lead. The cards,³ therefore, are to be regarded as indicators rather than as absolute guides.

These cards, covering a wide range of subjects, are perforated and hung on a large ring which the house pupil carries with him on his history-taking errand. There are also cards which indicate the points to be noted in the postoperative course of patients, e. g., the immediate and more remote postoperative symptoms, the treatment and its result, the placing and withdrawing of wicks, sutures, etc., the character and amount of discharges, etc.

Furthermore, if in connection with any disease some new point of diagnosis, etc., is brought out, the placing of this on the proper card calls the attention of the house pupil to it, its presence or absence is noted and statistics bearing on its importance are thus obtained.

Our experience thus far has led us to feel that the use of these cards puts the house pupil in the way of taking an intelligent history and aids him in the formation of good habits in that direction. If further experience corroborates this view, we shall feel that something needed has been accomplished.

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OPERATIVE TREATMENT OF TUBERCULOUS JOINTS

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The treatment of tuberculous-joint disease has long been a disputed question, and the profession is not to-day agreed on a uniform plan of action.

Many methods of treatment have been advanced and these methods have been supported and resupported by long series of statistics and by thoroughly credible reports of results.

When the complete review has been made it seems to me that we must conclude that there is no one correct line of treatment for tuberculous-joint disease, but that the method selected must depend on the nature and stage of the lesion, the age and social position of the patient, facilities for treatment, the individual experience of the physician in charge, or that results must be accomplished by a combination of all available methods.

Treatment by rest, diet and in favorable hygienic conditions, by Bier's congestion hyperemia, by iodoform injection, by vaccine therapy and by cutting operations must each have a definite field of applicability or be used in proper combination.

It is not my purpose to discuss the comparative value of the different methods of treatment that have been advanced, nor does my experience justify me in drawing conclusions regarding the entire field of application of the operative treatment. My experience has been largely confined to the operative treatment of adults who have suffered from this disease. Inasmuch as seven-eighths of all patients who suffer from joint tuberculosis are less than fourteen years of age, it will be readily seen that my experience and results can not justify general conclusions.

Twenty-five patients have come under my care in whom the operative treatment has been used, and it has seemed desirable to me to report the results in these cases as a contribution to the general subject.

Of the lesions, 13 have been in the knee, 7 in the ankle, 3 in the elbow, 1 in the wrist and 1 in the hip. Inasmuch as a fairly uniform method of procedure has been used in these cases, I wish first to describe the operative technic in each joint.

TECHNIC OF OPERATIONS ON THE KNEE JOINT

In the knee joint the incision is uniformly made from condyle to condyle across the center of the patella, the lateral quadriceps expansions are divided, the patella is sawed through, the knee is acutely flexed, the fragments of the patella are drawn upward and downward and a complete exposure of the ends of both bones and of the entire joint is obtained. A correct estimate of the nature of the lesion can now be promptly obtained, and the points considered are (1) bone involvement, (2) extensions outside the joint into the soft tissues. A tourniquet is always used for the purpose of giving a bloodless field for accurate dissection.

My experience includes an unusually large percentage of purely synovial cases (fifteen out of twenty-five), under which heading I would include those cases in which there is merely a superficial erosion of bone. When the case is of this type a sharp knife dissection begins in the lower half of the joint, just behind the patella, progresses in a systematic manner and removes the synovial membrane, together with all thickened tissue, out to the quadriceps aponeurosis.

When the dissection reaches the head of the tibia a heavily bladed yet sharp knife is used and the bone is pared, not only around its borders, but over the upper surface, when the articular cartilage is diseased or loosened from the bone.

When this dissection reaches the posterior border of the tibia it is discontinued for the time being. The dissection then begins first on one side, then on the other, then between the condyles, and all tuberculous or suspected tissue is in the same manner dissected around the head of the condyle to the popliteal soft tissues.

When this point has been reached the bones can be much more freely separated than previously, and the same sharp dissection is continued over the entire posterior portion of the joint, particular attention being given to the posterior border of the tibia.

Caution must be used in this part of the dissection not to injure the popliteal structures. When this part of the dissection has been completed the upper fragment of the patella is drawn strongly upward and the quadriceps bursa is accurately dissected out. In some instances this cannot be completely accomplished without a lateral longitudinal incision at the outer border of the patella. Any superficial erosion of either bone or small area of necrosis is cut out with a sharp knife; never with a curette. Indeed, a curette is never used in this operation unless there should be a sinus or cavity extending into the soft tissues in such a way that free incision and dissection is impossible. The curette necessarily mashes the tissues and exposes the patient to the risk of having tubercle bacilli jammed into deeper tissues, which are left behind. I would make a special point of clean-cut, sharp dissection with a knife. A most careful search is always made for bone foci or minute sinuses extending into the deeper bone structures. The bone-paring is always made down in perfectly healthy bone.

When there is a focus of bone tuberculosis in the head of the tibia or in either condyle and the focus is not of a size sufficient to necessitate the re-

3. Cards 5 $\frac{7}{8}$ inches by 3 $\frac{15}{16}$ inches.

removal of the end of the bone, the area is likewise excised by cutting around with a sharp knife well below the deepest point of the focus; then a sharp gouge is used to lift out this cylinder or one of bone tissue. I consider this decision as to the extent of bone involvement a heavy responsibility and one not to be undertaken until careful microscopic study of such tissues has justified a fair degree of accuracy in such judgments.

When the dissection has been completed, pure carbolic acid is swabbed over the entire area of dissection and left in contact with the tissues for three minutes. Alcohol is then applied to neutralize the carbolic acid. The entire dissection has been conducted according to the same principles followed in malignant disease.

When cavities are left in the bone these are carefully dried and filled with the Moseley-Moorhof iodoform bone-plugging mass, which is allowed to harden. The tourniquet is now removed, all bleeding points are secured, and the wound is ready for closure.

Conservatism in the removal of bone has been my rule in all these operations, and the end of the bone must be very seriously damaged to justify sawing it off. Those patients in whom erosion or atypical excision is done heal as satisfactorily as after a typical excision, and the function has seemed to me so much improved by maintaining an extremity of normal length that I consider this to be a very important point. Those patients who have not had bone removed get along almost without a limp. Indeed, one young woman whose occupation was that of elocutionist has continued her professional work on the New York stage and very few people know that she has a stiff knee. Even her manager did not know this fact until he saw her going upstairs.

Bone foci of considerable size can be cut out and filled in with iodoform mass without great sacrifice in the length of the bone. In Case 10 the upper surface of the tibia was sawed off in an excision and the focus was seen to extend much deeper into the head of the tibia. When this focus was removed a cavity was left which was, I think, about the size of an egg. This was carefully filled in with iodoform mass. This patient has had perfect recovery and has a solid, well healed leg.

The wound is usually closed with interrupted No. 3 plain catgut. In excisions two chromic gut sutures are usually put into the bone through drill holes to maintain position until the splint can be applied. The patella is not wired, since a heavy suture on either side and suture of the soft tissues in front are usually sufficient to maintain the apposition. A drainage tube is regularly placed on one side or the other to take care of the blood and serum for the first three to seven days; then it is removed. A strip of sheet rubber or gutta-percha tissue is usually placed on the opposite side of the joint for a similar reason and left for the same length of time.

After the wound is closed dressings are applied in such a way as to facilitate subsequent change. Plaster-of-Paris bandages, four to five inches wide, are then made into a strap long enough to extend from the gluteal fold to the tips of the toes. This strap is made of about twenty layers of gauze and a heavy piece of strap iron about eighteen inches long is included. This reinforced plaster-of-Paris strap is then placed on the posterior surface of the extremity, which has been well wrapped with ordinary splint cotton; then plaster-of-Paris bandages are used to make an encasing splint,

which extends from the perineum to the tip of the toes but does not include the knee.

When a sufficient number of turns have been made to give solidity a second strip of hoop iron is placed on the anterior surface. This strip is bent in such way as to make a high arch over the knee, the arch being six to eight inches broad at the base, and the strip is curled up at each end to make a hook. More plaster-of-Paris bandages are now rolled on to incorporate this anterior iron strip. When the splint is completed and the plaster hardened immobilization is complete; the arch at the knee gives free access to the wound and the hooks at either end, together with the arch at the middle, give three points from which the entire extremity can be suspended by rubber cords to a longitudinal bar which is placed over the bed. This swinging position adds greatly to the comfort of the patient.

The wound is dressed on the third day, drainage removed on the fifth to the seventh day. The sutures are removed on the tenth day; the wound is healed, as a rule, in three weeks. The splint is removed in three to five weeks and replaced by a simple encasing splint which extends from the ankle to the middle of the thigh.

Bony union is often very slow and may not be complete until eight to twelve weeks after operation.

TECHNIC OF OPERATION ON THE ANKLE JOINT

By far the best exposure of the ankle joint is given by an anterior incision which extends from one malleolus to the other, directly across the instep. I have sometimes modified this in such way as to make an anterior skin flap extending somewhat downward on the dorsum of the foot and have divided the tendons and other structures on a higher level, yet both methods seem to be efficient. The incision extends first through the skin and subcutaneous tissues, the tendons are exposed and sutures are placed well above and below the point of division in each tendon and so marked that identification will be easy when they are to be reunited. The ligaments and other surrounding tissues are now divided and the joint opened. The same careful dissection is now instituted as has been described for the knee, and every vestige of tuberculous tissue is most carefully removed. Particular attention is given to the calcaneo-astragaloid articulation, which is frequently secondarily involved and may be the primary focus of infection. Whenever the patient complains of great pain in standing and inability to walk, this joint is probably involved.

In Case 20 it became necessary to remove a practically normal astragalus in order to thoroughly expose and dissect out this joint. Attention is likewise called to the great importance of the tibiofibular articulation. This articulation must be thoroughly exposed, since it is regularly involved. When cavities are found in the astragalus, os calcis, tibia or fibula they are cut out with a sharp knife and the cavity filled with iodoform mass.

After the dissection is completed the joint is treated with pure carbolic acid and alcohol, the tourniquet is removed, vessels secured and the joint closed. The dressings are applied in two sets, one on the anterior surface, which can be removed without disturbing the foot in the cast; the other set are laid in the cast before it is applied. The splint used after this operation is a posterior strap of plaster-of-Paris, which has incorporated within it a strip of hoop iron; then several

rolls of plaster bandage are put on as an encasing splint, or an anterior strap is first applied; then the circular turns are used to hold the anterior and posterior straps in place. This joint is likewise treated by tube drainage for from five days to one week. The after-treatment of the ankle is practically the same as that of the knee. The results in this joint, as in the knee, are much more satisfactory when a mixed infection has not taken place.

TECHNIC OF OPERATION ON THE ELBOW JOINT

The elbow joint is best exposed for careful dissection of all rarifications of the synovial membrane by posterior incisions. A longitudinal incision is first made along the inner border of the olecranon, extending about two and one-half inches below and three inches above the tip of the process. A second transverse incision is then made on a level with the radiohumeral articulation and extends from the first incision to the outer border of this articulation. The longitudinal incision extends through into the joint. The transverse incision is first made through the soft parts; then with a chisel or saw the olecranon is divided on a line with the superficial incision. This gives a flap above which includes the olecranon the triceps muscle and overlying skin. This flap is retracted upward and strong flexure of the elbow causes the three bones to stand out distinctly. Careful attention must be given to the ulna nerve during this flexure, and it may be necessary to do a subperiosteal dissection beneath the nerve and lift it over the inner condyle, or to clip off the inner epicondyle before completing the flexion.

The dissection of the synovial membrane is now carefully completed in the same manner as has been described for the other joints, great care being given to the radioulnar articulation.

The joint is closed with drainage and all parts are sutured back into position. The olecranon is reunited with gut, which is used in the soft tissues only. A strap plaster splint is applied with the elbow at a right angle. The after-treatment of this joint differs in no way from that given for the knee, except that I have endeavored to get motion in this joint, and begin with gentle movements about three weeks after operation.

SUMMARY OF TWENTY-FIVE CASES

Detailed case reports can not be included in this paper, and the following summary of important points may be of interest:

There were 12 female patients and 13 males. All except one were of the working class and were dependent on their own or their parents' daily labor for support.

There was no family history of tuberculosis in 19 cases. There had been a definite injury to the joint in but 7 cases. The duration of the joint trouble ranged from five weeks to twenty-one years. In fifteen cases it had been more than one year. The general health was bad in 10, fairly good in 6, good in 9. There were tuberculous lesions elsewhere in 5 cases, 1 in lung, 1 in opposite knee, 1 in opposite ankle, 1 in Fallopian tube, 1 in spine and lung.

There were three children whose ages were 6, 7 and 15. The ages of the remaining patients varied from 18 to 40. Three were under 20. Thirteen were between 20 and 30; 6 were over 30. There were no sinuses present in 19 cases.

Some of these cases have been reported incompletely in a previous paper, but are included in the present re-

port in order to give the conditions of the patients to-day.

Twenty-five cases are reported. Of this number 18 may be considered to justify a conclusion as to the cure of the disease. It would seem justifiable to consider a patient cured when the wound has healed and remains healed and painless for many months and when the extremity has been restored to its function for a sufficient period to justify the conclusion that it will be permanent. I realize that exceptions may be taken to such conclusion and that a much longer period may be demanded by some.

Of this number 12 are completely cured and are using the extremity without support in their ordinary duties. Two have a single persistent sinus of minor importance, but have good function. In one the result is not known, but the progress was favorable up to the time of the patient's disappearance, one year after operation. In three the extremity was amputated subsequently, but I am not convinced as to the justification for amputation in two.

In the remaining seven recent cases the wounds have healed satisfactorily, the primary result is good and a cure is confidently expected in all, but a sufficient length of time has not elapsed since operation to justify a report of final results.

In the three cases in which amputation was done two showed extensive and extreme destructions of the joint at the time of the excision, and the general condition of the patient was bad. Excision became in these cases a trial measure of conservatism. There were other cases in this list, however, in which that joint seemed to be as extensively involved, cases in which amputation had been advised, yet excision and erosion accomplished a cure.

Seven erosions or, more properly speaking, atypical erosions have been done in the knee, 7 in the ankle, 3 in the elbow, and 1 in the wrist.

No flexures have developed and useful motion has been developed in three knees and two elbows. The motion is perfect in one elbow. The motion in other cases is slight, varying from 10 to 25 degrees, but is much prized by these patients. The endurance in the recovered cases seems good.

In one case a secondary operation was necessary, and in two I have cured a persistent sinus by local applications and without the use of a general anesthetic. I do not know what might have been indicated in the cases of amputation.

There have been no deaths from operation. No patient has developed tuberculosis elsewhere by metastasis. Patient 5 showed some pulmonary symptoms for a time within a year after her operation, but they were never clearly tuberculous and I believe that from the facts that they disappeared promptly and that the girl has remained in perfect health, we may safely assume that they were not. Patient 1 had the physical signs of tuberculosis at the time of her operation, but these signs disappeared and she has been in excellent health for almost four years since operation. Patient 16, whose ankle was amputated subsequently to the original operation, suffered from tuberculosis elsewhere at the time of her operation and died of tuberculosis of the bowel. This patient was in wretched health as a result of generalized tuberculosis and the bowel condition developed more than one year after operation.

The operative method of treatment has been recommended and adopted in these cases for a variety of

reasons. In many it has been adopted after a careful application of the accepted non-operative methods of treatment. In Case 7 the patient has been under treatment by competent men for eight years, yet she came to me on crutches. In this case I found such marked evidence of pelvic tuberculosis that I first operated on the abdomen and removed a tuberculous right Fallopian tube. I then used immobilization and Bier's congestive hyperemia on the knee for a period of almost six months without the slightest improvement. At the time of operation the inner one-half of the joint showed an active fungous tuberculosis. The outer half showed well-advanced healing within the joint, but the outer portion of the tibia immediately beneath the healed portion of the joint showed an active bone focus the size of the last phalanx of my index finger. Again in Cases 18 and 19 under long continued hygienic conditions the joints grew worse or failed to improve.

In other cases operative treatment has been recommended because of the seriously destructive nature of the lesion at the time the patient came for treatment.

In the third group of cases the social position of the patients demanded an early restoration to a wage-earning capacity and after a thorough explanation of the situation the patient has selected the operative course.

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PHOSPHORUS COMPOUNDS AS BRAIN FOODS *

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Our knowledge of the nutritional requirements of the nervous system may be said to be very incomplete. As it is probable that the efficiency of any tissue as a working machine is largely dependent on a proper state of nutrition, it may be of interest to review critically, in the light of recent work, some of the suggestions that have been put forward with regard to the nervous system. Two general methods of procedure may be observed, the one depending purely on stimulants, such as caffeine, strychnin, cocain, alcohol and similar substances; the other using as its basis the supply of such substances as the nervous system is supposed to use in its function, namely, phosphorus in different combinations; the one attempting to stimulate the nervous system to activity, the other to increase its efficiency by giving it the proper food.

We all naturally wish to have our nervous systems in the best of condition at all times, and the correct knowledge of how to accomplish this will add greatly to our efficiency. The difficulty of obtaining accurate knowledge on this point makes it appear likely that this field may pass into the hands of the psychologists altogether. No one will deny that the development of proper habits¹ will add greatly to our efficiency as workers and that to cultivate habits of day-dreaming is bad and probably can not be cured by the administration of phosphorus in any convenient form. At the same time a normal healthy person with a nervous system in a good state of nutrition is very apt to be an efficient working machine. When such a machine becomes fatigued as the result of use the question arises whether it needs stimulation or

food. Our present knowledge does not permit us to give an answer to this question. We do know, however, that those stimulants which we at present use have a deleterious effect when taken in excess, but there may be other stimulants normally manufactured in the body which are not open to that objection. We are just beginning to acquire some knowledge as to the extent to which the tissues of the body are dependent on one another for their activity.

The work carried on in this laboratory on chemistry of the nervous system has so far not taken up the first point, but has followed the question of the nutrition of the brain during growth and as the result of mental disease. A brief statement of the bearing which the results so far obtained have on our present-day ideas may be of interest.

The idea of the relation of mental activity to phosphorus is old, and as far back as 1869 there appeared an article by L. H. Wood² on the influence of mental activity on the excretion of phosphoric acid. Now it is apparent to any one that a tissue which represents only about 2 per cent. of the total body weight can not possibly influence to a considerable extent the composition of a fluid which derives its material from all the other tissues of the body, unless such a tissue is very much richer in phosphorus than in the other tissues or has a much more active metabolism. That such is not the case, in spite of popular notions to the contrary, is well illustrated by Table 1.

TABLE 1.—PERCENTAGE OF PHOSPHORUS IN BODY TISSUES

	—Total Phosphorus.—	
	Per Cent. in Dry Fat Free Tissue.	In Moist Tissue.
Muscle	0.90-1.50	0.22-0.38
Liver	1.34-1.60	0.34-0.40
Kidney	1.34	0.42
Pancreas	1.70	0.40
Brain	1.44-1.50	0.33-0.35

From Table 1 it is evident that the brain has by no means an unusual amount of phosphorus in comparison to the other tissues. As the above figures apply to the normal brain the question arises whether it may not be necessary sometimes to supply the brain with phosphorus when its total store has become decreased. Before answering this, let us see if there are any special forms of phosphorus compounds in which the brain is especially rich and of which, reasoning teleologically, it would therefore be in greater need. The figures in Table 2 do, indeed, lend some support to such a notion.

TABLE 2.—PERCENTAGE OF LECITHIN IN BODY TISSUES

Tissue.	—Percentage of Lecithin.—	
	In Dry Matter.	Total Phosphorus.
Pancreas	5.0	12.
Muscle	5.0	15.
Kidney	8.0	25.
Liver	10.0	26.
Brain	27.0	73.

The brain, both relatively and absolutely, is richer in lecithin than are the other tissues. The adrenal, which is not given in this table, comes nearest with 12 per cent. of lecithin. The term "lecithin" is here used collectively and designates a group of phosphorized fats with the properties of colloids now coming to be grouped under the more general term "phosphatids."

In studying the brain, therefore, in conditions of exhaustion it is necessary to determine not only its total but also its lecithin phosphorus content. Also on ac-

* From the Laboratory of Bio-Chemistry and Pharmacology, University of Chicago.

1. James: Psychology: chapter on Habit.

2. Proc. Conn. Med. Soc., 1869. Reprint kindly loaned by Dr. L. B. Mendel.