever of tuberculosis. Camphoric acid may be administered in 5 to 15 grain doses in wafers at bedtime. It is also given subcutaneously in 10 per cent. oily solution.‡ Dr. Walter Koch, of Freiburg, has used it by inunction, and speaks highly of the results.§

Gomenol.

This is a volatile product of distillation of the leaves of a variety of *Melaleuca viridiflora* (Myrtaceæ), investigated by Bertrand in 1893, and much used on the Continent. It contains a large proportion of a kind of eucalyptol, but being

* *Münch. Med. Woch.*, 1888, Nos. 40, 41 ; 1889, No. 4. *Deutsche Med. Woch.*, 1890, Nos. 14, 15 ; 1893, Nos. 9, 10. *Journal of Tuberculosis*, vol. v., January 1, 1903. 'Die Behandlung der Tuberkulose mit Zimtsäure' (Leipzig, 1898). 'Anweisung zur Behandlung der Tuberkulose' (Leipzig, 1899).

† *Lancet*, July 12, 1902 ; May 23, 1903.

‡ *Ibid.*, July 11, 1891 ; January 2, 1892. *Berl. Klin. Woch.*, 1898, No. 48.

§ *Berl. Klin. Woch.*, 1904, No. 18.

free from aldehydes, is neither caustic nor toxic. It is used in 10 per cent. oily solution for intratracheal injections; also for external and internal application in pharyngitis. Given by subcutaneous injection in 10 per cent. oily solution, it is stated to reduce the fever, the cough, and the expectoration, and to be free from all drawbacks.*

Eucalyptol.

Eucalyptus infusion has been much used in the treatment of various forms of catarrh. Eucalyptol is also largely prescribed on the Continent in capsules for tuberculosis. It diminishes the quantity of secretion, and probably relieves congestion like turpentine. The appetite is also stimulated, and flatulence relieved. The essential oils are mostly antiseptic, and increase the formation of leucocytes. Oil of peppermint was used long ago in China as a specific against tuberculosis.

Thymol.

De Renzi recommends thymol for reducing the fever of tuberculosis.†

§ 82. Carbolic Acid and its Allies.

As carbolic acid destroys tubercle bacilli out of the body, it has been prescribed for the living tuberculous patient. By inhalation it is distinctly useful for its effect on the upper air passages. A carbolic pill may sometimes be useful in cleansing the alimentary canal, but beyond these uses it does not appear to do much good.

Cyllin, which is presumably related to phenol, is an extremely useful inhalant for bacterial inflammations of the nose and throat.

Izal has been prescribed internally by Tunnicliffe and others,‡ and appears to be useful in disinfecting the alimentary canal, and indirectly in other ways. It may be given in 2 to 10 minim doses in capsules, with or without cod-liver oil.

* Barbary, *loc. cit.*

† *New York Medical Journal*, August 6, 1898.

‡ *Lancet*, January 18, 1902.

§ 83. Nuclein Treatment.

Some years ago the treatment of tuberculosis by pure cultures of yeast was strongly recommended, and more recently nuclein and nucleinate of soda have been used for the same purpose. Chantemesse injects 0·4 gramme of nucleinate of soda in 40 c.c. of normal saline solution as a prophylactic where abdominal operations are to be performed; the effect is to cause marked leucocytosis, and to raise the opsonic index against various pathogenic bacteria, including tubercle, in much the same way as specific vaccines. As far as my own experience goes, treatment with yeast or with nucleins does no harm, but the results have been less striking than with tuberculin or staphylococcus vaccine respectively.*

X.—SPECIFIC TREATMENT

§ 84. General Considerations.

Ever since the discovery of the tubercle bacillus attempts have been made to discover a specific antidote for it analogous to the antitoxin of diphtheria. This is much needed in acute attacks of tuberculosis, where the body has not had time or has not the capacity to defend itself effectively against an overwhelming dose of tubercle toxins. Were it possible to neutralize these, and at the same time to stimulate the defensive mechanism of the body, some of the most intractable cases might be saved.

Unfortunately, up to the present no reliable serum has been discovered, although there are a number of useful vaccines against tubercle which, within limits, will increase the formation of antibodies, provided there is time for their action and sufficient constitutional strength remains.

* See *Therapeutic Gazette*, September 15, 1907; Huggard and Morland, *Lancet*, June 3, 1905; Vaughan, *Philadelphia Medical News*, December 17 and 22, 1897.

The absorption of a bacillary toxin into the general circulation ought to lead to the formation of antibodies. If the quantity absorbed is at first small and is very gradually increased, tolerance is established for fairly large doses. If, on the other hand, the tuberculous foci are shut off from the lymphatic and blood circulation until they are extensive, overwhelming doses of toxin may enter the circulation and cause a dangerous breakdown in health.

The object of vaccine therapy in tuberculosis is to introduce small and gradually increasing doses of tubercle toxins into the circulation, so that the body may become capable of dealing with large doses when they are liberated by softening of the tuberculous foci. As, however, during the course of treatment some absorption of toxins is sure to take place, the therapeutic doses must be regulated in accordance with clinical indications, not merely repeated or increased according to a preconceived rule or at invariable intervals.

Vaccine treatment of tuberculosis differs from the exhibition of most drugs in this need for a variable dosage according to the response which is made to each dose in succession. Too small a dose fails to provoke an adequate response, too large a one overpowers the forces of the body, and what is an appropriate dose at one time will not be the right one later on when tolerance has been established or an extra sensitiveness provoked.

Another difference from ordinary drug treatment lies in the extreme minuteness of the doses. In vaccinating against smallpox we are introducing a living vaccine, a modified pathogenic organism ; but in tuberculosis this has, up to the present, been found to be too dangerous, and only dead vaccines have been employed. These, however, have all the effect of a ferment, and probably contain more than one actual ferment within them.

Tuberculin has now been extensively used in various forms by many physicians, and it can be confidently affirmed that if judiciously employed it is absolutely harmless, and can often accomplish what cannot be done by unaided hygienic treatment. No harm can be done by giving it in early afebrile cases in accordance with accepted rules, and there is increasing evidence that in still minuter doses it is equally useful in many febrile cases. The reason for the widespread condemnation of tuberculin soon after its introduction was entirely because it was used in too large doses, and because Koch's own rules for dosage and for selection of cases were disregarded. Tested in the same way, it would be quite easy to discredit strychnine, digitalis, or any other powerful remedy.

It is true that much can be done by graduated exercise in raising the bodily resistance to tubercle. This is essentially a method of auto-inoculation; but there is a large class of cases in which it is impossible to give sufficiently minute doses of tubercle toxins by auto-inoculation, because the slightest exertion leads to an overdose. In such cases vaccine treatment with strict rest will accomplish what hygienic treatment alone fails to do. In other cases it may be a matter of indifference whether the one or the other method is adopted, provided that sufficient care is taken to give suitable doses.

§ 85. **Koch's Method.**

The accepted rules for using tuberculin in Germany are now as follows:*

Suitable cases are such as have early disease of not more than one, or at most two, upper lobes, without marked constitutional deterioration, without more than very slight fever, without heart affections or other grave complications.

The dose is chosen with the hope of avoiding any high febrile reaction, but a short wave of fever usually follows, rising to a maximum of perhaps 101° or 101·5° F., and subsiding within three or four days. If the same dose is repeated, a smaller febrile rise (or none at all) is excited. The initial dose depends upon the preparation used, and on the nature of the case. If old tuberculin (T.) is used, the initial dose

* See 'Möller's article in Schröder and Blumenfeld's 'Handbuch der Therapie der chronischen Lungenschwindsucht,' p. 230 (Leipzig, 1904). Also Bandelier and Röpke, 'Lehrbuch der specifischen Diagnostik und Therapie der Tuberkulose' (Würzburg, 1908).

may be $\frac{1}{10}$ milligramme in an average case. This dose is not increased unless the body-weight is rising, the general health improving, and the temperature normal. The interval between successive doses is usually from three to four days, but no fresh dose is given until the temperature has been normal for at least one day. As a rule, the doses are successively increased in using T. by $\frac{1}{10}$ to $\frac{1}{5}$ milligramme until a slight rise of temperature is produced. This dose is then repeated until it produces no febrile reaction, and then similarly increased. When the abnormal physical signs have disappeared from the chest and the health is apparently normal, without fever, cough, or expectoration, the dose is no further increased, and the treatment is at an end. Some physicians continue to increase the doses until a full diagnostic dose[31] has been reached, and repeat the test after a twelvemonth. If there is evidence of disease being present, a fresh course of treatment is given; also if there is a relapse, at an earlier date. It should be remembered that no general rules can be laid down for all cases, but the initial dose and treatment generally must be varied to suit each case. The description given above is for an average case.

The mode of injection is as follows: The patient's skin at the selected spot is cleaned and disinfected, pure lysol being often used for the latter purpose. The place chosen may be the skin of the abdomen or the skin between the scapulæ. The chosen spot should not be such as is likely to be rubbed or pressed when the patient is in bed. One advantage in using lysol is that it destroys bacteria, such as the tetanus bacillus, which might be accidentally inoculated. A sterilized glass syringe is used, the tuberculin being injected under the skin, and a small dressing applied if preferred. There is usually no discomfort afterwards at the point of inoculation. It is, however, not uncommon to find (even after doses which do not affect the temperatures) an increase in the adventitious sounds (especially of the 'moist' sounds) at the tuberculous parts of the lungs, and such sounds may appear at spots which were not positively known to be affected. These changes, however, are usually evanescent, leaving an improved condition behind them. If the doses are chosen in accordance with the rules already mentioned above, there is no evidence that any permanent inflammation or congestion ever follows, or that healthy parts of the lungs are in any way affected.

Koch's treatment is especially applicable to afebrile cases of phthisis of strictly limited extent. It is also useful in third-stage cases without fever and with a limited extent of unhealed lung tissue. It is less applicable to second-stage cases and to those which are still feverish; indeed, in such cases it may be actually mischievous.

Koch's new tuberculin (T.R.) has been perhaps more frequently employed for curative purposes than the old (T.), which is reserved by many for diagnostic purposes. Recently Koch's tubercle emulsion (T.E.) has been a good deal used as a remedy.

§ 86. **Varieties of Koch's Tuberculin.**

Koch has chiefly employed three preparations of tuberculin, called respectively old tuberculin (T.), new tuberculin (T.R.), and bacillus emulsion (T.E.).

Old Tuberculin.

In the production of Koch's old tuberculin, tubercle bacilli are grown on a slightly alkaline glycerine bouillon culture medium for six to eight weeks, after which the fluid is filtered through porcelain and evaporated to one-tenth its original bulk. It is a somewhat thick yellowish-brown liquid. As it usually requires to be used in fractional doses, it has to be diluted. For this purpose normal salt solution containing 0·4 per cent. of phenol may be used, a 10 per cent., a 1 per cent., and a 0·1 per cent. solution being successively prepared. Of the 1 per cent. solution $\frac{1}{10}$ c.c. is the equivalent of 1 milligramme of the original preparation, which is the usual initial diagnostic dose. For curative purposes the first dose would usually be $\frac{1}{10}$ milligramme, or $\frac{1}{10}$ c.c. of a 0·1 per cent. solution (see *Deutsche Med. Woch.*, November 3, 1890).

New Tuberculin.

This is made by grinding dried cultures of highly virulent tubercle bacilli in an agate mortar and centrifugalizing in distilled water. The fluid is poured off, what remains is again centrifugalized, and the resulting fluid poured off and standardized to correspond with 1 per cent. of bacillary substance, glycerine being at the same time added to preserve it. Since the solids extracted from the bacilli are about one-fifth of the original weight of the bacilli themselves, there was for a time a little doubt as to the real meaning of a given dose. Originally the dose was stated in terms of solid extract of bacilli, but now it is usually stated in terms of actual weight of bacilli, or five times less—*e.g.*, $\frac{1}{2000}$ milligramme by the old method is equivalent to $\frac{1}{10000}$ milligramme by the new method of dosage ; or, in other words, each 1 c.c. contains 2 milligrammes of solid extract, and is derived from 10 milligrammes of tubercle bacilli. To dilute this preparation, a mixture of glycerine and water is used, made by boiling 20 parts of pure glycerine with 80 parts of distilled water for several minutes. The dilution keeps for about a week or ten days, but should be thrown away if it becomes cloudy.

Koch's initial dosage of this preparation is usually $\frac{1}{1000}$ to $\frac{1}{500}$ milligramme, which would now be stated as $\frac{1}{5000}$ to $\frac{1}{2500}$ milligramme (see *Deutsche Med. Woch.*, 1897, No. 14).

Bacillus Emulsion.

This is an emulsion of dried and powdered tubercle bacilli in distilled water with 50 per cent. glycerine, and contains 5 milligrammes of solid substance in 1 c.c. Since the whole substance of the bacillus is used in its preparation, there is no room for doubt in stating the dose.

The initial dose of this preparation is $\frac{1}{2000}$ milligramme of the original solution, which is previously diluted 1,000 times by the addition of normal saline solution containing 0·4 per cent. of phenol.

This preparation is said to be more active for curative purposes than the other preparations, but to be open to the objection that bacillary fragments are liable to remain for some time in the tissues and to act as irritants. In some cases it appears that a sort of abscess has been caused, which, however, only contains a sterile serum (see *Deutsche Med. Woch.*, 1901, No. 48).

§ 87. Wright's Method.

This is the outcome of Sir Almroth Wright's opsonic test,[32] by which it was shown that much smaller doses of vaccine have an effect on the formation of antibodies than could be shown by ordinary clinical observation.

The chief differences between Wright's method of treatment and Koch's are that the initial dose is much smaller, and the doses are only repeated when there is evidence from the opsonic test that the production of antibodies is diminishing. Moreover, no attempt is made to induce tolerance of large doses of tuberculin.

The initial dose would depend, as in Koch's method, on the case, as well as on the preparation used. Wright has chiefly employed T.R., but has latterly also used T.E. My own experience in opsonic treatment is exclusively confined to T.R. In strictly localized tuberculosis larger initial doses could safely be used than with more widespread lesions. It is also advisable to reduce auto-inoculation by keeping the patient at rest; and to febrile patients much smaller doses must be given than to those who are entirely free from fever. In the latter the initial dose might be $\frac{1}{20000}$ milligramme T.R.; in febrile cases it would be much smaller. The opsonic index would be estimated before beginning the treatment, and if subnormal or within normal limits, a dose would be given to raise it to, say, 1·5 or over. In very early tuberculosis the effect of a small dose would be more marked than in disease of longer standing, but still of limited extent, because in the former no tolerance would have been established for the tubercle toxins. Observations made every other day would show the effect of the dose on the opsonic index, and if the maximum has been passed and the index is subsiding towards normal, another dose would be given. The dose would be altered if the response were unsatisfactory. Too small a dose produces a rapid rise, which is not lasting; too large a dose produces a marked negative phase, followed by a slight rise. The best dose would produce a small negative phase, followed by a steady rise, lasting several days, and succeeded by a high opsonic index, lasting some days longer. Such a dose need not be repeated for a week or a fortnight. If the opsonic index be very low before treatment is begun (below 0·5), a very small initial dose should be given, to avoid producing a dangerously low index during the negative phase. As regards increase of doses, it is usually advisable to raise them to, say, $\frac{1}{1000}$ milligramme, and continue such doses in the absence of a contraindication once a week until the physical signs are those of arrested disease.

In some cases it is probably necessary to raise the dose to a higher figure, in order to get permanent results. Wright sterilizes his vaccines by subjecting them to a temperature of 60° C. for half an hour. A higher temperature may spoil the therapeutic value of the vaccine. He also adopts the precaution of adding a small proportion (0·1 per cent.) of lysol to successive dilutions, and rubs the skin at the point of inoculation with pure lysol before and after the injection. To sterilize the syringe he draws oil at 150° C. into the barrel. This does not rust the points like boiling in water.

The great merit of Wright's opsonic method is that it has to some extent explained the mechanism of natural curative processes in tuberculosis. It is conceivable that the formation of opsonins, being only one out of many modes of reaction against the bacillary invasion, may not be the chief one at all stages of the defence, in which case it would not be an absolute guide to dosage with tuberculin. But even so it is a valuable indication of the sufficiency or otherwise of small initial doses, especially when auto-inoculation is going on. Under these circumstances we may be in doubt whether a rise of temperature is due to the disease or the remedy until we can test the matter by taking a series of opsonic indices. Those who are familiar with Koch's method and not with Wright's freely declare the inadequacy of the latter to produce a complete and permanent recovery; but Koch's method is not applicable to febrile cases, and the scope of the two methods appears to be somewhat different. Probably many of the later doses given in Koch's ordinary method are unnecessarily large; while, on the other hand, it may sometimes be advisable to use larger doses than are adopted by Wright's followers, after toleration has been established.

§ 88. Latham's Method.

It has been shown by A. C. Inman* that the opsonic index varies inversely as the temperature, although the relationship is probably not a simple one. It follows from these observations that it should be possible to reduce the fever in some cases of tuberculosis by the administration of tuberculin. The doses employed in Koch's method, however, tend rather to raise the temperatures—at all events, as the first effect of their administration; but A. Latham found that much smaller doses had an opposite effect, which corresponds with the well-ascertained fact that very small doses of tuberculin or other vaccine produce an immediate rise in the opsonic index, not preceded by a negative phase. Latham also found that tuberculin could be usefully given by the mouth in normal saline, provided that it were given on an empty stomach. The effect of this method of administration is much milder than the subcutaneous method; and Latham also found that the addition of normal horse serum was a useful adjuvant in some cases. The latter still further increases the mildness of the tuberculin, and possibly supplies some substance necessary to the formation of antibodies which is not properly produced in some febrile consumptives. The chief difficulty in the way of treating febrile tuberculous patients with tuberculin lies in the irregular auto-inoculation, and it is essential to reduce this as far as possible.

Latham sometimes begins his treatment with a dose of

* Transactions of Medical Society, vol. xxxi., p. 117 (London, 1908).

$\frac{1}{2000000}$ milligramme T.R., given with horse serum, gradually increasing the dose every few days if no effect is apparent on the temperature. If, on the other hand, the temperature rises in the form of a wave, as after the more usual doses of tuberculin, the dose must be diminished until a suitable one is found. When the correct dose has been found, the effect is very remarkable, the temperature coming down rapidly to about normal. In some cases after a time the horse serum does not agree with the patients, in which case it has to be replaced by normal saline solution. The usual dose of horse serum is from 5 to 10 c.c.

§ 89. Spengler's Method.

As already mentioned (Sections 1 and 6), Spengler regards pulmonary tuberculosis as caused by both the bovine and human varieties of tubercle bacilli. Moreover, he believes that the two varieties are often associated in the same case, and that when such association occurs the case runs a milder course clinically.

He bases on these considerations a method of treatment whereby tuberculin from the human variety is given for disease caused by the bovine variety, and *vice versâ*. He uses special preparations of tuberculin from these two sources, which are given in very minute doses.

Spengler's theories and results are disputed by many Continental physicians, and must be regarded as still *sub judice*. Spengler's preparations are three in number, one of which is an emulsion of bovine tubercle bacilli (P.E., or perlsucht emulsion), after the T.E. of Koch, the two others being vaccines obtained from human and bovine sources respectively, prepared somewhat like Koch's T.R., and marked T.B.V. and P.B.V. The initial dose used by Spengler varies from $\frac{1}{1000000000}$ to $\frac{1}{100000000}$ milligramme, rapidly increased (*Deutsche Med. Woch.*, 1904, No. 31; 1905, Nos. 31 and 35).

§ 90. Tuberculin of Denys.

Denys prepares a form of tuberculin which is not concentrated by heat. It consists of a filtrate made from the bouillon culture medium in which tubercle bacilli have been grown. It is stated that smaller doses will cause a reaction than is the case with Koch's T.A. The usual initial dose is 1 milligramme in afebrile cases, and as little as $\frac{1}{100000}$ milligramme in febrile cases.*

§ 91. Béraneck's Tuberculin.

Béraneck has prepared a form of tuberculin made from recent cultures of tubercle bacilli, and said to contain both intracellular and extracellular toxins. The former are obtained by means of a 1 per cent. solution of orthophosphoric acid, while the extracellular toxins are obtained by growing the bacilli upon a medium free from peptones.

The preparation is sent out in seventeen different strengths labelled (according to Sahli's scale) $\frac{A}{512}$, $\frac{A}{256}$, $\frac{A}{128}$, $\frac{A}{64}$, $\frac{A}{32}$, $\frac{A}{16}$, $\frac{A}{8}$, $\frac{A}{4}$, $\frac{A}{2}$, A, B, C, D, E, F, G, H. Each of these preparations is half the strength of the succeeding one. For patients with normal temperature Béraneck recommends an initial dose of 0·05 c.c. of the $\frac{A}{128}$ solution ; in febrile cases an initial dose of 0·05 c.c. of $\frac{A}{256}$ or $\frac{A}{512}$. In the latter case the optimum dose is very near the initial dose.†

R. W. Philip, who praises the remedy highly, makes successive decimal dilutions, calling the original preparation T.Bk., the 1 in 10 $T.Bk_1$., the 1 in 1,000,000 $T.Bk_6$. In afebrile cases he begins with 0·1 c.c. of $T.Bk_5$. ; in febrile cases, debilitated subjects, or children, $T.Bk_6$., which may be further diluted if necessary. Stronger solutions are suitable for lupus and other localized tuberculoses.‡

*. Denys, Transactions of Tuberculosis Congress, Paris, 1898.

† Béraneck, *Comptes Rendus de l'Acad. des Sciences*, Paris, 1903. *Medical Annual*, Bristol, 1909, p. 61.

‡ Philip, *Medical Annual*, 1909, p. 600.

§ 92. Other Forms of Tuberculin.

A number of other preparations have been used by different physicians, all of which are more or less nearly related to Koch's tuberculin.

Klebs' Preparations.

Klebs obtained from the filtrate of tubercle cultures a substance called tuberculocidin (T.C.), which, he states, is free from the drawbacks of Koch's preparations. More recently he has introduced another, called antiphthisin (A.P.), obtained by treatment of the filtrate with sodium bismuth iodide in acetic acid and absolute alcohol. Dose: *sub cute*, 1 milligramme to 10 milligrammes; by the mouth, 5 to 10 drops.* Opinion is divided as to the value of these remedies.

Hirschfelder's Oxytuberculin.†

This is a form of tuberculin which has been submitted to the action of hydrogen peroxide. Dose, 5 to 20 c.c.

Landmann's Tuberkulol.‡

A substance obtained from highly virulent bacilli by extraction at rising temperatures with saline solution, distilled water, and glycerine.

Von Ruck's Extract.

This is a watery extract made from tubercle bacilli after the removal of the fats by alcohol and ether. It is standardized like T.R. Initial dose, 0·1 c.c. or less of a 1 per cent. solution, or 1 milligramme of the original extract, rising to 1,500 or 2,000 milligrammes (see Pottenger, *loc. cit.*, p. 176).

* 'Behandlung der Tuberkulose.' Hamburg, 1892.

† 'The Cure of Tuberculosis by Oxytuberculin,' *Med. Soc. State of California*, April, 1897.

‡ *Hygienische Rundschau*, 1898, No. 10; *ibid.*, 1900.

Thamm's Tuberal.

This is also an extract from the tubercle bacillus, stated to be free from all toxic substances, and a safe remedy in febrile stages of tuberculosis. The initial dose recommended is 3 drops in a little water, taken by the mouth daily on an empty stomach, gradually increased, if necessary, to 40 drops. Afebrile patients may begin with 5 drops.

Von Behring's Tulase.

In the preparation of this substance, which von Behring has used for immunization of cattle and of human beings, the tubercle bacilli are treated with chloral. Too little has been published to enable one to draw any safe conclusions as to its value.*

§ 93. **Serum Treatment.**

The antituberculous sera which are best known are Maragliano's and Marmorek's. Neither of them appears to have been strikingly successful, excepting in the hands of the respective discoverers. Von Behring has suggested the use of milk from cows immunized by his special method, for the protection of children at susceptible ages.

Maragliano's Serum.

This is made by mixing the toxalbumin from filtrates of tubercle cultures with a watery extract from the bacilli, and injecting the mixture in increasing doses into horses. These become immunized against tubercle for about four to six months, during which time their serum may be used for therapeutic purposes.†

The initial dose is 1 c.c. for afebrile patients, rising to 2 c.c. ;

* *Wiener Med. Presse*, March 15, 1903; Transactions of International Tuberculosis Congress, Paris, 1905; Hyslop Thomson, 'Pulmonary Phthisis,' p. 144 (London, 1906).

† *Berl. Klin. Woch.*, 1895, No. 32; 1896, No. 35. *Zeits. für Tuberkulose*, Bd. I., p. 432.

for highly febrile patients 10 c.c., followed by smaller daily doses. The remedy is costly.

Marmorek's Serum.

Marmorek obtained a toxin by cultivating tubercle bacilli on glycerine-liver broth containing watery extract of blood and leucocytes. In this medium the bacilli grow very fast, and form a toxin which Marmorek regards as distinct from that of Koch's tuberculin. This new toxin was used to immunize animals in order to obtain an antitoxic serum.*

The serum is supplied in small bottles, of which one or a half is an ordinary dose. It may be given subcutaneously in doses of 2·5 c.c. upwards. It is common to get considerable general discomfort after the injection, as well as skin rashes. These are less likely to occur if it is given *per rectum* in doses of 5 c.c., care being taken to warm the remedy and inject it slowly, either alone or with saline solution. A series of thirteen daily doses is given, followed by two to three weeks' interval; then another series, followed by a longer interval if there were distinct results, and a final (third) series. Kaufmann states that in some cases there was no result, in others an unfavourable effect. In the few cases which I have personally followed the results were not noticeable, beyond bodily discomfort. Habershon believes the serum to be useful in early febrile cases.

Diphtheria Antitoxin.

Diphtheria antitoxin has been recommended in tuberculosis, given in small doses subcutaneously. I tried it on one case. It caused extreme stiffness of the limbs, so that it was difficult to wash the patient; beyond this no noticeable result.

Normal Horse Serum.

This appears to be useful in some cases, judging by Latham's statements (see Section 88).

* See Köhler, *Internat. Centralblatt für d. Ges. Tuberkulose Literatur*, Jahrg. I., Heft 2; Kaufmann, *Beiträge zur Klinik der Tuberkulose*, Bd XI., Heft 3 (Wurzburg, 1908).

XI.—THE TREATMENT OF MIXED INFECTION

§ 94. The Opsonic Method.

When mixed infection is found early in the course of pulmonary disease, before the patient's strength has been exhausted, a great reduction in temperature may be effected by giving a corresponding vaccine according to Wright's method, the patient's general condition improving at the same time. Specimens of the blood should be tested by the opsonic test with Leishman's stain against each of the pathogenic organisms found in the sputum, and if the index is low against one or more of them, vaccines should be prepared from pure cultures of the same. If, on the other hand, the opsonic index is normal against all but the tubercle bacillus, the presumption is that tuberculin is more needed than other vaccines.

Wright estimates the strength of his vaccines by comparison with the blood-corpuscles in normal blood. The vaccine should be sterilized by being heated for an hour at 60° C. A higher temperature appears to injure the therapeutic value of the vaccine.

The average dose in the case of *Staphylococcus aureus* is 250,000,000, for pneumococcus 50,000,000, for streptococcus 10,000,000 ; but the initial dose should be smaller if the index is very low.

There does not seem to be as much danger of the summation of negative phases from repeated doses of these vaccines as in the case of tuberculin, so that the doses may be repeated at short intervals until the temperature falls to a more manageable figure.

Mixed infection occurring in late stages of pulmonary disease is much less likely to yield to opsonic—or, indeed, to any other—treatment, since the power of reaction has been lost in the reduction of bodily strength.

§ 95. The Nuclein Treatment.

In fairly hopeful cases of mixed infection it may be worth while administering a few doses of nuclein, or a yeast or some other preparation which contains nuclein, since this has the power of stimulating the production of opsonins generally, and is known to be useful in the case of *Staphylococcus aureus*, possibly in other cases also.[82]

§ 96. The Collargol Treatment.

Stachowski * has introduced a method of treatment which is said to rapidly reduce high fever in cases of mixed infection. He injects intravenously 0·05 gramme of collargol once a week in a 0·5 per cent. solution.

An alternative method employed in children is to remove the superfluous fat from the skin of the axilla, and then to rub in a 7 per cent. ointment of collargol.

Collargol is a colloidal form of silver which is soluble in water and in the body fluids. It has been used for pneumonia and various septic diseases.

XII.—PROGNOSIS AND RESULTS OF TREATMENT

§ 97. General Considerations.

The recovery of a tuberculous patient depends partly on the severity of the attack, partly on the adequacy of the defence. There is reason to believe that tubercle bacilli (like other pathogenic organisms) are not all equally virulent, and that the progressive or retrogressive characters of tubercle in the human body depend sometimes upon such differences in virulence, while in other cases (probably the majority) it is the human resistance that varies, owing to constitutional vigour or the reverse, satisfactory or unsatisfactory conditions of life, adequacy of treatment or the reverse.

* *Pester Med. Chir. Presse*, No. 32, 1902.

It has been shown that the effect of tubercle inoculated into animals depends partly upon the particular strain employed, partly on the initial dose. Where this is but small, much fibrosis is produced around the seat of inoculation, and the disease remains local and limited, and finally disappears. Larger doses, or more virulent cultures in small doses, produce a more destructive progressive form of general disease.

The prognosis in a case of pulmonary tubercle may be estimated in two different ways, according to the danger to life or to the amount of crippling likely to follow.

The danger to life is greatest where the constitution is much undermined, especially if this happens very quickly. This is especially likely to happen about the age of puberty and in young adults ; also in cases where the heart or kidneys are unsound, or the digestion has been ruined by alcoholic intemperance.

The degree of constitutional disturbance may be estimated by the height of the fever, rise in pulse-rate, loss of strength, loss of flesh, and presence of marked anæmia. Patients in whom the temperature during the first week of observation continues to rise daily over 103° F., who have a pulse-rate over 120 at rest, with great weakness or marked loss of flesh, while the attack appears to be of recent date, are in great danger of their lives, and will require very energetic and skilful treatment if they are to be saved. In many of these cases the physical signs will be ill-marked, owing to the predominance of miliary tubercle, and the extent of the disease is likely to be much greater than can be discovered by physical examination. Patients with much greater extent of obvious disease, but with less marked constitutional disturbance, may have a much better chance of recovery. Those who remain persistently anæmic, in spite of abundant fresh air, also usually do ill, as also do those in whom the pulse-rate continues above 100 for many weeks, or in whom a moderate degree of fever persists in spite of treatment.

On the other hand, if the fever quickly subsides under hygienic treatment, the anæmia rapidly disappears, and the patient begins early to gain flesh and strength, the pulse-rate quickly sinking to below 100, the chances of recovery are proportionately good.

The extent of the disease has a great influence over the completeness of recovery, but less over the actual immediate danger to life. Rapid involvement of large areas of lung tissue augurs ill, but a large extent of disease is quite compatible with recovery, if it has been slowly produced. If a patient gets the greater part of one lung involved in disease inside of six months from the beginning of his symptoms, the prognosis is worse than if this has resulted from a prolonged attack spread over several years, provided that the deterioration in the latter case has not persisted in spite of suitable treatment. In estimating the danger to life from the extent of lung involvement, we must therefore take into account the conditions of life; if these have been bad, the disease may begin to heal when they are improved.

The extent of the disease should be estimated in several ways to arrive at a just conclusion—positively, negatively, and by the amount of dyspnœa. If we try to estimate the extent of healthy lung, we may find the disease to be more extensive than by estimating the extent of obvious and unmistakable disease. Also, if there is well-marked dyspnœa without enough discoverable disease to account for it, in the absence of marked anæmia, high fever, pleuritic adhesions or effusion, or cardiac weakness, we should conclude that the disease is more extensive than is apparent from the examination, probably because there is miliary tubercle affecting some of the apparently healthy lung. Where it is safe to do so, spirometric observations will help in estimating the extent of disease. Disease which spreads from several points in the lungs is more dangerous than a more localized patch, even if this be large.

Some complications are always of bad omen in tuberculosis, while others which are less dangerous are a great hindrance to recovery. Tubercle of the soft palate or pharynx is an almost absolute bar to recovery. Well-marked tuberculous ulceration of the larynx enormously increases the danger to

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life, though in this case much may be done by skilful local treatment. Widespread involvement of lymphatic glands usually marks a severe attack or a feeble constitution if associated with well-marked lung disease. On the other hand, patients with widespread disease of the bones and joints, without marked lung involvement, will often make a good recovery. Well-marked cardiac weakness is a great hindrance to recovery; so also is aneurysmal dilatation of a fair-sized bloodvessel, or copious hæmoptysis. It is, however, unusual to meet with hæmoptysis of sufficient amount to threaten life. Out of 325 consecutive cases at the Crooksbury Sanatorium, there were only eight in which the hæmorrhage was sufficient to cause anxiety. Copious hæmoptysis may happen as a consequence of rapid softening of a consolidated patch; more often it is due to the bursting of an aneurysmal dilatation. The former condition may to some extent be guarded against. The latter is less easily anticipated.

Well-marked emphysema with chronic bronchitis is also a hindrance to recovery, or a chest crippled mechanically by old-standing pleurisy or empyema. Evidence of renal disease increases the gravity of the prognosis unless the complication is very slight. Well-marked dyspepsia, which is sufficient to interfere with the digestion of a reasonable amount of food, is a great hindrance to recovery. Cases in which there is much vomiting do not usually recover, unless it can be quickly remedied; and the same is true of diarrhœa, which, if uncontrollable, is a sign of intestinal tuberculosis or of profound toxæmia.

According to Robin and Binet, the urine gives valuable indications for prognosis. Polyuria and phosphaturia are common features both of early tuberculosis and of a predisposition to tubercle. In very early stages an excess of solids in the total urine is of good augury if there is no fever or diarrhœa, because it is evidence that the demineralization of the tissues common as a forerunner and a consequence of tuberculosis has not yet been completed. In tuberculous cachexia these authors usually find less than 30 grammes of total solids in the daily urine. If, on the other hand, in an early case without fever or diarrhœa there are less than 30 grammes of urinary solids excreted daily, the prognosis is good, especially if the weight increases more than the urinary solids diminish. A gradual diminution in weight, as well as in total urinary solids, shows advancing disease. A sudden diminution in urinary solids is usually due to a complication.

The excretion of urinary solids in tubercle specially affects the inorganic constituents. If the total quantity of urine diminishes in advanced phthisis without compensatory increase in density, the prognosis is bad. If there is a rise in density not due to phosphates or to renal disease, the prognosis is better. The total quantity of urine is usually diminished by inflammatory complications, whether tuberculous or other.*

The appearance of tuberculosis in other parts of the body during the progress of lung disease is of bad augury. Multiple tuberculosis suggests a poor constitution. Pregnancy is a great hindrance to recovery from pulmonary tuberculosis.

In the absence of complications, the chances of recovery depend partly upon thorough energetic treatment, partly on the possession by the patient of a reasonably good constitution. By skilful treatment some severe cases may have the drag put on their downward course ; and, once the temperature has come down to reasonable figures, a good recovery may follow. Adequate treatment will save life in most cases of but moderate severity, and in all the slighter cases.

Turning now to the question of completeness of recovery, this depends chiefly upon the extent of the disease when first discovered, and upon the adequacy of treatment. Obviously, if a man only recovers after much lung tissue has been destroyed or much fibrosis of lungs and pleuræ has resulted, he will always be short of breath, unable to exert himself freely, and less able to resist intercurrent ailments. His recovery is incomplete, his tenure of life conditional on the

* A. Robin, *Études cliniques sur la Nutrition dans la Phtisie pulmonaire chronique* (*Archives Générales de Médecine*, May, 1894 ; June, 1894 ; and April, 1895).

observance of precautions. So long as he lives under suitable conditions, he may escape relapses and complications; but if he cannot do so, his health is likely to undergo progressive deterioration, and to be at the mercy of medical accidents.

In the last resort, therefore, the completeness of recovery depends upon early diagnosis, persistent treatment from an early stage, and the possession of a reasonably good constitution.

§ 98. Statistics of Results in Sanatoria.

There is abundant evidence to show that the recovery of a tuberculous patient is enormously favoured by early hygienic treatment. Turban, of Davos, gives statistics* of the patients treated at his sanatorium from 1889 to 1896, showing that of those who were reported by their own doctors as permanently benefited, 80·4 per cent. were in the first stage, 48·8 per cent. in the second, and 17 per cent. in the third. If treatment was begun within a month of the onset of the illness, 72·7 per cent. of all stages were permanently benefited; when six months after, or more, only 40·2 per cent.

Weicker† states that in 1899 the proportion of his patients who had been under treatment in 1896, and were still capable cf full work, was as under:

Admitted in the first stage, 100 per cent.
Admitted in the second stage, 47 per cent.
Admitted in the third stage, 3·8 per cent.

Rumpf ‡ investigated the condition of 150 patients who left Dr. Schröder's sanatorium in 1901 without any râles in the chest. He found that of these 71·3 per cent. had been admitted in the first stage, 27·7 per cent. in the second stage, and 2 per cent. in the third stage.

For other figures relating to the effect of treatment in the Alps and by sea voyages, see Sections 40 and 41.

* 'The Diagnosis of Tuberculosis of the Lungs,' translated by E. C. Morland, p. 40 (London, 1905).

† 'Beiträge zur Frage der Volksheilstätten' (Leipzig, 1901).

‡ Schröder and Blumenfeld, 'Handbuch der Therapie der chronischen Lungenschwindsucht,' p. 486 (Leipzig, 1904).

§ 99. Results of Tuberculin Treatment.

Möller * gives results of treatment in 657 cases, of which 55 were treated with tuberculin as well as hygienic remedies, while the rest were only treated with the latter. According to stages, the following were the results :

Stage.		*Cases.*		*Cured.* Per Cent.		
I.	..	195	..	31·8	..	without tuberculin
	..	20	..	75	..	with tuberculin
II.	..	206	..	1·9	..	without tuberculin
	..	24	..	20·6	..	with tuberculin
III.	..	201	..	—	..	without tuberculin
	..	11	..	—	..	with tuberculin

Taking all stages together, of 602 cases treated without tuberculin, 10·9 per cent. were cured, 31·2 per cent. much better, 37·3 per cent. better, 17·4 per cent. unaltered, 2·6 per cent. worse, 0·6 per cent. died. Of 55 cases treated with tuberculin, 36·3 per cent. were cured, 30·7 per cent. much improved, 25·8 per cent. improved, 7·2 per cent. unchanged, none worse.

Möller † has also reported the results in 1904 at Belzig, from which it appears that of those treated with tuberculin, 36 per cent. were apparently cured ; without it, 10·9 per cent.

Turban ‡ gives 52 per cent. apparent cures with tuberculin, as against 39 per cent. without tuberculin, in 327 patients treated at his sanatorium.

Pottenger § reported the results of tuberculin treatment in 121 cases as follows :

Stage.	*Cases.*	*Apparently cured.*	*Arrested.*	*Improved.*	*Unimproved.*	*Dead.*
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
I.	27	92·6	7·40			
II.	28	67·85	25·00	—	8·15	
III.	66	7·58	48·48	33·33	7·58	3·03

* *Loc. cit.*, p. 260.

† *Jahresbericht der Heilstätten* (Belzig, 1904).

‡ Quoted by Pottenger, *loc. cit.*, p. 201.

§ *Therapeutic Gazette*, 1906.

Since this time he has treated about 200 more cases, in which he says the results are much the same.*

From a collective investigation made by him in 1903, he concludes that out of 1,200 first-stage cases, of which 611 had the usual sanatorium treatment, while 589 had in addition tuberculin treatment, 64 per cent. of the former and 84·2 per cent. of the latter were apparently cured.† He is of opinion, however, that there is even greater advantage obtainable from tuberculin treatment in third-stage cases.

§ 100. How Long should Treatment continue?

A distinguished physician, being asked how long he recommended patients to undergo sanatorium or hygienic treatment, replied: 'I try to divide them into one of two classes: to the one I advise from three months to three years, to the other from six months to six years.' This illustrates the fact that people seldom are able to stay long enough at a sanatorium to be absolutely cured of lung disease. The time necessary for such a result is habitually underestimated even by doctors. Whatever benefit is obtained from a course of treatment in such cases will only be maintained if the patient leads a satisfactory kind of life afterwards, and avoids the causes of his original breakdown. The only exception to this rule is where very early localized disease, without fever, has been treated by combined hygienic and specific treatment, such as a progressive course of tuberculin at a sanatorium.

For incipient mischief, in which the local changes are barely discoverable and fever is absent, three months' systematic treatment should usually suffice to arrest the disease. In early cases with well-marked fever it is impossible at first to forecast the duration of treatment necessary. Just as with Æsop and the traveller, the rate of progress must be watched in order to make a reliable estimate. All that can be said

* 'Diagnosis and Treatment of Pulmonary Tuberculosis,' p. 208 (London, 1908).

† 'A Critical Study of Tuberculin,' *Therapeutic Gazette*, March, 1906.

with safety is that six months will be necessary, and very likely more.

Third-stage cases, with only slight evening fever and a gradual and prolonged onset, will often improve enormously with a few months' treatment, although their recovery is usually incomplete. It is in these cases—in which a good constitution has held out for a long time against the onset of the disease—that systematic graduated work is likely to lead to the most striking improvement in working capacity.

In all complicated cases it is impossible to give a reliable opinion as to how long treatment will be necessary until one has seen the effect of such treatment for a time.

Seeing that in the vast majority of cases patients are unable to stay at a sanatorium until the disease is arrested, it is useful to have some definite criteria of progress, and to estimate this monthly or at some other convenient interval.

§ 101. Evidences of Improvement.

German insurance companies, which send their clients for treatment at a sanatorium directly there is evidence of pulmonary tuberculosis, classify the results of treatment under three heads—general improvement, local improvement, and working capacity. Under each of these heads there are several degrees, according to the amount of improvement, or the reverse. This, however, if unsupplemented, leaves many details to the examiner, and opens the way for the personal equation to an undesirable extent. By discussion of such details it should be possible to diminish the uncertainty. To some extent it has been done by Turban's classification, as adopted at the International Tuberculosis Congress at Copenhagen in 1904.

Turban's Classification.

Three stages are recognized by Turban :

1. Disease of slight severity, affecting at most one lobe or two half-lobes,

2. Disease of slight severity, more extensive than the first, but affecting at most two lobes; or severe, and affecting at most one lobe.

3. All cases of greater extent and severity than the second.

By slight severity is intended disseminated foci, recognized by slight impairment of resonance, rough or weak breathing, whether vesicular, vesiculo-bronchial, or broncho-vesicular, with fine and medium râles. By severe disease is meant compact consolidation or cavitation, shown by great impairment of resonance, tympanitic note, very weak broncho-vesicular, bronchial, or amphoric breathing, with musical or toneless râles, whether medium or coarse.

Simple pleuritic dulness of small extent is to be disregarded; if considerable, it should be placed among complications. Rough breathing or prolonged expiration, and the like, are disregarded if unassociated with râles or with altered percussion note.

As regards fever, this is considered to be slight (*f*) if the daily maxima are between 99·7° and 103·3° F.; severe (F) above this figure. Fever is considered to be absent if, after rectal thermometry every two hours, no temperature is recorded above normal. What this is is not stated. If at rest, I should be disposed to put it at 99° F. in men, 99·5° F. or less in women.

For other details the reader may be referred to Turban, 'The Diagnosis of Tuberculosis of the Lung,' translated by E. C. Morland (London, 1905).

Local Improvement.

If the local condition appears to have improved while the general condition is still unsatisfactory, it is probable that much undiscovered disease exists, for in a really improving case general improvement always precedes local improvement. If, however, the general state is better than it was, diminution in the apparent extent of disease or in the number of adventitious sounds, together with increase in the area of healthy breath sounds, is good evidence of local improvement.

Without such increase in the healthy breath sounds the improvement is uncertain or doubtful.

Where there were originally areas of diminished breath sounds, improvement is shown by increase of normal breath sounds, even if coincidently there should be an increase in adventitious sounds. Such an increase in adventitious sounds is an almost necessary condition of improvement in these cases; later on the adventitious sounds should again diminish, and eventually disappear. Possibly this may not be true of all climates, but in my experience it is the rule in this country. Lung areas in which this process has been followed may eventually appear to be quite normal, showing that the appearance of adventitious sounds is not necessarily evidence of softening and destruction.

Another evidence of local improvement consists in the substitution of 'dry' sounds for 'moist.' Disappearance of marginal areas of fine râles around foci of disease is an important sign of improvement, because such areas are usually associated with fresh tuberculous deposit. The substitution of a few mixed râles for numerous fine râles is a satisfactory sign, pointing to reduction of the diseased area, with limited excavation. These cases of limited excavation are far more satisfactory than those presenting less limited disease without obvious excavation. Especially unfavourable are cases in which there is a very large extent of lung presenting sticky inspiratory sounds, with half-choked crepitations and diminished vesicular breath sounds. Even in the absence of marked fever such cases usually do badly in this country, and are always liable to sudden exacerbations, with widespread disintegration.

Contraction of cavities is usually a favourable sign, especially if associated with an increase in the apparent size of the healthy lung. Increased dulness on percussion is compatible with improvement if there is good normal breathing over the dull area. Such dulness may be due to thickening of the pleura, or to fibrosis of limited parts of the lung. It is, however, quite common to find such dulness disappear towards the end of a sanatorium course, either from reduction in the fibrous material, or (more usually) from increase in permeability of the adjacent lung, or from emphysema.

Dr. C. G. Higginson believes that a blowing inspiratory and expiratory sound is a sign of fibrosis, if the sound is continuous, without the interval which is a mark of bronchial breathing. If tissues are badly damaged, the best thing that can happen to them is localized cavitation and removal. The next best thing is fibrosis. Extensive fibrosis brings in its train dyspnœa and obstructed circulation.

General and Symptomatic Improvement.

The most important sign of general improvement is reduction or disappearance of the fever, unless coincidently there be increased frequency of the pulse or other evidence of increasing weakness. Especially important is an increase in the hours free from fever. As a rule, in the most favourable cases the temperature first drops in the morning. Where the late afternoon temperature falls without corresponding improvement in the morning temperature, the case is likely to be obstinate. The onset of inverse temperatures is an unfavourable sign. It is not safe to assume that the first few days' temperatures are a measure of the patient's condition. Quite commonly this only represents the trough of a wave of fever, the acme appearing a week or two later. Improvement in such cases is first shown by a reduction in the acme of each succeeding wave and a diminution in the number of highly febrile days.

A very long range of temperature is evidence of serious constitutional depression. Reduction in the range shows improvement, if it be downwards towards the normal. A high temperature with a reduced range may accompany advancing disease.

Reduction in the pulse-rate is a sign of improvement. In Turban's scheme the pulse-rate is directed to be taken at rest in the morning. Although a firmer pulse is usually a sign of improvement, it should be remembered that tuberculous patients are liable to have periods of increased vascular tension from digestive disturbance or from the action of remedies. In such cases increased pulse tension would not be a sign of improvement.

The expression and facial appearance are of great value in estimating progress. Under open-air treatment it is usual to get a healthy ruddy colour in all favourable cases within a few weeks. If this does not happen, caution is called for. There are, however, some healthy people who, through thickness of skin or peculiar circulation, never get rosy in the open air. Still, persistent pallor should be regarded as a danger-signal. Blueness of lips and cheeks shows obstructed circulation. Many such cases need treatment in a warmer climate. An anxious expression is evidence of an unsatisfactory condition. If the expression be anxious, the doctor should be so too.

Gain in weight, taken alone, is evidence of improvement ; but gain in weight with persistent pallor is compatible with serious advancing disease. Gain in weight with dyspnœa on slight exertion in afebrile patients may be entirely due to injudicious stuffing and lack of suitable exercise. This applies chiefly to those who have reached or passed the normal weight for height.

Increasing dyspnœa is commonly due to advancing disease or fibrosis, sometimes to circulatory disturbance. Sudden dyspnœa suggests pleuritic effusion, pneumothorax, or an overfull stomach distended with gas. Diminished shortness of breath is an important sign of improvement. The amount of dyspnœa should be considered in relation to the amount of exertion which calls it forth, whether talking, ablutions, walking on the level, or hill-climbing.

Increase of chest girth may be due to mere deposit of fat. Increased expansion is good evidence of progress.

As patients improve, it is usual for the cough to diminish, and to be confined to those times when there is something to be expectorated. The amount of the sputum is usually at first increased and then diminished by open-air treatment. No reliance can be placed on the number of bacilli in slides from a given specimen of sputum as a sign of progress. Bacilli may be few in the sputum of advancing disease of a severe type, and numerous in cases which are improving. Repeated failure to find bacilli in the sputum may, however, be a sign of real improvement.

Disappearance of dyspeptic symptoms is a sign of improvement. Troublesome lack of appetite and dyspepsia are common in early phthisis, but are usually overcome by combined hygienic and medicinal remedies. Persistent well-marked dyspepsia is a great hindrance to recovery.

Urinary changes have been referred to in a previous paragraph.

Capacity for Exercise.

In early stages of treatment it is a sign of improvement if the patient can get up for a few hours without rise of temperature. Later on the improvement should be measured by the distance he can walk without suffering; still later by his capacity for work. Such work may be classified as clerical work and the like, light manual occupation and games involving but little exertion of the arms (such as putting at golf), and heavier manual labour of various degrees of severity, as described in Section 46. The criteria, in addition to those described elsewhere, should be the amount of dyspnœa, persistent rise in pulse-rate after exertion, and rise in temperature at the next rest hour.

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THE END

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