ber of the closest neighbors of Czechoslovakia had hardly any representatives at Prague. The organizing committee, and particularly its prime mover, Dr. M. Valouch, did their best to counteract this tendency and in so doing they had as good success as could be expected. There were a number of foreign delegates, and the congress had a strong international tinge. There were very pleasant social activities and numerous opportunities to get together scientifically and otherwise. The congress had eight sections devoted to the principal branches of mathematics with 111 individual communications. There were also a number of more extended lectures by E. Cech ("On Duality Theorems in Topology"), V. Jarnik ("On Geometrical Number Theory"), Sierpinski (Superpositions of Functions, this address being read by Professor Cech owing to the absence of the lecturer), Menger ("Metrical Geometry") and others.

The organizers of the congress can not be praised too highly for their endeavors. It is only through such meetings that one may hope to nullify to some extent the ever-growing scientific autarchy the world over, the most serious menace to science at the present time.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE CULTIVATION OF ENDAMOEBA HISTOLYTICA IN ERLENMEYER FLASKS

WHEN large numbers of *Endamoeba histolytica* are needed in culture, either for the inoculation of a series of experimental animals or for the preparation of antigen for the complement fixation test, the use of test-tube cultures is both expensive and time-consuming. A single rich culture in a test-tube is sufficient for the inoculation of only one kitten, and in testing the degree of pathogenicity of a strain of *E. histolytica* it is advisable to use at least twenty kittens. In the preparation of antigen several hundred tubes of rich cultures are required. We have found that much labor and some expense can be saved by growing the amoebae in Erlenmeyer flasks.

Probably any of the accepted media for cultivating *E. histolytica* may be employed in this way. We have used the medium recommended by Dobell and Laidlaw[1] consisting of whole egg diluted with Ringer's solution, overlaid with horse serum diluted with six parts of Ringer's solution and enriched with sterile rice flour.[2] We have used 250 cc flasks for cultivating amoebae for our animal inoculations and have found that one flask provides approximately the same number of amoebae as twenty-five to thirty test-tubes of 25 cc capacity. In the preparation of antigen we have used 500 cc flasks and have found that twenty-five to thirty flasks provide as much antigen as 350 to 400 test-tubes.

In the test-tube containing slants of coagulated egg-Ringer medium the amoebae multiply only in the rice flour and bacterial sediment at the bottom of the slant, whereas in a flask they have the whole egg-Ringer surface at the bottom to multiply upon. Approximately 15 cc of egg-Ringer mixture are required in a 250 cc flask, and 25 cc in a 500 cc flask. This covers the bottom of the flask in a thin layer. The egg-Ringer is coagulated by placing the flasks in a pan of boiling water, in an Arnold sterilizer or in the autoclave heated by live steam without pressure. The flasks must be watched to avoid overheating, which causes the formation of bubbles. A smooth base is desirable in order to provide the best surface for growth. After coagulation the flasks are autoclaved and placed in the refrigerator until needed. The serum-Ringer and rice flour are added a few days before use, and are tested for sterility by incubating for at least forty-eight hours before inoculation. Approximately 75 to 85 cc of horse-serum-Ringer are required for a 250 cc flask and 125 to 150 cc for a 500 cc flask. This provides a depth of fluid over the egg-Ringer base of about seven eighths of an inch. Approximately 0.25 cc of sterile rice flour is added to each flask. For inoculation with *E. histolytica* approximately 1 cc of a rich culture is transferred to each flask. This will usually give excellent growth in 48 to 72 hours. As with test-tube cultures a flask occasionally fails to produce good growth for some unexplained reason, but the chance of failure is less with flasks than with test-tubes.

The advantages of the flask method of cultivation are a saving in time in preparation of media and washing of glassware, a saving in glassware and a saving in media. A 250 cc flask requires only one fifth as much egg-Ringer and only three fifths as much horse serum-Ringer as twenty-five test-tubes. Furthermore, the chance of contamination in handling fewer containers is greatly reduced, owing to the reduction in the number of transplants. Again the chances for cultural variations in individual tubes is eliminated when constant conditions are desired in the inoculation of a series of animals. There is also a considerable reduction in the amount of rice flour used, which is a distinct advantage in the preparation

[1] C. Dobell and P. P. Laidlaw, *Parasitology* 18: 283–318, 1926.

[2] L. R. Cleveland and J. Collier, *Amer. Jour. Hyg.* 12: 606–613, 1930.

of antigen, as it is desirable to wash the amoebae as free as possible from the solid constituents of the culture before extracting.

Test-tube cultures are, of course, more practical than flask cultures for simply maintaining strains of amoebae, since only a few tubes are required. They are also useful for seeding flasks when these are required.

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ON THE REMOVAL OF OXYGEN FROM WATER BY CUT BRANCHES[1]

IT is well known that rooted plants, in water, will remove the dissolved oxygen rapidly, under certain conditions, or not at all, under other conditions. Among the modifying environmental characters are the temperature of the water and the insolation of the shoot. Whether or not rootless shoots, or branches, with leaves, may behave in an analogous way does not appear to be known. The present note indicates that they have the capacity of removing oxygen at least, but whether the rate of such removal can be modified by the factors above mentioned remains to be shown.

In the experiments here summarized the cut ends of leafy branches of a few species of shrubs and trees were kept in distilled water for various lengths of time and the oxygen content of the water was determined at the beginning and at the end of the experimental periods. It was found, in every instance, that the oxygen content of the water was decreased. A similar result was obtained with cut flowers.

As to the effect of the external factors spoken of above, a few experiments appeared to indicate that the temperature of the water had little influence, as opposed to the results with plants having roots. It is possible, however, that the rate of oxygen removal is related to the intensity of the light to which the shoot is exposed. In four experiments, for example, with leafy branches of mulberry the rate of removal was greater during darkness than light.

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[1] The study was made with the aid of a grant from the Carnegie Institution of Washington.

SPECIAL ARTICLES

MEASUREMENT OF THE VELOCITY OF LIGHT IN A PARTIAL VACUUM[1]

THE plan to measure the velocity of light in a vacuum was proposed in 1929 by the late A. A. Michelson, professor of physics at the University of Chicago and research associate of the Carnegie Institution of Washington. He obtained the funds for the project and lived to see the apparatus installed, but was unable to take part in the measurements, which were carried out by F. G. Pease, of the Mount Wilson Observatory of the Carnegie Institution of Washington, and F. Pearson, of the University of Chicago. The apparatus was installed at Irvine Ranch, near Santa Ana, California; observations were made at intervals during the period from February, 1931, to March, 1933. The method used was that of the rotating mirror, the mirror itself being a cylinder of glass, on the periphery of which 32 equally inclined and optically flat surfaces were ground and figured parallel to the axis. The cylinder was rotated about its axis at a speed such that a beam of light reflected by one surface and traveling a distance of 8 or 10 miles was received and reflected by the next succeeding face of the compound mirror. From the measured speed of rotation of the mirror and the length of path of the beam of light, the velocity of light was readily deduced. The mirror was driven by an airblast regulated by a sensitive, hand-controlled valve; its rotational speed was ascertained stroboscopically by bringing it into coincidence with the vibrations of an electrically driven tuning fork whose frequency was in turn determined stroboscopically by comparison with the period of a gravity pendulum swinging freely under reduced air pressure. The rate of the pendulum was ascertained by flash-box methods in terms of an accurate clock whose rate was determined by comparison with corrected radio time signals from Arlington. For the two optical path lengths of 8 and 10 miles the speeds of the mirror were 730 and 585 rotations per second, respectively. The apparatus was mounted in a tube one mile in length, consisting of 60-foot sections of corrugated steel pipe 36 inches in diameter joined with rubber sleeves, placed on trestles a foot above ground and evacuated to pressures ranging from $\frac{1}{2}$ to 5 mm of mercury. Steel tanks were attached to the ends of the tube; in these the optical parts, consisting of a small diagonal flat, an image-forming concave mirror and two 22-inch optical flats, were installed. Light from an arc lamp, after passing through a collimating lens and slit, was reflected from the upper half of the rotating mirror through an optically plane window in the side of the tube, and after repeated reflections was imaged on one of the large flat mirrors. It was then returned over a path just below the entering path, received on the lower half of the rotating mirror and thence through a small diagonal prism into a micrometer eyepiece. The length of the path followed by the beam of light was ascertained by reference to a base established with extreme care by the U. S. Coast and Geodetic Survey by the side of the pipe line. The ends of the base consisted of two concrete piers with inserted bronze reference plates placed opposite to the 22-inch plane mirrors. Transfer of the positions of these mirrors to the

[1] Read before the National Academy of Sciences, Cleveland, 1934.