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]

we may thence infer that bacteria which have succeeded in gaining a foothold in the bone marrow itself will be found to be possessed of a high degree of virulence, and we may accordingly expect to find, as indeed we do, that direct infection from a case of acute osteomyelitis will be apt to be very grave. Again, the highest stage of the triumph of pyogenic germs over the animal body is seen in the conditions known as septicæmia and pyæmia, and it is in just these cases that we find the danger of direct inoculation at a maximum.

In further support of this argument, as tending to show its converse, we may mention the fact that often, in cases in which the human or the animal organism is ultimately victorious over the germ infection, it is found that cultures taken at the beginning of the struggle are more virulent than those taken from the same case later on in its course, when a portion of the virulence of the infecting organisms seems to be overcome; *e.g.*, a beginning carbuncle may afford germs of far greater virulence than one over which the defences of the organism have in a measure successfully asserted their power.

We can now understand why it should have been universally observed that inoculations from severe septic cases are more prone, than those from the lighter forms of sepsis, to give rise to the type of surgical disease which is the subject of this article. Puerperal fever, pyæmia, septicæmia, carbuncles in their acute stage, malignant erysipelas, acute osteomyelitis, phlegmonous cellulitis, and suppurative peritonitis are most frequently named as the origin of dissection and operation wounds, whether from surgical operations proper, from surgical dressing, or from post-mortem examinations. These germs, when inoculated directly from man to man, occasionally, even if rarely, acquire an enormously enhanced virulence, exhibited at its maximum, however, only in cases of direct inoculation. Infected knives, sponges, dressings, or other objects may indeed carry the infection for some days, or even weeks, if not properly disinfected, but it is probable that the full degree of virulence that attends direct inoculation at the time of operation, or at the moment of a post-mortem examination, would not be manifest in an infection conveyed by the same germs at a later period, after the lapse, that is, of an interval during which the germs, even if surviving, were exposed to influences, such as desiccation or chilling, comparatively unfavorable to their existence, or at least to the maintenance of one of their more unstable characteristics, their virulence.

On this same basis, likewise, is to be explained the notable difference in the comparative danger of a wound received at a recent, with one received at a delayed autopsy. In the first case, the remaining bodily warmth, and the absence of the further development of the defensive proteids on the part of the dead subject, allow the bacteria to develop under conditions most favorable for their growth; in the second case, the chilling of the body, and, likely enough, the beginning decomposition of the tissues, and the struggle for existence with saprophytic bacteria, so affect the environment as to yield a less suitable culture medium for the pyogenic germs, which, continuing indeed to grow, yet develop under less favorable circumstances, and consequently lose that acme of virulence which manifests itself only under peculiarly favorable conditions of growth.

A phenomenon analogous to the greater danger of direct, man-to-man infection as compared to indirect, filth infection, lies in the well-known occasional virulence of the bites of animals. Here, too, septic conditions are sometimes communicated in which germs are directly transferred from one host to another, in a condition of "exalted virulence"; indeed, the bite of a man is not less dreaded than that of some of the lower animals.

Cases of exalted virulence of the infecting germs, due to direct transference, were not infrequently seen when "arm-to-arm" vaccination was still in vogue, where apparently healthy children communicated severe disease to others.

The experiments of Fehleisen tend to show another reason for the greater danger of "direct inoculation" as compared with "filth infection." This observer[6] showed that a minimal quantity of an artificial culture of staphylococcus aureus added to a little of the clear serum obtained from the germ-free zone of inflammatory œdema around a spreading cellulitis, was capable of producing extensive abscesses, whereas the mixture of the same organism with water had no effect. The inference is that the bacteria, in the first case, were accompanied by their toxins, and entered the contest armed, as it were, for the fray; while in the second case, the bacteria were washed free from their toxins, and were unable to gain a foothold in the tissues until their toxins were again secreted in sufficient quantity to weaken the defence of the tissue cells; in the case of these particular experiments, the staphylococci employed were unable to do this in time to prevent their destruction by phagocytosis. Now, in cases of direct inoculation, the bacteria will be more likely, than in cases of filth infection, to be accompanied each with its minute quantum of toxins, which will enable them to increase and multiply, where similar germs, without the accompanying toxins, would be exterminated.

In conclusion let me say that to ascribe, as some were inclined to do, when the germ theory of disease was younger, a special and peculiar infecting agent to dissection and operation wounds, on account of their occasional extreme virulence, is entirely gratuitous and uncalled for. Ample explanation can be given for all the phenomena observed, if we distinguish clearly between the differing possibilities of gravity in cases of direct inoculation, as compared with ordinary filth infection.

Having now considered the nature of the germs which give rise to dissection and operation wounds, and the effect upon the virulence of the infecting germs of the source from which they are derived, it now behooves us to consider:

(*a*) *The Types of Disease These Infecting Germs are Prone to Engender.*—Of the germs which were mentioned under (*a*), as possible causes of dissection and operation wounds, it is unnecessary to describe the type of disease which would be likely to follow the inoculation of the more specific forms: the anthrax bacillus, the bacillus of malignant œdema, the tubercle bacillus, and the Bacillus diphtheriæ would all of them be likely to give rise to more or less characteristic lesions, whose description may be sought under the appropriate headings elsewhere in this work. The virus of syphilis would give rise to a hard chancre. Indeed it is doubtful whether the lesions which these germs produce are properly classed under our heading, and they are mentioned rather for the sake of rounding out the subject than for their actual importance as frequent causes of dissection and operation wounds; and we shall not have further occasion to consider them here, as we shall confine our future discussion to lesions caused by the "pyogenic" germs proper, whether in pure or in mixed infection.

Now the name "pyogenic" implies that the most characteristic result of infection with these germs is the formation of pus; yet though this is the characteristic outcome of such infections, this result does not always follow, nor yet is its appearance, in any true sense, a measure of the virulence or of the gravity of the infection. Suppuration, indeed, represents the most intense and complete *local* action of these bacteria, but the less advanced forms of inflammation are always precedent stages of suppurative action, and very extensive and dangerous lesions may fatally compromise the vitality of the patient without the presence of pus in any one focus; this, too, with staphylococcus infection, with streptococcus infection, and with mixed infections of the two germs. Says Welch: "All of the affections caused by one species of the pyogenic cocci may be caused by any of the others. For example, the Staphylococcus aureus may produce spreading phlegmons, inflammations of serous membranes, puerperal infections, general septicæmia, as well as the Streptococcus pyogenes, and the Streptococcus pyogenes may cause circumscribed abscesses and ostcomyelitis, as well as the yellow or white staphylococcus. Jordan claims that the Staphylococcus

aureus may cause erysipelas, but Petruschky does not regard his observations on this point as conclusive."

"Furthermore, these pyogenic staphylococci and streptococci may cause all kinds of inflammation besides the suppurative. They may, and often do cause serous, sero-fibrinous, and fibrinous inflammations of serous membranes. The Streptococcus pyogenes may cause catarrhal and fibrinous inflammations of mucous membranes. Pyogenic cocci may be the sole cause of simple inflammatory œdema or serous infiltration of the tissues. They are sometimes found in cutaneous vesicles and blebs containing clear serum. They may be the sole organisms present when the inflammatory exudate is hemorrhagic. They may produce extensive necrosis of the tissues with scarcely any inflammatory exudate. We find the same staphylococci and streptococci in those rarer forms of osteomyelitis which do not suppurate, as in the ordinary suppurative form. They are the usual cause of periostitis and ostitis albuminosa, in which the exudate is serous. A serous or sero-fibrinous inflammation caused by pyogenic cocci may be transformed into a purulent one without the appearance of any new species of micro-organism."[7]

While we recognize, as above related, the great variety of lesions to which the pyogenic cocci may give rise, and also the fact that any of these protean forms of disease may, with the possible exception of erysipelas, be occasioned either by the Staphylococcus aureus, or by the Streptococcus pyogenes, or by a mixed infection of both germs, yet, nevertheless, the more typical characteristics of infection by one of these germs, as distinguished from the other, can very often be made out. It is the general tendency of the staphylococcus to form circumscribed abscesses, surrounded by a distinctly marked zone of dense inflammatory exudate; while it is equally the tendency of the streptococcus to excite spreading phlegmonous processes along the connective-tissue planes, and to invade the lymphatic vessels and glands.

Mixed infections of the two cocci may take on the characteristics of both, or may follow the type of either one Mixed infections, when either the staphylococcus or the streptococcus is in combination with some other non-pyogenic form of bacteria, may follow either the staphylococcic or the streptococcic type, or may present a more confused type of inflammation. The importance of distinguishing, if possible, the cause of the infection lies in its bearing on the prognosis, which becomes most grave in the presence of the streptococcus.

B. Pathogenesis.—We shall consider under this head, first, the type of wound by which infection is prone to occur; secondly, the condition of the constitution which favors spreading of the infection; thirdly, the various forms of internal resistance offered to the advancement and multiplication of the microbes; and, fourthly, the means of eliminating the microbes and their products from the system.

(*a*) *The Type of Wound through which Infection is Prone to Occur.*—As a matter of fact, the wounds through which septic infection has been received during the performance of surgical operations and post-mortem examinations, have been, for the most part, in themselves most trifling; generally slight scratches or abrasions, superficial cuts, punctures from needles, and, in a not inconsiderable proportion of cases, lesions either literally microscopic, or so small as to defy discovery after minute examination.

Inasmuch as other types of wounds, as a matter of fact, do not occur under the circumstances, we are not able to institute comparisons between the behavior of one type or of another type of operation wounds, but there are some reasons which lead us to suppose that the type of wound ordinarily received during surgical operations and post-mortem examinations is not without influence upon the subsequent development of sepsis in their recipients. Two reasons would lead one *a priori* to suppose that the class of wounds described above would be more prone to permit the development of severe sepsis than deeper or more extensive traumata, and of these the first has reference to their *superficial position*.

Especially in cases of slight abrasion of the skin, the infecting bacteria are apt to be implanted directly into the cutaneous lymph channels. Now three several circumstances combine to make such a lodgment of the bacteria one particularly favorable to their subsequent development. First, the most dreaded type of infecting germ, the Streptococcus pyogenes, has notoriously its favorite habitat just here, as it will be remembered that not only does the streptococcus tend in general to accumulate particularly, and sometimes almost exclusively, in the lymph spaces, but that the invasion of the cutaneous lymph spaces is *par excellence* the attribute of this streptococcus, which is now generally conceded to be identical with the Streptococcus erysipelatis of Fehleisen.

Secondly, aside from the specific type of the infecting germ, experiment has indicated, with other forms of bacteria also besides the streptococci, that actual infection of the organism occurs via the lymph channels. The following experiments have been instituted to demonstrate this conclusion[8]: Rabbits were first inoculated on the tip of one extremity with anthrax cultures, and observations were made as to the length of time necessary for the bacilli to reach the lymph glands; a certain number of observations established more or less exactly the time necessary for this to occur. The extremities of other rabbits, similarly inoculated, were amputated before the lapse of the minimum time necessary for the anthrax bacilli to reach the lymph glands; these animals survived, while those whose extremities were amputated after the critical time perished. The inference drawn is that infection must occur through the lymph channels and not through the sanguineous circulation, else amputation of the extremity had not rescued the inoculated animals. Though this can hardly be said to constitute rigid proof that pyogenic infection constantly occurs in this way, yet it gives ground for the suggestion that a slight abrasion opening the lymph channels without affecting directly the deeper tissues might afford an exceptionally favorable portal of entry to septic germs. The experience of public vaccinators in general would seem to support this same idea, inasmuch as they assure us that vaccination is far more likely to "take" if the scarification of the skin, for the purpose of introducing the vaccine, is not made sufficiently deep to occasion actual bleeding.

The third circumstance, which makes a superficial wound or abrasion one which is prone to septic involvement, is the circumstance that, from the mere fact of its superficiality, it is in a measure removed from the defensive apparatus of the animal economy, and germs there entering are less freely exposed, than those deeper ensconced, to the protective influences of chemotaxis and phagocytosis. Germs implanted in the connective tissue proper have far less chance of survival than those introduced directly into the cutaneous or other lymphatic channels. Not only the observations of Wauters, already referred to above, but those also of Marmorek and of others, have established the fact that the connective tissue is the most efficient defender against bacterial invasion, owing largely to the fact that this tissue contains in itself a comparatively high proportion of actively bactericidal substance. But Marmorek further asserts that the observed fact of the unstable foothold obtained, as a rule, by pathogenic germs in many parts of the body, depends not only on a special antibacterial force, but is also in close relationship with strictly anatomical conditions. When the bacteria have once succeeded, owing to the prevalence of their virulence or of their number, in overpassing the zone of protective infiltration in the connective tissue, they have, *ipso facto*, overcome the "first system of defence" at that point. They then, at length, obtain a foothold in a lymph vessel, and thence extend themselves to the lymph glands; the lymphatic system he regards as the organ of the "second line of defence."[9] Thus, pyogenic germs inoculated immediately into the cutaneous lymphatics are introduced within, or we may say behind, the outer defences of the body, and so are, in a measure, relieved of a portion of the combat for supremacy with the cells of the animal microcosm.