present enrolment is 5,300, exclusive of summer session and extension courses, which bring the total to 10,000.

The administration of the university is encouraging to educational experiment, so that in addition to "projects" now under way at Syracuse supported by four of the great educational foundations, a great deal of reconstruction is going on in curricula, in a cottage system of student housing in individual tutor-adviser work with freshmen, and in a progressive program for intramural athletics.

The Hotel Syracuse has been designated as convention headquarters. The decision has not been made as yet as to whether the university dormitories will be opened for convention guests. Hotel accommodations, together with information concerning the hotels are as follows:

Hotel Syracuse—Harrison, Warren and Onondaga Sts. (608 rooms). Single rooms, $3 to $6.50 per day; double rooms, $4 to $8.50 per day. All rooms with bath.

Onondaga Hotel—Warren and Jefferson Sts. (500 rooms). Single rooms, with or without bath, $2.50 to $6 per day; double rooms, with or without bath, $4 to $9 per day.

Yates Hotel—Montgomery and East Washington Sts. (200 rooms). Single rooms, with or without bath, $1.50 to $3 per day; double rooms, with or without bath, $3.50 to $6 per day.

Jefferson-Clinton Hotel—Jefferson and Clinton Sts. (140 rooms). Single rooms, with or without bath, $2 to $4 per day; double rooms, with or without bath, $4 to $6 per day.

Mispah Inn—Montgomery and Jefferson Sts. (120 rooms). Single rooms, with or without bath, $1.50 to $3 per day; double rooms, with or without bath, $2.75 to $5 per day.

Hotel Hilton—Harrison and Montgomery Sts. (120 rooms). Single rooms, $2.50 to $3.50 per day; double rooms, $3.50 to $5 per day. All rooms with bath.

Hotel Wood—Jefferson and Clinton Sts. (50 rooms). Single rooms, $2 to $3 per day; double rooms, $4 per day. All rooms with bath.

Truax Hotel—Warren and Harrison Sts. (51 rooms). Single rooms, with or without bath, $2 to $2.50 per day; double rooms, with or without bath, $3 to $5 per day.

Kirk Hotel—West Fayette and South Clinton Sts. (31 rooms). Single rooms, with or without bath, $1.50 to $2.50 per day; double rooms, with bath, $4.50 to $5 per day.

The evening lectures are to be held in the large auditorium of Syracuse Central High School. The high school is situated between the down-town district and the university and is within easy walking distance of either the hotels or the university campus. All the hotels given above are centrally located and are within convenient walking distance of the Central High School. All are convenient to direct transportation lines to Syracuse University.

We are assured that a sufficient number of rooms will be reserved by these hotels to accommodate those who attend the Syracuse meeting, but in order to save possible disappointment, members are urged to make their reservations at once. These should be sent direct to the hotels selected.

CHARLES F. ROOS,
Permanent Secretary

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE ESTIMATION OF THE HYDROGEN-ION CONCENTRATION OF THE TISSUES IN LIVING ANIMALS

THE great need for suitable methods for the estimation of chemical potentials in the tissues of living animals was emphasized in previous papers from this laboratory.[1] The purpose of this note is to briefly describe a method for the estimation of pH by means of the capillary glass electrode. Further details concerning this method and its application to biological problems will be published in another paper (Public Health Reports). We have previously called attention to the superiority of the glass electrode over other electrodes for the measurement of pH in biological material.[2] The chief advantage of the glass electrode is that it is not affected by the presence of oxidation-reduction systems which are always present in tissues. Another advantage is that the glass electrode can be given almost any desired shape. For the purpose of measuring tissue pH the capillary type is the best, because the glass capillary can be inserted into any of the soft tissues with a minimum of tissue injury.

Special soda lime glass tubing (No. 015 Corning Glass Works) of the following composition is used: SiO_2 72 per cent., CaO 6 per cent., Na_2O 22 per cent. Tubing of approximately 7 mm outside diameter and 1 mm wall thickness is drawn out to a thin-walled capillary, tapering rapidly from the shank. The latter should be about 20 cm in length. The capillary is severed at a distance of 10 to 15 mm from the shank and the tip is carefully sealed in a flame. The work of Kahler and DeEds[3] has shown that the

[1] C. Voegtlin and Floyd DeEds, Public Health Rep., xliii, 380, 1928; H. Kahler, Floyd DeEds, S. M. Rosenthal and C. Voegtlin, *Amer. J. Physiol.*, xci, 225, 1929.

[2] C. Voegtlin, Floyd DeEds and H. Kahler, Public Health Rep., xlv, 2223, 1930.

[3] H. Kahler and Floyd DeEds, *J. Amer. Chem. Soc.*, liii, 2998, 1931.

elimination of the so-called hygroscopic "deviation film" on the glass surface above the surface of the system whose pH is to be measured greatly improves the reliability of the glass electrode. The lower surface of the shank is therefore coated with a firmly adhering layer of deKhotinsky cement. The shank is partly filled with a phosphate buffer of about pH 7. The electrode is then connected by means of a pressure rubber tubing to a high vacuum pump. With the electrode in a vertical position, the capillary end being at the bottom, the electrode is evacuated. The air in the capillary is thus completely replaced by buffer. Additional buffer is now added, so as to almost fill the inside of the shank. Fig. 1 illustrates the cross-section of the electrode.

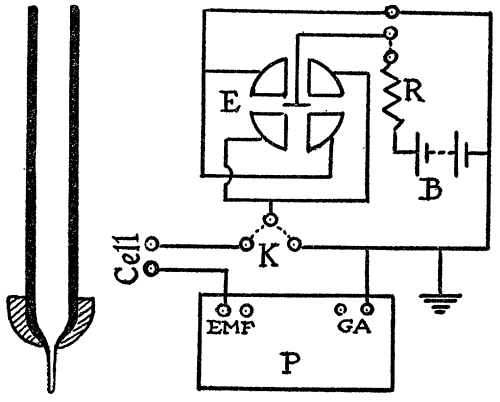

FIG. 1

The next step is to calibrate the electrode by means of two or more pH buffers covering the range of hydrogen-ion concentration of the tissues. We have found phosphate buffers of about pH 7.4 and 6.3, respectively, satisfactory for this purpose. The pH of these standard buffers is carefully determined by the hydrogen electrode at 30° C. The observations of Kahler and DeEds[3] have shown that the potential at an imperfect glass electrode varies slightly if the temperature is raised from 30 to 40°. As the pH of tissues is measured at body temperature, it is therefore necessary to make a temperature correction. This is done by calibrating the glass electrode at 30 and 40° C., or still better at body temperature, in the standard phosphate buffers. Actual experience with several capillary glass electrodes has shown that this temperature correction with phosphate buffers in the physiological range of pH amounts to only a few millivolts. If therefore the electrode is calibrated at body temperature (rectal), it is evident that the error committed can not be significant and certainly will not prevent a fairly accurate measurement of tissue pH. The calibration curve (Voltage—pH) of each glass electrode at body temperature is plotted on coordinate paper. The pH values corresponding to the actual voltage of the tissue at a given time are then read off from these calibration curves.

The animal is given first just sufficient anesthetic (urethane or pentobarbital) for immobilization. The tissue to be measured is exposed, care being taken to avoid bleeding. The surface of the tissue is carefully cleaned with absorbent cotton and the electrode is cautiously inserted and fixed by means of a suitably insulated clamp. The whole length of the glass capillary must be in the tissue. Electrical contact is then rapidly made between the buffer on the inside of the electrode and a saturated calomel half cell by means of a KCl-agar bridge. One end of another agar bridge is placed on exposed and moistened tissue at any suitable part of the animal's body. The other end of this bridge leads to a second saturated calomel half cell. The other electrical connections are shown in Fig. 1. The measuring equipment consists of a Compton electrometer and a Leeds and Northrup type K potentiometer. For purposes of proper screening the animal and potentiometer are placed in a grounded wire cage. During moist weather it is essential to lower the humidity of the room air in order to prevent electrical leaks. This can be accomplished in a manner previously described.[1]

It is obvious that only such potential readings in the tissues are of value which are not accompanied by more than relatively slight time drifts. In numerous experiments done with this new method it was found that careful observation of all necessary precautions will eliminate drifts exceeding those shown in the following table. In some experiments, however, larger drifts occur, and these results are rejected. It appears that this drift may result from the following causes: (1) Injury of blood vessels; (2) imperfect immobilization of the tissue and consequent progressive tissue injury from continuous motion of the electrode in the tissue due to respiratory movements; (3) blood films over the tissue through which the electrode is inserted.

It may be stated, however, that the results as a rule are surprisingly satisfactory, considering the obvious difficulties which are involved in the application of this method. Further work is necessary to ascertain the experimental error of this technique. We believe, however, that sufficient repetition of the measurements of a given tissue with several accurately calibrated electrodes probably involves average errors not exceeding 0.05 pH. The most reliable results are obtained by selecting from a set of electrodes those which give the best results on calibration in the standard buffers, *i.e.*, a nearly theoretical calibration.

To illustrate the technique the results of the fol-

lowing experiments dealing with the estimation of the pH of the Rous chicken sarcoma No. 1 are given.

pH OF ROUS CHICKEN SARCOMA

Subcutaneous tumor No. 1		Subcutaneous tumor No. 2		Large intramuscular tumor No. 1	
Minutes	pH	Minutes	pH	Minutes	pH
1	6.76	3	6.89	2	6.42
3	6.76	5	6.87	4	6.49
5	6.73	7	6.85	5	6.47
8	6.76	10	6.84	9	6.42
11	6.76	16	6.82	13	6.32
13	6.78	30	6.79	16	6.32
		61	6.79	18	6.32
		95	6.80		
		125	6.82		

These results indicate that the Rous chicken sarcoma in the living animal is characterized by an extremely low pH, as compared with that of blood. Work with the Jensen rat sarcoma and the Walker rat carcinoma 256 has also revealed pH values considerably on the acid side of 7. These very significant observations have led us to a systematic investigation of the pH of a great variety of normal and malignant tissues in the living animal.

Since October, 1931, Dr. R. H. Fitch has joined us in this work and we are indebted to him for assistance in the final development of this new method.

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A CULTURE MEDIUM FOR PARAMECIUM

THE medium set forth in this article has proven itself to be very satisfactory in the culturing of various species of Paramecium in pure line cultures. The main result of the use of the medium is that the organisms do not exhibit a lowering of their normal metabolism after continuous culturing.

The basic part of the medium is the usual hay infusion of ten grams of chopped timothy hay boiled for fifteen minutes in a liter of well water. This infusion is filtered and sterilized in the Arnold sterilizer at 100° C. one hour a day for three days. It is diluted with nine volumes of sterile well water just before using. Two portions of this infusion are placed in sterile liter flasks with sterile cotton stoppers. One liter is inoculated with *Bacillus subtilis* and the second with *B. coli communis*. A third portion of the medium is made up as follows: Approximately thirty grains of wheat are boiled in a small amount of water for ten minutes. The wheat grains only are then placed in a third liter flask of sterile well water. The three portions are incubated at 37° C. for twenty-four hours, and then combined in one large sterile flask. The medium is now ready for use. The cultures may be used in almost any size of container, but that used has been the three hundred cc Erlenmeyer flask. These flasks are fitted with cotton stoppers and sterilized. Each flask is filled about two thirds full of the medium, and different species of Paramecium are transferred to the cultures with sterile pipettes.

The original basic infusion may be made up, sterilized and stored in a refrigerator until ready for use. Likewise, the medium, made of the three portions, may be stored in a refrigerator for later use.

Sterile precautions are maintained throughout the procedure, but after Paramecium has been transplanted, such strict precautions are no longer necessary. The essential part of the process is to provide a medium rich with a suitable food in which Paramecium will continue to grow normally. With these sterile precautions, other ciliates and flagellates are eliminated. A single organism placed in such a medium will produce a flourishing culture in seven to ten days. One should transplant every two to three weeks. *Paramecium multimicronucleatum, P. bursaria* and *P. aurelia* have been thriving for eight months in this medium.

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SPECIAL ARTICLES

SIZE OF INFECTION AS AN INFLUENCE ON THE PERSISTENCE OF ADULT TRICHINAE IN RATS[1]

THE statements that can be found in text-books and published work on trichiniasis regarding the length of life of adult *Trichinella spiralis* are usually quite vague and indicate that wide variations may occur. The usual statement is that the adult worms live for several weeks or longer. Ransom[2] says that adult trichinae of both sexes have been found in the intestine as late as 12 weeks after infection, and that they may commonly be found in large numbers for as long

[1] From the laboratory of parasitology, department of bacteriology, University of Rochester, School of Medicine and Dentistry, Rochester, N. Y. This investigation was aided by a grant from the Rockefeller Foundation.

[2] B. H. Ransom, "Trichinosis," Rep. U. S. Live Stock San. Assoc., pp. 147–165, 1915.