In outward dislocation of the bone, which is the more frequent form, the breadth of the knee is increased, the internal condyle is prominent, the limb a little flexed, the joint fixed, and the borders of the bone may be felt as it lies in an antero-posterior direction toward the outer side of the joint. Reduction is usually easy, the bone sometimes slipping back unaided. If interference is needed, it will be found sufficient to flex the thigh to a right angle—the patient lying on the back, with the leg extended to relax the quadriceps tendon—and then to exert lateral pressure upon the joint.

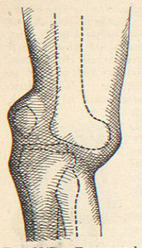

FIG. 1647.—Forward Dislocation of the Leg. (Helferich.)

In some cases the dislocation may consist in a partial or even complete rotation of the bone on its perpendicular axis. Under these circumstances the limb will be found in a position of complete extension, and there will be no difficulty in making out the position of the bone on account of its nearness to the surface of the skin. It may lie to either side or in front of its proper site. Rotary dislocations, as they are termed, require forced flexion of the thigh upon the abdomen, the leg being in an extended position; and if manipulation, on the part of the surgeon alone, fails to restore the patella to its natural position, the addition of alternate flexion and extension, to be carried out by an assistant, will aid the surgeon in his efforts to manipulate the bone back into its place with his fingers. After the patella has been reduced, the limb should be placed on a double-inclined plane for a week or ten days, or the knee should be fixed by means of a posterior splint or by a plaster-of-Paris dressing. For a week or ten days after the occurrence of the dislocation cold applications, in the form of an ice-bag, cold cloths, etc., should be made to the knee, or lead and laudanum should be applied, and then, after the temporary dressings are removed, a stout knee-cap should be worn for some time, the patient being cautioned as to the liability of a recurrence of the dislocation.

The Knee may be dislocated forward, backward, or laterally to either side. Forward dislocation may be complete or incomplete, and is the result of over-extension of the knee. In complete dislocation the leg will be shortened to an extent of from one to three inches, and may be extended or slightly flexed. The head of the tibia will be found to project in front, with the patella resting on it or in the depression above it, while the lower end of the femur will project backward.

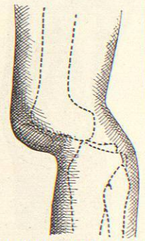

FIG. 1648.—Backward Dislocation of the Leg. (Helferich.)

For the reduction of this dislocation anæsthesia may be required. Extension having been applied to the leg and counter-extension to the thigh, the patient lying on the back, the surgeon gradually flexes the leg over his arm and at the same time makes pressure forward in the popliteal space. For a period of a week or ten days, after the dislocation has been reduced, the limb should be placed on a well-padded posterior splint, and local applications of cold or of anodynes should be resorted to for the purpose of subduing inflammation. Then, for about three weeks, a plaster-of-Paris dressing should be employed; after which the patient should be allowed to use the limb cautiously, the joint being guarded or protected by some form of splint or brace.

In backward dislocation, which may be complete or incomplete, and is due to force applied to the front of the leg or to the back of the thigh, the patella is generally displaced in an outward direction, and the leg is in a condition of extreme extension, shortened, and it may be bent forward. The femur will be felt anteriorly, and the head of the tibia posteriorly. Extension and counter-extension with manipulation, at the hands of the surgeon, should suffice for reduction; the after-treatment being the same as in the former variety.

Lateral dislocations are generally incomplete, and if complete they are very apt to be compound. The patella is displaced and there is a laceration of the lateral as well as the crucial ligaments. There is no shortening of the limb, which is generally extended. Reduction is usually accomplished without difficulty by extension and counter-extension, combined with manipulation of the bone in the proper direction. The after-treatment is the same as in the other forms of dislocation of the knee.

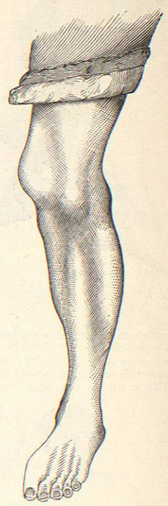

FIG. 1649.—Incomplete Outward Dislocation of Tibia.

In order to overcome the contraction of the powerful muscles of the limb, anæsthesia may be required in all dislocations of the knee. Extension and counter-extension by means of mechanical devices, as well as forced flexion and slight rotary movements of the tibia, may also be needed; yet we must bear well in mind at all times, in carrying out these procedures, the possible danger of seriously injuring the popliteal vessels. As a matter of fact this very injury may have already occurred at the time of the accident.

In rare instances the head of the tibia may be twisted outward or inward, and when the attempt is made to reduce the dislocation it will be found necessary to rotate in the opposite direction while extension and counter-extension are made.

Compound dislocations of the knee require the most thorough attention to aseptic details and possibly also to drainage. After reduction has been effected it will be necessary to apply an immovable straight dressing. In some cases it may even be necessary to resort to partial or complete excision of the joint. If ankylosis develops, the limb may be permitted to assume a position of slight flexion.

As a result of a sudden twisting of the leg, when semi-flexed, the semilunar cartilages may be forced from their natural position. Twisting the leg outward will displace the internal cartilage, while torsion inward displaces the external. The first indication of the fact that this has occurred will be a sharp, sickening pain in the knee, immediately following, in some cases, a perceptible snap. The knee remains fixed in its semi-flexed condition, and the cartilage may present an elevation on the outer or inner aspect of the knee—except in those cases in which the anterior edge is torn away and undergoes displacement inwardly toward the middle line, when there will be a slight depression opposite it. Recurrence is common. Reduction is effected by increasing the flexion and rotating the leg to the side of the displaced cartilage. If this does not succeed, flexion may alternate with slight extension and rotation. Synovitis, mild or severe, will follow, and rest

of the joint, with local measures to combat inflammation, must be resorted to. If a well-made knee-cap fails to secure the retention of the cartilage in its proper place, and if in consequence much inconvenience results, it must be removed under strict asepsis. Attempts at fixing it by other operative procedures will prove only annoying and futile.

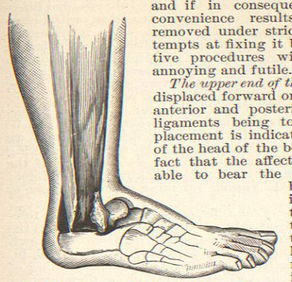

FIG. 1650.—Forward Dislocation of the Tarsus.

The upper end of the fibula may be displaced forward or backward, the anterior and posterior tibio-fibular ligaments being torn. This displacement is indicated by mobility of the head of the bone, and by the fact that the affected limb is unable to bear the weight of the body. By flexing the leg upon the thigh and thus relaxing the biceps, the head of the bone may be pushed into place. A moulded leather, gutta-percha, or binder's-board splint with a compress placed over the head of the bone, or a plaster-of-Paris dressing, should be applied; and in some cases it will be found necessary for the patient to wear such a dressing permanently.

The lower end of the fibula may be torn from its attachments and the foot displaced backward. By extension of the foot and manipulation the bone may be replaced, and maintained in its proper place by a fixed dressing of plaster-of-Paris or other material.

Dislocation of the Ankle, unaccompanied by fracture, is extremely rare, and is caused by a violent movement of the limb when the foot is fixed. It may occur in a direction forward, backward, or laterally.—In forward dislocation the foot will be lengthened and the heel shortened, while the tendo Achillis, resting against the tibia, will have lost its prominence. (Figs. 1652 and 1653.) For the reduction of this dislocation the leg should be flexed upon the thigh, in order to relax the soleus and the gastrocnemius; then extension should be applied to the foot and counter-extension to the knee. In some cases an anæsthetic may be needed, and possibly also subcutaneous section of the tendo Achillis. The foot should be kept at rest, with temporary splints, until the swelling has subsided; after which a plaster-of-Paris dressing may be applied.—In backward dislocation the foot, while in an extended position, may, through the action of some violent force, be drawn backward, until the tibia rests upon the neck or head of the astragalus, or upon the scaphoid or even as far forward as the cuneiform bones. (Figs. 1654 and 1655.) The foot will then appear shortened from the ankle forward, and the heel will be extended and elevated. At the same time the tendo Achillis will be unusually prominent and the toes will point downward. For the reduction of this dislocation counter-extension must be made from above the knee by an assistant, while the surgeon makes traction upon the foot and extends it with one hand, and with the other pushes the lower end of the tibia back. The after-treatment is the same as that advised for forward displacements. Section of the tendo Achillis facilitates the reduction and lessens the tendency to subsequent displacement.

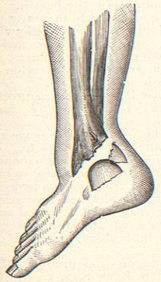

FIG. 1651.—Backward Dislocation of Tarsus.

In outward dislocation at the ankle we have marked eversion of the foot and prominence of the internal malleolus, the foot resting on its outer border. The deformity is the same as that of Pott's fracture, with which it is usually associated.

In inward dislocation, which occurs more rarely, the foot is inverted and the external malleolus is more prominent. In reducing it the surgeon must make extension from the foot and counter-extension from the leg, in combination with such manipulations as may be found necessary.

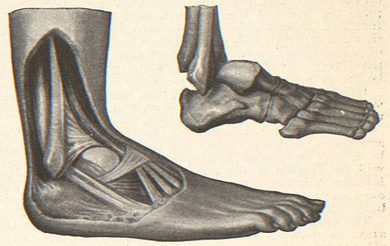

FIG. 1652. FIG. 1653.

FIGS. 1652 AND 1653.—Forward Dislocation of the Foot, the Front Part Appearing to be Lengthened Whilst the Heel Does Not Project to the Normal Extent.

If fracture accompanies the dislocation, which is the rule, we shall have crepitus, immediate recurrence after reduction, and the other signs of fracture accompanying the deformity of the peculiar dislocation. The after-treatment in all cases is similar to that needed for fracture. Temporary dressings are to be applied until all swelling and inflammation have subsided, and then the plaster-of-Paris or other dressing of a permanent character may be used.

In compound dislocations the following measures are of importance: thorough asepsis, free drainage, and excision, partial or complete; and if there is much suppuration, which must be carefully watched for, irrigation will be required.

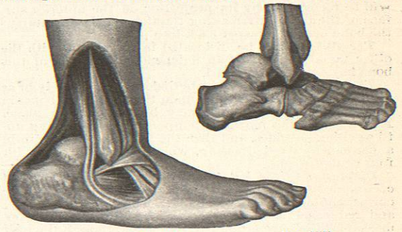

FIG. 1654. FIG. 1655.

FIGS. 1654 AND 1655.—Backward Displacement of the Foot, the Peroneal Tendons Being Placed Between the Astragalus and the Malleolus, and the Foot Apparently Shortened Whilst the Heel Projects Abnormally.

The Astragalus may be dislocated forward, backward, or laterally, or it may be rotated on its axis. In forward dislocation, which may be complete or incomplete, the

foot is generally inverted with the external malleolus prominent, and with an irregularly shaped prominence in front of the ankle. By flexing the leg upon the thigh and then resorting to extension and counter-extension from the foot and leg, the surgeon may be able to push the bone back into place. In some cases it may be necessary to divide the tendo Achillis or to resect the bone.

In posterior displacement the foot is shortened, the heel is prominent, and the tendo Achillis is stretched over the projecting end of the bone. Reduction may be accomplished by extension and counter-extension from the foot and leg. The latter, however, must first be flexed on the thigh, and in his manipulations the surgeon must push the bones of the leg backward and pull the foot forward. Anæsthesia may be required, and even with this assistance all efforts may prove ineffectual. In some of these cases, however, the foot may prove to be comparatively useful despite the deformity; in others it will be found necessary to resort to excision.

Lateral dislocations are, as a rule, associated with fracture of one or the other malleolus, and efforts at reduction, similar to those already cited, may be tried.

Dislocation by rotation is extremely rare. The astragalus, which occupies a position between the malleoli, may be turned vertically or transversely. There will be fixation of the ankle with change in its shape. Extension and counter-extension, with manipulation and even section of the tendo Achillis, may fail to restore the bone to its place, and excision may then be required.

The after-treatment, in these luxations, should be the same as that advised in the paragraph relating to the after-treatment of compound dislocations.

In subastragaloid dislocations we have the astragalus separated from its articulations with the scaphoid and os calcis, while yet retaining its connections with the bones of the leg. These dislocations result from the same causes as those which produce true dislocations of the astragalus; they may also occur in the same directions as the latter. As regards the diagnosis and treatment nothing additional needs to be said. If the injury is compound, amputation may be essential, either by Syme's or by the subastragaloid plan.

The Os Calcis becomes separated from the astragalus above and the cuboid in front only in rare cases. The heel will be distorted, and there will be inability to abduct or adduct the foot. This dislocation, which is easily recognized, will require anæsthesia and manipulation and pressure for its replacement.

Dislocation of the Scaphoid is also a rare accident and will be recognized by its projection on the anterior surface of the foot. By making traction on the metatarsus the bone may be pressed back into place.

The Cuboid may be dislocated in connection with the other tarsal bones, but an independent luxation of this bone has not been reported.

The Cuneiform Bones may be dislocated separately or as a whole. By exerting force upon the metatarsal bones in an outward direction, they may be pushed into place. All these injuries require a temporary fixed dressing until swelling subsides, and then the foot may be put up in a permanent fixed dressing, which should be worn for four or five weeks.

Dislocation of the Metatarsals and Phalanges of the Foot occurs much more rarely than it does in the case of the corresponding bones of the hand. The diagnosis is easy, and reduction is to be accomplished by the ordinary measures of manipulation and extension, though the task is more difficult in the case of the foot than in that of the hand. After the dislocation has been reduced a fixed dressing of plaster-of-Paris or a moulded splint of leather, gutta percha, or binder's board, should be worn for several weeks, to secure apposition and rest.

Duncan Eve.

DISSECTION AND OPERATION WOUNDS.—The class of wounds to be considered under the title are those wounds received in the course of surgical operations, or of post-mortem or other anatomical dissections, which induce in the wounded subject a more or less grave condition of local or general sepsis. Such wounds are generally received upon the hands or forearms, but, except in unimportant particulars, the seat of the original infection has no special bearing upon the course or the character of the ensuing disease, which, when it passes beyond the status of a local inflammation, is essentially a pyæmia, a septico-pyæmia, or a septicæmia, differing in no essential respect from these diseases occurring as the result of infection received in divers parts of the body, and in the pursuit of the most varied occupations.

A. Etiology.—In investigating the etiology of dissection and operation wounds, a microbial origin will be taken for granted without further discussion, and we shall proceed to consider, first, the nature of the infecting microbe; secondly, the effect upon its virulence of the source from whence it comes; and thirdly, the different types of disease the various infecting germs are prone to engender.

(*a*) *The Nature of the Infecting Microbe.*—That the foremost place as an infecting agent is to be assigned to the Streptococcus pyogenes, is to be inferred from our knowledge of septicæmic and pyæmic processes in general, induced through other means than by the performing of surgical operations and anatomical dissections, rather than to be gathered directly from the somewhat sparse records in medical literature of cases in which a bacteriological examination "en règle" has been reported. One decisive case of streptococcus infection is recorded by Harrington,[1] and is reported below.

The Staphylococcus pyogenes aureus is, probably, the next most frequent organism which can give rise to the septic processes we are considering. Though sometimes found in pure culture, it is perhaps still more frequently found in association with the preceding.

It is hardly to be doubted that any and all of the well-recognized "pyogenic" germs may, under favorable circumstances, give rise to a more or less virulent septic process, if inoculated on the hands of the surgeon or the pathologist, but the literary sources are not at hand to enable me to verify this at the present writing. Furthermore, the minor pyogenic germs, Staphylococcus albus, citreus, cereus flavus, epidermidis albus, etc., do not ordinarily manifest a sufficient degree of virulence to occasion severe dissection or operation wounds, even though they may sometimes cause some local inflammation.

Outside of the germs more frequently included under the head of "pyogenic," the anthrax bacillus may be mentioned as one apt to occasion a condition which would properly come under our title. I have no record of a case in which anthrax infection has occurred either during a surgical operation or during a post-mortem examination, yet Gaston alludes, rather indefinitely, to a case in which inoculation with anthrax occurred as the result of the breaking of a culture tube containing the bacilli.[2]

The bacillus of malignant œdema, which in many respects closely resembles that of anthrax, would likewise seem peculiarly apt to cause infection of operation wounds; yet we have the authoritative statement of Welch (1895) that "no instance is recorded of infection of a previously healthy person with this bacillus."[3] One of the French names for the disease it induces, "gangrène foudroyante," describes a condition occasionally characterizing dissection and operation wounds.

The Bacillus tuberculosis is notoriously the occasion of infection in the so-called "anatomical tubercle," or "necrogenic wart," which is prone to appear on the hands of those frequently employed in the dissecting-room. The occurrence of a local or general tuberculous process as the result of an infection during a surgical operation I have not been able to find recorded, but both local and general tuberculosis, arising from accidents to the fingers and hands in the bacteriological laboratory, are believed to be not uncommon.

The Bacillus coli, the Diplococcus pneumoniæ, the gonococcus, the bacillus of Eberth, have been known to cause pyæmic abscesses and have been found in the blood in some forms of septicæmia; that they should, however,

gain access to the tissues during operations or post-mortem examinations, and be able to multiply there in such a way as to occasion sepsis, seems, on the whole, unlikely.

The Klebs-Löffler bacillus, or Bacillus diphtheriæ, has frequently been the occasion of more or less severe diphtheritic processes following inoculations acquired during professional attendance upon diphtheritic patients. In one instance under the writer's observation, a sluggish and painful ulcer of the eyelid, which yielded a pure culture of this organism, followed an examination of a child's fauces, in which the patient had coughed in the face of the physician at the moment of the examination.

The virus of syphilis has repeatedly evoked a primary chancre on the hands and fingers of surgeons.

In many cases, as notably in that of Professor Park, detailed below, it has not been possible to identify the infecting agent, and in many cases also a mixed infection has been passed on from the patient to his physician, or has been acquired during the performance of autopsies.

(*b*) *The Effect upon the Virulence of the Infecting Germ of the Source from Whence it is Derived.*—Accurate statistical information on this particular branch of our investigations I have not had the opportunity to collect; indeed, the sparse records of dissection and operation wounds to be found in medical literature, of sufficiently recent date to throw any valuable light on this question, are remarkably deficient in their reports as to this phase of the problem. In considering the enormously enhanced virulence of the pathogenic organisms which we occasionally encounter in dissection and operation wounds, we are again driven to inferences derived from observations of the broad and complicated subject of the virulence of pathogenic bacteria in general, and I must content myself with some suggestions as to possible conditions which may enhance the virulence of the germs in question, rather than proceed to report a categorical list of recorded cases.

I would call attention, in the first place, to the means commonly made use of in the bacteriological laboratory to exalt at will the virulence of any given form of pathogenic germ, namely, the expedient of passing the organism through the body of a susceptible host. Particularly are the streptococci thus susceptible of manipulations calculated to enhance their virulence. To cite but a single instance of a well-known procedure, Denys and Marchand, in studying the Streptococcus pyogenes,[4] procured samples of these germs from four different sources, all four of very slight virulence, and for the purpose of comparing the effects of the inoculation of mild cultures with those of virulent cultures, multiplied the virulence of the original cultures by this means, until the increase in virulence, as measured by the size of the minimum fatal dose, was expressed by a factor not less than 10,000. Nothing, however, is ordinarily more difficult than to maintain this condition of exalted virulence in cultures grown in artificial media: each successive generation grown "in vitro" showing a great and progressive diminution in virulence.

Now it is this well-known attribute of the pyogenic bacteria which affords us a key to the enormously exaggerated virulence sometimes evident in the infecting agents of dissection and operation wounds.

We are daily made familiar with the occurrence of sepsis, more or less profound, occasioned by the infection of slight abrasions and minute wounds of the fingers and hands with pyogenic cocci inoculated upon these wounds from contact with inanimate objects; this "filth infection" may be very severe, and is occasionally fatal.

Let us once consider a case in which pyogenic bacteria, streptococci, if you choose, growing upon a splinter of wood, constitute a source of infection which we will call A; let us suppose that a mechanic infects his hand from this splinter of wood, and becomes himself, through the means of a "cellulitis" induced by these streptococci, a second source of infection, B. Let us further suppose that a culture is made from the mechanic's wound; after this culture has grown a certain length of time in a test tube, this becomes a third source of infection, C.

Now let us examine the comparative virulence of the three sources of infection: A, the "filth-infection"; B, the "direct infection"; and C, the "test-tube infection." The virulence of A we know, for we have just supposed it to have produced a more or less severe cellulitis on the hand of the mechanic. Let us suppose now, further, that the surgeon who dresses the mechanic's hand himself receives a minute scratch in the operation, and that this scratch is directly infected from the source B; the presumption is that a severe, possibly a fatal, septic process would develop in the person of the surgeon. Again, let us suppose that the bacteriologist (he, the surgeon, and the mechanic being equally robust men, with normal powers of resisting infection) breaks his test tube and cuts himself with the glass, infecting himself with the same germs, but from source C; the presumption, in this case, is that he would suffer from a septic process approximately equal in severity to the cellulitis on the hand of the mechanic; *i.e.*, in undergoing culture on an artificial medium, the septic germs would be liable to lose again the increment of virulence which they may be supposed to have acquired in passing through the human body; but, as we have seen in the case of the surgeon, direct inoculation from the septic focus on the hand of the mechanic manifests a very decided increase in the virulence of the germs, an increase acquired by their passage through a susceptible host.

This is what I conceive to be the essential difference, as far as an essential difference may be conceived to exist, between an ordinary case of septic infection and a "dissection or operation wound."

When we dwell upon the numerical size of the factors by which the virulence of a given germ may, under some circumstances, be multiplied—10,000; 100,000; or even 1,000,000,—we can form a conception of the extreme degree of virulence which some cases of direct infection, from man to man, may present.

The cruder ideas of wound infection, as being analogous to the simple process by which a sterilized infusion undergoes putrefaction when a single suitable germ is introduced, have been superseded, now that fuller investigation has shown the elaborate means of defence with which our bodies are provided to enable them to ward off the deleterious effects of pathogenic germs; and we can now better appreciate what powers of noxious influence a germ must possess which succeeds in overcoming all these barriers, and in accomplishing the undoing of a man or an animal.

It is a well-known biological law that exaltation of functions comes from their successful exercise. We speak of the acquired immunity of a man or of an animal to the noxious powers of certain germs, and we understand thereby that his defensive proteids either are present in greater quantity, or have acquired a higher potency. It is just as logical, however, to speak of the acquired immunity of a germ to the (to it) noxious powers of the human or the animal cells, and we may properly understand thereby that the analogous proteids of the bacteria, what we may call the "offensive proteids," either are formed in greater relative quantity, or have acquired a higher degree of virulence. Just as a man who has successfully struggled with the germ of typhoid fever is generally immune to attacks of the bacilli typhosi in the future, so a streptococcus which has succeeded in vanquishing the opposition to its development offered by the cells and the alexins in the serum of a human body may be conceived to carry with it an "acquired immunity" to the influence of such cells and such serum, if it pass directly from one human subject to another. And the more complete the victory of the germ over the human body cell, the more complete the "immunity" acquired by the germ against the defences of the human organism; and, ergo, the more apt is the germ to induce a grave type of infection, always provided the transmission is direct from one human host to another. Now, by way of illustration, bone marrow has been ascertained, by Wauters, to contain larger proportions of bactericidal substance than any other tissue of the body;[5]