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SUTURELESS SKIN-SLIDING METHOD FOR THE RADICAL TREATMENT OF LUNG ABSCESS AND CHRONIC OSTEOMYELITIS

SPECIALLY ADAPTED TO WAR WOUNDS[1]

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THE present war has produced a tremendous increase in the number of chronic suppurations. The hospitals of Europe are overcrowded with just such cases and no doubt before long we too will have thousands of these chronic suppurative cases to treat. It is, therefore, imperative and timely to discuss the treatment of chronic suppurations of bones and joints and the chest cavity.

I desire to bring before the profession some new suggestions for the treatment of this protracted type of suppuration. These suggestions are based on an experience gained in treating several thousand cases of chronic suppuration. Although most of the cases treated were not due to injury but originated from infectious diseases, the late conditions in both instances are so similar that I believe the treatment here outlined will be just as effective in war injuries.

Nearly all of the war wounds are infected from the very moment the missile penetrates the tissues. Infection is carried into the wound by fragments of clothing or the trench dirt, which usually covers the soldier's skin. It is fortunate that the field surgeons are now in a position to disinfect most of the wounds before the infection has spread and thus prevent many deaths, or the loathsome chronic pus discharge.

The methods of this immediate sterilization of wounds, such as were introduced by Carrel and others, and likewise the total excision of the infected wounds as practiced by English surgeons, need only to be mentioned here, since my remarks will be confined to the treatment of the late cases, those in which the prophylactic method had already been employed but in spite of which the chronic suppuration had persisted.

Guillot and Woimant[2] who recently published their experiences with infected fractures in the French base hospitals, state that probably 50 per cent of all fractures of the thigh still suppurate after ten months' treatment. Can any one of us realize what an amount of suffering this causes and what expense and labor is involved in dressing these wounds, aside from the economic loss caused by the incapacity of this vast number of men?

We shall divide the subject into two parts:

1. The treatment of chronic empyema and lung abscess after prolonged suppuration.
2. The treatment of chronic suppuration resulting from bone infection.

There is a vast amount of literature on both of these subjects. The evolution of methods of treatment varying from decade to decade, is well known to surgeons, but the fact that thousands of cases remain uncured indicates that we have not yet perfected our methods. We still encounter chronic suppurative empyema and lung abscesses, as well as sinuses from bones and joints, which have persisted for a quarter of a century, although they may have been operated upon repeatedly by most competent surgeons.

CHRONIC SUPPURATION OF THE LUNGS AND PLEURA

In order to arrive at a rational and consistent treatment, we must first ascertain in each case the etiology and pathology. The majority result from infectious disease of the lung or pleura, pneumonia and tuberculosis being the most common. Other diseases furnish a minor percentage. Injury to the lung caused by stab or gunshot wounds, or crushing, in peace times produce only a small percentage of cases, but now in war times the traumatic type predominates.

A foreign body penetrating the chest nearly always carries with it some infectious material and this produces a suppuration.

[2] Surg., Gynec. & Obst., 1917, xxv, 507.

[1] Read before the Western Surgical Association, St. Paul, 1916, and Omaha, 1917; and before the Chicago Surgical Society, January 5, 1918.

J. P. Simonds,[1] who has made an extensive study of the gas bacillus infection, stated that the spores of the bacillus welchii were found in 100 per cent of the uniforms of Belgian soldiers who had come directly from the trenches, and also in the meshes of the samples of the new cloth from which the uniforms were made. Of twenty fresh war wounds, fifteen were found to contain this group of bacteria.

Even if the wound is sterile, the injury to the lung and the accumulation of blood furnishes a very favorable pabulum for subsequent infection and a consequent pyothorax.

At times a foreign body will remain in the lung for years without causing any symptoms and then give rise to the most distressing condition, "a lung abscess." The repeated puncture for a serous effusion, may change the sterile fluid into pus and thus produce an empyema.

The diagnosis of empyema is a rather simple matter. It must be differentiated principally from a serous effusion and from a lung abscess. A dullness of the chest, which changes with the position of the patient, corroborated by stereoroentgenograms, establishes the presence of fluid with unmistakable certainty. All that remains to be ascertained is whether this fluid is blood, pus, or serum. A puncture will decide the question.

Quite different and difficult is the diagnosis of lung abscess. A patient may be ill for weeks or months, carrying an abscess in his lung without its detection by the most painstaking search of the ablest diagnosticians. Even repeated puncture may fail to reveal its presence.

The cause of this difficulty is apparent when we consider that a lung abscess is usually much smaller in size than an empyema, is more centrally located, and is often surrounded by healthy lung tissue, or associated with a pneumothorax.

I regard a stereoroentgenogram of the entire chest as the most helpful aid in the diagnosis of lung abscess. We rely upon this one aid more than upon all the other diagnostic means except the history of the case. The stereoscope separates the different structures in the chest. The overlapping shadows, which in the single plate produce an indistinct and blurred picture, stand out in plastic effect, so that the lung abscess may be detected.

When a lung abscess has once ruptured into a bronchus, the diagnosis is as a rule mighty easy. In fact, we cannot escape it. It forces itself on one with the expiration of the patient's first breath when he begins to relate his complaint. Not all lung abscesses, however, have this characteristic foul odor. Some have no odor at all, but the patient will give the history of rupture of the abscess. He will relate how all at once he spat up a cupful of matter. Such cases, however, offer great difficulty in the localization, because the abscess sac is collapsed and never fills sufficiently to give a distinct shadow in the roentgenogram, or a sufficiently large area of dullness which can be outlined by percussion.

The diagnosis ascertained, the surgeon must decide what form of treatment to use. The accepted procedures are so well known that I shall not discuss them in this paper, except to make a few suggestions which may be helpful in preventing the formation of persistent drainage.

The empyema should be drained as low as possible and preferably posteriorly. Many cases persist in discharging because the tube has been inserted too high, and a recess formed by the dome of the diaphragm and the chest wall allows the retention of quantities of pus. When the drainage is low, the suppuration will usually cease within three or four weeks; occasionally it will persist for three or four months. A small residue, about one case in twenty, will keep on discharging indefinitely, especially a lung abscess which communicates with one or more bronchi. I have in my records of 110 consecutive cases of this last mentioned type of empyema and lung abscess, a case in which the sinus resulting from drainage persisted for thirty years.

When there is no tendency to spontaneous closure, the problem becomes a very difficult one. The patient usually resigns himself to his misfortune, dresses his chest wound once or twice a day, and is well enough to perform some light work. Whenever his health suffers, he becomes discouraged and is willing to take great risk; he will submit to any opera-

[1] Simonds, J. P. J. Exp. Med., 1917, June 1.

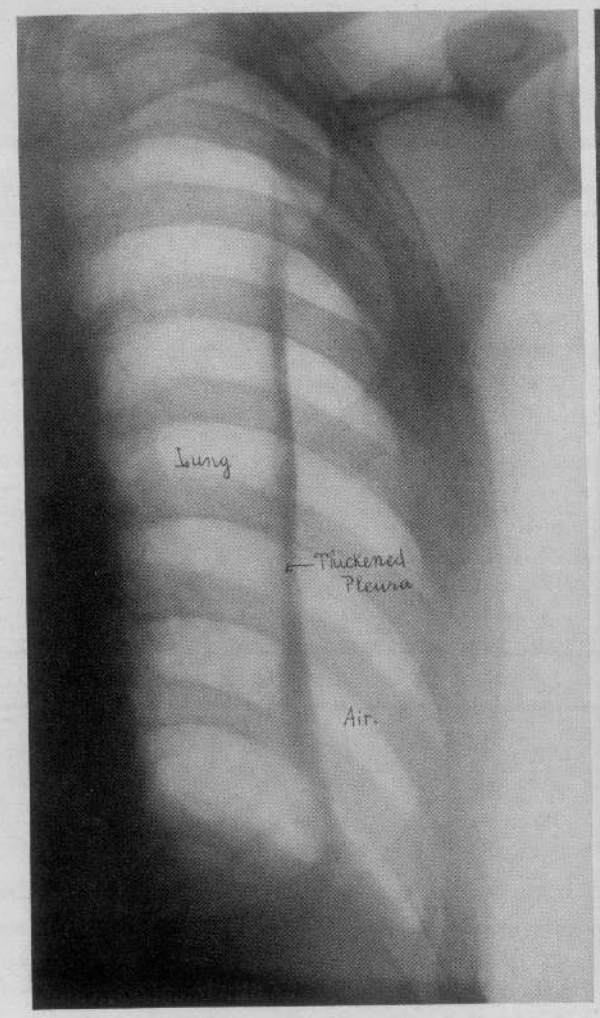

Fig. 1. Empyema showing thickened pleura dividing chest cavity; to the left the compressed lung, to the right the empyema cavity.

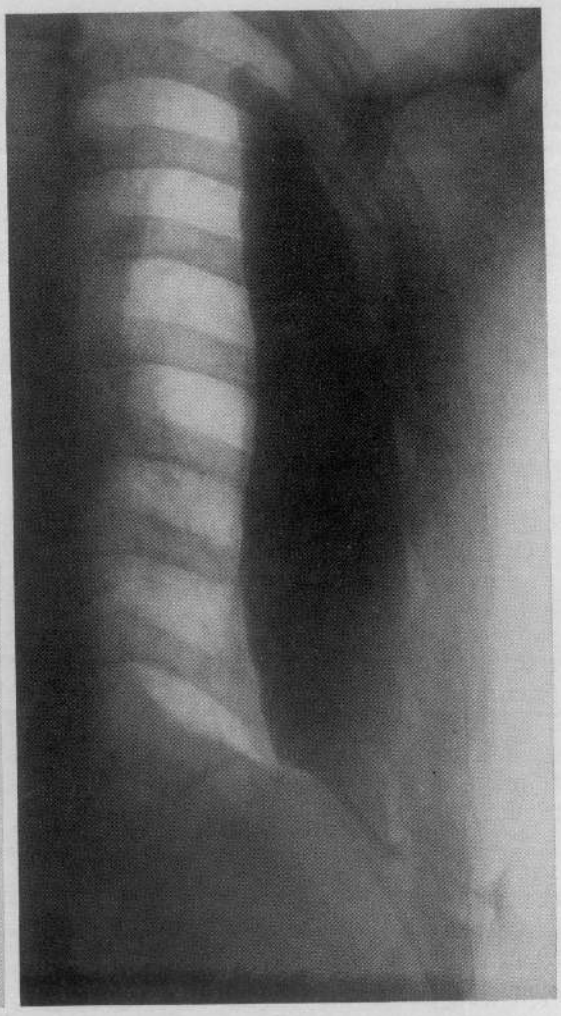

Fig. 2. Empyema (shown in Fig. 1) injected with bismuth paste. Note the thick pleura on margin of paste.

tion which will either cure him or commit him to his grave.

Ten years ago we introduced into surgery a new method of dealing with this class of cases; namely, the injection of bismuth paste. It is unnecessary here to repeat in detail the advantages and technique of this method. By this time the bismuth method is well known and the results from its employment and its dangers are all well defined. Let it be said that after ten years of trial, in almost all parts of the world, it has retained its place and is employed more extensively now than ever. The reports in the literature indicate that at least 4 out of 5 cases of the very old neglected suppurative empyemata or lung abscesses may be cured by this simple procedure. Ochsner, of Chicago, reported to the American Surgical Association on June 4, 1909, 14 cases of empyema, all of which had been operated on (two by Estlander's operation), with sinuses in all cases persisting nevertheless. He applied the bismuth paste in each of these cases, with the result that 12 cases healed completely and 2 were still under treatment at the time and very much im-

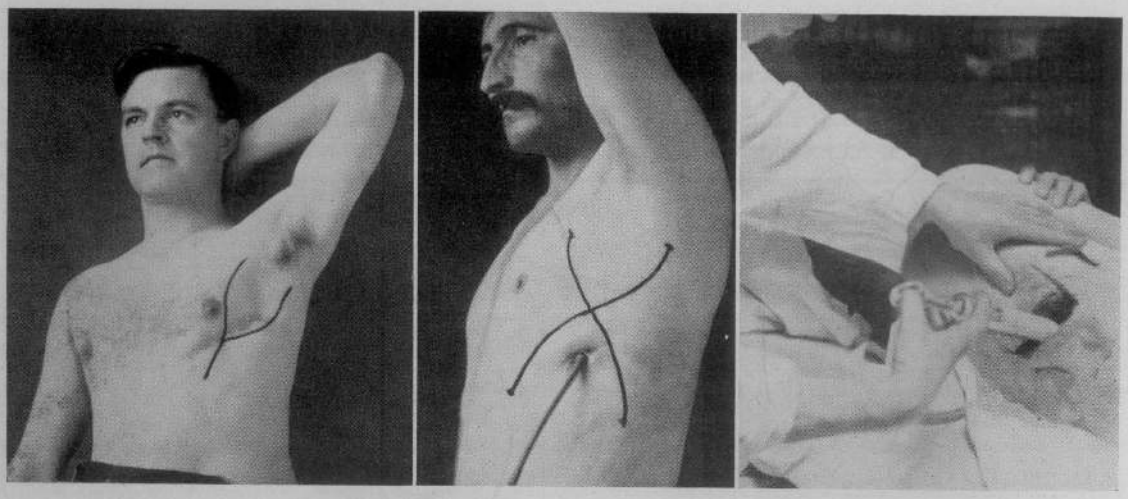

Fig. 3. Fig. 4. Fig. 5.

Fig. 3. Y-shaped incision for empyema, cavity high.
Fig. 4. X-shaped flap incision for very large cavities.
Fig. 5. "Trap-door" incision for lung abscess, when posterior.

proved. Others have reported equally good results. In my own series of 110 cases, approximately 80 per cent were cured by the bismuth injection treatment alone.

Omitting minor details it will be of benefit to mention some practical points in the technique:

Subsequent to a physical examination a stereoscopic roentgenogram of the entire chest (plate size 14x17) should be taken. This is a splendid guide to rational surgical treatment. The roentgenogram of an empyema or lung abscess resulting from tuberculosis of the lung will invariably give a characteristic picture; namely, a chronic or healed tuberculosis of the lung parenchyma, calcification of glands, and linear scar markings within the healed tuberculous lung tissue. A non-tuberculous case will show healthy, transparent lung tissue around the rather well-defined lung abscess.

After the pathological condition is ascertained and cultures taken, the cavity is injected with a 10 per cent bismuth-vaseline paste: bismuth subnitrate 10.0; vaseline 90.0.[1]

When the cavity or sinus is completely filled with this mixture, another set of stereoroentgenograms is taken. This set will illustrate the exact size of the cavity and its relation to the ribs and other structures in the chest. Whenever a communication with a bronchus exists, the patient will at once cough up the excess quantity of paste.

A word of caution is here necessary: the patient should be warned not to take a deep inspiration during the injection. He is apt to inhale (through the existing opening of a bronchus on the infected side) some of the mixture and force it into the bronchus of the opposite side.

The cavity may hold as much as 600 grams, but from 100 to 200 is the average. I here illustrate with Figure 1, which gives the definite outline of the cavity filled with air before the injection, showing the thickened pleura covering the contracted lung, thus dividing the left chest into two almost equal sections.

The second roentgenogram, Figure 2, shows the cavity entirely filled with bismuth, and plainly shows the inner boundary of the cavity to be formed by the thickened pleura. The sizes and shapes of these cavities vary so much that there are no two cases alike. Sometimes we find a small globular sac, communicating with the outer chest wall by a long tortuous channel, and then again we find that there exists merely a long sinus which communicates

[1] In former years I employed a mixture containing 30 per cent bismuth subnitrate but found that the above mixture produces equally good results and is not likely to cause bismuth absorption.

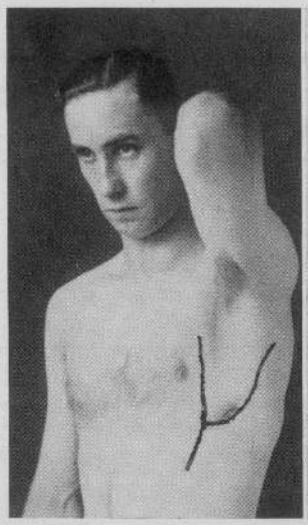

Fig. 6.

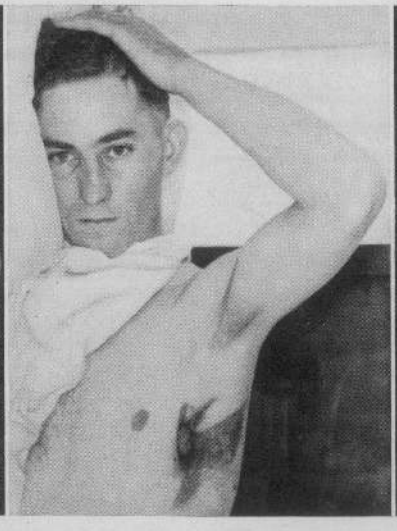

Fig. 7.

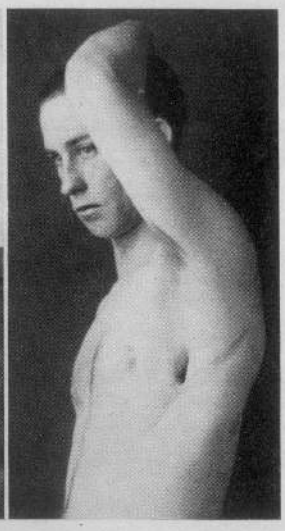

Fig. 8.

Fig. 6. Outlining the flap incision for empyema.
Fig. 7. Skin flap implant into empyema, 2 weeks after operation showing width of denuded surface.

Fig. 8. Patient 8 weeks after operation, showing denuded surface covered with skin, pus discharge ceased. Gain 20 pounds.

with a bronchus, without any cavity whatsoever. The stereoscopic effect permits us to estimate with considerable precision the depth of the cavity and its location (Plate I[1]).

As stated before, these bismuth injections are not only of great diagnostic but also therapeutic value. The first injection does not always produce healing. It requires at times repeated injections during several months, but whenever the discharge changes from pus to a serous character, the injections should be stopped because healing will usually follow. Only when the discharge continues to be purulent, should we consider more radical surgical procedure.

I have tried to ascertain why some cases respond to the bismuth treatment and why others do not, and I have come to the conclusion that whenever the cavity holds more than 200 grams it will be less likely to heal by bismuth injections. Cases which communicate with the bronchi are also more resistant than simple empyema.

Some cases will heal shortly after the injection and remain closed for a year or two and the patient be in good health, often gaining as much as thirty pounds, and then the sinus will reopen. The injections are then to be

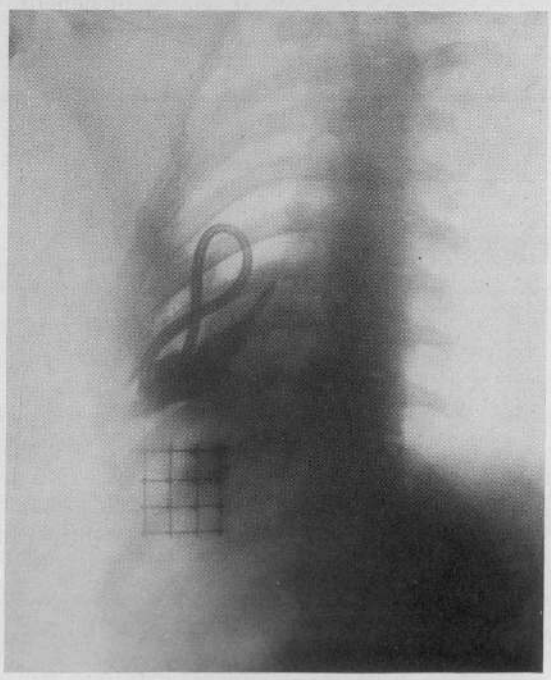

Fig. 9. Roentgenogram of empyema with rubber catheter, estimating the size of the cavity. Wire localizer estimates distance of abscess from the skin.

[1]The stereoscopic pictures accompanying this article may be viewed through the ordinary hand stereoscope, being specially printed with that purpose in view.

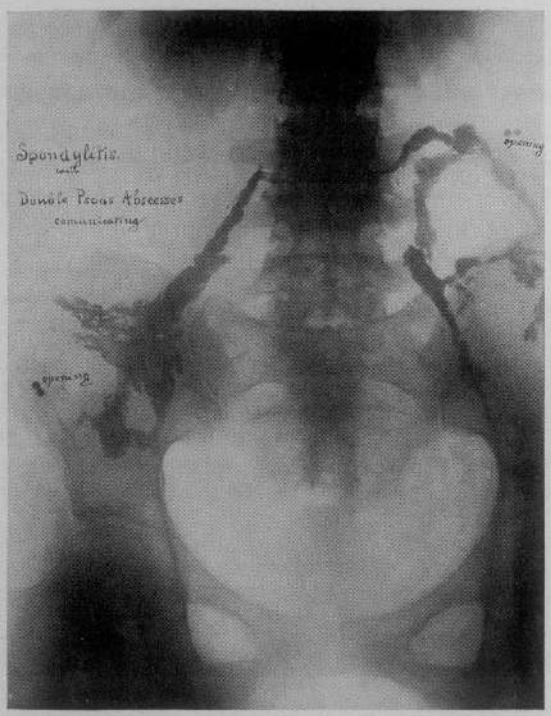

Fig. 10. Roentgenogram showing injected sinuses and illustrating the fallacy of probing the same.

repeated. Closure usually follows for another year or two, only to have another relapse after that period. The patient often prefers to keep on treatment in this way, not being much inconvenienced and perfectly well in the intervals.

But there remains a small number, about 1 in 5 cases, which have no tendency whatever to heal under any form of treatment, and these require the most radical surgical procedure.

The methods in vogue in dealing with these refractory cases are known as the Estlander, the Schede operation, or the decortication of the lung. The patient who has to submit to one of these extensive surgical procedures is, of course, in a desperate situation. He is told that the operation causes a high mortality and the surgeon cannot promise him an absolute cure even with this method. Aside from that, the surgeon must warn him of the prospect of a considerable deformity of his chest, whether he be cured or not. I have always hesitated to advise such extensive procedure and in the last seven years, I have not resorted to any of the above-mentioned operations.

SLIDING SKIN–FLAP OPERATION FOR LUNG ABSCESS

During the past seven years I have employed a surgical procedure in these cases which is far less dangerous and is, I believe, more effective than the Estlander or similar operations.

The patient is placed in a semirecumbent posture and anæsthetized. Before incising the skin a rubber catheter is introduced into the existing sinus and kept there as a guide during the first part of the operation. The skin incision differs in almost every case. It depends entirely upon the location of the abscess or empyema. I have devised and employed three different types of skin incisions, the Y shape, the X shape, and the trap-door incision. I illustrate here each of these incisions schematically (Figs. 3, 4, and 5).

It will be noted that each of these incisions forms one or more flaps of skin of various lengths, which are intended for implantation into the lung abscess after it has been exposed. The skin is not dissected from the underlying fat or muscle until we are ready to implant it into the abscess cavity.

From three to five ribs overlying the abscess cavity are now widely exposed and as many are resected as seems necessary to expose the lung abscess to its full extent. In cases of empyema even more than five ribs may have to be resected. One should not hesitate to remove as much rib length as seems feasible, four to seven inches of each if possible. In cases of empyema, where the cavity usually extends into the apex, we should endeavor to include the third rib in the resection if possible. This will facilitate the implantation of the skin flap into the very recess of the apex of the pleura, and prevent the granulation of this recess which occurs when the skin flap does not cover it completely.

The ribs removed, a small incision of the thickened pleura is made along the catheter, the finger is introduced into the abscess cavity and the cavity explored.

The incision of the pleura is extended up-

ward to the highest point, without cutting into the lung, and then the cavity is fully exposed to ocular inspection by removing as much of the parietal pleura as possible. This will usually make the opening into the abscess cavity large enough to introduce the entire hand.

In most cases of chronic empyema, the lung will be found retracted upward and inward. At times the apex will contain functionally normal lung. In the cases of lung abscess, however, the matter is different. The globular or multilocular cavity, with thick septa, exists, into which frequently open one or more bronchi. In one of my cases seven bronchi opened into one lung abscess. (Case shown at the Western Surgical Association in 1914.)

The cavity being fully exposed, it should be swabbed with dry gauze and the usually smooth surface of the abscess wall sufficiently scarified either by rubbing it roughly with gauze or even resorting to a mild curettage. This is done for the purpose of producing a favorable condition for the adhesion of the skin flap.

The cavity being dry, the tips of the skin flaps are drawn into the very deepest recesses by means of forceps. Gauze is packed tightly against them, to keep them in contact with the raw surfaces of the abscess cavity. No suture whatever is used.

The denuded surfaces from which the skin flaps are taken are then covered with sterile gauze, and no attempt is made to reduce the size.

At this stage the operation is completed, while in the Estlander, a great deal more work is necessary to complete it. The procedure should not last more than 100 minutes in the very extensive cases and can be done in 60 minutes in the less extensive ones. From a series of nine cases I cite only two for illustrations.

EMPYEMA PLEURÆ, WITH SINUS

The procedure just described was carried out on a young man, 26 years old, who retained a fistulous empyema subsequent to a pleuropneumonia six years ago. The case had the usual history of resection of one rib,

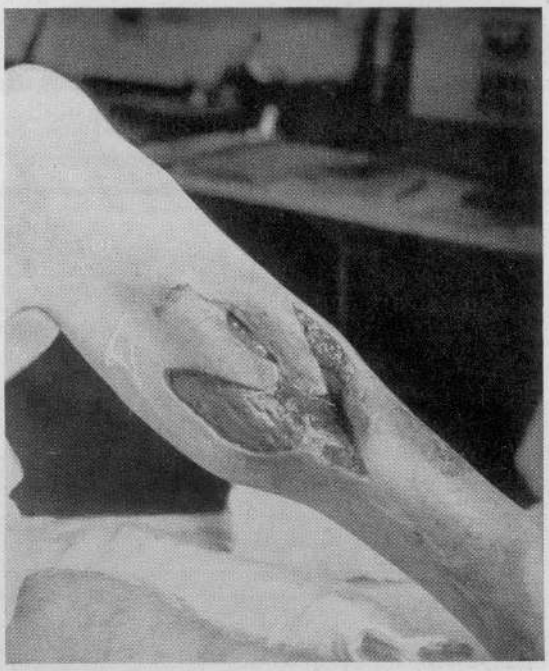

Fig. 11. Three skin flaps implanted into tibia, 6 days after operation.

rubber drain, with no tendency to cessation of the discharge:

I first saw him four years ago (1913). His temperature rose daily to about 100°, his weight was 123 pounds. The empyema cavity would hold 22 ounces of the bismuth. Subsequent to the injections the cavity closed and he was in good health for about two years. Since then the abscess has reopened three times at intervals of 6 months.

The patient's health began to deteriorate and he returned in June, 1917, for the radical operation. The cavity was then discharging large quantities of pus, holding about one quart of fluid. A culture showed staphylococcus in pure culture.

The operation took place June 30, 1917. Although the work was done under favorable conditions, a film camera having been operated, causing frequent interruption, yet it look less than an hour to complete it. Four days later, the patient was able to walk around in the halls of the hospital. The cavity gradually diminished in size until at the present time it will not hold more than two Mayo sponges, whereas at the time of operation, I could introduce my entire hand into the cavity. Figures 6, 7, 8, and 9, illustrate some phases of the operation.

The technique will naturally vary a little in every case. Where bronchi communicate with the abscess cavity, the technique is

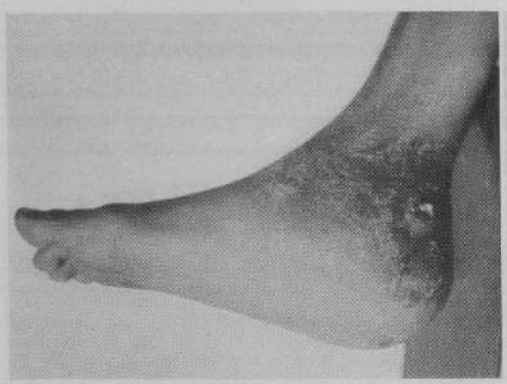

Fig. 12.

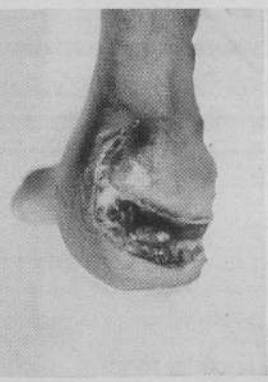

Fig. 13.

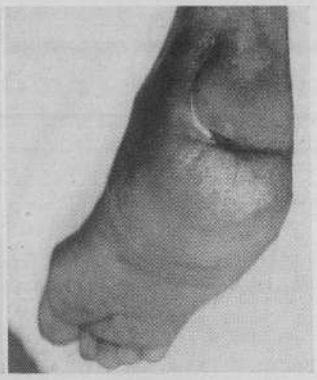

Fig. 14.

Fig. 12. Tuberculosis of os calcis. Discharging sinuses.
Fig. 13. Implanted skin flap into cavity left after removal of the os calcis.

Fig. 14. Complete closure of wound without suture, 5 weeks after operation. The foot has assumed nearly normal shape.

considerably changed. For this reason, I shall illustrate such a case, but mention only the principal difference in the technique.

LUNG ABSCESS WITH OPEN BRONCHUS

A girl of nineteen developed a lung abscess at the age of five, which was drained in the axillary line, in the region of the fifth rib. Constant discharge for fourteen years with expectoration of pus, in spite of all treatment, was the deciding factor for this extensive operation. A flap including skin, fascia, and muscle, eight inches in length, with the base toward the axilla and the apex pointing downward, was raised and the ribs exposed (Plate II). Two sections of the fourth and fifth ribs were removed. This laid open a small abscess cavity, so small as to be considered a portion of the bronchial fistula. The walls of the abscess cavity were smooth and glistening, and in this respect different from the epithelial lined bronchial opening.

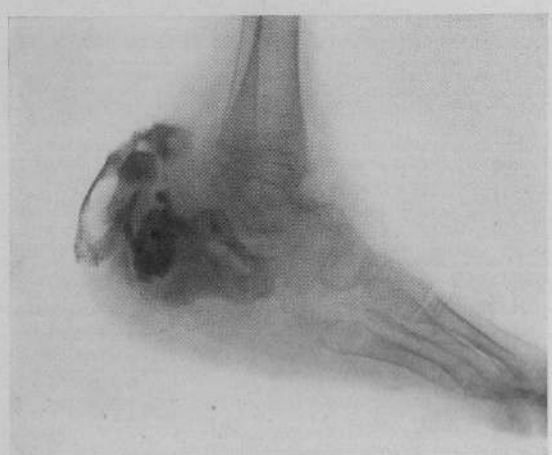

Fig. 15. Destruction of entire os calcis and two metatarsal bones.

The abscess cavity was explored with the finger. No foreign body was found, but on inspection the opening into a large bronchus was visible. The actual cautery was employed in this case to destroy the mucous membrane in the large bronchus, and thus insure complete obliteration of the opening. In order to prevent a fire, the ether anæsthesia was interrupted, and for about three minutes the patient was given oxygen by inhalation, to get rid of all the ether in the bronchi. The mucous membrane of the bronchial opening was destroyed by means of the Percy cautery (Plate III).

The steps in the implantation of the skin flap are practically the same as in the first case cited (Plate IV).

The further treatment of the case consisted in the adhesive plaster method of epidermization of the raw surfaces and daily dressings, until the entire cavity had been covered with epithelial growth. The discharge and cough stopped a few days after the operation and the patient gained 30 pounds in weight. The final result is shown in Plate V.

If the abscess cavity remains widely open, the cauterization of the bronchus may be done subsequently at different sittings. The procedure is entirely painless and causes no other discomfort than the irritation produced by the smoke from the burning flesh, drawn into the trachea and nostril during inspiration.

The correct after-treatment in these cases is of the utmost importance. The gauze packing should not be removed for 48 hours. After this period the skin flaps will usually have become firmly adherent and the gauze

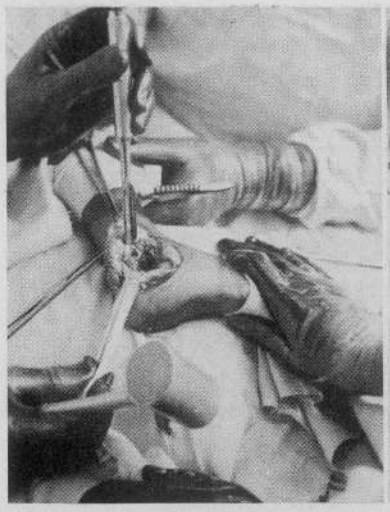

Fig. 16.

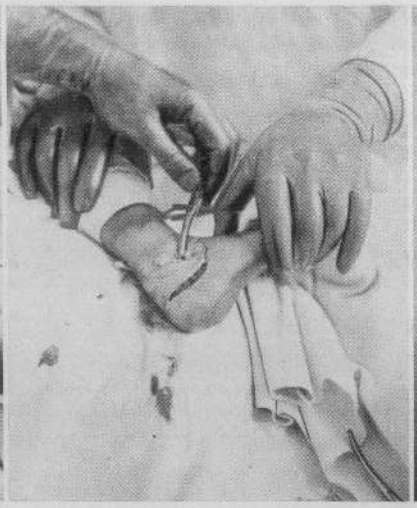

Fig. 17.

Fig. 18.

Fig. 16. Removal of diseased metatarsal bones. Tendons held back by gauze strips.

Fig. 17. Implantation of skin flap into ankle-joint. Compression by packing gauze against it.

Fig. 18. Photograph showing final result. Flexion and extension were nearly normal. The child is able to walk with but a slight limp.

packing can be safely removed without detaching them, although great care should be taken against such a mishap. A spatula should be pressed against the skin flap, while the gauze is being pulled out. No irrigation or medication is necessary, merely careful packing. This should be repeated daily and it will be noticed that the cavity is growing smaller from day to day and that the skin is gradually growing from the edges of the skin flaps, paving the cavity by degrees.

The most gratifying observation is the fact that the reduction of the size of the cavity is not due to filling of granulation tissue but rather to the expansion of the underlying lung, so that after a period of several months the skin flaps which were deep down in the cavity are now very much nearer the surface of the chest and only a shallow depression or a short funnel eventually remains.

The minor details and changes in procedure in individual cases must be left to the good judgment of the surgeon. He who attempts this class of work must have mature experience in general surgery. A novice had better not begin his career with such extensive operations.

CHRONIC SUPPURATIVE OSTEOMYELITIS (TRAUMATIC AND PATHOGENIC)

Aside from the vast number of cases of chronic bone and joint suppuration which result from diseases, such as tuberculosis, syphilis, and systemic pyogenic infection, we encounter many chronic suppurative bone lesions due to *external injuries*, such as compound fractures and gunshot wounds, also from bone plating and other operations. The traumatic types will, no doubt, be very prevalent after the present war. The progress made during the past three years in the treatment and especially in the prevention of suppuration after gunshot and shrapnel wounds, surpasses anything that has previously been done. Nevertheless, there is bound to be a vast residue of cases in which surgical procedures as well as the prophylactic measures have failed.

I shall illustrate by striking examples that some of these apparently incurable cases can be entirely healed by a method of operative treatment which I have employed with great satisfaction in 35 cases during the past five years. The method of procedure differs from the treatment of chest cases just described only in technique, the principle being

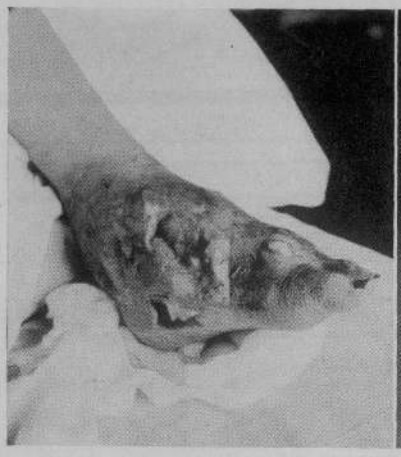

Fig. 19.

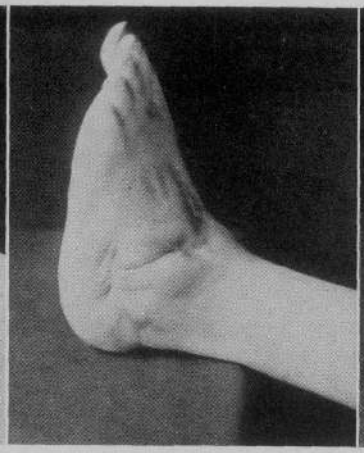

Fig. 20.

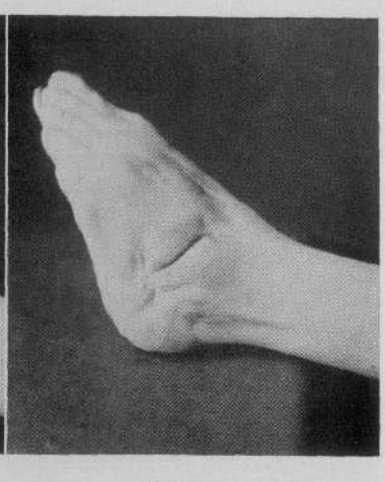

Fig. 21.

Fig. 19. Tuberculosis of foot, showing extent of diseases. All metatarsal bones destroyed.

Fig. 20. Result after excochleation of practically all metatarsal bones and part of os calcis.

Fig. 21. Showing final result after skin implant. Moderate extension and flexion. Three months after last operation. The patient can wear an ordinary stock shoe and walks without a crutch.

practically the same. The illustrations here presented will be more helpful in teaching the technique of this operative procedure than a verbal description.

The bismuth paste treatment should precede the operative treatment in every case, in order to save the patient an operation, if possible. I am pleased to say this is accomplished in more than 65 per cent of cases.

It is superfluous to mention again the technique in employing bismuth paste. It has been fully described in my previous publications.[1]

Guillot and Woimant [2] present a valuable contribution to the subject of early sterilization of the infected wounds and the late suppurations. They advocate first the Carrel-Dakin method of sterilization, usually followed by injections of different combinations of paste. They give preference to the bismuth paste, as they have observed no toxic effects and have obtained good results. They also advocate after sterilization of the wound, the implantation of fat and suture of the wound.

Those who have studied their report and observations and who will compare them with those contained in this article, will observe the essential difference to be as follows: They suture the wounds, while I do not. They use watery irrigation preceding the paste injection, while I omit all watery flushings. I believe the sutureless method to be preferable, since it does not lock up the paste mixtures, which after all are foreign substances and may lead to absorption and poisonous effects. The scars resulting from the sutureless method are not objectionable, as they are very inconspicuous.

We discarded the practice of flushing sinuses with watery solutions long ago, and have obtained very good results without them. It should, therefore, be established by those who are using flushings and the paste afterward whether the use of the paste alone will not accomplish as much.

As to the choice of the different pastes which are now being employed in practically all the war hospitals, I do not venture to dogmatize. I have now employed the bismuth-vaseline paste for ten years with very gratifying results and have found no reason to employ other new mixtures. This, however, does not preclude the possibility of an improvement, and I shall be pleased to adopt any other combination of paste as soon as I am convinced that it is superior to the bismuth.

The "b. i. p." mixture advocated by Rutherford Morrison of England is said to pro-

[1] Surg., Gynec. & Obst., 1917, xxv, 507.
[2] J. Am. M. Ass., 1916, lxvii, 21-27.

duce very favorable results. I used the combination of iodoform and bismuth when I first introduced the method about 10 years ago,[1] but on account of its odor, to which the patients objected, I had to discontinue it. I have found no difference in the results since its discontinuation. I would, however, warn against the closure of the wounds after the iodoform or bismuth mixture has been injected. Iodoform is even more toxic than bismuth. We have had our sad experience with bismuth intoxication which fortunately we are now able to avoid entirely.

It is, of course, essential that sequestra should not be allowed to remain in bone cavities, otherwise the bismuth treatment will not be effective. To ascertain the pressure of sequestra and foreign bodies, it is essential to take stereoscopic roentgenograms and submit them to a qualified roentgenologist. Upon his interpretation of the roentgenograms depends the decision as to whether an operation is indicated or not.

I consider the injection of bismuth for diagnostic purposes in these cases most essential and at the same time enter a protest against the use of the probe as a diagnostic instrument. The probe is very misleading when we wish to ascertain the depth of sinuses or bone cavities. One needs only to glance at one of these roentgenograms in which the sinuses have been injected, Figure 10, to convince himself that the use of the probe in ascertaining the course of the tract borders on the ridiculous. The tip of the probe may be resting in the nearest pocket or recess of the tract, and leave us under the impression that we have reached the bottom, whereas in fact there may be a network of sinuses into which the probe can never be introduced. In fact, the sinus at times may be twice as long as the probe itself.

Curettage of the bony cavities without ocular inspection is likewise inefficient, especially if it is done blindly by introducing the curette through the sinus opening and scraping in all directions. Such a procedure is mere guesswork. No one can know whether he has reached all the diseased areas. Many times I have convinced myself of this by

[1]See original article. J. Am. M. Ass., 1908, Mar. 14.

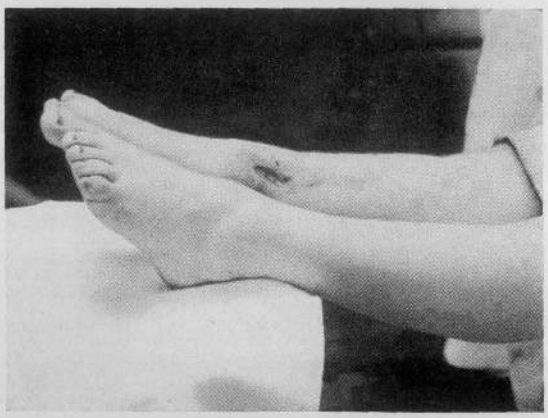

Fig. 22. Curettage without skin flap lower part of tibia. Eight years ago.

exposing the cavities which I had curetted and found that I had curetted in the directon of healthy bone and left the most diseased area untouched. Even exposure of the bone cavity and a very thorough curettage under ocular inspection does not always prevent the recurrence of the suppuration.

The customary procedure, for instance, of curetting the shaft of the femur, introducing a drain at one end and sewing the skin over the wound, will in most instances result in failure. A channel usually remains underneath the sutured skin and the suppuration soon returns.

The Mosetig-Moorhof plug, if properly introduced, may be of real service in such cases; but I shall describe a surgical procedure which I believe is more dependable.

SKIN-SLIDING OPERATION FOR OSTEOMYELITIS

After the diseased area is located by means of the roentgenograms, it is freely exposed by cutting away all the unhealthy skin and scar tissue. The diseased bone is then thoroughly curetted or chiseled away until one is certain that there is not a vestige left. Should this produce a deep groove, it must be converted into a very shallow one or even into a flat surface, by cutting away a sufficient quantity of healthy bone on either side.

After this is done, a skin flap is cut from one or each side, sufficiently large to cover almost the entire denuded bone surface, care being taken however, that no subcutaneous

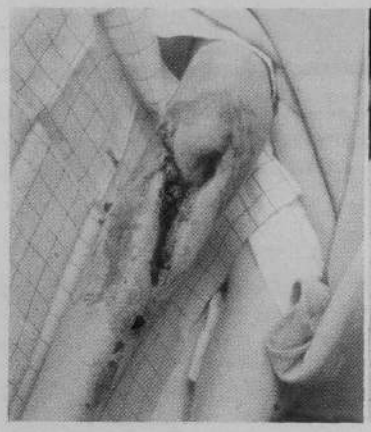

Fig. 23.

Fig. 23. Large skin implant in head of tibia. Healing took place rapidly. Note denuded surface. Two years ago.

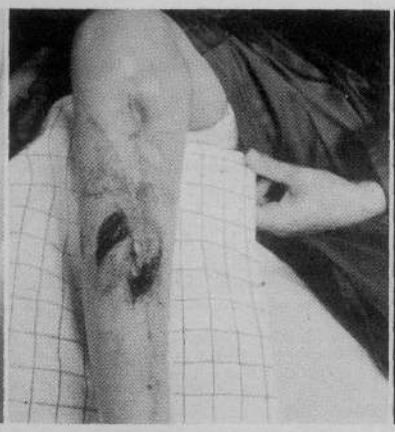

Fig. 24.

Fig. 24. Note healed head of tibia and new skin implants into middle of tibia.

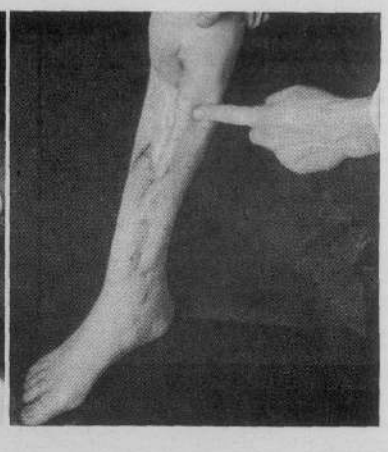

Fig. 25.

Fig. 25. Final result.

fat is carried with it. The flaps are then shifted into the depth of the cavity and retained there by packing gauze against them. It is not absolutely necessary that every part of the bone cavity should be covered. The skin will grow from the edges of the flaps until every portion of the raw bone surface is covered with true skin. To prevent retraction or slipping of the skin flaps, I have frequently used a carpet tack to fasten temporarily the tip of the skin flap to the bone until adhesion has taken place. The areas of muscle and subcutaneous tissue which have been exposed by sliding the skin are left denuded. No attempt should be made to bring their edges together by suture or otherwise. In only very rare instances has it been necessary to use any suture material whatever, except, of course, the ligation of bleeders.

Forty-eight hours later the gauze pack which has kept these flaps in apposition to the denuded bone surface is removed, and it will be found that firm adhesion has already taken place. In one case, in which an assistant displaced one of the flaps during the application of the dressing immediately after the operation, I was unable, twenty-four hours later, to replace the skin flap in its proper place, until I had loosened it with a raspatory. The rapidity with which adhesion of the skin to the bone takes place is remarkable (Figure 11, this case six days after operation).

The after-treatment is most interesting. As soon as granulations on the denuded surfaces from which the skin has been removed, begin to form, strips of adhesive plaster are applied, covering the margins of the skin border and the granulating surface all around the wound. This procedure will produce rapid epidermization of the denuded surface. The adhesive is changed daily. Within two or three weeks large areas will be covered by healthy skin and in practically every instance the suppuration will stop after the denuded area has been epidermized. Small scars, of course, remain but will gradually shrink, so that a denuded surface the breadth of three fingers will have a scar no wider than one-half centimeter.

When the wound is not too deep, the skin flap may be omitted. It is simply left widely gaping and packed with gauze and allowed to granulate from the bottom. Later on adhesive plaster is put on the edges of the wound.

I have employed this method of skin sliding in a variety of cases: osteomyelitis of the femur, tibia, in hip-joint disease, in knee-joint disease in the removal of the os calcis and of the metacarpal bones, in osteomyelitis of the ribs and of the sternum, and in other cases, including infected fractures and other injuries.

I shall now illustrate the efficiency of this procedure by some typical cases selected from my series.

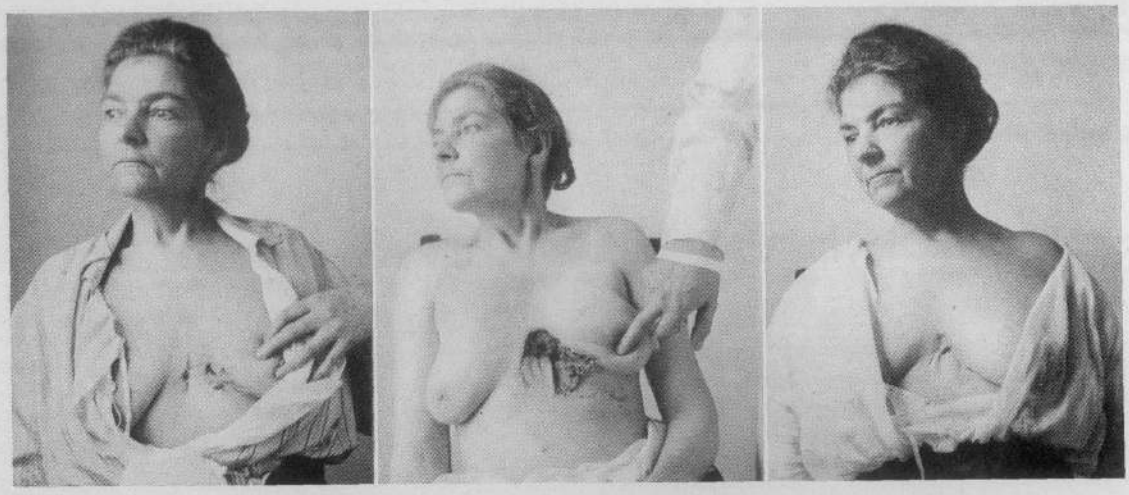

Fig. 26. Fig. 27. Fig. 28.

Fig. 26. Four sinuses from tuberculosis of sternum, discharging 15 years. After 5 operations.
Fig. 27. Skin flap implant after removal of sternum.
Fig. 28. Final results, 6 weeks later. The sinuses closed and the denuded surface was obliterated. The patient gained 20 pounds.

TUBERCULOSIS OF OS CALCIS — REMOVAL AND SKIN FLAP IMPLANT

Lillian P., colored, age 8. Stepped on a pin with right heel two years ago. The pin was extracted but a temperature of 104° followed, one foot became swollen, and an abscess resulted, which was drained. Suppuration continued and she remained in a hospital for six months. During her stay at the hospital, incisions into the heel were made at thirteen different times, then she was discharged as incurable. Ten months later, the left hip became swollen and painful. Tuberculosis of left hip was diagnosed. Rest in bed four months. While an abscess was prevented, the limb gradually became thinner and shorter. In September 1917, we find the right heel twice the normal size, with three profusely discharging sinuses (Fig. 12). Stereoscopic roentgenograms show destruction of the entire os calcis (Fig. 15). The left limb is three inches shorter than the right, the muscles atrophied. Stereoscopic roentgenograms disclose a healed tuberculosis of the hip-joint, the head being entirely absorbed and joint ankylosed. Diagnosis: Tuberculosis of right os calcis, associated with healed tuberculosis of the left hip.

Operation. A tongue-shaped flap with its base upward at the back of the heel was dissected. The tendo Achilles which was still firmly attached to some of the fragments of the os calcis was divided. This gave splendid access for the removal of the entire os calcis (Fig. 13). Instead of suturing, the flap was pushed into the cavity produced, and gauze packed against it. Within twenty-four hours the skin flap was adherent, and filled part of the large cavity. The defect grew smaller each day and finally healed completely and the foot assumed nearly normal shape (Fig. 14). The child is now able to walk since a pair of shoes has been provided for her. The right shoe has a padding in the heel to make up the deficiency. The left foot was provided with a regular 3-inch high sole shoe to overcome the shortening due to the hip disease.

TWO CASES OF TUBERCULOSIS OF THE ANKLE

Florence B., age 5, had tuberculosis of the right ankle, which progressed so rapidly in spite of all treatment in a well equipped hospital, that within two years from its inception, amputation of the foot was recommended. The child was unable to walk and profusely discharging sinuses persisted after several minor operations had been performed.

On March 15, 1917, I performed a radical operation by the skin-sliding method. Figure 16 illustrates the flap incision with exposure of the metatarsal bones, the tendons being held back by a gauze strip. The metatarsal bones were removed and the skin flap implanted (Fig. 17).

The final result of this case is shown in Fig. 18, the child being able to walk with only a perceptible limp and able to flex and extend the foot to almost the same degree as her healthy foot.

A vary similar case is that of boy 8 years old, in which the disease had destroyed practically all the metatarsal bones and the os calcis. The condition was so deplorable that nothing but an amputation seemed advisable (Fig. 19).

A complete excochleation of all the diseased bones was done by large openings on both sides of the foot, a suitable skin flap being provided in the incision on either side. These flaps were inserted deeply into the cavities. The final result is shown in Figs. 20 and 21, all the sinuses having closed, the boy being able to

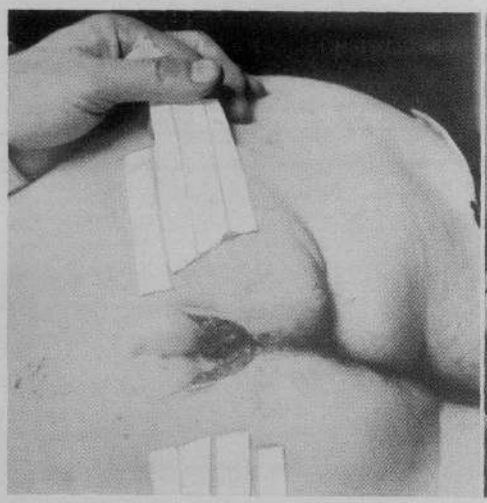

Fig. 29 (at left). Showing skin implant into depth of dermoid cyst.

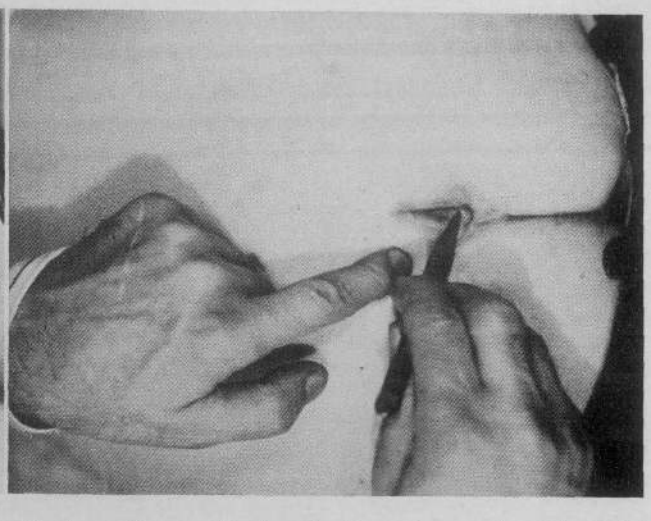

Fig. 30. Final result. Depression completely lined with skin. Suppuration ceased.

flex and extend the foot, to wear an ordinary stock shoe and to walk without a crutch (Figs. 20 and 21).

CHRONIC OSTEOMYELITIS OF THE TIBIA — TWO-STEP OPERATION

Miss I. C., age 26, when eight years, was kicked in the leg by a cow. Two years later, the leg suddenly became painful and swollen and within six weeks an abscess opened in the center of the tibia. Two months later, an operation was performed at home, but this failed to check the pus discharge, and from that time on, she has had repeated operations without any beneficial results.

In April 1909, I took stereoroentgenograms and found that the entire length of the tibia was involved in a chronic suppurative osteomyelitis. But the discharge being present only at the lower end of the tibia, Figure 22, I excised the skin overlying the diseased bone, chiseled off as much of it as possible, and allowed the cavity to granulate. The skin grew in from the sides and left a small scar.

In May, 1915, the patient returned on account of pain in the upper part of the tibia and high fever. At this time, I performed what I have described in this paper a skin-sliding operation, removing the diseased bone from the head of the tibia and sliding a flap of skin about 4 inches in length into its depth. Healing took place rapidly and the denuded surface of the tibia was covered with healthy skin within two months.

She remained perfectly well until August 1917, when she complained of pain in the middle of the tibia. A stereoroentgenogram proved that there was a sequestrum in the center of this bone, and another plastic skin-sliding operation was performed, using two skin flaps, one from each side to meet in the deep recess of the tibial canal. Figures 23, 24, and 25, illustrate the different phases of this procedure and the results. At the present time the entire limb is in perfect condition, no sinuses existing.

TUBERCULOSIS OF THE STERNUM

Miss D., dressmaker, age 40, has been suffering from disease of the sternum for 16 years. After five unsuccessful operations performed during this period, four profusely discharging sinuses remained (Fig. 26).

I saw her first in 1912, injected the sinuses with bismuth paste and suppuration ceased for about six months. Thereafter, I curetted the sinuses and injected them again, which produced a cessation of discharge for one year. From then on, the sinuses kept on suppurating and the condition grew worse. The patient lost in weight and she suffered a great deal of pain.

On January 20, 1917, I performed the skin-sliding operation, as illustrated in Figure 27. The skin covering the area involved was excised, the lower part of the sternum exposed and resected, and the deep bed from which it was removed curetted. A triangular flap of healthy skin was then cut from underneath the left breast and slid over into the depth of the cavity and kept there by compression of a gauze packing. The denuded surface of the breast was not sutured. Within six weeks the entire denuded surface was obliterated, partly by the contraction of the skin edges and partly by new growth of skin from all borders (Fig 28).

In this case we illustrate how the implanted skin flap, which at the time of operation reached into a deep funnel-like depression, has gradually risen toward the surface, so that at present it is almost level with the rest of the sternal surface. The patient's general condition has improved from the time of the operation, and she has gained some 20 pounds in weight.

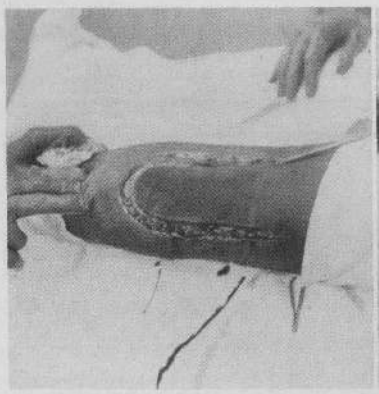

Fig. 31.

Fig. 32.

Fig. 33.

Fig. 31. Flap incision for the exposure of the femur.
Fig. 32. Wide exposure of diseased femur. Skin flap covered with warm salt gauze.
Fig. 33. Complete eradication of disease, leaving no groove in the bone.

DERMOID CYST MISTAKEN FOR RECTAL FISTULA

G. M., age 60, was operated on ten years ago for what was then supposed to be a rectal fistula. The operation was very extensive having produced incontinence and later a stricture of the rectum. In 1914 the condition became very much aggravated, a very profuse discharge of pus from the rectum, pain and severe eczema around the anus, and gradual emaciation, compelled him to seek further treatment.

Intrarectal examination revealed a sinus opening in the posterior rectal wall, about two inches above the anus. The pus virtually poured from this sinus. The injection of bismuth paste into the cavity revealed a large area undermining the anterior aspect of the sacrum and coccyx. Diagnosis at this time: coccygeal tuberculosis with abscess formation. Operation: Instead of the longitudinal incision usually employed for the removal of the coccyx, I made a triangular flap with the apex pointing toward the anus. Raising the skin flap, I resected the fat and the coccyx and found underneath a fibrous structure resembling an indurated cyst wall. A urethral metal sound was then introduced through the rectal sinus and the wall of this sac pushed upward into the wound and incised. The skin flap was pushed into the depth of the wound to meet the opening just made into the sac.

Our diagnosis was then changed to dermoid cyst, the sac having contained a few long hairs. Figure 29 illustrates the condition a week after the operation, the skin flap having already healed in the depth of the wound, now about two inches deep. The pus now discharged through the external opening instead of the rectum. The bismuth injections were carried on through the external opening and within a short period the suppuration stopped, and both the intrarectal and extrarectal openings healed. The large wound contracted gradually and at present there is only a small depression in the region of the coccyx, as shown in Figure 30.

OSTEOMYELITIS OF FEMUR

Mr. B. The case here illustrated represents a type of chronic suppuration from the femur not very uncommon. The sinuses usually form near the ham-string tendons and the disease is most persistent, lasting indefinitely. Operations for this class of cases are particularly unsatisfactory. I have adopted a procedure entirely different from that heretofore employed.

The bismuth treatment had in this case been tried for six months without much effect. It was discovered that the shaft of the femur up to the middle of the thigh was filled with sequestra and pus. The knee-joint was also affected. The operation here illustrated was preliminary to a resection of the knee-joint, which was done later. Amputation was refused by the patient.

It is unnecessary to describe the steps of the operation, since the legends below the illustrations explain the technique as well as the underlying principles in the treatment (Figs. 31 to 36).

The disease in the femur is now entirely healed, Resection of the knee-joint as well as the operation on the tibia were performed later, the same principle having been carried out.

TUBERCULOSIS OF THE HIP, OF FIFTY YEARS' STANDING. OPERATION

Mr. D., age 54. Fell out of bed when about four years old and soon after developed tuberculosis of the hip, which resulted in the entire destruction of the hip-joint, which remained quiescent for about 35 years. The limb remained infantile and contracted at the age of 40, abscesses formed and many sinuses opening around the hip resulted. The condition improved spontaneously until three years ago, when he developed a severe pain in the hip and new abscesses began to develop. From this time on, conditions grew rapidly worse and he began to lose in weight and suppuration increased. He presented

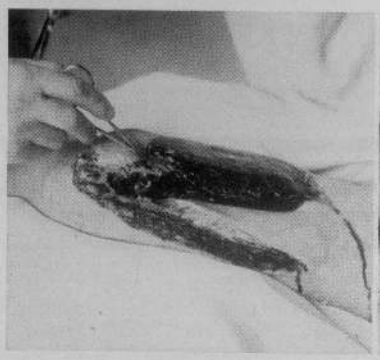

Fig. 34.

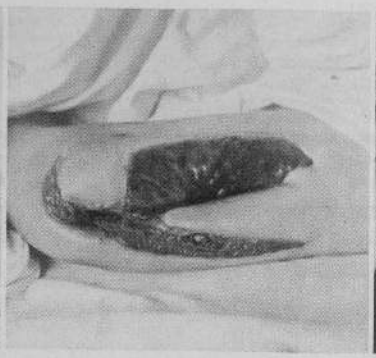

Fig. 35.

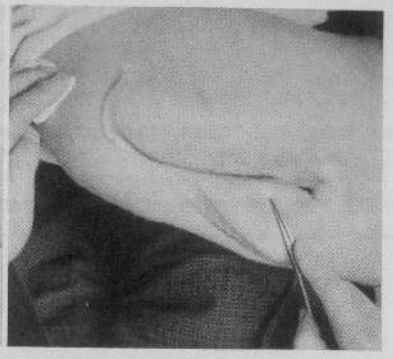

Fig. 36.

Fig. 34. Skin flap inserted into depth and anchored with tack to bone. No suture.

Fig. 35. Wound 2 weeks after operation, showing gradual epidermization of denuded surfaces.

Fig. 36. Photograph taken 8 weeks after operation showing complete closure and epidermization. The disease in the femur is entirely healed.

himself in October, 1916, with four sinuses profusely discharging from the right hip, associated with severe tenderness, an œdematous and eczematous condition.

The stereoscopic roentgenogram shows a large network of sinuses surrounding the femur and the acetabulum. Injections of bismuth were continued and soon given up as futile, there being a number of sequestra in the hip, and the case was then considered incurable. Six months later, I reconsidered the matter and performed a radical skin-sliding operation. The hip-joint was exposed by cutting away all the diseased skin overlying it, the acetabulum was freed from all necrotic bone, the head having been destroyed previously. A healthy skin flap was denuded from the region of the buttocks and implanted into the depth of the cavity (Plate VI).

A month later another operation was performed as shown in Plate VII which illustrates the second step of the operation. This consisted of the resection of the greater trochanter and the implantation of another very large skin flap, to pave the lower part of the exposed hip-joint. This flap, about four by six inches in diameter, was denued from the lower part of the buttocks and implanted in the usual manner. Plate VIII illustrates the condition two weeks later, and Plate IX three months after complete healing had taken place.

The patient gained 20 pounds in weight, is in perfect health, but of course has an ankylosed short limb.

During the evolution of this skin-sliding method of treatment, I have from time to time presented some of the cases before medical associations and since then a number of my confrères have reported to me their satisfactory results in trying out this method. I therefore anticipate that now when the method has been perfected and when there is such an abundance of material in which it can be employed, its usefulness will be readily established.

SUMMARY

To sum up, I would advise the following procedures:

1. The methods of primary sterilization by means of aqueous flushings of wounds should be thoroughly tested to determine whether or not they are effective and practical without the additional use of pastes.

2. That the wide excision of tissues as now practiced in the war hospitals should be adhered to, as a means of preventing chronic suppuration.

3. That in cases in which early sterilization was not obtainable and the wounds persist in suppurating, the bismuth injection treatment or its similar substitutes should be employed, before any radical operation is resorted to.

4. That in the residue of cases in which the bismuth treatment is not effective, the sutureless method of skin sliding, as described in this paper, should be employed, since with this method we are able to clear up nearly all of these apparently hopeless cases.

DISCUSSION BEFORE THE CHICAGO SURGICAL SOCIETY, JANUARY 4, 1918

DR. E. WYLLYS ANDREWS: Dr. Beck has given us a very interesting and instructive presentation on this subject, and one might think from seeing the pictures that this was only a mechanical problem in the sliding flap method. Perhaps there is nothing gained by turning points of skin flaps inward over leaving a bridge of skin; but apparently we are dealing here with a principle of surgery which we see illustrated in all kinds of skin grafting; namely, if one can approximate epithelial surfaces to growing or living surfaces, the stimulating or regenerative action from the margins of the epithelial surface actively go on and proliferate and close over areas more quickly. We see in one method, old-fashioned reverdin grafts scattered like islands over the surface, and from the presence of this implanted epithelium rapid stimulation and epithelization. That seems to be the secret of Dr. Beck's success; otherwise one might say we cannot gain anything in point of time or in the quality of healing by merely sewing points of flaps in, because the skin can be made to sink in and the cavity collapse as completely by the older Erstlaender or Schede operations.

DR. JAMES M. NEFF: I would like to ask Dr. Beck what he does with the areas left after taking these large flaps, whether he skin grafts or not; how these surfaces contract and how rapidly.

DR. DANIEL N. EISENDRATH: There is one point I would like to emphasize in connection with the X-ray, and that is that the stereoscopic X-ray has superseded practically every method of diagnosis.

I want to show some lantern slides illustrating points in the differential diagnosis of some of these thoracic lesions.

This slide illustrates beautifully the difference in density of the shadow between a serous effusion and a bloody effusion. Oftentimes it is necessary, especially after an injury, to say whether we are dealing with a serous effusion or a bloody effusion. In the lung it does not make much difference. Unless pressure upon the heart supervenes, the thorax will take care of itself.

The next slide shows the lesser density of a serous effusion and a transverse line of dullness. The heart is not displaced at all, and the lung appears compressed.

The next picture, which was taken with the patient in a horizontal position, shows that the fluid is movable which confirms the diagnosis of a nonencapsulated fluid as distinguished from an encapsulated empyema. The surface of the fluid is at right angles to the diaphragm instead of being parallel to the diaphragm.

The next picture shows a difference in density of the blood because the shadow is absolutely opaque. This was a stab wound of the abdomen with an extensive contusion of the thorax, with an enormous hæmothorax on the left side, which displaced the heart to the right and had to be aspirated to save life.

The next is a picture of an abscess in the posterior half of the lower lobe of the left lung and in the posterior half of the upper lobe of the left lung. It shows a circumscribed shadow distinct from an empyema or even a serous effusion. On the left side there was a lung abscess following tonsillectomy, which finally yielded to the injection of bismuth paste after resection of the ribs had proven of no avail.

This next picture is a beautiful example of a shadow which might be taken for an abscess of the lung. An abscess of the lung seldom will, if ever, give rise to such a dense shadow. This was an endothelioma of the pleura, a circumscribed mass due to this tumor.

I want especially to recommend something which Dr. Beck did not emphasize and that is the value of the surgeon himself going into the X-ray room and studying shadows himself under the fluoroscope, watching the movements of the diaphragm and noting the influence which changes in position will have upon the fluid in the chest. The X-ray in my experience has superseded for our surgical purpose every other method of diagnosis.

DR. CARL BECK: In the first case that you saw my brother pointed out that gradually the tissues pushed the flap out and slowly obliterated the cavity, so that the skin flap came more to the surface. You noticed that in most of the pictures. There is an important lesson in this when we study recent war pictures.

I have been much interested in plastic work and in studying pictures of cases; without intentionally doing the same thing, surgeons have had to promote this healing with skin flaps. Wounds of the face in this war are very ragged. The skin forms flaps by the injury, and these flaps turn inward as the wound which is treated is an open wound at first. As all surgeons know the open wound treatment, whether you irrigate or not, is the best treatment. This treatment opens all recesses of the wound and allows the discharge of secretions. Gradually the flaps turn inward and the result is a disfigurement of the face. That is the picture which comes to the plastic surgeon afterwards. These scars of the flaps healing to the bone remain unsightly if not subjected to a plastic operation. When these war wounds have held retracted skin flaps toward the bone and formed these irregular deep scars in the face, which often show deep retractions clear down to the upper jaw, the plastic surgeon has to retrace the steps of wound healing; he has to resect every vestige of the scar, and if there is no infection, to bring together the healthy surfaces and healthy muscles and healthy fascia, and after he has united all he brings together the borders of the epidermis over this elevated portion, making a good plastic effect and obliterating all the defects and scars. That is what I call scar elimination. The same thing has been reported by others who have worked along this line, resecting the scars gradually bringing the normal tissues in

their normal position. Thus we obliterate cavities, and bring the skin together, so that the deeply retracted scars of the cheeks fill out. If there is bone, fat, or cartilage missing, it has to be transplanted and implanted, and we get plastic results which obliterate these defective scars.

DR. EMIL G. BECK (closing): We use adhesive plaster strips which adhere like a postage stamp along the border covering the junction of the skin and the granulating surface. This gives a sort of leading surface along which epithelial cells grow. It is remarkable with what rapidity skin grows from the sides, often covering surfaces as large as my hand. After removal of a breast I left a surface as large as my hand denuded and I gradually healed over with normal skin.

The adhesive plaster method I learned from the dressing of wounds of burns. One of our ex-internes treated a great many electric burns in that way. I watched his cases and saw surfaces ten inches long and four inches wide epidermized by that method, and so I adopted it for this new purpose.

In reply to Dr. Neff, I do not decry skin grafting because I know some excellent results have been obtained from it, and I occasionally resort to it.

DISCUSSION BEFORE THE WESTERN SURGICAL SOCIETY, OMAHA, DECEMBER 14-15, 1917

DR. BYRON B. DAVIS (Omaha): I suppose the more closely the advice of Dr. Haines is followed in the treatment of the acute form of osteomyelitis the fewer will be the number of very bad cases, such as have been demonstrated by Dr. Beck. I have always felt that most of these exceedingly bad cases, which last year after year and have many operations done without success, are due to more or less dilatory tactics at the beginning. This, of course, is not always the case, but very frequently so.

In these chronic cases of osteomyelitis, where we have long-continued trouble, sinuses running year after year, it is exceedingly important to know how much bone is diseased, and, fortunately the X-ray helps us out. If we find that the disease is rather sharply localized, if we do not have a very large sequestrum there, I have always been very much in favor of a minor operation, and, preferably, the use of bismuth paste in these cases; but Dr. Beck has touched upon a class of cases that cannot be relieved by any of these ordinary measures. If we have extensive trouble in one of the serious cases, with probably a lot of eburnation of bone, we have a large operation to do; and one thing I want to know positively before beginning, is something about the resisting power of the patient. I have seen one or two patients die from these operations where an amyloid condition of the viscera already existed and it was only to be expected that a fatal result would follow. I want to warn you to look after the general condition of the patient very carefully before you begin, and when you begin, I believe, like Dr. Beck, you should be absolutely radical — make such a large incision that you can inspect every part and remove all disease with one fell swoop.

The particular point of Dr. Beck's paper in leaving open wounds, it seems to me is just the thing; and when he emphasizes using absolutely no sutures, I believe he has emphasized a point that is very important. I know the tendency is for all of us not to leave too much of a wound. We think that a suture or two will improve the condition, and then we will probably pass another suture about the other end. We narrow the thing down, and we do not get the good drainage we ought to have. In addition to all the other advantages of Dr. Beck's operation of leaving the skin wound wide open, we leave opportunity for epidermization, and we get a covering there which we would not otherwise get, and could not get, unless we leave the wound open as he does.

I wish, in conclusion, to compliment Dr. Beck on the splendid results he has obtained in these three very bad cases.

DR. H. E. PEASE (Kansas City): I think the more we study the bacterial infections in bone, the more apt we are to get away from the theory that the bone manifestation is primary. In other words, hæmatogenous infection does not take place until the tissues of the body are widely infected; and the only reason osteomyelitis requires special treatment is because of the terminal results in the bone and because of the inability of the bone to take care of itself.

Recently there came to me a boy with a swollen right limb and fluctuating knee-joint, with a temperature of 106 per cent, with delirium, and with a history of a long course of boils upon his body. There was one slight abscess on the opposite shoulder at the time. The internes on the service were rather doubtful about the pathological conditions. One of them insisted that the patient was suffering from an acute osteomyelitis; another one said that he had secondary arthritis of the knee-joint secondary to the long boil formation; and a third insisted that on account of the boy having a red spot upon the external portion of the knee-joint we had erysipelas to deal with, and in consequence of that idea they took a culture from the boil on the shoulder. Immediately following that we prepared to open the bone, because I was satisfied of the presence of an acute suppurative osteomyelitis of the shaft of the femur. After the primary incision was made through the skin, the œdematous tissue lying beneath the skin was immediately cultured into several tubes. After cutting through the soft parts, I struck the chisel through the bone and found no pus, but with the end of the bone-scoop I went deeply into the medullary cavity of the bone and carefully cultured the substance taken from the center of the bone. I gave up my diagnosis of suppurative osteomyel tis, and one interne gave up his erysipelas, and agreed we had a secondary knee-joint infection. I opened the knee-joint, removed several ounces of turbid fluid, which was not pus, and this was placed in

culture tubes. All of the cultures show a virulent streptococcus except the one cultured from the boil on his shoulder, which grew to be a rather innocent staphylococcus albus. We covered the wounds, let them alone without drainage or further interference, and the man made a good recovery, with perfect restoration of function of the limb. We must recognize that hæmatogenous infection is general, and that the infection in the bone is only on account of the limited ability of the bone to take care of itself.

I wish to congratulate Dr. Beck upon his fastening skin into these deep wounds. I tried to do this a few years ago by turning the edges of the skin, and holding them down with iron nails, and we did not get anywhere. The reason of Dr. Beck's success is the very large and long skin flap which he uses allowing the flap to press to the deepest portion of the wound without tension. I am very glad to have seen his technique.

Dr. D. W. Basham (Wichita, Kan.): The transplantation of skin in the bottom of osteomyelitis is a most excellent thing but I do not think we should allow it to pass as something new. If you will turn back and consult your old books of 25 years ago, you will find the operation very well described. I did it myself very nearly 20 years ago.

Dr. F. T. Murphy (St. Louis): In Dr. Beck's paper I think we have all been impressed by the results he has obtained, and personally it seems to me, the use of skin flaps and the removal of dead bone, is to be enthusiastically advocated. In my own mind I was a little confused as to how much emphasis Dr. Beck would place upon the use of bismuth-paste injections. I think the statement was made in the first part of his paper that some 40 or 60 per cent of the total cases were cured by the injection of bismuth paste. In my own experience that has not been the case. If I understand Dr. Beck correctly, I would congratulate him very heartily upon the results; but I would have to confess that personally I have not been able to get them, and it seems to me that the injection of this paste into sinuses is a different thing from filling an open cavity with Beck's paste or with the Moorhof bone-wax, especially putting it into a tortuous sinus. To put it into the latter is to introduce there a dangerous principle in the surgery of bone.

Dr. J. D. Griffith (Kansas City): With regard to Dr. Beck's paper, I want to thank him for proposing the introduction of epithelium into the bottom of the abscess he has cleaned out. This helps to solve the mystery of those old cases in which healing would not take place. In the case of the man where a bronchial tube was opened, the old treatment of going in and doing extensive rib resection and getting down there with the Schede operation, would have given him very marked scoliosis, but he has very little scoliosis. If you examine him closely you will find there is resistance in his spine, but it is very slight.

I wish to congratulate Dr. Beck on his excellent paper and on the results he has achieved in these cases.

Dr. J. N. Jackson (Kansas City): I desire to emphasize one small factor in the technique used by Dr. Beck which is not only applicable to the condition which he describes in bones but can be widely utilized elsewhere. I refer to the use of adhesive plaster to stimulate epithelialization. In 1895, before the Mississippi Valley Medical Association, in Detroit, I listened to a very interesting paper by Dr. Carter Cole, of New York, on the cure of chronic ulcers. In this paper he outlined his method which, practically speaking, was the use of adhesive plaster to cover and protect the epithelial cells of the granulating surface. I have used that method extensively ever since he first described it, first, beginning with the ordinary chronic ulcers of the various types about the lower extremities. Having obtained remarkable results in this type of cases, I have extended the application of the method to practically all forms of granulating wounds. For instance, wounds of the abdominal wall which have suppurated or have become necrotic, are hard to heal. If they are covered with ordinary zinc oxide adhesive plaster, the rapidity with which new skin is formed is remarkable.

I think the beauty of the results shown by Dr. Beck, and the wonderful absence of great scarring, are due to the use of adhesive plaster; and you will find a wide service for it, therefore, in any form of granulating wound. Old burns which, after necrotic suppuration, have reached the stage of granulation you know are slow in getting well. You cannot find anything which will promote so rapid a closure of a granulating wound as adhesive plaster covering the granulating surface.

Dr. J. F. Percy (Galesburg, Ill.): I would like to ask Dr. Beck some questions. First, as to the technique he uses with the plaster. When does he begin the use of the adhesive plaster? Second, how often does he change it? Third, how long does he continue its use? Fourth, how does he dress these cases? Fifth, is there any special form of dressing he uses? Sixth, has he ever found it necessary to resort to skin-grafting for these extensive wounds?

Dr. Dean Lewis (Chicago): I think opinions will always differ as to the treatment of osteomyelitis. There has not been much, if anything, said with reference to bone-plugs. I believe Ashton was the first to introduce skin flaps in the treatment of osteomyelitis cavities; and the purpose for which the pedunculated skin graft was introduced was to close cavities in the tibia, particularly in the upper end, where a large amount of skin was removed at the primary operation. I believe, if the proper work is done with bone-plug at the first operation, there will be less necessity, at all times, for the use of this pedunculated skin graft.

In the last few years I have treated osteomyelitis cavities with sequestrum in a number of different ways, but I think, by all odds, the most satisfactory

way is that introduced by Burgess, in which the sequestrum with the hard indurated involucrum was taken out *in toto*, not healthy bone, and that can be closed with Moorhof bone-plug. I have done a number of operations in which I have treated these cases very much after the manner that a dentist prepares a cavity in a tooth. I have taken out the sequestrum with the hard involucrum, I have carbolized that, and neutralized the carbolic acid with alcohol, leaving in a little alcohol, and have applied the cautery for the purpose of coagulating blood to have a dry cavity, then filled it with the Moorhof bone-plug, sutured the skin over, and closed it as you would an abdominal wound, or a clean wound. What happened is this: Within a few days the Moorhof bone-plug begins to be extruded. You take this off (it requires no packing or dressing) and it has been my experience in the majority of cases these bone cavities will heal with the Moorhof bone-plug where the primary operation is radical enough to remove the seat of infection. There has been less and less use for the pedunculated skin graft since it was first introduced to close cavities in the upper end of the tibia, but the bone-plug was not resorted to at this time.

DR. A. T. MANN (Minneapolis): We have been using the Moorhof bone-plug or bone-wax in Minneapolis for 12 years. I saw Moorhof use it in 1904, and he certainly secured remarkable results in the cases in which he could practically close the cavity in the chronic and subacute cases. The disinfection can usually be made complete enough to secure healing by first intention in the skin and overlying tissues, leaving the wax in as a plug to be gradually taken out. The serial X-ray pictures show that perfectly. The formula is 20, 40 and 40 — that is, 20 parts of iodoform, 40 parts of spermaceti, and 40 of rapeseed oil. The X-ray shows in the first picture as though the bone-wax were made of lead, very clear and sharp. The picture taken two or three weeks later shows that they are beginning to look a little irregular at the margins. In pictures taken 10 days later they begin to melt away at the margins, and so on up to about three months, when the wax will be gone, and you will have a callus of bone and connective tissue, mostly bone, in its place.

We have gone a step further than that in the acute cases, because some of the infections are so violent that we would not think of closing the wounds. We use carbolic acid, followed by alcohol, sterilizing the cavity after it is scooped out. We use wax in such cases. We fill the cavity. The wax is prepared so that it will be fluid at 110 deg., not hot enough to burn the tissues. It is made that warm over a water bath, and is mixed and poured in. It is a solid wax when it cools to the temperature of the body, and that makes the plug. It can be left in a wide-open place. We put a piece of rubber over the wax, and the wax will stay there for weeks; and all you have to do is to change the outside dressing. The moderate discharges will ooze out about the bone-plug and under the rubber which is over it. This gets rid of the great pain caused by the pulling out of the gauze packings we formerly used, and by the repacking of the cavities with gauze. It makes the dressings easy and rapid, and the healing is fully as rapid as by the old method, if not more so.

DR. J. F. BINNIE (Kansas City): I am very glad Dr. Lewis and Dr. Mann spoke as they have done. In recent years I have come more and more to close, or partially close, osteomyelitis cavities after an operation. I clean out the cavity as thoroughly as possible, take out the sequestra, clean again as thoroughly as possible, and use the various antiseptics or sterilizers, such as carbolic acid neutralized with alcohol. One should not bother his head about thoroughly drying the cavity. Pack the hole completely with crystals of boracic acid, mixed with a little iodoform, close the wound or leave it open, and apply dressings. I have found this method very effective in a large number of cases; only the outside dressings require changing.

DR. BECK (closing): We have used this adhesive-plaster method for two years on granulating surfaces, and have given up skin-grafting for good. I have used it in amputation of the breast, where I did not have enough skin and in two or three weeks the entire defect was covered.

About the dressings: Pus forms after 24 hours, when the plaster is taken off, and without rubbing the granulations a new piece of adhesive plaster is put on. We do not use zinc-oxide plaster. The adhesive plaster strips cover a part of the edge of the skin and the edge of the granulating surface, with the center left open. As we take off the adhesive plaster the next day, we find a bluish margin one-quarter of an inch wide, which is newly formed epithelium.

In regard to the mortality. One should hesitate to operate on weak people. I have found that patients with osteomyelitis of this type stand a lot of trauma and long operations without bad results. I have no mortality in a series of 42 cases. But the neglected cases of hip-joint disease do not stand operations so well. One of the patients I have here exhibited, who had an operation lasting 2½ hours, wanted to get out of bed on the third day; and the man with the rib resection walked around on the third day. These patients gain in weight rapidly after operations.