effort should be made to establish an attractive post-graduate school where the subjects could be taught in a manner worthy of their importance. It is especially important to get the scheme started as soon as possible, even in a small way, for when the war is over there will be many medical men who have done the comparatively mechanical war x-ray work who will be attracted to the subject, and who will welcome the idea.

Lay assistance is necessary in x-ray and electro-therapeutic work, and provision will have to be made later for the training of qualified assistants, to whom a certificate would be granted.

The next step would be to approach the General Medical Council on the question of the recognition of radiologists, and the making of it illegal for any other than a qualified member to practise these subjects.

This would at once lead to the raising of the standard and the multiplication of posts of responsibility which would attract the better type of medical man to the new subjects.

B. The Scheme for Cambridge.

Clinical material for adequate teaching facilities is not available in Cambridge, but, on the other hand, there is quite sufficient for research, and the intention would be that, while London, and possibly other large towns, are the teaching centres, Cambridge should be the examining and research centre.

For this purpose it is necessary that there should be some man in charge in Cambridge who would, in conjunction with the duly appointed board, make the necessary arrangements for the examinations and undertake the direction of the research hospital.

In the first instance the duty of the man in charge would be to find out what men were at work and what work was being done in the various hospitals throughout the country, and to enlist the active and sympathetic support of all workers, not only in the central institute in London, but also to obtain their co-operation in the research work. As far as possible he should also be in touch with the work that is being done abroad, especially in Canada and the States.

There is room for endless research in radiology, not only on the physical side, but also on the human, for example, in the investigation of the alimentary tract, and especially in the action of drugs, etc., and it is proposed that a research hospital should be started with twelve or more beds and certain laboratories attached; this should be placed as close to the Addenbrooke Hospital and also to the existing laboratories as can be arranged.

In the first place it would be advisable that this hospital should be started in temporary buildings as it is impossible to foresee on what lines the hospital would develop.

Yours, etc.,

Another meeting was held on June 15th, 1917, when the following encouraging replies to the letter addressed to the Vice-Chancellor of Cambridge University were read:

The Vice-Chancellor wrote (May 28th, 1917):

I brought your letter before the Council of the Senate this morning. The proposals contained in the letter were received favourably and the whole question was referred to a special board for medicine, with the request for an answer to the Council before the end of the term.

Dr. Lawrence Humphrey, secretary of the special board for medicine, wrote (June 7th, 1917):

The special board for medicine considered your letter re medical radiology and welcomed the proposal. It was unanimously agreed to approve the general principle, and the board were prepared to recommend that steps be taken to institute a diploma. It was thought advisable that the scientific teaching should, as far as possible, be carried on in Cambridge and that the appointment should be rather a director or reader and not a professor. The board appointed a small committee to consider the details and, if desired, to meet members of your committee to discuss the matter.

The Committee further considered that, in view of the importance of the questions involved, and of the necessity for unanimity of opinion, it would be a proper step to invite the leading radiologists and electro-theraputists to attend a meeting, and the Secretary was authorized to call such a meeting and to invite the co-operation of the deans of the various London schools. Most of the deans have replied approving of the scheme, subject to the consideration of details, and there can be no doubt that in the near

future it should be possible to arrange for post-graduate teaching at several of these schools.

The meeting of radiologists and electro-theraputists was held at the Royal Society of Medicine on July 23th, when, after much lengthy argument and discussion, the following resolution was carried unanimously:

That this meeting of medical men practising as radiologists desire to express their approval of the initial steps taken by the gentlemen who have submitted an outline of a scheme, and to thank them heartily for the work they have done; and further we propose that the gentlemen who have already taken action in the matter should form an executive of a larger committee representative of all the London and provincial schools.

If such a body had been in existence at the beginning of the war it would have been in a position to advise the military authorities as to the general organization of radiology and electro-therapeutics, and, further, to undertake the teaching of men appointed to the various departments on standard methods; unfortunately this was not the case. But is it yet too late? From what I have seen and heard even in the last few weeks I should say decidedly No, but I fear nothing so simple as saying No will help us out of the anomalous position in which we find ourselves; but, as Captain Thurstan Holland has truly said, "The time has come to enter a strong protest against the continuance of methods which allow of such anomalies to exist." I think we are now in a position to enter such a protest. From what has been done there appears no doubt that the Cambridge part of the scheme could soon be in active being, if the necessary financial support can be arranged. It remains for us to see that the London scheme is put upon a sound basis, so that the two may be able to co-operate in practical teaching and research work.

To do this we must endeavour to establish a central institute in London with facilities for post-graduate teaching on a fairly large scale, in order that men who desire to study these subjects may be able to do so under conditions comparable with those already established in other countries.

The task is not easy, and I foresee that there are many obstacles still to be overcome, not the least being the lack of funds. The way, however, has been paved, and if we push on with sufficient energy and determination there is no reason why in the near future our efforts should not be crowned with success.

THE MYCOLOGICAL DETECTION AND DETERMINATION OF CERTAIN CARBOHYDRATES AND OTHER CARBON COMPOUNDS IN PATHOLOGICAL WORK.

BY

ALDO CASTELLANI, M.D., M.R.C.P.,

LIEUT.-COLONEL ROYAL ITALIAN MEDICAL SERVICE (NAVY); MEMBER OF PERMANENT COMMITTEE, INTERNATIONAL SANITARY COMMISSION;

AND

FRANK E. TAYLOR, M.D., M.Sc., M.R.C.P., F.R.C.S.,

LECTURER ON BACTERIOLOGY, KING'S COLLEGE, UNIVERSITY OF LONDON; PATHOLOGIST, ROYAL WESTMINSTER OPHTHALMIC HOSPITAL.

VARIOUS carbohydrates and other carbon compounds are currently used in the identification of certain bacteria and higher fungi. The reverse process may also be carried out, namely, certain hyphomycetes and bacteria presenting permanent biochemical reactions may be used in the determination of various carbohydrates and other carbon compounds in pathological work.

For many years ordinary German yeast has, as is well known, been used in the detection of glucose, but this is the only substance for which so far such method of detection has been employed in pathological investigations. As a matter of fact, the method is scientifically incorrect, at least when using the German yeast obtainable in London, for judging by the results of the investigation of several specimens collected by us, this yeast ferments with the production of gas, not only glucose, but several other sugars. When, therefore, gas is thus produced it does not mean with certainty that the sugar present is glucose; it might be levulose, or some other. To detect glucose recourse should be made to really specific germs for that sugar—namely, germs which will ferment glucose only.

with production of gas; for instance, *Monilia balcanica* Castellani, *Monilia parabalcanica* Cast. We have not specific germs for each of the other sugars and carbohydrates, but, as there are a number of species of hyphomycetes and bacteria which select certain carbohydrates to the exclusion of others, we have found it possible, by using certain of these hyphomycetes and bacteria and comparing the results, to devise a general method with the object of assisting in the detection and identification of some carbon compounds, especially certain sugars and other carbohydrates.

General Principle of the Method.

The three more important sugars which have to be dealt with in physiological and pathological investigations—namely, glucose, lactose, and maltose—may, as is well known, be distinguished by their relative powers of reducing Fehling's solution, and by the characters of their osazones; but they may also be distinguished, in our experience, by a very simple mycological test, which may be carried out as follows:

Make a 1 per cent. solution in peptone water of the substance, which it is assumed is known to be one of the three sugars, and distribute it into two tubes, (1) and (2). Inoculate No. 1 with *Monilia balcanica* Cast., or *M. parabalcanica* Cast., or *M. krusei* Cast. Inoculate No. 2 with *M. pinoyi* Cast. or *M. tropicalis* Cast. Incubate at 37° C. for forty-eight hours, and then read the results. If both tubes present gas, the sugar must be glucose; if No. 1 presents no gas and No. 2 gas, the sugar must be maltose; if neither of the tubes present gas, the sugar must be lactose.

This is explained by the fact that *M. balcanica* Cast., *M. parabalcanica* Cast., or *M. krusei* Cast., while producing gas in glucose, have no action on maltose or lactose; and *M. pinoyi* Cast., or *M. tropicalis* Cast., while fermenting glucose and maltose, have no action on lactose. Acid fermentation without production of gas is not to be taken into account. We have carried out the experiment also with certain species of the genus *Saccharomyces*—either with live organisms or their extracts (zymases).

Instead of hyphomycetes, certain bacteria may be used. Thus:

Inoculate Tube No. 1 with *B. proteus vulgaris* Hauser (P.I. strain); inoculate Tube No. 2 with *B. diffuens* Cast. If both tubes show presence of gas, the sugar is glucose; if No. 1 shows gas and No. 2 no gas, the sugar is maltose; if both No. 1 and No. 2 show no gas, the sugar is lactose.

This is explained by the fact that *B. proteus vulgaris* Hauser (P.I. strain) does not ferment lactose, while it ferments with production of gas, glucose and maltose; and *B. diffuens* Cast. does not ferment lactose and maltose, but does ferment glucose with production of gas.

Differentiation of Fehling-reducing Substances.

If we have a Fehling-reducing substance we can determine which it is of the six sugars which may be found in pathological urines—namely, glucose, levulose, maltose, galactose, lactose, or pentoses—by the following method:

Make a 1 per cent. solution of the substance in sugar-free peptone-water, and distribute it in four tubes, each containing a Durham's fermentation tube. Label them Tube 1, Tube 2, Tube 3, Tube 4. Inoculate No. 1 with *Monilia balcanica* Cast., or *M. parabalcanica* Cast.; No. 2 with *M. krusei* Cast.; No. 3 with *M. pinoyi* Cast.; No. 4 with *M. metalondinensis* Cast. Incubate the tubes at 35° C. for forty-eight hours and then read the results.

- (1) Tubes 1, 2, 3, 4, gas present: the reducing substance is glucose.
- (2) Tube 1 no gas; tubes 2, 3, 4, gas present: the reducing substance is levulose.
- (3) Tube 1 no gas, tube 2 no gas; tubes 3, 4, gas present: the reducing substance is maltose.
- (4) Tubes 1, 2, 3, no gas; tube 4 gas present: the reducing substance is galactose.
- (5) Tubes 1, 2, 3, 4, no gas: the reducing substance is either lactose, a pentose, or a reducing substance belonging to the group creatin, uric acid, hippuric acid, etc.

The above conclusions are easily explained when the biochemical reactions of the four monilias we have used are kept in mind. *M. balcanica* Cast. produces gas only in glucose; *M. krusei* Cast. in glucose and levulose; *M. pinoyi* Cast. in glucose, levulose, and maltose; and *M. metalondinensis* Cast. in glucose, levulose, maltose, and galactose; while none of them produces gas in lactose or the pentoses or any other Fehling-reducing substance we have experimented with.

The reducing substance in which none of the monilias mentioned has produced gas may be further investigated, as follows: Take two tubes (5 and 6) of the 1 per cent. peptone water solution, and inoculate No. 5 with *B. coli* Escherich, and No. 6 with *B. paratyphosus* B, Schottmüller, taking care to use strains producing a large amount of gas. Incubate for forty-eight hours and read the results. If both tubes contain gas, the reducing substance belongs to the so-called pentoses; if No. 5 contains gas and No. 6 no gas, the reducing substance is lactose. This is explained by the fact that *B. coli* Esch. produces gas both in lactose and the pentoses; while *B. paratyphosus* B, Schott., does not ferment lactose, but ferments with production of gas the so-called pentoses (arabinose, etc.). If both tubes show absence of gas, the substance belongs to the non-fermentable group of reducing substances, including uric acid, creatinin hippuric acid, etc.

The working of the method can be seen at a glance in the accompanying table and key.

Table showing Identification of Certain Fehling-reducing Substances.

<i>M. balcanica</i> Cast.	<i>M. krusei</i> Cast.	<i>M. pinoyi</i> Cast.	<i>M. metalondinensis</i> Cast.	<i>B. paratyphosus</i> B, Schott.	<i>B. coli</i> Esch.	Reducing Substance
+	+	+	+	+	+	Glucose.
0	+	+	+	+	+	Levulose.
0	0	+	+	+	+	Maltose.
0	0	0	+	+	+	Galactose.
0	0	0	0	+	+	Pentoses.
0	0	0	0	0	+	Lactose.
0	0	0	0	0	0	Non-fermentable reducing substances of the groups creatinin, hippuric acid, uric acid, etc.

+ = Production of gas; simple acid fermentation is not taken into account.

0 = No gas.

The reducing substance is made into a 1 per cent. peptone water solution. Selected strains of the various organism with permanent biochemical reactions and producing a large amount of gas should be used.

Key to the Identification of Certain Fehling-reducing Substances.

Inoculate Tube 1 with *Monilia balcanica* Cast.

0; inoculate Tube 2 with *M. krusei* Cast. + = GLUCOSE.

0; inoculate Tube 3 with *M. pinoyi* Cast. + = LEVULOSE.

0; inoculate Tube 4 with *M. metalondinensis* Cast. + = MALTOS.

0; inoculate Tube 5 with *B. coli* Esch., and Tube 6 with *B. paratyphosus* B, Schott. + = GALACTOSE.

B. coli +, *B. paratyph.* B +, = PENTOSE.
B. coli +, *B. paratyph.* B 0, = LACTOSE.
B. coli 0, *B. paratyph.* B 0, = Non-fermentable reducing substances of the groups creatin, uric acid, hippuric acid, etc.

Presence of More than One Reducing Substance.

If the presence of more than one sugar and other carbohydrates is suspected, this may, to a certain extent, be ascertained, and the various carbohydrates determined by our mycological method. Let us assume that a liquid, after gas fermentation with *M. balcanica* Cast., is still fermentable with production of gas by *M. krusei* Cast.—the conclusion is that in addition to glucose the liquid must have contained levulose; strains of *M. balcanica* Cast. and of *M. krusei* Cast. should be used having approximately the same fermentation power on glucose. If, now, the liquid, after exhaustion, first with *M. balcanica* Cast. and then with *M. krusei* Cast., is fermentable with production

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

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 to assisting in the detection of certain other substances—saccharose, inositol, 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. pseudocoli* 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, adding to samples of urine various 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 grafts have not grown on account of the generally septic conditions prevalent. Hitherto the first principle of successful skin grafting has been the most rigid asepsis, without using antiseptic solutions on the raw surface of the wound, since efficient antiseptic solutions have proved as fatal to the delicate 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 retained in the best position possible, so that the grafts are sometimes pulled out of place in handling the dressings.

By the method here described I have been able to obtain successful grafts upon 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 at 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 guillotine amputation in France, which had remained septic; the wound in the thigh had been excised in France, and when I received the patient in England it consisted of an area on the posterior surface extending from two inches above the knee to the natal 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 quarter inches of the rectum—an area of approximately seventy-two square inches, in which all the skin, superficial fascia, and fat had been removed and had left the hamstring muscles exposed and still in a septic condition in very nearly their whole length. On first viewing this leg it seemed doubtful whether it could be saved, especially as the wound was of such an irregular 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 third day with pure sterilized liquid paraffin containing one drachm of ordinary bipp to the ounce. At the end of this period the wound was quite clean at the edges and had granulated well over the muscles; a skin graft under the following conditions was decided upon in spite of the fact 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 zoel, 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 1½ lb. of No. 20 pure salt; to this is added 5½ lb. of granulated borax and the whole well shaken together. Combination of the caustic soda with the borax takes place rapidly, resulting in a mixture (zoel) containing 19½ per cent. sodium chloride, 3 to 4 per cent. of sodium diborate, and 76½ to 77½ per cent. of sodium monoborate. I then raised small portions of the skin of the buttocks with forceps and dissected off portions about a quarter of an inch in diameter and one-sixteenth of an inch thick in the centre. I passed a single stitch through each graft and through the granulation tissue, suturing each graft in careful apposition; in all I planted about thirty-five grafts in this way. Again I sprayed with an atomizer a solution of zoel upon the grafted wound, and then dressed the whole with gauze 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 this period the dressing had begun to smell, and the edges of the dressing had become green. I therefore re-dressed the wound, and sprayed it again with a 2 per cent. solution of zoel, 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.,

THEALE, BERKS.

THERE appears to be a tendency among surgeons to avoid the operation of skin grafting chiefly because, with 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 to 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 much discharge many pieces of grafted skin are raised and so fail to "take." To prevent this the wound 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