pin is passed through healthy skin and tissues in the first place, no serious bone infection seems to occur. The punctures have generally healed within ten days of removal of the pin, and in the case of a persisting sinus curettage has effected healing.

WALKING

It is undoubtedly a terrifying experience for the average patient to commence walking on a recently broken leg, and, as in all unpleasant physical ordeals, firmness on the part of his mentor is the quickest way to banish the fears of a nervous individual. While fully realizing that we bear another's pain with more fortitude than we bear our own, experience in ambulatory treatment in fracture work convinces me that the pain in early walking is by no means unbearable. All of us have an instinctive fear of leaning upon a visibly broken prop, in spite of reason telling us that the prop itself is adequately supported. It is just the proportion of calm reason to instinctive panic in any one individual that determines his response to early ambulatory treatment.

Although the splint described here may seem rather brutal, a little reflection shows that any splint which separates the bone fragments, and keeps them apart, removes the one source of pain in a fractured limb—namely, repeated slight trauma to the sensitive periosteum at the line of fracture, produced by muscle spasm or misguided handling of the limb. It is generally agreed that skeletal traction is both efficient and painless for this very reason, and as the transfixion pin, with attached weight bearing on the bone, causes no pain in recumbency, it is illogical to suppose that the same principle applied in the upright posture can differ markedly in its sensory

effects. I found no difference in this respect from cases treated in the "Delbet" plaster splint.

OEDEMA

This seems to be a source of anxiety to patient and doctor alike, and Bohler describes a special zinc-gelatin bandage which he applies to the leg for several weeks after union of the bone has occurred. But surely this question of oedema is exaggerated as a disability in fractured legs, and, apart from causing some stiffness at the ankle, its presence is of little import. The oedema is due to damage to lymphatics and small blood vessels around the broken bones, and it will persist and recur with dependency of the limb until new channels of absorption are opened up by centripetal pressure, as in massage or walking.

The objection to massage is that at best it is a poor substitute for natural function—that is, walking; also, it centres the patient's attention on his disability as such. In contrast to this, the exercise of walking causes progressive elimination of the idea of disablement. It must be admitted that early walking greatly increases the oedema, but on the other hand, if persisted in, it is probably the quickest way of permanently reducing it. In the first case upon which this splint was used swelling around the ankle was so marked in the second week that pus was suspected in or around the joint, yet within three months from the date of accident difference in size between the two legs was barely noticeable.

One of the advantages of the splint is that the whole limb is exposed to view, thus giving a rough idea of the position of the bones at a glance; also, apart from the pin-holes, there is no apparatus to cause pressure sores.

THE PROBLEM OF LYMPHOID TISSUE

BY

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The designation "lymphoid*" is applied to a complex of tissues scattered throughout the body. Since the classical work of His¹ in 1860, much has been written concerning this tissue aggregate, yet there has been little real advance in our understanding of its functions. For this there have been two important reasons. The lymphoid tissues are not concentrated into one organ, but are widely diffused throughout the body. Consequently the methods of direct experimental attack, involving complete extirpation, are inapplicable. Indirect methods of extirpation, such as exposure of the animal to x rays, are not sufficiently selective to be of value. Failing the experimental approach we have been compelled to fall back upon a clinical and pathological study of the problem. Here, unfortunately, both the clinician and the pathologist, looking at the lymphoid tissues from their own special angle, have combined to draw a particularly bright red herring across the trail.

THE "BARRIER" FUNCTION

The clinician and the pathologist have repeatedly observed that lymphoid tissues are often the seat of secondary inflammation or malignant deposits. They have therefore assumed that lymphoid tissue exists for that very purpose, serving as a barrier which holds up—for a time, at any rate—the spread of injurious matter.

* In recent years Aschoff, Ehrlich, and others have endeavoured to distinguish between "lymphatic" and "lymphoid" tissues. The grounds for this distinction are somewhat arbitrary, and hence the older term "lymphoid" is here retained.

Yet even a brief consideration will serve to show that there are serious flaws in this interpretation.

It is undoubtedly a striking phenomenon to observe a mass of lymph glands enlarged as a result of inflammation or malignant deposits. But while it is true that the lymph glands act as temporary barriers against the spread of disease, it is equally true that the lymphatic vessels greatly facilitate this spread. Thus, quite a small epithelioma on the back of the hand may cause metastases in the axillary lymph nodes. Once in the lymph nodes the metastases are then held in check, albeit only for a time. Had it not been, however, for the lymphatic vessels affording these metastases an easy and rapid pathway, they would never have been able to travel as far as the axilla, but would have remained strictly localized to the hand. The gain from the barrier action of the axillary glands is more than offset by the dangerously easy dissemination made possible by the lymphatic vessels. Similar considerations apply, *mutatis mutandis*, to the lymphatic spread of acute inflammation. The lymphoid tissue found in the wall of the alimentary canal has been thought to be even more obviously defensive in function, lining as it does a hollow tube full of micro-organisms. On this hypothesis one would expect that the removal of tonsils and adenoids would leave the nasopharynx weak and defenceless, which is not the case. It would appear that the picture of countless hordes of lymphocytes lying in wait in the tonsils to pounce upon passing bacteria may be attractive, but does not fit in either with our knowledge of what happens when they are removed, or with the fact that the lymphocyte is not an actively phagocytic cell.

The same arguments apply, but with added force, to the lymphoid tissue present in the lower end of the ileum and the appendix. In old age the lymphoid masses (Peyer's patches) in the terminal ileum have, as a rule,

completely disappeared. In dissecting-room subjects (usually old inmates of Poor Law institutions) it is almost impossible to demonstrate to students the presence of these patches. Yet old people, except in the terminal stages of illness, are much less liable to intestinal inflammation than young people, with their full complement of intestinal lymphoid tissue. If intestinal lymphoid tissue is defensive in function, it is somewhat remarkable that the intestine should be better off without it than with it.

LYMPHOID TISSUE IN HEALTH

There are enormous numbers of people who live the greater part of their lives without either acute inflammation or malignant disease. Are we to assume that in these people the lymphoid tissues are functionless, merely marking time, as it were, until they are needed? One need merely propound this question to realize what the answer is likely to be. It is this "silent" lymphoid tissue—the lymphoid tissue occurring in the healthy organism—which we must first understand before we can appreciate the significance of pathological changes.

In the normal body the one function which we can definitely assign to lymphoid tissue is the formation of lymphocytes. Whether it is the so-called germ centres which are responsible for this is open to doubt, but taking the lymphoid organs as a whole, this lymphopoietic function is well established. Since the greater part of the body lymph drains into the blood via the thoracic duct it is possible, by inserting a cannula into the thoracic duct, to collect this lymph and investigate quantitatively the lymphocyte output of the body and its variations under different conditions. In this connexion it is very interesting to read the classical papers of the older physiologists such as Heidenhain,² who devoted considerable time and effort to the investigation of lymph flow, but were interested almost exclusively in the fluid content of lymph, and not in its cellular elements.

SOME EXPERIMENTAL FINDINGS

After tying a cannula into the thoracic duct of a dog anaesthetized with chloralose, the lymph was collected and measured hourly, a few drops of lymph being taken every hour for the purpose of making a lymphocyte count. In any given animal both the lymph flow and the lymphocyte output are astonishingly constant, showing but little fluctuation. In a 10-kilogram dog on the average about 25 c.cm. of lymph was collected hourly from the thoracic duct, with a lymphocyte count of 10,000 to 11,000 per c.mm. The longest period over which lymph was collected was eight hours; after that time there is a falling blood pressure, and lymph flow diminishes. An hourly flow of 25 c.cm. with a lymphocyte content of 11,000 per cubic millimetre would mean a daily lymphocyte output of 6,600,000,000 lymphocytes. But the total number of lymphocytes in the circulation at any time (easily calculated from the lymphocyte count per cubic millimetre if the blood volume is ascertained) would be on the average about 2,000,000,000. It seems, therefore, from these figures that the lymphocytes of the blood are replaced three times daily. Actually there appears to be a definite age factor, and in older animals the lymphocyte output is less. A 7-year-old dog, for example, showed a lymphocyte count in the thoracic duct lymph of only 3,500 per c.mm. In younger dogs, however, higher figures are obtained, similar to those quoted above. In the next column is given a typical set of experimental data.

In spite, however, of these enormous numbers of lymphocytes daily entering the blood stream, the blood lymphocytes remain constant. Hence one is driven to the conclusion that equally large numbers of lymphocytes must be leaving the blood stream daily—about the same number as enter the blood via the thoracic duct—other-

wise the blood lymphocytes, instead of remaining constant, would be continually increasing.

The number of lymphocytes in the blood at any given moment is therefore the resultant of these two processes

Time	Lymph Collected	Lymphocyte Count per c.mm. of Lymph
1.30 p.m.	25 c.cm.	11,500
2.30 "	23 "	11,300
3.30 "	22 "	12,200
4.30 "	26 "	11,100
5.30 "	23 "	11,300
6.30 "	23 "	10,100
7.30 "	24 "	10,100

—the balance between those entering and those leaving. Consequently lymphocytosis may mean one of two things: either more lymphocytes are entering the blood stream than are leaving it, in which case we are dealing with an active or true lymphocytosis, or there is some interference with the mechanism whereby lymphocytes leave the blood, so that they accumulate in it and give rise to a false or retention lymphocytosis. Infants, for instance, show a true lymphocytosis, one which we are able to correlate with the presence of lymphoid tissue in increased amount. It is quite likely that the lymphocytes are concerned with the active growth processes of childhood, and that the lymphoid tissues act as a storehouse of primitive wandering mesenchymal cells to supply the various tissues as they are needed. It is difficult otherwise to understand why the growing child should be so well endowed with lymphoid tissue, and why, when the period of active growth is over, the lymphoid tissues should shrink so markedly.

THE BASIC PROBLEM OF LYMPHOID TISSUE

The fundamental problem of lymphoid tissue is concerned more than anything else with the fate of the lymphocyte. If such enormous numbers of lymphocytes leave the blood daily, in what part of the body do they leave it, and for what purpose? Reasons have already been given³ for believing that the lymphocytes are filtered off in the bone marrow and there develop into the various blood cells. Whether this is so or not—and it is difficult to prove conclusively—it is certain that the lymphocyte is a young and actively growing cell. It has enormous developmental potentialities, as shown in tissue culture experiments. Like other actively growing cells it is extremely sensitive to radiation. Whatever part of the body the lymphocytes may be intended for, it must be a region which is in need of a regular and unfailing supply of young and active cells. This consideration helps to narrow down the field of inquiry.

Since it is generally believed that lymph and lymphocytes play an important part in fat absorption some observations were made bearing upon this question during the present work. One must, to some extent, discount the results by reason of the inhibitory action of the anaesthetic on intestinal movements; but this is not very marked, as may be seen when the abdomen is opened. In a dog which is given half a pound of lard (226 grams), fat is present in the lymph as long as twelve hours after a meal. The lymph is perfectly white, and appears to contain a large quantity of fat. Chemical analyses (very kindly carried out for me by Mr. Pryde of the Physiology Department) showed, however, that this appearance is very deceptive. Lymph collected over eight hours (about 200 c.cm.) contained between 1 and 3 per cent. of fat. In no animal was the fat percentage higher than

3 per cent., so that this would account altogether for 6 grams absorbed via the lymph out of a total fat absorption of 226 grams. Furthermore, even this small amount of fat was not absorbed by the lymphocytes. The lymphocytes of the thoracic duct are practically all (98 per cent.) small, with the faintest suggestion of a cytoplasmic rim. Presumably fat would be carried by the cytoplasm of the cell and not by the nucleus. No fat, however, could be demonstrated in the lymphocytes by histo-

chemical methods. These preliminary results are so striking that they are being subjected to more detailed investigation.

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TREATMENT OF CHOREA BY BATHS*

BY

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A series of cases of chorea in children under 15, numbering forty-four in all, has been treated in the wards of the Cheyne Hospital for Children, Chelsea, since August, 1929, by means of reclining baths at skin temperature for considerable periods of immersion. The cases were graded on admission as follows:

Very bad, 9; bad, 15;
bad + mitral stenosis,
3; moderate, 13; mild, 4.

All these children, most of whom had been transferred from other hospitals, had a long previous history of the disease, the average length being three months—in one case it was one year. Three of the cases were relapses—in one instance a third relapse—of previous attacks.

TECHNIQUE

The patients were placed in the ward baths for a period of one to one and a half hours, in the morning and again in the afternoon. The bath was filled with tap water at skin (neutral) temperature, and kept at this point throughout by partial refilling at intervals. The ward possessed only two baths, and as several cases were always under this treatment baths were given in rotation; any child whose treatment coincided with meal-time was fed in the bath. Each child had an air-ring placed round his neck (Fig. 1), which enabled him to lie back in the bath and relax without fear of his head becoming submerged. In bad cases, when this danger would still be present, a canvas cover was fitted over the bath, and the head emerged through a hole. (Fig. 2.)

Subsequent to the bath the child was put to bed for an hour, after which light skin massage (sedative) was given to the limbs and back for twenty minutes. Children with heart disease were also treated in this way, but were conveyed on a trolley, and lifted in and out of the bath.

PHYSIOLOGICAL EFFECTS

The sedative effect, which it is the object of this method of treatment to produce, was generally manifest after about a week of treatment. The effect of individual baths on the pulse rate was somewhat variable. If the pulse rate was initially over 100 a slowing effect of eight to ten beats per minute was practically invariable by the end of the bath. With lower rates the most usual effect was a decrease in frequency of 4 to 8 beats. Occasionally

this was only manifest after one of the two daily baths in which case it was always after the afternoon bath. It was noticed in several of the original cases that the pulse rate increased after baths. This was investigated more fully, and it appeared likely that it was due (a) to the child playing while not observed, or (b) turning on the hot tap while unobserved; an increase in the pulse rate was only noticed on very few occasions after closer observation was instituted.

In practically every case the child became very fond of the treatment. During the first four or five days slight cyanosis, shivering, or looseness of the bowels was observed after the bath in a few cases, but this passed off and did not recur except in one case, when looseness of the bowels persisted for three weeks. The cyanosis occurred chiefly in the cardiac cases. All these patients were kept on treatment, however, and ultimately did well.

CLINICAL RESULTS

All the cases responded well after periods of treatment varying from eight to twelve weeks in the milder ones, and up to five months or more in the severe cases. A certain number of additional unselected cases were treated in the same ward on more usual lines with various drugs, including "nirvanol," during this period. It was noticed that these responded more quickly, but relapses were more common. The notes of fifty unselected cases treated on orthodox lines were examined, and the incidence of relapses was compared with those occurring over four years in the present series. In the former group (treated with drugs) there were found to be eight relapses (1:6), while in the present series there have been three (1:13). Of these three relapses one occurred in a boy whom we had been treating for his third attack of chorea, while another "relapse" only amounted to an undue "nerviness."

SUMMARY

Forty-four cases of chorea of long standing, referred mostly from general hospitals, were treated without drugs but by means of somewhat prolonged immersion in baths at "neutral" temperatures, and general (light) massage. A small control series was treated on orthodox lines. It was found that the same result was ultimately achieved in both groups. The bath group took longer, but the ultimate incidence of relapses proved lower than in the orthodox group. It is probable that a combination of the method described with ordinary drug therapy would prove a more successful measure than either separately. This could easily be adopted in hospital, since no special apparatus—other than an ordinary air-ring or a canvas bath-top cover to fit the ward bath—is necessary.

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* Read in the Section of Physical Medicine at the Centenary Meeting of the British Medical Association, London, 1932.

FIG. 1

FIG. 2