length of history of ulcer symptoms. Here the tobacco factor must be allowed for.

Thus, if those with a history of one year and under be compared with those who have suffered for over two years, there is some evidence that earlier treatment is likely to yield the best results. For in the first class 71 per cent. were cured (tobacco was a factor in only 20 per cent.); whereas in the second class 52 per cent. were cured (tobacco influenced the result in 38 per cent.). There were no recurrences in the first group and 10 per cent. in the second, in 5 per cent. of which tobacco may be blamed. The failures were 5 to 7 per cent.; and whereas tobacco could fairly be held responsible in all of the first group, no such influence could be traced in the second.

Gastro-enterostomy forms an essential part of the treatment of the ulcer in the majority of cases, as it permits regurgitation of bile and diminishes intragastric and duodenal tension, and the ulcer should be invaginated whenever possible. In the thin type the associated remedy of mesenteric and peritoneal abnormalities is indicated. In all types the reduction of or abstinence from tobacco is essential.

CONCLUSIONS.

The predisposition to duodenal ulcer consists in the relative increase of the normal vagus stimulation, which establishes the "duodenal stomach." Tobacco is the outstanding cause. Factors which may excite ulceration in such a type of stomach are: (1) acid, (2) distension, (3) trauma, (4) infection, and possibly (5) alcohol; the effect of all these in producing ulceration is accentuated by an incompetent pylorus. Any combination of these exciting factors may determine ulcer formation in such a type of stomach; but in the "sympathetic type" with the closed pylorus (the antithesis) a gastric ulcer is the more probable result.

I should like to express my gratitude to many colleagues who have allowed me free access to the notes of their cases; and to add that in this study percentages have only been adopted as the simplest means of comparison.

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TREATMENT OF TUBERCULOSIS OF BONES AND JOINTS.*

BY

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TWENTY years ago tuberculous disease attacking the spine or the hip dealt hardly with the bodies of its victims; only too commonly the story was one of persistent pain, increasing deformity, sinuses profusely discharging, the dragging out of months, then lardaceous disease with its added miseries, and at the last end, death. But now there is little excuse for delay in diagnosis or prompt admission to a special hospital; and if admitted in good time the patient quickly loses all his pain, ceases to go downhill, and starts the slow process of recovery. This review must cover first the conception of the disease, then the general treatment of the patient, and finally the local treatment of bone or joint focus.

THE CHARACTER OF THE DISEASE.

Spinal caries—or any other bone or joint focus—is an obvious manifestation of a hidden deep-rooted disease.

Tuberculous disease of a joint or a bone is serious enough, but it is a weed with a very deep root; you may pluck the head, but the root will not come with it. A bone focus is a proof of established tuberculous infection of the body; but even this is not all, for the new focus is tangible evidence that the invasion of the body is advancing. For

months or years trench warfare has been carried on in the deep-seated lymph glands; from time to time there have been attacks, bacilli have been distributed in showers by the blood stream, but the tissue cells have known how to deal with them. But now things are going wrong.

The rival powers of man and tubercle bacillus seem very delicately balanced. The virulence of the tubercle bacillus in bone and joint disease is almost invariably constant.¹ Man is the variable factor. In good circumstances he has the upper hand; under sufficiently bad conditions he becomes its prey. But this is a fight in which we can join, and treatment has now become so effective that we can almost ensure victory. We can decide whether the patient will almost certainly recover or run very grave risk. This responsibility rests jointly upon those on whom it falls to authorize the admission to hospital and pay the maintenance, and upon those who carry out the treatment.

But success costs time and money. At present these necessities are often dealt out to us so grudgingly that we are driven to make a fine art of spending the smallest possible sum on the treatment of each patient. This makes our task not only very difficult, but often very unsatisfactory; for while it is comparatively easy to restore health in an open-air hospital, it is difficult to maintain that health after the patient goes home, and often impossible if he goes too soon. Similar causes produce similar results: a deep-seated tuberculous infection, and his home conditions, produced the focus for which our patient came into hospital. If he goes back with the infection inconclusively checked, and his home conditions are unimproved, his vitality and powers of resistance are likely to return to a low level. Further showers of bacilli may follow and lead to a new focus, or the old focus may be lit up again.

A cure in one hospital's register may be a very sick patient in another hospital's bed. This is tragical for the patients, misleads the surgeons, and falsifies statistics. But it is an experience that is disappearing where the hospital staff make certain of maintaining constant supervision of their cases after they go home.

THE TREATMENT OF THE DISEASE.

- I. First to raise the patient's general vitality as quickly and as fully as possible.
- II. Ultimately to restore the full health of the patient, who should be free from any sign of tuberculosis, focal or general, with his powers of resistance to the tubercle bacillus so raised as to enable him to repel any further attack.
- III. The prompt elimination of any factor, such as strain or movement, harmful to the diseased part, and the application, so far as possible, of rest, comfort, and stimulus to local circulation.
- IV. The avoidance of septic infection.
- V. The restoration of the strength and function of the affected part.

These points are best achieved by prompt admission of the patients to an open-air orthopaedic hospital. The development of perfect technical methods of treatment is the first duty of the hospital staff, the organization of team work to bring the patient promptly to that treatment is another, and for this they must rely on the help of the doctors of the district as well as of the tuberculosis officers. A little delay, then a little postponement, and we may find the disease has become, to quote the words of Percival Pott, "Most melancholy to see, most miserable to endure." We can neither afford delay nor to remit any established principle of treatment. The virtues of sunlight and moving air should not induce us to relinquish the accuracy of our splintage. Operations may be helpful, or even essential, to cure, but to consider them as short cuts is a sin which will be visited on our patients. Rest and time remain the essential ingredients of our prescription.²

General Treatment.

General treatment comprises the skilled use of four great natural remedies: *rest, good feeding, open air, and sufficient time.* Of the rest and the time, Hilton and Thomas have said all that is necessary—the one with charm, the other with emphasis.

Good Feeding.—Food must be adequate but not excessive, simple but well cooked and attractive, appropriate to the

* Founded on a paper read at the provincial meeting of the Tuberculosis Society at Cambridge, April 11th, 1924.

season and the weather. Our patients are very much exposed to the weather, and when it is cold require more food and especially more fat. In very hot weather, on the other hand, flesh and fat should be very largely replaced by fruit and vegetables. Plenty of water should be given, mostly between meals.

Action of Sun.—Ultra-violet rays are stopped in the outer layers of the skin; in large doses they destroy bacteria on the surface and epidermal cells; in smaller doses they stimulate the cells and tend to produce pigmentation. The sun's rays, as their wave-length increases from violet towards red, gradually lose photo-chemical activity, but gain in penetration and heating power. It is unknown whether epidermal pigmentation is associated with an indirect antibacterial or antitoxic effect in tuberculosis. That there is some indirect photo-chemical effect is clear from the danger of focal or general reaction in patients unprotected by pigment; but I know of no proof that the effect is antibacterial or antitoxic. The skin is heated throughout its depth. The arterioles in the corium dilate, and the circulation in the skin becomes very active. The warmth and increased circulation in the skin intensify its metabolism. But the strong rays of the summer sun, if unchecked by cool and moving air, quickly overdo this heating, the skin and the whole body get too hot, general loss of tone results. Any further overheating leads to danger. Thus we learn that free use of the sun's light without protection, or of its heat without associated cooling, is wholly bad. Sun and air act together, but the sun has been given all the credit. It is the old story—it pays to advertise! Expose a child to sun and wind, a coloured advertisement of the sun's action appears in the skin; in the public eye that settles it: the virtue must lie in the sun, and the treatment is termed *heliotherapy*. This is a little unfair to the wind. But it is equally unfair to the sun to assess his value on the effect of his untempered activities. We should make sure of our ground before we single out photo-chemical action as the beneficial agent, concentrate on its administration, and measure actinic activity as a guide to the value and the dosage of the sunlight. I am not yet convinced that the advantage of pigment is other than protective. Good pigmentation is a great help to a patient; for he can be exposed to sun and wind for much longer periods than others who have been unable or less able to protect themselves with bronze armour. But the very pigmentation has its dangers. It is the visible and obvious thing in heliotherapy—it catches the eye and diverts the mind. One danger is that it may divert the mind from a true conception of the help of the sun; another is that its degree may be taken as a *measure* of cure. This brings me to a question of great importance. Sunlight acts on the body in two ways—*photo-chemical* and *calorific*. These activities differ profoundly. Is it not just possible that in deep-seated tuberculosis, as in rickets, photo-chemical action and cod-liver oil are only of value in cases where there has been a diet or light deficiency? For this the doses needed are but small; and there is some evidence that the respiration of air exposed to unfiltered sunlight is enough.³ Certainly the stimulating quality of light is helpful up to a limit, not yet defined. But where there is no such deficiency, has the exposure of the skin of the body to photo-chemical light any further value? Now I would put forward these points:

1. The first step in heliotherapy is the carefully graduated exposure of the body in order to develop pigment; and until and unless pigment is developed only a small dose can be tolerated, and more than a small dose is definitely harmful.
2. Pigmentation, so far as is known, is definitely and merely a protection of the deeper layers of the skin and underlying tissues from the photo-chemical effect of sunlight.
3. Sunlight contains both light and heat; a good skin takes prompt steps to stop the light as near the surface as possible. This is exemplified in the highest degree in the negro; in fact, the better the skin and the more acclimatized the race, the more effective the barrier.
4. The more completely photo-chemical activity is cut out, the better the patient responds to heliotherapy.

It is already clear that for superficial lesions a source of ultra-violet light is necessary; this can be supplied arti-

ficially, but in other forms of surgical tuberculosis the tungsten arc or the mercury-vapour lamp are cold and relatively valueless substitutes for the sun.

The Wind.—The sun saves the patient from undue cold, the wind from undue heat. The combination is pleasurable, and, like a contrast bath, it promotes an active hyperaemia in the skin. There is also reflex stimulation of deep organs; we all feel the benefit after a run in the back of an open car.

To sum up: Neither sun nor wind can be used to the best without the other. Together they work in ways far beyond direct heliotherapy as a source of health and vigour. Possibly, too, the partnership between sun and air may be more intimate than we know fully yet; one virtue of open-air wards may lie in the effect on our patients of breathing air which is often sunny as well as always fresh.

The Skin.—Clearly the skin is our first line of defence against invasion of the body, and it is so effective in resisting bacteria that its efficiency is often forgotten. There is evidence that it plays an important part in our reaction to the tubercle bacillus. Both its sensibility and metabolism appear to share in this action. Good pigmentation carries with it a good prospect of sound and permanent healing. Pigmentation is a response of the skin to light and *ipso facto* a sign of a good skin—a skin capable of cutting out the violet end of the spectrum, capable also of gaining the best and most lasting benefit from other effects of sun and wind. We talk of the sun and think little of our skin. Sun and wind may give the skin useful hints, but it is the skin which interprets them to our advantage.

There is an experience which deserves special memory when the factors in the success of modern treatment are being assessed. There was a short period when surgical tuberculosis was being treated in open-air hospitals without heliotherapy. Fresh from London I went to the open-air hospitals at Baschurch and Heswall. Pott's disease and hip disease had meant sadness and suffering, and I found a set of children as healthy and jolly as could be, and at Heswall I was told that not a case had been lost from lardaceous disease for two years. Between the old days of white children and these days of brown children there was a decade or so when rosy-cheeked children thrived in open-air wards.

Local Treatment of the Affected Parts.

Rest from strain and movement without constriction, comfort, and stimulus to local circulation. It is necessary to decide first what degree of surgical rest is to be maintained and for how long; further, whether there are stages for each of which a different degree of rest is appropriate; and, finally, to consider the principles of splintage. Once our aims are defined we want to be able to pick out those methods which will lead to sound healing with the best and most free use of the part—healing which will stand wear and tear and pass the test of time. The splintage should:

1. Hold the parts accurately and comfortably.
2. Not constrict the circulation in the affected part.
3. Not interfere with respiratory movements.
4. Allow exposure to sun and air.
5. In spinal cases should allow full exposure of the back without risk of strain, and where bone destruction has made a local kyphos inevitable and desirable it should be minimized and compensatory curves developed.
6. Be as simple, inexpensive, and widely applicable as possible.

Methods of Immobilization.—First let me take Shropshire and the rule of H. O. Thomas—"Rest, enforced, uninterrupted, and prolonged." When we remember that Thomas's father was a successful bonesetter, and that before he was qualified he assisted his father, his very conservative methods have added significance. To him the secret of success was rest with avoidance of local constriction: (a) *rest from movement*, and (b) *rest from pressure*. He favoured unremitting rest throughout the whole period of unsoundness, but was insistent on "secondary diagnosis," an ascertainment of the recovery of a joint so that it might be known when movement might begin. Thomas hated the constriction of an inflamed joint. He says that joints thus treated "are always long delayed in

the unsound condition, and even when they improve they remain long hampered by some degree of false or unsound ankylosis."⁴ At Alton great care is devoted to posture, and to weight extension of the joints with a view to mobility, but immobilization is less complete. At Leysin everything is designed so that the whole body may be exposed to the sun. Mobility is Dr. Rollier's aim in every instance. In cases where one can expect the bearing surfaces to be well adapted this is undoubtedly right, but where the joint surfaces are much deformed the marriage of extensive disease and restricted movement is perhaps happy at Leysin, but afterwards the wear and tear of life and the ups and downs of health will put the couple to severe tests. We have found divergences of aim and of method; in one hospital mobility is always the goal, however serious the disease and deformed the articulating surfaces. So, too, there are schools of absolute and of relative immobilization. My own belief is that during the period of active disease, characterized by pain and muscular spasm before splints are applied or if they are inefficient, perfect surgical rest is indicated. But when all pain and muscular spasm are past, and muscles are no longer quick to resent, but ready to induce, minor movement of the joint, relative immobilization is allowable. At the end of treatment comes the "secondary diagnosis of restoration." But in the meantime, as soon as the height of the disease is past, one must decide whether ankylosis or mobility is to be the aim. Where the damage has been severe, ankylosis may be preferable to limited and not altogether safe mobility.

Except in the minority of cases where ankylosis is the aim, three stages can be distinguished: (1) during active disease—rest, enforced, uninterrupted; (2) during the stages of healing—comparative immobilization; (3) the stage of free use, under careful supervision. During the convalescent and after-care stages Thomas's tests should be applied again and again.

Operative Methods.

For children under 16 formal operations are seldom if ever warranted, but in adults when disease is advanced, and a stiff joint is the best that can be hoped for, an excision will give a healed, strong, painless limb more quickly, more certainly, and of sounder stability, than conservative measures, and more safely. *Operative internal splintage* has real value in spinal caries in adults.

Cold Abscess.—Sir Henry Gauvain aspirates frequently, but at Shropshire and Leysin an abscess is only aspirated if it threatens the skin. A fine needle is used; no determined effort to empty the abscess is made; as a rule nothing is injected. Sir Robert Jones has always taught that the fluid in a cold abscess is harmless; Dr. Rollier is equally convinced. To open and drain a cold abscess is to commit a surgical crime.

Besides all these things there are many points of technique suitable for a demonstration, but too confusing to include in a review such as this. I have tried to make the main issues clear. A tuberculous focus in a bone or a joint is the obvious part of a deep-rooted disease, serious in itself, crippling if there is delay, disastrous if there is neglect; but it is also evidence of tuberculous infection of the body which pre-existed but is now gaining the upper hand. On the other hand, modern treatment, with its artistic use of *rest, food, and weather*, if started in good time and kept up long enough, will almost always bring about a cure—a cure that skilled after-care will make permanent. Thus crippling and disaster can be forestalled, and health and activity take their place. This treatment necessitates a special open-air hospital and a staff experienced and expert; but there is no need to transplant a patient from his home climate to a distant hospital. Rather is a hospital in the district best, for it will admit its patients early, follow them home when they go out, and spare no effort to make their cure complete and final.

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LACK OF EXERCISE AS A DETERMINING FACTOR IN THE EPIDEMIOLOGY OF BERI-BERI.

BY

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DURING investigations by a committee into the occurrence of beri-beri in the prison at Freetown, Sierra Leone, it was observed that the disease affected those who were employed as tailors to a greater extent than other prisoners. Of 59 cases of beri-beri in 1922, 34 occurred in tailors—that is, 57 per cent. The average daily strength of tailors was 15 per cent. of the average daily strength of all prisoners; that is to say, the 15 per cent. of the population employed as tailors yielded 57 per cent. of all the notified beri-beri cases. It appears, therefore, that in Freetown Prison in 1922 there was some factor in the occupation which rendered tailors particularly prone to develop beri-beri.

It has been suggested that convicts sentenced to three years or over suffer more from beri-beri than other prisoners, and also that they are, from mental depression, more prone to all diseases. Of the 34 tailors affected, 18 were convicts (long sentence) and 16 were common gaol prisoners (short sentence); on the figures, the conclusion was that both convict tailors and non-convict tailors are susceptible to beri-beri.

In an endeavour to discover factors other than length of sentence which may predispose tailors to disease generally, and to beri-beri in particular, the conditions under which the tailors worked were considered. Such factors as overcrowding or insanitary surroundings were not found to have any influence, nor was there any distinction between tailors and any other class of prisoners as regards food, water supply, or sleeping accommodation. The factor which appeared to be all-important was lack of exercise, due to the sedentary nature of the occupation. It should be pointed out that even the exercise of half an hour a day prescribed was liable in the rainy season to be curtailed or even omitted altogether.

The facts which came into prominence during the investigation were reported upon, and recommendations were made as regards diet, also one which involved drastic alteration in the employment of tailors; it was to the effect that no prisoner should be employed for more than half his working day in tailoring, and that the other half should be spent in some active outdoor occupation, such as stone-breaking.

The effect upon the death rate among the prisoners is shown in the following table; the years mentioned are those in which beri-beri appears in the records.

Year.	Total Deaths.	Deaths from Beri-beri.
1913	20	5
1919	8	2
1920	12	3
1921	25	3
1922	12	3
1923	3	1*

* This case arrived in Freetown Prison from Kennema Prison on July 26th, 1923, and died September 5th, 1923.

The effect upon the admissions to hospital for beri-beri is seen in the graph.

The admission of cases early in the year 1923 is partly to be attributed to the detection of early cases due to the increased vigilance of the prison medical officer. The notable fact is that whereas in 1922 the beri-beri admissions commence in July

Continuous line: Months of admission to hospital of 59 cases of beri-beri during 1922. Broken line: Months of admission to hospital of 20 cases of beri-beri during 1923.

commence in July and rise to a maximum in October, which is the common curve of beri-beri admissions in Freetown Prison Hospital, in 1923 no case was admitted subsequent to August; that is to say, that in 1923 the disease disappeared just at the very time when usually it begins to