behold! these buildings all converted into palaces of equal beauty, sumptuousness, and magnificence! And these inhabitants—all transfigured! all strong, noble, intelligent, learned, rich, luxurious, free, and secure in every right or privilege acquirable by man! Alas! such a condition is not maintainable! Humanity may be crushed, but cannot be elevated, to a common level. Crush society to a common level, and the result will be a common condition of barbarism or brutality. Utopian philosophers and pious dreamers, of all ages and nationalities, have imagined and predicted the coming of all manner of impossible conditions of society, equally chimerical, because implying unification of human qualities, capabilities and necessities, and a final solidarity of good, and disappearance of evil. But whether pietistic or political, such prophetic dreams have ever been discredited by disappointment, as they ever will be, so long as the conditions of mankind are determined by growth and environment, and not by miraculous interpositions of hypothetical influences, which cannot be rationally contemplated, because of implied disturbances of the relations of sequences to antecedents, which it is impossible to regard as otherwise than inevitable.

ARE CONSERVATIVE AMPUTATIONS ALWAYS IN THE BEST INTER- ESTS OF THE PATIENT?

Read before the Mississippi Valley Medical Association, St. Louis, Mo., October 16, 1897.

BY CHARLES TRUAX,
OF CHICAGO.

In pre aseptic days, amputations were properly governed by an inflexible rule which taught that the first duty of the surgeon was to save every possible ounce of tissue, because, first, experience had demonstrated that the nearer the point of amputation approached the trunk and the broader the stump, the greater the risk of life; second, it was generally believed that in all cases the usefulness of a stump increased with its length.

These principles, still taught in all of our standard text-books (save one) and having been practiced by every eminent operator from the first records of surgery down to the days of asepsis, are in general use to day—although the conditions forming the basis for their advocacy no longer exist, at least in their former weight and importance.

The first of these principles was formulated at a time when pyæmia, septicæmia, or like complication endangered the life of nearly every patient who submitted to an amputation, so that even if the patient survived both the original condition and the operation, his life was still in danger from some one of these dread maladies.

It was found that this danger increased with the size and extent of the wound, so that surgeons were unconsciously led to vie with each other in their efforts to amputate with the least sacrifice of parts.

When the principles promulgated by the eminent Lister came into general use, they practically sounded the death knell of those forms of disease resulting from external wounds, and rendered obsolete the infallibility of the so-called "golden rule" which taught conservatism in amputations under all circumstances, for statistics collected from the records of nearly one thousand surgeons, embracing only such amputations as have been performed since 1885, prove conclusively that there are at least some exceptions to this rule.

Admitting it to have been a fact that, in the earlier history of prosthetical art, the longer the stump remaining after an amputation the greater was its value, it does not follow that it is so today, and I trust to be able to demonstrate that in some classes of cases and with certain limits the value or usefulness of a stump actually decreases with its length.

During the past quarter of a century the development of prosthetical science has advanced with a rapidity unprecedented in the history of the art. The first of the two great causes which stimulated this development may be found in the dreadful carnage and mutilation observed in the late Civil War which left thousands of veterans maimed by the loss of one or more limbs, for whom it was necessary to provide artificial substitutes.

The second, and now the most important factor in producing injuries necessitating amputation, is the great increase in the volume of machinery in use and the velocity with which much of it is operated. These two causes, combined with others of minor importance, have increased the demand for artificial limbs and developed a competition that has called forth the best efforts of our inventors, resulting in improvements so wide and varied in their extent as to place American artificial limbs, in point of efficiency and durability, second to none. To so high a state has the art been advanced that, under favorable conditions, makers of such appliances are enabled to construct artificial legs that permit the wearer to live and move in society without his being known or considered as a cripple.

An examination of a given number of applicants for artificial legs will, I think, demonstrate that only a moderate number are what may be termed favorable cases; *i. e.*, those permitting the use of the most perfect and complete forms of mechanism. Aside from these, a fair number could be selected for which limbs could be constructed that would furnish means for locomotion which, though more or less imperfect, would

be accepted by the patient as the best results that could have been provided, on account of the nature of the disease or injury. The balance of these applicants (and of the three classes they would scarcely represent the minority) can, at best, only secure unsatisfactory or miserable means of support, and for these subjects, unless they be in quite comfortable circumstances, life can only promise to be a burden.

Experience and investigation has convinced me that the percentage of favorable cases can be largely increased provided surgeons will familiarize themselves with the necessary mechanism of ordinary artificial legs and the relations existing between them and the stumps on which they are to be worn, and select their point of amputation accordingly.

If, out of a given number of cases, say only one third of them are at the present time favorable ones, is it not possible to largely increase the number by amputating only at points which will provide stumps that are favorable? And if this be possible, is it not the duty of surgeons to familiarize themselves with these points and the reasons for their selection and, as Stephen Smith has well expressed it, "Have a humane regard for humane surgery?"

Notwithstanding that the old Golden Rule has been firmly impressed upon the minds of graduates and practitioners by the writings and teachings of standard authors from time immemorial, it is still a fact that a fair percentage of the more careful, conscientious and progressive surgeons of the present day have for some time been operating to a greater or lesser extent on an entirely new system—not only a new system but one that is in direct opposition to the ideas and principles that for ages have been accepted without question.

The old system as previously stated, was in all cases to perform an amputation with the least possible sacrifice of parts. The new system does not interfere with this in stumps for prehensile purposes, but in operations in the lower extremities it teaches that amputations should be made at such points as will enable instrument makers to construct the best possible form of artificial substitutes even if in so doing the surgeon removes tissues that, under former methods, would have been permitted to remain. The question of saving an inch or two, or even more, in the length of a stump is of no importance if its removal will secure a stump permitting the application of a more perfect and satisfactory appliance.

The conditions essential to a favorable stump for locomotion are a conical form without sharp corners or protuberances, with cicatrix underneath and preferably at the posterior margin, and length enough to obtain a good bearing in the stump socket. If these requirements are

complied with and the stump possesses the necessary firmness to bear the contact with the socket, the patient, if properly fitted, will be enabled to operate the artificial part of the member in such unison with the natural portion that detection of the former is almost if not quite impossible.

Fig. 1. Showing Section of a Thigh Socket.

The section of a thigh socket here shown will, I think, show why it is necessary that leg stumps should be of a conical form and may, at the same time, demonstrate that our text-books are in error when they teach that stumps should be so formed that they may bear more or less of the weight of the patient on their ends. When a section has been made through a bone, if the cut surface be not covered by an osteoplastic operation, no weight can be borne on the end of the stump. If surgeons will make their amputations at proper points not one ounce of weight need be carried by patients on the ends of their stumps.

It is a fact easily proven that, in most cases where a stump is so formed as to necessitate its bearing a portion of the weight of the patient on its end, it is usually a source of annoyance, because it not only forms an inferior means of support, but as the late Dr. Gross well expressed it, "it is constantly liable from the slightest causes to pain, irritation and ulceration."

As the internal diameter of a well formed socket decreases from above downwards (see illustration) and as its carrying power depends largely on the lateral pressure of the stump against its converging walls, it is evident that if the stump be of a conical form it will distribute the weight or pressure surface over a larger extent of the limb.

These sockets are carved or cut from the inside and so shaped that they fit the exterior of the stump as accurately as a kid glove does the hand, consequently the more circular the stump and the more nearly free it is from all uneven surfaces, the more perfectly it can be adjusted.

The position of the cicatrix must depend largely on the method employed in the operation. In selecting this method the surgeon should, by all means, locate the cicatrix to one side of the end of the bone and posteriorly if possible.

In amputations of the femur the value of the stump to the patient increases with its length until it reaches a point where this length precludes the use of what is known as the long or cylindrical form or joint.

In order, then, to choose the proper point in amputations of the lower third of femur, it is only necessary to learn the amount of space requisite for the working of this joint and where possible if there be no increased risk of life, operate

accordingly. By actual measurement, we find that in an adult this joint can be inserted and successfully used in an artificial limb provided three inches are removed from the lower end of the bone. Here, then, is the point of election and the one that should be adopted if circumstances be favorable.

In amputations of the tibia, the value of the stump also increases with its length, and the same rule should be applied as in the case of the femur, excepting that the point of election should be the juncture of the lower and middle thirds. Here the amount of surface exposed to the lateral pressure of the socket is not of as much importance as in thigh stumps, because the weight of the body is principally carried by the condyles of the head of the tibia. These afford a firm, unyielding surface which, when once well fitted with a socket, will, if necessary, carry the whole weight of the patient. It is, however, preferable to secure the advantages of a natural, conical-shaped stump by amputating below the calf, and thus increasing the bearing surface, and removing a part of the pressure from the head of the bone. Further, the amount of leverage increases with the length of the stump, so that if the operation be performed at the point indicated, the patient will have better control over the artificial limb than if the operation be at a higher point.

This point of election not only gives to the patient every benefit offered by amputations at or near the ankle, but it enables the instrument maker to display his mechanical ability to the greatest possible advantage.

Following injuries involving the middle and upper thirds of the tibia, many works on surgery advocate the leaving of short tibial stumps, that the patient may be provided with what are known as knee-bearing legs, or those in which the weight is taken on the anterior aspect of the flexed limb. It seems almost unnecessary to present arguments to demonstrate that such limbs would be clumsy appliances at best, owing to the imperfect connection between the natural and artificial portions. Short tibial stumps usually contract to a greater or lesser extent, and for this reason should be avoided. I would say that an amputation should not be performed within 3 inches of the joint. In cases where only from 3 to 4 inches of the tibia can be preserved, and there be no danger from inflammation in the joint, it would seem better, from my standpoint, to excise the remaining portion of the fibula. Its presence is of no benefit to the patient, while its removal facilitates the forming of a more conical stump, and insures a greater degree of firmness therein. Several cases have come to my knowledge, where the pressure of an artificial limb socket on the remaining fragment of fibula has proven a constant source of pain and discomfort, and one or two cases of ulceration I believe were due to this cause.

The fundamental principle that forms the basis for the new theory is the fact that the successful operation of a limb, whether natural or artificial, depends largely on the action of its joints. Therefore, unless the surgeon amputates at points that not only leave the natural joint intact, but provide below it sufficient leverage to swing the substituted portion, he will interpose obstacles in the way of the instrument maker that will prevent the construction of the best form of appliance.

To amputate through the knee or ankle-joint is to assume the position of the dog in the manger, for the remaining structures occupying the half of the space of the joint are of no use to either the surgeon or patient, but take up room that should be used for joint mechanism. The natural half of a joint remaining after a knee or ankle disarticulation is of no more use to the patient than the odd half of a pair of shears, for only in a limited number of cases can much, if any, weight be borne by the ends of the bones.

It is true that external knee-joints of the carpenter's rule pattern, such as are used in deformity braces and a sample of which is here shown (Fig. 2), can be employed after amputations either through or close to the articulation. Experience, however, has demonstrated that this joint is not a suitable one for long continued service if compelled to carry a weight.

Fig. 2. Showing Rule Bearing Joint.

It required only a brief experience in the construction of artificial limbs to satisfactorily demonstrate to my mind that patients in large numbers are being crippled annually by tarsal and tibio-tarsal amputations, but it was with considerable hesitancy, even after an extensive investigation, that I first dared to advise the entire abandonment of all operations of this class.

My researches extended through the range of mechanics, I examined the laws governing the physiology of locomotion, inspected patients and their appliances from an esthetical standpoint, investigated the relative first cost of the various forms of compensative apparatus, and the approximate yearly expense necessary to keep them in order, collected statistics showing comparative results following tibial on the one hand, and tibio-tarsal, tarsal and tarso-metatarsal amputations on the other, ascertained the risk of life in these two classes of operations, and liability to re-amputation, and placed on record, for the first time, statistics showing the practical value to the

patient of these two classes of stumps, and in each instance arrived at the same result (*North American Practitioner*, July, 1891); and I stand here to-day in defense of this position, knowing that, so far as I have any knowledge, I am opposing the teachings of every standard work on surgery except the writings of Stephen Smith.

From a mechanical standpoint, we find the same principles operating in the case of the ankle as in the knee-joint, and unless the stump be short enough for the insertion of some form of a cylindrical joint like the one here shown

Fig. 3. Showing Cylindrical Joint.

(Fig. 3), or its equivalent, the manufacturer is compelled to resort to the rule pattern previously referred to. The latter, besides wearing away quickly, will not withstand heavy lateral strains. The operation and use of these rule joints is very unsatisfactory to the patient, and the necessity for their use should be avoided.

The laws of the physiology of locomotion show conclusively that the foot, or a portion of it, cannot be adequately substituted. It is true that Syme's operation will admit of the use of a whole artificial foot, but as its successful operation must depend on certain forms of construction and methods of attachment, unless there be space for the insertion of such mechanism, the foot will be more or less helpless and the patient crippled. Ease and grace in walking are not attainable unless the lower limbs are provided with levers or propellers by which the body is moved forward. Remove these levers at or below the ankle, and the patient is compelled to assume an awkward, limping gait, even if assisted by the best artificial substitutes made.

The principle of the lever is well exhibited in the flexion and extension of the foot while walking, the foot itself being the lever, the Tendo-Achilles furnishing the power, the ground the fulcrum, and the body the weight to be moved. To take a complete step forward necessitates the raising of this weight, because the trunk, at the time when the forward foot is planted on the ground (being then midway between its two

oblique supports), has dropped until the pelvis is on a lower plane than before the step was commenced. The completion of the step requires the raising of the trunk to its original level. This elevation of the body is accomplished by the exercise of the lever power, because the extension of the foot then in the rear forces the body forward until the trunk is in a position perpendicularly over its advanced limb, and the step completed.

In walking, the heel and ankle rise on the ball of the foot, and by the lengthening of the limb caused by the extension of the foot, the body is forced forward, and is raised by the changing of its supporting limb from an inclined to an upright position. This falling and raising of the trunk produces the undulating motion so noticeable in walking.

If one or both of these levers are amputated at points where they cannot be artificially replaced, an awkward, limping gait will result. If one lever be removed, it becomes necessary for the patient to take a shorter step with the sound limb, otherwise he would be unable, for want of the extension previously referred to, to complete the movement—at least, without undue exertion. It is evident that the longer the stride, the lower the level reached by the pelvis, just as increasing the length of the base of a right-angled triangle decreases the height of the perpendicular, provided the hypotenuse remains the same. The taking of a short step with the sound limb, however, does not entirely compensate for the loss of a foot, but usually compels the patient to adopt a lurching movement of the body. This lurching, due to rotation of the pelvis upon the hip of the sound limb, is frequently assisted by a greater flexion and extension of both knees. These movements, whether made use of singly or conjointly, are directed toward the accomplishment of the same result, viz., the forward propulsion of the body, and the consequent elevation of the trunk until it has reached the level occupied by it before the step is commenced. Patients who have suffered amputations of this class, after being provided with artificial substitutes, rarely walk as well (and to walk at all requires the outlay of more labor) as where the amputation has been performed through the tibia. I have examined several patients with double tarsal amputations, and in each instance found them taking short, mincing steps, while those with double amputations of the tibia usually take full-length steps.

From a financial point of view, artificial limbs for Symes operations usually cost as much as if made for amputations at a higher point, but stumps resulting from osteoplastic, sub-astragaloid, medio-tarsal and tarso-metatarsal operations can be furnished with appliances at about two-thirds their cost. A full-length artificial limb,

however, *i. e.*, for amputation above the ankle, can be purchased from most manufacturers with a five years' guarantee as to durability, during which time it will cost practically nothing to keep it in order. Such a limb will wear from five to twelve years, while those for stumps ending at or below the ankle will usually last only from two to four years, and be out of order a good part of the time at that.

More important than, or rather the cause of the loss of the lever principle following tarsal amputations, is the breaking down or total removal of the arch of the foot, and it matters not which one of the specific operations of this class is employed, nothing is left of the arch that affords even a slight degree of elasticity; in short, the string of the bow is gone and the bow itself broken.

From a statistical point of view, I find that out of 2,135 tibial amputations reported to me as being performed between the years 1885 and 1891, 90.7 per cent. resulted in healthy stumps; 3.1 per cent. suffered re-amputation, while 5 per cent. died, leaving only 4.3 per cent. of stumps (including the re-amputations) upon which compensative appliances could not be worn. Of these tibial cases, 962 were seen by the surgeons after they were wearing, or had attempted to wear, an artificial limb, 86.9 per cent. of which walked with an easy movement and a comparatively graceful step.

Of 658 tarsal and tibio-tarsal amputations reported at the same time, 82.7 per cent. resulted in sound, healthy stumps; 8.3 per cent. underwent re-amputation, while 3.2 per cent. died, leaving 14 per cent. (including re-amputations) upon which prosthetical apparatus could not be worn. In this class of cases, 169 were seen after attempting the use of compensative appliances, 54.4 per cent. of which could walk well.

If we can judge correctly from the foregoing statistics, in every 100 cases of each of these classes of operations, we may reasonably expect the death loss to be in favor of tarsal operations as 5 per cent. is to 3.2 (but it must be borne in mind that in the majority of these cases reported the tibial operations were performed in preference to the tarsal, because of the greater extent of the injury, and the difference in mortality may safely be attributed to shock or complicating injury, and not to the fact that the operations were made nearer the trunk), while the ratio of re-amputations necessary will be in favor of tibial amputations as 8.3 is to 3.1. The number of healthy stumps resulting from these operations would be in favor of tibial operations as 90.7 is to 82.7, while the number of unhealthy stumps would also be in our favor, as 4.3 is to 14. Of those who attempt to wear artificial substitutes, we may expect to get favorable results in 82.9 in tibial and 54.4 following tarsal operations.

Owing to the unsatisfactory service resulting from the use of artificial arms and hands, the surgeon is not warranted in adopting radical methods in treating injuries or disease in the upper extremities. On the contrary, he should exhaust the last resources of conservative surgery and save all of the parts possible.

Instead of the old conservative so called Golden Rule which has formed the basis for amputations for ages, I would recommend, from my experience as a manufacturer and from the foregoing review of the question, the following: Avoid amputating within three inches of the knee joint; do not amputate between the metatarsal bones and the junction of the lower and middle thirds of the tibia; at all other points save all you can, and you will, in every case, have done the best for your patients.

In conclusion, I will state that from the evidence at my command, I believe that I am justified in stating that the so called conservative amputations of the lower extremity are not always in the best interest of the patient.

75 and 77 Wabash ave.

SOCIETY PROCEEDINGS.

American Public Health Association.

Nineteenth Annual Meeting, held in Kansas City, Missouri, October 20, 21, 22 and 23, 1891.

FIRST DAY—MORNING SESSION.

The Association convened in the auditorium of the Warder Grand Opera House, and was called to order at 10 A.M. by the President, Frederick Montizambert, M.D., F.R.C.S., D.C.L., of Quebec.

Prayer was offered by the Rev. Samuel N. Neel.

After considerable preliminary work, the reading of papers was proceeded with.

Dr. C. D. McDonald, of Kansas City, read a paper on

THE CAUSE AND PREVENTION OF INFANT MORTALITY.

He gave statistics showing that infant mortality soon after birth was 20 per cent. One of the principal causes was the exposure to a low temperature—a chilly room—soon after birth. He had been present when it had been necessary to wear an overcoat in a room where a newly-born child was exposed to bathing. Forcing sleep by soothing syrups to overcome the effects of this exposure was another evil. Another trouble was the forcing of food, such as crackers, and water and whisky into the young, inert stomach of the newly born. The mother who