of gas by *M. pinocy* Cast., the presumption is that the liquid contained three sugars—glucose, levulose, and malose. The explanation is found in the fact that *M. belanica* Cast. ferments with production of gas glucose only; *M. krusei* Cast, glucose and levulose; *M. pinocy* Cast., glucose, levulose, and malose.

There are, however, in certain circumstances some sources of error, but with these, as well as the precautions for avoiding them, and with the whole subject of the presence of more than one reducing substance, we propose dealing in a future paper.

**Application of the Method to the Detection of Certain Non-reducing Substances.**

The method, using certain species of fungi and bacteria, may be applied also in assaying in the detection of these other substances—saccharin, saccharate, dextrin, etc. To help in the identification of saccharose, for instance, make a 1 per cent. peptone water solution of the substance to be examined, and inoculate two of the tubes of the solution with two germs (bacteria or monilias or saccharomyces) identical in all their biochemical reactions except on saccharose; for instance, inoculate No. 1 with *B. coli* Esch. and No. 2 with *B. pseudocole* Cast. If after forty-eight hours' incubation at 37° C. No. 1 shows absence of gas, while gas is present in No. 2, the sugar is saccharose.

With this subject also we propose dealing more fully in a future paper.

**Use of the Method in Urine Analysis.**

From a number of experiments we have carried out, making the number of urines in which sugars and other carbohydrates, and also from a few pathological specimens, we can say that the method can be used in urine analysis for the detection and differentiation of certain sugars and other substances—glucose, levulose, lactose, pentose, etc.—provided that the amount of such substances present is not too minute (not less than 0.1 per cent.). The urine is distributed in sterile tubes containing Durham's fermentation tubes or similar devices and inoculated with the organisms mentioned in the table and key. Two points of considerable importance are (1) the urine must be aseptic; if it cannot be collected aseptically it should be sterilized as soon as possible—after distribution in the tubes—by heating in Koch's steamer for thirty minutes on two or three consecutive days. It should never be autoclaved, as this procedure may alter the characters of the sugars and other carbohydrates present. (2) It is of great advantage to add a third or the same amount of peptone water to the urine before inoculation, otherwise the organisms may grow very scantily, and there may be no production of gas.

**A METHOD OF SKIN GRAFTING UNDER SEPTIC CONDITIONS.**

**BY PAUL BOUSFIELD, M.R.C.S., L.R.C.P., RESIDENT SURGEON, AMERICAN WOMEN'S HOSPITAL FOR OFFICERS, LONDON.**

The difficulty which has arisen in connexion with skin grafting is recognized by most military surgeons. In a considerable number of instances they have not overcome the generally septic conditions prevalent. Hitherto the first principle of successful skin grafting has been the most rigid asepsis, without using antiseptic solutions or on the raw surface of the wound, since efficient antiseptic solutions have proved fatal to the living grafts as the bacteria which they sought to eradicate. As a rule, the only solution used by most surgeons has been normal saline. Another difficulty arises when a patient has multiple wounds and the wound to be grafted cannot therefore be used in the best possible position, so that the grafts are sometimes pulled out of place in handling the dressings.

By the method described I have been able to obtain successful grafts on areas which, though "clean" to the naked eye, were still actually suppurating, dressings which had been left on for twenty-four hours showing a certain amount of pus, and even possessing an offensive odour.

The following is a case which seemed less promising of the beginning than any other I have dealt with:

The patient had been wounded in the arm, the head, the back, and the left thigh. The wound in the arm had necessitated a major amputation, France, which had remained septic; the wound in the thigh had been exposed in France, and when I received the patient in England it consisted of an area on the posterior surface extending slightly over the lower part of the thigh in line with the rectal fold. The outer border reached to about one and a half inches in front of the great trochanter, and the inner border to within about one and a half inches laterally in the rectal fold—an area of approximately seventy-two square inches, in which all the skin, superficial fascia, and fat had been removed and had been left exposed and without any natural condition in very nearly their whole length. On first viewing this leg I seemed doubtful whether it could be saved, especially as the wound was of such a shape that a plastic operation by means of which parallel strips of skin might be brought over portions of the exposed surface was not possible.

For ten days the wound was dressed on every day by spray with pure sterilized liquid paraffin containing one dram of ordinary soap to the ounce. At the end of this period the wound was quite clean at the edges and had granulated well over muscles; a skin graft under the following conditions was applied upon one of the facts that the dressings were still somewhat offensive.

The edges of the wound and the skin of the buttocks, whence the graft was to be taken, were sterilized with iodine; the surface of the wound itself was sprayed with zyoL, which the manufacturers inform me is made by mixing 1 lb. of 78 per cent. electrolytic caustic soda ground to pass through a sieve with ten holes to the linear inch, with 1 lb. of No. 20 pure salt; to this is added 5 lb. of granulated borax and the whole well shaken together. Combination of the caustic soda and borax takes place rapidly, resulting in a mixture (zoel) containing 9 per cent. sodium chloride, 3 to 4 per cent. of sodium diphosphate, and 76 to 78 per cent. of sodium monoborate. I have raised small portions of the skin of the buttocks with forceps and dissected them off from the posterior quadrant of an inch in diameter and one-sixteenth of an inch thick in thickness. I passed a single stitch through each graft and through the granulation tissue, suturing each end of the graft in contact; in all I planted about thirty-five grafts in this way.

At this time I sprayed with an atomizer a solution of zyo in the graft wound, and then dressed the whole with a spray soaked in sterilized paraffin, so that the dressing should not dry and tear off the grafts or cause bleeding when it was changed.

The paraffin dressing was left on for forty-eight hours without removal, but was moistened from time to time with fresh paraffin in order to prevent it from sticking. At the period the dressing had been on the graft and the new healed, the dressing had become green. I therefore re-dressed the wound, and sprayed it again with a 2 per cent. solution of zyo, afterwards again placing over the surface gauze soaked in paraffin. This procedure I repeated from time to time on the average every twenty-four hours, and at the end of twelve days every graft had not only taken but had spread to more than twice its original area.

I have used this method on other cases, of which that quoted is typical, and the success of the technique I ascribe to three outstanding conditions:

1. The fixing by means of sutures of the grafts, so that, although in an awkward position, they cannot be removed when the wound is dressed.
2. The use of liquid paraffin as a medium for the dressing, which prevents any adhesion, and hence movement of the grafts.
3. The use of an antiseptic spray which is efficient in its germicidal powers, and yet non-irritant and non-poisonous to such delicate tissues as skin grafts: this last is, without doubt, the most important of the three.

**A NOTE ON SKIN GRAFTING.**

**BY NORMAN H. JOY, M.R.C.S., THELE, BERN.**

There appears to be a tendency among surgeons to avoid the operation of skin grafting chiefly because, in the usual methods adopted, no great measure of success is obtained. With proper care and attention to certain details, there should be very few, if any, failures. The details to be attended are:

1. The raw surface must be in a good condition for skin grafting—that is, it must be covered with healthy granulations and as free as possible from discharge. If there is a discharge make all pieces of grafted skin are raised and so fall to "take." To prevent this the recipient should be dressed with 1 in 1,000 flavine for four to seven days before operation. In the cases I have treated by this method
there has been no discharge whatever between the grafts, although I had regarded them as very unsuitable cases before the application of flaxine.

2. The grafts should not be covered with any dressing and should properly protected. As the suggestion of Dr. Culverwell I have used inverted boxes of various sizes and shapes cut to fit the contour of a limb if necessary.

Jeweller's or instrument maker's cardboard box is the most suitable. The edges should be slightly padded, and the box should be ample large so that there is no risk of the peduncle touching the wound.

3. The technique I have used is as follows: The surface from which the skin is to be taken is prepared in the usual way. The wound is covered with a simple gauze dressing, and when this is removed care is taken to disturb the surface as little as possible. Two razors are employed, so that one can be dipped into boiling water while the other is being used; thus the freshly cut surface heals without any suppuration. The grafts are cut about the size of a postage stamp, and with practice can be cut to almost any shape. The skin and razor are kept thoroughly wet with normal saline, so that the grafts can be more easily cut and removed from the razor. The graft is conveyed to the wound on the razor, and slipped off it with the help of a blunt probe. The grafts are generally placed about one-eighth of an inch apart, but can be closer together in a very clean wound. The box, sterilized beforehand, is adjusted to the part and fastened down by long strips of rubber plaster; the ends of these are thoroughly bandaged, the bandage being brought up to the box as close as possible on all sides, but not over it. As a further safeguard against any chance of slipping the bandage is always used in the form of a splice whenever possible. It is then pinned to the box with a liberal supply of safety-pins.

The box remains quite firm for three or four days, when it can be removed. The grafts are then found to be firmly fixed, and any dressing, such as fomentations or red lotion, can be applied.

LECTURES
ON
THE ANATOMICAL AND PHYSIOLOGICAL PRINCIPLES UNDERLYING THE TREATMENT OF INJURIES TO MUSCLES, BONES, AND JOINTS.

GIVEN AT THE ROYAL COLLEGE OF SURGEONS OF ENGLAND, NOVEMBER-DECEMBER, 1917.

BY
PROFESSOR ARTHUR KEITH, M.D., F.R.S., CONSERVATOR OF THE MUSEUM.

IV. THE INTRODUCTION OF TENOTOMY.

The events which led to the introduction of tenotomy as a measure of surgical routine had nothing to do with Hunter's experiments; they occurred nearly thirty years after he was dead.

The man who best serve as a guide, as we follow the march of events, is William John Little, the son of parents living in comfortable circumstances in the East End of London. Little was born in 1810, and was therefore a contemporary of Hilton. In his infancy he suffered from a fever which left the extensor muscles of his leg (so he informs us) paralysed. As he grew up his left foot became inverted, the heel raised, and a typical talipes equino-varus developed. At the age of 16 he was apprenticed to a neighbouring apothecary, but two years later, in 1828, his indenture being cancelled, he began the study of medicine at the London Hospital. He entered his studies with the fixed intention of discovering what could be done for the relief of such a condition, so that he was driven from. He found that club-foot was regarded as lying outside the legitimate scope of surgery, and, in the opinion of his teachers, was properly confided, as his own case had been, to the care of hosceans and spin rubbers, who treated the condition with massage and instruments, often with a fair degree of success. A man whose chief object in devoting himself to medicine had been the alleviation of a personal infirmity—one with which his senior contemporaries Lord Byron and Sir Walter Scott were afflicted—was not likely to remain content with the comfortable promise of his time. All through his time of study at the London Hospital he sought every opportunity of making himself acquainted with the actual condition of paralysed feet; he had a facile command of the French tongue, and during his student-hood followed medical progress in the literature of Paris as well as that of London. He became particularly interested in the work of Delpech of Paris, who had described and carried out that he was his example. Achillis for the cure of club-foot. When he had passed through the curriculum of his own hospital he went to study in the post-mortem room at Guy's Hospital, under Thomas Hodgkin, and to study comparative anatomy under Dr. Robert Grant at University College in 1834. He then went to a city practice in Billiter Street, and was appointed lecturer on comparative anatomy and physiology in his own hospital—the London. In 1834, being then 24 years of age, he became a Member of the College, but in that year was his failure to obtain a vacant assistant surgeoncy at his hospital. He therefore resolved, as is not unusual under such circumstances, to become a Licentiate of the College of Physicians, and devote himself to medicine. For that purpose it was necessary for him to spend two years at a university. He chose Berlin, drawn thither by the great fame of Johannes Muller. In 1834 we see this same lanne and somewhat sensitive Englishman set off for Berlin armed with a letter of introduction to Muller from Grant and a liberal supply of the status accorded to him because of his office of lecturer in comparative anatomy. When Little entered Muller's laboratory he found there Schwann, Hensle, Remak, and the father young, when it was possible to reveal the cellular constitution of living matter. Little had every opportunity given him in Muller's laboratory of continuing his dissections of deformed feet. The condition revealed by his dissections supported the conclusions he had drawn from his investigations in England—that surgeons were in error in believing club-foot to result from an inherent defect in the growth of the bones of the foot; the cause of the deformity lay in the soft parts—particularly in a disordered action of the muscles, with the conclusion Muller associated with Little in regarding the condition as one which should be amenable to surgical treatment.

Before leaving England Little had read of a young surgeon at Hanover, Stromeoyer by name, who had modified Delpech's operation, and was cutting the tendon Achilles for the rectification of club-foot. Muller agreed with Little that such an operation had a rational basis. Hence we find Little, in the summer of his second year of study in Berlin, in the twenty-sixth year of his age, visiting Stromeoyer in Hanover.

Stromeoyer was only six years Little's senior. He was born in Hanover in 1804, the son of a surgeon there who had strong leanings towards the art as practised in England. After spending almost a year in Edinburgh he commenced practice in his native town in 1828. From the outset of his practice Stromeoyer applied himself to the treatment of physical disabilities and deformities. He fitted out a small private hospital, but found the establishment of the kind of practice he desired an uphill task. In 1831 his opportunity came. The son of a local school-master, a boy of 14, was the subject of club-foot—ineffable, painful, the despair of his relatives and medical attendants. Stromeoyer gave the lad a bed in his hospital, and settled down to give his case eighteen months of unremitting attention and care. As a last resort, he cut the tendon Achilles by a new—a subcutaneous—method; fitted up that the foot could then be flexed (dorsiflexed) and that the cut ends of the tendon were quarters of an inch. The gap evidently frightened him somewhat; at least he again extended (plantar flexed) the foot until the ends were in apposition, before he fixed it in that position. After six days he removed the bandage finding the foot that the cut ends of the tendon did not separate, but moved together. He gradually dorsiflexed the foot, thus, as he supposed, stretching the scar in the tendon, so that in eight weeks the heel was brought down to the proper level and all of the legs had been removed. Stromeoyer ascribed his success, not to the eighteen months of unremitting attention he had given to the case, but to the operation he had thus introduced into surgery. Tenotomy, he declared reduced the