REMARKS

ON

SANATORIA FOR THE OPEN-AIR TREATMENT OF CONSUMPTION.

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REQUISITES FOR THEIR INSTALLATION.

MORE than forty years have passed since Dr. Brehmer devoted his private fortune to the establishment of an institution for the open-air treatment of phthisis. The Goerbersdorf Sanatorium was commenced in the year 1859. In 1874 a private company began the building of Falkenstein, and Dr. Dettweiler, its chief, has proved an able apostle of Brehmer's views. Since then many similar establishments have been founded, and they are to be met with in all parts of the world. But in Great Britain, the home of hygiene, until quite recently at Bournemouth (Dr. Pott's and Dr. John's Sanatoria) no such institution devoted to this purpose was to be found. Dr. Burton-Fanning has treated some patients upon this plan at the Convalescent Hospital at Cromer, and has published an excellent report upon the results, but at the present time there is not in any part of the United Kingdom any open-air sanatorium for the benefit of the poor, or for consumptives of small means.

We cannot doubt, now that attention has been called to the subject, that attempts will soon be made to supply this deficiency. It may, therefore, be useful to enumerate at least some of the conditions that such sanatoria must fulfil. In doing this I propose to make free use of recent publications on the subject, such as Dr. Léon Petit's *Le Phthisique et son Traitement Hygienique*, Dr. Duhourcau's *Conditions Générales d'un Sanatorium*, and Dr. Moeller's and Dr. Knopf's works on sanatoria.

THE RATIONALE OF THE OPEN-AIR TREATMENT OF PHTHISIS.

It is not without reason that the open-air treatment has been included by Drs. Daremberg, Léon Petit, and others, within the bounds of the hygienic treatment of consumption; for, undoubtedly, an abundance of fresh air is one of the essentials of complete hygiene; but it is probable that there is something more than mere ventilation at the basis of true open-air treatment. It requires not only sufficient pure air to supply the needs of the body, but also constant currents of such air, sweeping over the patient, flushing away all impurity, and conveying abundant supplies of ozone; in other words, "hyperaération."

It has long been known that an excess of fresh air, approaching to open-air treatment, has been beneficial in all kinds of microbial disease, not only in consumption. It is especially in military campaigns that this has been noticed. Thus, in the American war it was found that nothing was better for the sick and wounded, winter and summer, than a tent or a ridge-ventilated hut. Erysipelas and hospital gangrene were almost unknown; wounds healed more rapidly; and, even in fractures, the beneficial influence of the fresh air was to be remarked. It has been said that camp fever may be almost banished; and Stromeyer observed the remarkable effect of free ventilation in arresting military granular conjunctivitis.

The same fact comes out strongly in the records of the Austrian army. In 1854, at some of the stations of the army in Hungary, the plan was commenced of treating a portion of the patients in tents instead of in the permanent hospitals. The results were very satisfactory. "The most severe maladies ran their course much more mildly in the fresh air," and the patients recovered more quickly and more perfectly than in the confined spaces of the hospitals. Typhoid fever, small-pox, wounds, and inflammations did much better in the tents; and in no single case could it be made out that gangrene originated in a tent.

In the South Afghanistan Field Force the artillery wintered (1880-81) in tents, and remained free from pneumonia, whilst the disease was prevalent among the infantry who were overcrowded in barracks. The 63rd, which was more crowded than the other corps, suffered most, having 30 cases in hospital at one time; one company, however, quartered in large airy

rooms near the residence of the general commanding, had no case. On March 25th a part of the regiment was turned out into tents; and the remainder were distributed in barracks so that each man had a minimum of 600 cubic feet of space; and, from that time, no more pneumonia occurred.¹

One more instance may be given with regard to phthisis. It is recorded by Tholozan, who remarked during the Crimean war, that "at Sebastopol, in spite of bad nourishment and living in tents, in rain and snow, out of 1,200 sick scarcely any were phthisical." Similar testimony is forthcoming with regard to animals—horses, cows, and monkeys; and we know that men who are much in the open air are much less liable to take cold than those who have indoor employments. It is natural to inquire what there is in the air of the open that can lead to such remarkable results?

(1) In the first place exposure to the open air means far more in quantity than the freest ventilation. It has been shown by Pettenkofer that, out of doors, the average velocity of the air currents is about 10 feet per second, or about 7 miles per hour. From this and some other data he calculates that "in the course of an hour 324,000 cubic feet of air flow over one person in the open." This is at least one hundred times the amount that is afforded in ordinary ventilation, and its scavenging work must be proportionally enormous. When the air is itself pure it must sweep away every particle of organic impurity. The air of living rooms, however cleanly these may be, always contains a large proportion of micro-organisms; and the mere cleansing of a room will often, for a time, materially increase the percentage of microbes floating about. Many of these are pathogenic organisms; and we may with great probability ascribe the disappearance of fever from our tuberculous patients, after a short exposure to the open-air treatment, to the almost total absence of streptococci or staphylococci. These organisms are always very abundant in the sick chamber, and they are found almost always associated in the lungs of phthisical persons. It is probable that these microbes are at least one cause of fever in cases of phthisis.

2. Not only is the air that enters the lungs in the open purer than that of a chamber or ward, but, in association with sunshine, it acts antiseptically both upon the bodies and the clothing of the patients, destroying all organic vapours that may emanate from either, thus still further purifying the air that enters the respiratory organs.

3. The air of dwelling-rooms never contains an appreciable quantity of ozone, whereas it is usually found in the open. It may well be, therefore, that only by the open-air methods can we get the amount of active oxygen that is necessary to act medicinally upon the body, or that is sufficient to destroy ordinary bacteria.

4. Lastly, we must not forget the beneficial influence of sunlight, which is much more intense in the open than in rooms or when it has to penetrate through glass. There can be no doubt that sunshine purifies the atmosphere by its bactericidal action, and, as some experiments by Professor Delépine and myself have shown,² it has an exceedingly rapid action in destroying the virulence of tuberculous sputum and of tuberculous dust.

Although the direct heat of the sun has in summer to be kept from patients, it has been shown by De Renzi that sunshine materially assists guinea-pigs in combating tuberculous disease. In human beings also the warmth and light of the sun must quicken all the vital processes, and thus increase the activity of phagocytic action.

It is possible that these considerations may account to some extent for the success of the open-air treatment of consumption; but, whatever the explanation, there can be no doubt as to the amount of benefit derived from the treatment, when it is carried out in its entirety, with open air and hygienic measures, rest, and medical care all combined.

THE SITE FOR AN OPEN-AIR SANATORIUM.

It seems certain that mere climate is of little importance in itself in the situation of a sanatorium. All the sanatoria at present in existence, whatever may be their geographical position and whatever their altitude above the level of the sea, show approximately the same therapeutical results.

Some of them are placed at altitudes of over 5,000 feet, others not more than 100 feet; some are to be found in the

changeable climates of Silesia and Saxony, some in the High Alps in the neighbourhood of perpetual snow. It is true that each region has its advantages and disadvantages. Thus, on the mountains the air is pure, sunshine usually abundant, the soil pure and dry, the temperature, though cold, yet more equable, and in the winter there is generally less wind. Cold often braces up the system, excites the appetite, improves assimilation; but, on the other hand, these rigorous climates bear hardly upon delicate and weakly constitutions, irritate the cough, and cause sleeplessness. A warm climate, again, is often depressing, especially when it is also moist, as at Madeira; but it often soothes an irritable cough and tempts an invalid into the open air.

On the whole, we may conclude, with Léon Petit, that climate plays only a secondary rôle in the treatment of consumption, and that "the best climate is that which restricts least the daily duration of the stay in the open air."

The chief authorities on this point are practically unanimous. Thus, Dr. Sabourin, the director of the Sanatorium of Canigou, in the Pyrenees, says: "Tuberculous patients are cured as easily in temperate as in cold climates. Altitude only plays a secondary part in the cure, and the best proof of this statement is the fact that perhaps the best results have been obtained at Falkenstein, a station but slightly elevated—from 450 to 500 metres above the level of the sea—and one, moreover, that is somewhat foggy. The superb results obtained in sanatoria of moderate altitudes are due simply to the fact that they fulfil the indications of the majority of the cases which present themselves. Further, their situation in intermediate climates—neither too hot in summer nor too cold in winter—permit them to remain open the whole of the year. This is the essential condition of a true sanatorium, if it coexists with a good medical directorate."

In a recent paper, Professor von Ziemssen discusses this question, and passes in review the relative merits of high and ordinary altitudes. He concludes that the only advantages of mountain climates are "the pure, dry air, the slight wind in winter." He points out also the disadvantages of treatment at high altitudes. Marked atmospheric changes occur not infrequently (wind, rain, snow), and are injurious to the patient. They make the acclimatisation of many patients difficult; and patients with high temperatures, especially those who do not reside in sanatoria, may become decidedly worse. Other objections are the wearisome journey with all its bad effects, the separation from the family, the comfortless conditions in severe illness, and in case of death; further, the financial anxiety and the economy necessitated; all these have a bad effect upon the patient. When the advantages and disadvantages are compared, the former are not so clear as to indicate the unconditional recommendation of high altitudes.

In the *Medical Courier* of St. Louis there is (December, 1885) a good article on this question. It says: "The individual peculiarities of each locality, the character and prevalence of winds, its aspect and situation under the shelter of protecting mountains, the nature of the soil, the purity of the water supply; all these must be taken into account. The site chosen may be in a climate ideally perfect for special cases; but are there also the conveniences and resources necessary to render existence there tolerable? such, for instance, as the possibility of good food, amusements, occupations, or agreeable society? In the choice of a site, these considerations have a value equal to that of mere climate; without them the climatic treatment will be a succession of disappointments. Without comfort, without an intelligent medical service, without appropriate regimen, without occupation or amusements, without friends, the unfortunate consumptive will not long stand the trial, but will hasten homewards, a prey to despair, preferring a shorter existence with comfort, to a sad life, prolonged perhaps by the bracing atmosphere of a given climate." Dr. Walshe says: "No climate will stamp out phthisis, however acquired, either in the individual or in the stock."³

With regard to the locality in which a sanatorium may be placed, Dr. Léon Petit lays down the following conditions, and it will be seen that they could easily be fulfilled in many places within the British Isles:

1. It is obvious that pure air is indispensable, and therefore

that we must avoid proximity to large towns, or to factories, giving forth soot, dust, or deleterious gases. Those places are best where there is an abundance of ozone in the air, and where the prevailing breezes sweep over the sea, or over moorland, or, better still, where these two conditions are associated, and fresh, pure air comes from all quarters of the compass.

2. The soil upon which the sanatorium is to be built should be sandy, without damp, and affording the smallest probability of fog or mist after sunset. Plains well exposed to the south, or broad valleys fully open to the sun, are particularly favourable, on condition that they are sheltered by hills or trees against north, or north-west or easterly gales. "The immediate neighbourhood of a forest of pines is likewise very desirable, both as a purifier of the air, and as a shelter in summer against the heat, and in winter and bad weather against the wind."

3. The phthisical patient must not feel himself in a barrack or in a prison; he should have before his eyes something better than walls. An extensive view exercises upon both mind and body a reflex action that is most beneficial. An elevated site, with a gentle slope from it, is therefore indicated. Well supplied with fresh water, if possible from a spring, it should be sufficiently extensive to afford a large garden, or, better still, a park, surrounding the building at some distance from it.

4. The access to a sanatorium for consumptives should be as easy as possible, and it should not therefore be far from a railway station, and the roads in the neighbourhood should be in good order.

THE BUILDING.

Sanatoria with an average number of from 60 to 80 patients are preferable to those that are larger or those that are too small. This number assures to the inmates sufficient society to prevent *ennui*, and at the same time a degree of medical supervision which is scarcely possible in establishments which are too vast.

It should face the south; or at least, if the contour of the site demands the variation, it may be turned slightly towards the south-west. In certain localities, however, the prevailing winds may prevent this general rule of a southern aspect from being followed.

The architectural arrangement most frequently adopted is very simple. All the buildings are placed in line, with neither recesses nor sharp angles; but it may be advantageous to deviate from this rule in order to afford shelter from the high winds. Sometimes, as at Falkenstein, two short wings are built at obtuse angles, from each end of the main central structure, thus affording screens from the wind, without cutting off either light or sunshine. At Ruppersheim, the same result is obtained by constructing the whole edifice in the form of an arc of a circle. The ground floor is reserved for the assembly rooms, dining and drawing rooms, on the south side; the administrative and the medical departments and the servants halls, etc., on the north side.

Another arrangement is to have a system of detached pavilions, each capable of accommodating from six to ten patients, and connected with its neighbours by glazed corridors. This plan has been adopted in the Adirondack Cottages, in America, and it has certain advantages. Behind the central pavilion are the buildings for the several common offices, for the dining hall, kitchen, etc., with a winter garden adjacent. The dwelling of the resident medical officer is on one side of the structures, and on the other a separate building for the friends and relatives of the patients. An isolation ward is also part of the plan, and there are various out-buildings, cow-house, stables, and mortuary disinfecting stove at a distance from the lodgings of the sick. On the south of the pavilions is a garden, with seats and adjustable kiosks. Walks are so arranged as to permit of graduated exercise being taken by the patients. Adjacent to the ground floor of each "cottage," looking due south, is a verandah, protected by a roof of glass with movable frames, and in these are the reclining chairs for the rest cure in the open air. Curtains or screens are here placed so as to protect the patients against strong winds or sunshine. On the first floor are the sleeping rooms of the patients, each having a cubic content of about 600 feet, and all opening by a large window-door on to a balcony about 7 feet wide, on which a

deck chair can be placed if the sick person cannot come downstairs. In the interior all angles are slanted so that no dust may rest, and there are no projections on walls, ceilings, or doors on which it might collect.

In every kind of sanatorium the sleeping rooms of the patients should look due south, and they had better not be of too large dimensions—though I think 1,000 cubic feet would be quite small enough—so that they may be the more easily warmed and kept at an even temperature. The windows—or, better still, the window-doors—should be high and wide, permitting the air and solar heat to enter freely during the day, when they should be always open. They should be provided at their upper portion with a sash capable of turning about a central horizontal axis—the *vasistas* of the French.

They should have outside louvre shutters, which could be closed in bad or too hot weather, and the louvres of which could be partially closed to keep out the direct rays of the sun in the early morning in summer and yet admit air freely. The best mode of securing permanent aëration of the rooms is to have the windows constantly open, night and day, to a greater or less extent, according to the weather and degree of acclimatisation of the patient. The doors should be placed directly opposite the window, so as to permit of the complete and rapid change of air of the room. This can scarcely be done if the room is partially a *cul-de-sac*.

The walls, ceilings, doors, and windows should be destitute of all ornament, except perhaps some floral paintings; they should be painted or varnished, or washed with some hydraulic distemper, so as to permit of thorough washing. The same remarks will apply to the furniture; no curtains, canopies, or fixed carpets.

The floors at most of the sanatoria are covered with linoleum or cork carpet; but Dr. Léon Petit recommends the following method, already extensively used in France: "After having carefully washed and disinfected the floor, a pinch of a preparation of paraffin, mixed when warm with benzine (density 750) in the proportion of 1 kilogramme of paraffin to 9 litres of benzine, is applied to the floor and allowed to dry during several days. The floor becomes as hard and smooth as marble, and is never sticky in the warmest weather. It suffices to renew the application once a year. The cost is about 3d. per square yard. The bedrooms should be simply furnished; an iron bedstead, with a spring mattress, and a thin hair mattress, should be placed so as to avoid the draught between the door and window; a small wardrobe, a washstand, toilet table, and a couple of chairs, are all that are needed. A strip of loose carpet or matting, and a simple screen only can be permitted. No curtain, no blind, nor canopy over the bed.

For the maintenance of cleanliness, the rooms thus treated with paraffin are well sluiced with water once a month; and every day they are cleansed with a woollen duster, lightly dipped in an antiseptic solution. The colour of the floor is rather brown and dull-looking, and the antiseptics do not contribute to the pleasantness of the apartments; but, as Dettweiler says, "so much the better, for then the patients will not be tempted to stay in them longer than is necessary. Except during the hours of sleep, their place is out of doors."

It would be well if Professor Delépine's method of brushing over all surfaces with a 1 per cent. solution of chloride of lime, were carried out occasionally, as it has been shown to destroy entirely the virulence of the bacillus of tubercle.

THE VERANDAH.

It is in the verandahs that the greater part of the open-air treatment of the consumptive is carried on. These structures are usually placed along the whole length of the south side of the main building or of the pavilions. They should be raised two or three steps above the level of the soil, and should be from 7 to 10 feet wide, or even more, so as to permit of the needful space for the reclining chairs. They should be closed at each end, and, in windy situations, it is often desirable to have a permanent glass screen brought forward from each end in front so as to afford complete shelter when the wind is from the south.

Window blinds or venetian blinds should be arranged along the whole front, which can be lowered when required to protect the patients from the sun or the wind. At Dr. Pott's

sanatorium at Bournemouth these blinds are constructed of very coarse canvas, which afford good shelter from strong winds and from great heat but do not impede the free circulation of air. Along the verandahs are arranged the reclining chairs, and, as Dr. Knopf points out, those are the best which are readily adjustable to the sitting posture when the patient takes his meals or light refreshment, or when for any reason he desires a change of position. Each couch should have its little table by its side and its electric lamp, and portable screens should be provided for those who wish for more complete repose.

The balconies for the first-floor rooms should be similarly provided, though they need not be quite so wide, but they should have a roof projecting 2 or 3 feet beyond the limits of the balcony.

HEATING AND VENTILATION.

In most foreign countries the warming of the establishments is usually accomplished either by stoves or by hot steam or hot-water pipes, but in England there is a strong prejudice in favour of open fire grates, a prejudice that is well founded, and, in my opinion, every chamber should have its small fireplace. At the same time, it is desirable to have hot-water pipes laid on to every room and even in the verandahs. The water should not be carried to any great heat, and fresh air should be continually passing over the pipes, and allowed to enter the rooms through grids along the skirting of the walls. This warmed air is not of the same value as the fresh cold air which comes in through the open windows and doors, for it contains little or no ozone, yet it is not to be despised, for it has the great merit of preventing the sensation of draught, warming the colder air as it comes into the rooms. It thus conduces to the supreme condition of the cure, namely, the admission of perfectly fresh pure air from the open. In some cases it is considered necessary to drive forward the ventilating currents with a fan, and to withdraw foul air by similar means, or by superheated steam pipes in the roof, but if the windows and doors are left sufficiently open there will be no foul air to withdraw, and these means will become unnecessary.

In addition to these appliances a complete sanatorium should also be provided with proper bathing apparatus, with a disinfecting stove and a mortuary, and detached adjustable kiosks should be placed in various parts of the grounds.

THE MEDICAL AND NURSING STAFFS.

In the establishment of a sanatorium it is of the utmost importance that it should have a good medical directorate and an adequate number of day and night nurses. The importance of this condition will become apparent upon a brief consideration of certain of the measures involved in the open-air treatment of consumptive persons. These measures may be shortly summarised as follows:

1. For many patients, rest in the recumbent posture in the open air for the greater part of the day, generally in the open verandahs or shelters, sometimes in the open grounds. To this course they have to be gradually acclimatised.
2. Careful but full feeding.
3. Massage, in some cases: carefully graduated exercises in others.
4. The judicious use of baths or cold sponging.
5. The provision of suitable amusements.
6. Appropriate medicinal treatment.

On all these points the constant supervision of a medical attendant and the watchfulness of trained nurses are absolutely necessary. Upon the doctor depends the gradual education of the patient to the new *régime*, and the infusion into him of a cheerful and hopeful state of mind.

The hygienic rules for the treatment of a phthisical patient are simple enough, but their application to each case is often difficult and delicate. In the first place, the physician should himself have full faith in the efficacy of the method for the cure of a large proportion of the cases; without this he can hardly inspire the necessary confidence, not only in the patients, but also in his relatives and attendants. These persons are often the most difficult to convince.

In the next place, the physician has to discriminate between the various forms of phthisis, and has to form a prognosis from all the circumstances of the cases. This he can only obtain by very close observation during the first few days or weeks of a patient's stay in the institution.

In every suitable case the physician should know how to

inspire hopefulness. Fortunately, under the open-air and rest cure this hopefulness is often encouraged, and to some extent justified, shortly after its commencement. In most cases after the first few weeks of the treatment the fever disappears, the night sweats are arrested, the cough ameliorates, and, owing to the rest and abundant feeding, the weight increases. It is often possible also for the medical attendant to point to instances of partial cure in apparently hopeless cases, and thus he can enhearten low-spirited or despairing patients.

The supervision of the physician is really required at every part of the treatment. It is particularly necessary in the early stages of the process, when the patient has to be gradually acclimatised to the open air, and when the greatest tact has to be exercised to overcome his prejudices, and to combat his fear of "catching cold" or of "taking a chill." In the day time it must be the doctor's object to have the invalid either in the open or lying down in the verandah or kiosk for as long a time as possible. In the night time he has to be satisfied to have the windows as widely opened as the velocity of the wind will permit. With most patients these objects can only be obtained by gentle measures, and they have to be led judiciously towards their full attainment, carefully screened from all sensation of draught, and thoroughly protected by suitable wraps and clothing.

I cannot forbear quoting the excellent remarks of Dr. Moeller on this point. At page 32 of his work on *Les Sanatoria dans le Traitement de la Phthisie* he says: "It is possible to abuse the stay in the open air. To convince oneself of this it is sufficient to recall the species of drunkenness which is produced by the first occasion of going out after a more or less prolonged seclusion in the house. It often happens that a consumptive has been submitted for weeks or months to the method of protection, that he has been carefully shut up in his apartments, where he has at least avoided every possible exposure to the action of cold air: Now, when such a subject arrives at the locality to which he has been sent he is only too likely to abuse the climatic treatment in which he expects to find his cure. Instead of passing through a wise and progressive period of transition, he stays in the open air for a long time without any discretion. He omits certain precautions which are necessary everywhere—in the health resorts of the South as well as in those placed amongst the mountains, in special establishments as well as in hotels. But it is essential that the air cure should be adapted in each case to the actual state of the invalid. There may be sometimes some incident, some complication, which should necessitate a delay in the sojourn in the open air. An unfelt chill may have taken place which only the eye of a clear-seeing and conscientious doctor could detect. If the patient is left to himself, if he is not kept under constant supervision, some imprudence may be committed which may lead to disastrous consequences. In a sanatorium these consequences are not likely to take place. The effects of the air cure are watched from day to day, from hour to hour; nothing is left to chance."

When their education in these respects is completed, it is remarkable how well they bear exposure to the coldest air, and how eagerly they seek it of their own accord. Their dread of taking cold soon vanishes when they find how rarely this accident happens in the open air.

The extent to which the patient must assume the recumbent posture has also to be carefully regulated. There are some to whom it is only necessary for about an hour after each full meal. Others have to lie down most of the time they are in the open air, as it is found that they cannot be kept warm in any other position. Many of these latter persons have in addition to be submitted to massage, in order to keep up muscular tone and to assist nutrition.

Dr. Burton-Fanning has some excellent remarks on this point. He says: "After carefully watching patients under conditions of moderate exercise and of absolute rest, I have satisfied myself that the latter should be enforced for those who have any perceptible weakness of the pulse..... The great cause of cardiac weakness in phthisis is the degeneration of heart muscle brought about by prolonged fever, even if this only obtains during some hours of the day. Open air lessens this fever, and thus checks further cardiac degeneration, and also by its tonic effects on the system repairs slowly the damage already done. This is, I believe, materially assisted

by complete rest, and I have watched improvement of the pulse occurring steadily during many months of this treatment. Not only has the pulse strengthened on the abandonment of any exercise, but the digestion and general vigour have also improved. With this condition of weak heart these patients commonly manifest cold and blue extremities; they require careful watching and the use of additional wraps, foot warmers, or doses of brandy. Digitalis has also been used with advantage in these cases."

I may remind those interested in this question how potent the Weir-Mitchell treatment of rest and massage, etc., has been found in putting on flesh, reviving the blood, and improving digestion.

Again, whilst the fullest feeding possible has to be aimed at, the particular diet that each individual can most readily take has to be ascertained, and the cooking sedulously attended to. Wonderful results have indeed been obtained by the stuffing plan of Debove, Walther, and others, but our aim should be true physiological feeding, and we should endeavour to nourish the body to the utmost without overtaxing the eliminatory organs. This object can only be obtained by watchful supervision. Baths and bathing also need great discrimination in their application, but, so applied, they are often of much service in carrying out the treatment.

The medicinal treatment also must not be overlooked, and it requires careful study to adapt it to each case.

On all these grounds, therefore, it is of great importance to have both an adequate staff of trained nurses and an efficient medical directorate. Both these services need the greatest tact and the greatest patience. Although many consumptive persons are gentle, patient, and quiet, some are extremely irritable and difficult to satisfy as to food and other things. The greatest forbearance and sympathy, and yet entire firmness, are needed in dealing with these people.

I once asked the late Dr. Burnier, of Leysin, whether he did not frequently fail in bringing English or Americans under the strict discipline of his establishment. But he replied: "Hardly ever; I leave them to their own devices for a few days, and they very soon come to me, and promise to be good, and to follow the example of the other patients." An important part of the treatment in a sanatorium is the education of the patient with regard to the means of permanent cure; and his discipline in the regular course which must be followed.

EDUCATION AND DISCIPLINE OF THE PATIENT.

Most physicians who have had much to do with consumptives can recall instances of the disastrous consequences of allowing patients to follow their own inclinations in their visits to the various "health resorts" of the Continent, or of the South of England. Many of these invalids or their friends are impatient of control and, either with or against the advice of their medical attendant, they rush off to some one or another of these places of repute in the cure of the disease, without any consideration for their actual state, and without knowing the nature of the accommodation or of the medical aid they can obtain there. Some of them are perhaps in too advanced a stage of the disease for there to be any hope of cure; others, of an excitable and sanguine temperament, think themselves capable of much exertion, and rush about in the pursuit of business or pleasure, keep themselves in a constant state of agitation, commit all kinds of imprudence, and finally die of self-neglect. Dr. Moeller says:

I have visited Nice, Cannes, Monte Carlo, etc. I have seen consumptives, in all stages of the malady, walking about everywhere, spitting on the ground, mixing with the crowds in the casinos, where the dust is incessantly being raised. Many sit down at the tables of play, and remain there until midnight or after, smoking cigarettes, and breathing the most unwholesome of atmospheres. Often they change one resort for another, as they find themselves no better, and they accuse their doctor of having sent them to a climate which does them no good. At each new place the same foolish course is pursued. . . .

Nothing of this kind is possible in a sanatorium. Here the invalid is constantly watched, he has to rest for prescribed periods of time, his temperature is frequently taken, and he is carefully guarded against any danger of chill. His food, his toilet, his ablutions, his exercise, all these are superintended, and a watchful eye is kept against the advent of any complication, such as catarrh, hæmoptysis, pleuritis, gastric disturbance, or the least elevation of temperature. If any-

thing of the kind should occur the doctor will deal with them at their onset, and will often prevent them from becoming serious. The idiosyncracies and peculiarities of each case also are noted and treated separately; there is no mere routine treatment, and it is often possible to take the patient into our confidence, and to make him work with us for his cure. All this is impossible in ordinary general practice, but it is carried out in most sanatoria. Lastly, every patient is taught how to regulate his cough, and how to prevent danger to others in the disposal of his sputum.

POSSIBLE OBJECTIONS TO SANATORIA FOR CONSUMPTIVES.

It has been made a serious reproach to all forms of hospitals or other establishments for phthisical persons that they are likely to become centres of infection, and that the disease will thus spread from the sick to the healthy. This accusation has, however, been amply disproved for most of the hospitals for consumption in this country.

It has been shown that there has been no such spreading of the disease even in the large hospitals in London and Manchester; and if this is the case in these great towns, it is still less likely to occur in the breezy open-air treatment of phthisis.

I have myself been able to prove that the most virulent tuberculous sputum entirely loses its power of conveying the disease after a comparatively short exposure to fresh air and sunlight; an exposure, in fact, too short to have permitted the formation of the fine tuberculous dust in the air which is the most potent means of contagion.

In sanatoria, where the air is freely flowing through the rooms night and day, and where there is full exposure of every dormitory to the light of the sun, we may be quite sure that the possibility of this accident is reduced to a minimum; and we may add that the care that is taken to disinfect and destroy every particle of sputum is sufficient to make infection from the patients an impossibility.

Another objection of more importance is that the patients are exposed to all the depressing influence of the presence of many invalids in all stages of the disease, and that the want of amusement and distraction is apt to cause *ennui*.

It must be admitted that to healthy people the sight of so many poor sufferers collected within the comparatively narrow limits of a sanatorium is a sad one; and it is no small tribute to the ability of most of the chief medical directors of these establishments that they have been able to triumph over the many depressing conditions that must prevail in them, and that they have succeeded in infusing a spirit of content and hope into the minds of most, if not all, of their inmates.

It must, however be remembered that these persons are all seeking a cure; that after a short stay in the place the amelioration of their condition becomes so manifest that they are ready to rejoice and to compare notes with other patients. Their life also is so taken up with the continual attention and care of the nurses and doctor that they have little time in which to nurse their sorrow, or to express their compassion for others.

I have visited several of these places on the Continent, and can testify to the general air of cheerfulness and hope which characterised the patients; moreover, the doctor in attendance was always able to assure me that the life was by no means a dull or uninteresting one, and that the tranquil amusements and little indulgences that were allowed amply sufficed to satisfy the most impatient of the invalids.

The truth is that the extraordinary success of this method of treatment, and the daily watching the progress towards cure of so many who otherwise must have been regarded as desperate—this daily spectacle, and the constant attention of the attendants, make the life of a sanatorium far from being the sad and lugubrious thing that we might imagine it to be.

Another important point is the question of cost. It may well be regarded as certain that it is impossible to bring together all the appliances of a sanatorium and to supply the inmates with the luxuries that they absolutely need without a considerable expenditure.

REFERENCES.

¹ *Parkes's Hygiene*, edition vi, p. 135. ² *Proc. Roy. Soc.*, vol. lvi. ³ *Diseases of Lung*, p. 385.

THE CROONIAN LECTURES

ON THE

CHEMICAL PRODUCTS OF PATHOGENIC BACTERIA CONSIDERED WITH SPECIAL REFERENCE TO ENTERIC FEVER.

Delivered before the Royal College of Physicians of London,

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LECTURE IV.

THE ACTION OF THE POISONS OF THE TYPHOID BACILLUS, GÄRTNER'S BACILLUS, AND THE BACILLUS COLI COMPARED WITH THAT OF OTHER ALLIED POISONS.

THERE are two poisons which are not the products of bacterial action being found in the seeds of plants, and which are of great interest in connection with the toxic products of the three bacilli which have been examined. These poisons are ricin, obtained from the seeds of the castor-oil plant, and abrin, obtained from the seeds of the abrus precatorius. The latter is used in India in the poisoning of cattle, and its symptoms are those of a general toxæmia. Both these poisons produce conjunctivitis when applied to the eye, and injected under the skin they cause diarrhoea with great general prostration. In an investigation I conducted some years ago I found that the two proteids present in the seeds of the abrin—namely, a globulin and an albumose—were both poisonous, and that they both produced similar symptoms. In one experiment a pigeon, weighing 216 g., received 0.2 g. of abrus globulin, and death followed in six hours, and was preceded by an increase in the number of respirations and a great lowering of the temperature, the total fall being 23.8° F. or 12.6° C. In another experiment a pigeon weighing 355 g. received 0.02 g. of the abrus albumose. The symptoms began in four hours and a half, and the animal died in about six hours. There was a more or less continuous fall of temperature, and, unlike the first animal, the number of respirations per minute fell instead of rose. In the rabbit abrin produces, like the poison of the typhoid bacillus, a rapid fall of temperature and death. The fact that the abrus proteids produce diarrhoea, which is most commonly bloody, is remarkable. This is associated with the signs of a hæmorrhagic gastro-enteritis, there being great inflammation of the mucous membrane of the intestine, and especially of the adenoid patches. The abrus poisons are very sensitive to heat, the action of the globulin being completely destroyed by the momentary raising of temperature of its solution to 75° or 80° C., that of the albumose at a rather higher temperature, 85° C. What property it is of the proteid which has this toxic action, whether it resides in the proteid itself, or whether there is some toxic body, possibly of a ferment nature, attached to the proteids, it is impossible to say; but the similarity of their action to that of the toxic products obtained from the closely allied micro-organisms, the typhoid bacillus, the Gärtner's bacillus, and the bacillus coli is remarkable. No doubt in all these cases the effect on the intestine occurs during the excretion of the poison by the mucous membrane in whatever way it may be introduced into the body. The diphtheria poison sometimes produces diarrhoea when given in sufficiently large doses, a result which I never obtained from the injection of even large doses of the albumoses of anthrax or of ulcerative endocarditis, and this is also not an effect which is noticed as a result of the action of the tetanus poison.

With regard to the diphtheria poison, the effect on the temperature and on the body condition of different doses is seen in the following experiment. A mixture of the albumoses and toxin was used, and in the first experiment 2 c.cm. were injected into the marginal vein. This was followed by some rise of temperature on the same day, and on the next day weakness in the hind legs appeared, and a rapid fall of temperature to about 96° F. occurred, ending in the death of the animal. In another experiment when 5 c.cm. of the same poison was given there was a great rise of tempera-