by my friend Dr. Douglas Guthrie, I was struck by a peculiar movement in the neck. The patient had been for a short time under chloroform, and I observed what seemed to be the pulsation of a vein, which extended from the left clavicle near its inner end half-way up the neck. The movement was perfectly regular at 60 beats a minute. When I felt the pulse and watched the veins in the neck I discovered that there was no relation between this curious beating and the arterial and venous pulse, the latter beating about 80 a minute, with frequent intermissions due to extra-systoles. Looking more closely at the movement and feeling it with the finger, it became evident that it was due to a few fibres of the platysma muscle. These fibres were about an eighth of an inch across and appeared to be attached to the skin over the clavicle at the lower end, and they extended up the neck for three or four inches and caused a movement of the skin at the level of the thyroid cartilage. There was also a smaller movement of the same kind at the lower end, about an inch behind the larger movement. These movements continued for fully an hour—in fact, during the whole time the patient was under chloroform. As soon as he came out of the chloroform the movement ceased.

It is very likely that the paralysis of certain muscles, as in diphtheritic paralysis, is really due to this loss of control. Dr. Maitland Ramsay tells me that the ciliary muscle in certain cases of errors of refraction may suddenly cease to act, and it occurs to him that probably the same condition is present here. It is well known that in dangerous *post-partum* flooding the uterine muscle is in a state of extraordinary laxity. Dr. Orr has suggested that when this happens the uterine muscle is probably in a similar condition. The circumstances certainly favour its occurrence, for experience has shown that a common factor in the production of auricular fibrillation is great bodily effort; and the observation of Dr. Ramsay points the same way, in that the ciliary muscle ceases to act after the strain in attempting to correct the error of refraction, and the uterus has just ceased from a severe strain shortly before flooding occurs.

That other organs may show the same peculiarity seems reasonable. Loss of control results in the cells taking on an individual action and stimulating one another. Professor Herring has called my attention to the fact that when the nerve to the salivary gland is cut the gland is not inactive but continues to secrete, and this secretion is spoken of as "paralytic."

Probably the condition of epilepsy affords another illustration. It is manifest that in this state there must be the same direct cell to cell stimulation as occurs in the fibrillating muscle. As we watch the onset of an attack of epilepsy we observe that the finer movements of expression or of the fingers are first affected, and from here the attack spreads to all the muscles of the body. It is evident that no other cause but the disturbance of the cellular elements in a localized area of the brain can produce these effects, and it is likely that here also the condition is due to a loss of control of some higher centre. The same explanation probably accounts for migraine attacks.

These views are not put forward as if they were established, but merely to provide a guide for further investigation. They are sufficient to justify the suggestion that we have here an abnormal process which is common to a great many organs, and that the aim of the investigator should be to find out the nature of the process rather than to study its result.

Terminology.

Though the term "auricular fibrillation" is misleading, it has gained such a wide acceptance that for the present it is better it should be retained. It would be more appropriate to describe the condition by the process which produces it, and in a sense the original term "auricular paralysis" might be employed, seeing that it resembles the paralysed muscle. But as that term does not clearly describe the process the change of term would avail little. The important consideration is that the fibrillating auricle is but one result of a vital process, as yet not fully determined.

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Remarks

ON

BONE GRAFTING AS AN AID IN TREATMENT OF TUBERCULOUS SPINAL CARIES.

[With Special Plate.]

BY

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THE use of bone grafting as an aid in the treatment of tuberculous spinal caries is of comparatively recent origin. It was introduced by Hibbs and Albee, and naturally, in view of the reputation of the originators, was tried at once by those who sought more satisfactory methods of treating Pott's disease than were previously known. As is usual in such cases, strong opposition has been provoked in many quarters, and it is therefore not surprising that a distorted conception of the value of the treatment exists at present in the profession. We have to attempt to sift out the truth from the apparently contradictory views expressed on the subject. When, from reports by reputable observers and from my own experience, the facts become established that cases of Pott's disease of the spine are enabled to return to a normal mode of life in a shorter period of time after this than after any other previously adopted method of treatment, and that such cases maintain their capacity without recurrence of the trouble over periods of many years, I am forced to believe that this operation has a useful place in the therapy of spinal caries and to seek to define the cases in which it may be applied with good prospects of success.

GENERAL PRINCIPLES IN THE TREATMENT OF TUBERCULOUS DISEASE.

The present-day conception of the rational treatment of tuberculous disease of any tissue may be briefly stated as follows:

If there is reasonable prospect of attaining complete eradication of the disease without maiming the patient most surgeons prefer to operate in order to procure this end, in spite of the fact that radio-therapists and other advocates of conservative treatment claim excellent results from their treatment. The help of the radio-therapist, however, is usually also invoked by surgeons in order to make cure as certain as possible—that is, such cases are treated on the same plan as cases of accessible cancer. If tuberculous disease cannot be eradicated surgically without interfering materially with the capacity of the patient to lead a healthy, active life, conservative methods of treatment are tried, and are often successful. The chief drawback to such forms of treatment is that they take a long time when compared with surgical ablation of the disease. In young children this is not of the same importance as in older children and adults. Generally speaking, however, the best remedy is that which most rapidly brings the disease to a standstill and is followed by cure. No form of treatment apparently can ensure that the disease will not break out at any time in other parts of the body.

Whether "conservative" or surgical methods of local treatment are used, all are agreed that general treatment, providing suitable diet, good hygienic surroundings, open air, sun baths, possibly vaccine or other inoculations, etc., is also of the greatest importance.

Local treatment aims at producing rest of the affected part. When bones or joints are concerned, fixation in the best possible way is established. Fixation is essential to success. The sooner all such measures are carried out in an efficient manner the greater is the prospect of cure.

APPLICATION OF GENERAL PRINCIPLES TO THE TREATMENT OF SPINAL CARIES.

It is obvious that disease of the bodies of the vertebrae cannot be attacked surgically in the satisfactory way in which a focus, for example, in the tibia can be dealt with. At best the occasional removal of sequestra is all that has been attained, coupled, perhaps, with more or less inadequate scraping of the surrounding affected bone; even such measures are attended with considerable risk to the patient. It is evident therefore that Pott's disease must be treated expectantly so far as the actual *focus mali* is concerned, and

that all efforts must be directed to raising the patient's resisting and recuperative powers, and at the same time to procure as absolute fixation as possible of the diseased parts and their surroundings.

All are agreed on the difficulty of fixing the spinal column efficiently by external splinting so that movement is entirely prohibited. It has been abundantly proved that absolute fixation of the affected part of the column can be obtained by the operation of bone grafting. Obviously, the grafts and the new bone stimulated into being by the operation must be strong enough to bear, without bending, any strain put upon them. It is for this reason that I carry out the operation which I shall describe later in preference to Albee's or Hibbs's methods. I believe that unsatisfactory results of operation by bone transplants in young children may be attributed chiefly to the grafts obtainable from the tibia being too thin and pliable to be efficient.

Considerations regarding the Time Element in this Form of Treatment.

If bone grafting is carried out efficiently we can reckon that fixation will be adequate in two to four months, and that thereafter the patient can usually be allowed an increasing amount of freedom, so that in six to twelve months he may be leading a normal life except for the slight restrictions imposed upon him by the stiffness of the part operated on. The formation of new bone, fixing and reinforcing the grafts, can be, and ought to be, verified by *x-ray* examination before such freedom is allowed.

It is thus seen that by the employment of operative fixation much time is gained for the patient when compared with fixation by external splinting. As to when freedom should be allowed each case must be considered on its merits. I do not believe in taking risks, and have decided upon the following rules: In uncomplicated cases (and the most important and frequent direct complication is probably abscess formation) I believe that at the end of two to three months all fixation apparatus may be removed, so that the patient can move in bed, carefully, in the horizontal position. This obviously adds to his comfort and happiness. The slight strain put upon the graft will tend to stimulate the bone growth and strengthen the fixation. If abscess has developed the time taken in the process of cure largely depends on the behaviour of the abscess, which is uncertain. Until the abscess in connexion with the vertebral bodies is cured no relaxation of treatment should be allowed.

The time element need not be considered in young children, in whom external fixation can be made most efficient, and who become easily inured to their irksome position; but in older children, especially those who have to learn a trade, and in adults, time is practically always of great importance.

Risk Involved in the Method of Treatment Employed.

In comparing the two methods of treatment the question of danger must be taken into account. In my experience the operation has not proved dangerous. One death which can be attributed directly to the operation has occurred in twenty-eight cases. This happened in a young child who was going downhill rapidly in spite of treatment. The case was treated soon after Albee had published the first account of his operation, and it must be remembered that the operation is not now generally recommended in young children.

Shock has not occurred in my cases to any noticeable extent. I believe that it can be obviated by flooding the parts operated on with local anaesthetic solution in the way I shall describe.

Royal Whitman has said, "Pott's disease is the most dangerous of all the tubercular affections of the bones or joints." In 1901 he stated that "at least 20 per cent. of all patients die during the progress of the disease and within a few years after its onset, from causes directly or indirectly dependent on the local lesion." Lovett, in Keen's *Surgery*, 1907, states that "the mortality is probably not under 33 per cent. if ultimate results are considered." No doubt under modern treatment the mortality is considerably less, but all the same it must still be so high that any measure which makes for success should be used in the "treatment complex."

The sooner remedial treatment is instituted in tuberculous disease the better the results, so that an operation of this nature, although it may be abhorrent for various reasons to some minds, should not be regarded as a last resort. The less the extent of the disease the less the severity of complications—or, in other words, the sooner remedies are

applied, and especially the more adequate the fixation, the more certain will be the cure. The operation is not difficult, but it must not be undertaken by surgeons who are unfamiliar with the technical essentials necessary for success in bone-grafting work. Hibbs (1918) reports 210 cases operated on down to three years before this date; there had been 31 deaths. Meyerding (Mayo Clinic, 1920) reports 100 operations down to two years previous (modified Albee operation); 86 per cent. had been relieved of symptoms, 3 were not improved, 3 were not heard from, and 8 had died since operation.

Advantages of Treatment by Operation.

To recapitulate briefly: Local treatment aims at establishing fixation of the affected parts. Operation by bone grafting effects this quickly and certainly, in a permanent manner, and, when carried out carefully, without undue danger to the patient, so that apparatus for external fixation can be discarded at a comparatively early period. The patient can resume a normal life much earlier, and, by reason of the bony fixation which extends beyond the diseased area, is less likely to suffer from local recurrence of the disease than after "conservative" treatment. Operation is not advisable in young children, but in older children and in adults it must be seriously considered.

Patients Unsuitable for Operation.

Patients I consider unsuitable for treatment by bone-graft fixation are:

1. Those in which there is pronounced disease elsewhere of a nature which would make one chary of performing any fairly severe surgical operation. I do not think slight or early tuberculous disease of other parts—for example, lung or other bone—precludes operation. In one case, indeed, a most gratifying result followed operation in a lady with fairly advanced phthisis. She was completely relieved of her spinal symptoms and was leading an active life when I heard of her five years later.

2. Those rare patients in whom it can be diagnosed that the spinal cord has become affected by infiltration by tuberculous disease in distinction from external pressure from tuberculous products. In one of my cases death followed several weeks after operation from spread of the disease in the spinal cord. In this case the pain and partial paralysis was at first thought to be due to extradural pressure. The onset of pressure paralysis, according to the late Mr. H. O. Thomas of Liverpool, increases the prospect of cure by means other than operation. This opinion is supported by Sir Robert Jones. I should advise operation at once if such paralysis developed during conservative treatment.

3. The operation is not indicated in the case of very young children for the reasons already mentioned. Well-nourished children of 10 or even younger are quite suitable for treatment in this way. At the same time I should not hesitate to use the operation in very young, otherwise healthy, children, when the patient does not show continuous progress towards recovery under non-operative treatment.

Operation Tends to Prevent Complications.

In other cases I believe that this operation enhances the prospect of rapid and permanent cure, and that therefore it should be performed by a capable operator as soon as possible after the disease is diagnosed. Patients in whom deterioration in various ways was pronounced before operation have usually begun to pick up again almost at once. On that account I feel that operation will prevent complications with greater certainty than conservative measures. Fixation by bone graft eliminates the danger consequent on restlessness of the patient, inadequacy of external splints, and movement of diseased parts when the necessary cleansing of the skin of the back is attended to.

A Probable Cause of Unsatisfactory Results.

I believe that many of the unsatisfactory results after operations are due to the fact that patients have been permitted to get up and walk too soon after operation. It seems to me to be "tempting Providence" to act on a belief that such a slowly developing and slowly improving condition as tuberculous disease of the bone can be regarded as cured in six to eight weeks, to say nothing of the probability that the grafts will not be solidly united in that time, and that therefore slight movement will occur. We do not allow the bones in fracture of a healthy femur or tibia to bear weight so soon, and it seems rather preposterous to expect grafts to be capable of bearing the strain of maintaining the trunk in

position, even when supported by external splints, any sooner than normally placed bone. I think that, for safety's sake, patients should not be allowed to walk or even to sit erect before four to six months after operation, even although exceptional cases may do so without apparent detriment at a much earlier stage. The disease is very insidious, and movement of the muscles attached to the front of the affected part of the spine may keep up or aggravate the lesion—for example, by causing abscess formation or increasing the size of abscesses already present.

Operation in Relation to Deformity.

Operation should be done before deformity occurs. If deformity is present before operation I try by postural methods to bring about gradual straightening. If these fail, and they frequently do, I deliberately break the grafts so as to adapt them accurately to the curvature. I have found that these fractures unite firmly. I never attempt to reduce the deformity forcibly. In rare cases tendency to formation of sores over a prominent spinous process may be prevented by removal of the process. After operation observations at frequent intervals should be made so that possible static deformity of the spine beyond the upper or lower end of the graft may be prevented.

Operation in Relation to Abscess.

Operation should be done if possible before abscess occurs, but in some cases the disease is so insidious that the development of abscess is the first reason for causing the patient to seek advice. Abscess usually dries up rapidly after operation is done, but in some cases it may be advisable to treat the condition by aspiration or by other remedies. If the abscess arises in the neck the head should be fixed by suitable apparatus; if in the lower dorsal or lumbar region, the lower limbs should be fixed, otherwise abscess may persist or develop. In one case I regret that I did not fix the lower limbs; the abscess increased so persistently that it had to be laid open and treated by instillation of antiseptics. I am glad to say that this patient is now thoroughly convalescent. I believe that movements of the diaphragm may have the same deleterious action as movements of cervical muscles or psoas muscles. One patient who had an abscess in the posterior mediastinum from mid-dorsal caries died two years after operation from pulmonary complications, the abscess having ruptured into the right pleural cavity.

On two occasions I have opened an abscess in the erector spinae mass while the bed for the graft on that side was being prepared. In both cases the graft healed firmly in position, although the abscesses went on developing and had ultimately to be laid open and treated by energetic surgical means. One of these cases (psoas abscess) is mentioned above. In the other case the abscess developed from caries of one of the lumbar transverse processes, a focus of disease additional to that in the vertebral bodies. Successful grafting under similar apparently unfavourable conditions has, of course, been noted by other operators.

Fate of the Graft.

It appears to be incontrovertible that the grafts grow in length, corresponding to the growth of the patient's spinal column and without producing deformity. It has always seemed to me to be rather misleading to say that all grafts become absorbed, although, no doubt, complete absorption may occur in badly placed or improperly cut grafts—that is, in grafts which do not "take," or, in other words, do not form osseous connexion with the bones with which they are placed in contact. I believe that ordinarily, in grafts which are properly cut and placed and take root, absorption and growth occur in a manner similar to that which takes place in the normal metabolism of bone. (See Plate, Fig. 1.)

THE WRITER'S OPERATION.

I have only once done Hibbs's original operation, and only once done Albee's operation, although I consider the latter to be the more satisfactory. I do not think, however, that bridging the tips of the spinous processes of the vertebrae, as is done in Albee's operation, gives sufficient fixation, as there must be a certain amount of "give" in these spinous processes and grafts, at all events in the dorsal region, where the disease is most frequently situated. Fixation of the diseased part seems to me to be rather uncertain owing to the graft being inserted at such a distance from the articular processes and intervertebral discs where movements can occur. I believe

that this inadequate fixation is the cause of some of the unsatisfactory results following this operation, especially in younger children. In Hibbs's most recent method, if a continuous column of bone is formed between the laminae as well as between the spinous processes, fixation must be good, but the operation seems to me to be needlessly complicated and severe and not likely to be so uniformly successful as that which I have practised and now recommend. I described this operation at the meeting of the British Medical Association in Aberdeen just before the outbreak of the European war, and I may say that I had previously had and have since had such satisfactory results that I can see no reason for altering the procedure. I have tested it in twenty-eight cases. The results are equally good whether the disease affects the lower cervical, the dorsal, or the lumbar vertebrae. The method is as follows:

The Plaster-of-Paris Splint.

On the day before operation a strong, accurately fitting, plaster-of-Paris splint is made, covering the whole of the back and curving slightly round the sides of the body; in cervical cases it reaches up to the vertex of the skull. While it is being applied and fixed with bandages the patient, as a rule, supports himself on his hands and knees and thereafter lies prone until the plaster has set. Dressings should be previously applied in the same way as at the end of the operation, so that the splint will lie comfortably and at the same time exert equable pressure at each side of the spinous processes over the erector spinae muscles. In this way the best position for fixation is attained.

At the operation the patient lies in the prone position. It may be necessary for his comfort to place a thin pillow under his abdomen.

Injection of Local Anaesthetic.

The erector spinae muscles, close to the spinous processes and laminae of the area to be operated on, are suffused with 1/2 per cent. novocain solution with adrenaline. This is done whether a general anaesthetic is used or not. The procedure obviates shock and reduces the loss of blood to a minimum; it also renders the operation easier owing to the comparatively bloodless field produced. (I make this infiltration in all laminectomies.) A similar injection is made on the subcutaneous surface and adjacent edges of the tibia from which the graft is to be cut. I have done the whole operation repeatedly under local anaesthesia alone.

The Operation Described.

A median incision is made; the aponeurosis is incised on each side close to the spinous processes; the muscles are elevated off the spines and laminae—all to an equal extent—above and below the diseased vertebrae and to a total length equalling the longest possible graft available from the tibia. The periosteum of the spines and laminae is incised and reflected upwards and downwards off the outer and posterior aspects of these structures. The exposed bone is roughened by making small irregular incisions with a chisel and raising the edges of these incisions. Gauze packs are then inserted firmly into the cavities on each side of the spines while the tibial grafts are cut.

The leg is freely flexed on the thigh so as to give access to the front of the tibia. A skin incision is made along the whole length of the tibia and the periosteum of the antero-internal surface of the bone is exposed by dissection. In a child the epiphyseal lines are left intact when the graft is cut; in an adult the bone may be cut to within about half an inch or

Diagram to show line of incisions on periosteum and drill holes on antero-internal surface of the tibia. At (a) the small dotted lines show the directions in which drills and osteotome should cut.

so from the articular surface. Owing to the general shape of the tibia and its medullary parts the grafts must be cut in wedge form—the breadth of their bases together extends to about three-quarters of the breadth of the anterior tibial surface. The periosteum is incised as indicated in the diagram, and the edges of the incision are separated slightly with a rugine.

Drill holes are made, reaching into the medulla, along these incisions at intervals of half to two-thirds of an inch. The bone dust from these holes is carefully preserved in a spoon. The tibia is split with an osteotome along the lines of holes—at first superficially, then deeply. The holes tend to keep the line of cleavage from diverging. (They are unnecessary in the comparatively soft bone of a young child if a sharp chisel be used.) In this manner two strong grafts are cut, composed of periosteum and dense and cancellous bone with pieces of medulla adhering thereto. They are made purposely with jagged edges, as in this way a larger amount of potentially successful osteoblastic surface is provided than in the usual way of cutting grafts with a circular saw.

An assistant stitches the incision in the leg while the grafts are being placed and fixed in the back. In my experience the tibia has never failed to regenerate without mishap. At the end of a few months the scar on the skin is the only sign of any operation having been performed.

The operator removes the gauze packs from the wounds in the back, and in the spinal groove on each side the bone dust is smeared along the line of junction of the spinous processes and laminae, where the grafts are going to lie, being spread more thickly at the upper and lower ends of the wounds, in order to foster osseous fusion. Care is taken that the periosteum of the spines and laminae is properly reflected so that the graft comes directly in contact with the bones. The grafts are placed so that their periosteum is outermost.

The edges of the aponeuroses are approximated across the mid-line by catgut sutures and the wound is closed without drainage. The pressure of the muscles and dressings is usually enough to keep the grafts in place. I have never used special fixation by sutures or other means. Mastisol is painted over the wound and surrounding skin before the sheet of gauze dressing is applied. The advantage of this application is at once obvious to those who have seen it in use.

In order to prevent soiling of the wound from urine or faeces the following precaution is taken: a transverse area of skin across the back of the sacral and iliac regions, about two inches wide, is painted with mastisol. The lower edge of an appropriately large piece of batiste is made to adhere to this area and the remainder of the sheet of batiste is then folded down over the buttocks and thighs.

A thick sheet of cotton-wool is made to cover the back, smooth extra pieces being laid over the erector spinae muscles on each side of the skin incision. The plaster splint is applied and a binder placed in position, the patient is turned carefully on his back, and the binder is pinned tightly over the abdomen and chest. In cases of caries in or above the mid-dorsal region this splint is all that is required in tractable patients, but in children and in adults when the disease is low down the patient is fixed as comfortably as possible in a Jones's double abduction frame, so that the lower extremities are prevented from moving. No special splint is applied to the leg that has been operated on, but a very thick layer of cotton-wool is placed over a mastisol and gauze dressing and the whole mass is very firmly bandaged. The foot is included in the bandage so as to prevent oedematous swelling. The toes are left out for inspection. Occasionally when the dressings are removed from the leg there is a gush of dark blood from one or more of the intervals between stitches. If there is evidence of pent-up blood one or more of these intervals is opened. In either case the excessive accumulation of blood is squeezed out of the tibial cavity, the skin is thoroughly cleansed again, and fresh dressings are applied. Usually all dressings can be left off in, at most, three weeks.

The Method of Cutting the Graft.

This is not the occasion to discuss the problems of bone grafting fully, but, as it is evident that the success of this operative procedure depends on the way in which the bone grafts take root and persist, it may be permitted to draw attention again to the way in which I cut the grafts and to the method by which they are placed. I can truly say that I do not know of any failure in operation by myself in any situation with a bone graft cut in the fashion I have described. I have already indicated some of the reasons which, I think, ensure such success. The chief of these is the provision of a large area of bone on whose surface undamaged osteoblastic tissue is present. I believe that this is attained in greater measure by cutting the grafts in the manner I have described than by cutting them with a saw, especially a rapidly

rotating circular saw, which tends to cauterize the cut surface of the bone by frictional heat. When orthopaedists try to prevent bone growth—for example, in arthro-plastic operations—they make the surfaces of the opposing bones as smooth as possible. Surely, then, it is of advantage, when bone growth is desired, to make the surface of a graft as irregular as is compatible with its future function, and to avoid damaging the exposed surfaces as much as possible. Because of the osteoblasts they contain the potential value of bone particles or shavings cannot be disregarded when we consider the formation of spurs or other osteomata after superficial injury to bone, or the formation of bony outgrowth in the muscles covering the amputation stump of a bone, which are almost certainly due to the bone dust scattered by the saw; this can be prevented by the use of a suitable guard retractor when the bone is cut during the amputation. I am convinced that the bone dust, used as described, plays an important part in the welding of the main grafts to their beds in the spinal grooves.

Results of Operative Treatment.

In the majority of the twenty-eight cases dealt with in this paper the disease had previously been treated by conservative methods. There have been three deaths in the series during ten years. One patient, a young, weakly child, 4 years of age, died on the third day after operation. This is the only death ascribable to surgical interference. The child was going downhill in spite of conservative treatment and belonged to a category of patients in whom, in the light of experience, I think operation should not be performed. One adult died within two months of operation from progressive disease in the spinal cord and canal. This patient would not have been operated on if it had been appreciated that the tuberculous disease was already infiltrating the cord. Another adult died two years after operation from empyema and pulmonary complications. In another adult psoas abscess continued to increase and was treated by open incision and disinfection of the cavity. She is now convalescent, the abscess cavity being almost obliterated. She is well in general health and is steadily putting on flesh. The bone disease is apparently cured. In one child operated on when 6 years of age the disease has apparently been cured, but deformity has increased as noted above. This child was operated on just before the war began, and did not receive the supervision which is necessary in such cases, owing to the fact that the mother did not bring the child for periodic inspection.

I do not think any patient should be pronounced cured unless free from complications and able to perform the ordinary duties of life at least two years after operation. The cure of the disease in the bone should be ascertained by x-ray examination. The remainder of the patients in my series do, I believe, satisfactorily pass these tests.

An Illustrative Case.

Most of the points I have discussed are exemplified in the patient from whom the skiagrams here reproduced were obtained.

The boy was 15 years of age, and the operation was performed on October 9th, 1919. There was well-marked angular deformity; the grafts were fractured, the left one in two places, so as to fit the deformity. In the concavity of the curve—that is, on the right side—a small extra piece of bone was inserted. Skiagrams (Plate, Figs. 2 and 3) show well-defined callus around the fractures of the grafts, growth from bone dust, fusion of grafts to the spinal grooves, and the persistence of the grafts in their original thickness after two and a half years. All this occurred in spite of the fact that an abscess, taking origin from a lumbar transverse process, was revealed at operation in the erector spinae muscles. It had ultimately to be laid open, scraped, and sutured; a sinus persisted for seven months, but is now soundly healed. On November 21st, 1919, he developed acute appendicitis, and appendicectomy was performed. No abscess or thickening was found over or near the site of disease in the spine. He was kept on his back for nearly four months. He has grown six inches in height since the operation. There is no detectable deficiency of growth in the lumbar region, and no alteration in the deformity and its relationships with the grafts. Unfortunately no local measurements were made before the operation. He has been playing modified golf and tennis for nearly twelve months in a careful way, and now (April 29th, 1922) applies for leave to play cricket, to swim, and to indulge in salmon fishing. He states that he has never felt better in his life. He writes: "I hardly notice two or three sets of tennis at a go, and certainly not in my back. I can do any amount of dancing and that sort of thing. As for walking, I can do as much as most people."

SIR HENRY M. W. GRAY: BONE GRAFTING IN THE TREATMENT OF TUBERCULOUS SPINAL CARIES.

FIG. 1.—Skiagram showing persistence of grafts, in original thickness, nine years after operation. The two grafts, one long and one short, were put in the right spinal groove. The bony fusion of the grafts to the spinal arches and to each other is distinct. This patient is leading a normal life. She climbed a hill 2,000 ft. high on two occasions last summer.

FIG. 2.—Skiagram two years after operation, showing well-defined callus around the fractures of the grafts. A, Growth of bone where bone dust was smeared most thickly. B, Caries of transverse process from which abscess in erector spinae developed. C, Callus where grafts were fractured at different levels.

FIG. 3.—Same case as Fig. 2, showing D, focus of disease.