could be made up corrected for glass thickness of one millimeter and a tube length of one hundred and sixty millimeters for something like $20.

Thanks to an American Association for the Advancement of Science research grant, I was enabled to secure such an objective. After trying it out for the period of a year, I am able to recommend it to my colleagues as an important aid for the detailed study of micro-mounted arthropods. The definition of the lens is as good as the four-millimeter objective used in the ordinary way, so that one side of a specimen is as easily scrutinized as the other.

The next step in improving technique is to limit microslides to a standard maximum thickness, say 1.3 millimeters. If the thickness is less, it can be compensated by placing a cover glass on the slide (held by a film of water) to make up the necessary thickness.

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AN INEXPENSIVE THERMO-REGULATOR

A VERY satisfactory regulator for operating a small isothermal bath may be made from an ordinary Babcock skim-milk bottle filled with mercury. One lead of wire is placed in the side tube, which is plugged with cotton and a small cork. The other lead is connected with a short piece of platinum wire supported in the capillary of the bottle. The regulator can be easily adjusted by increasing or decreasing the volume of mercury and by varying the height of the platinum wire. The accuracy of control is estimated at 0.1 degree C.

If a more accurate instrument is desired a Wagner's improved skim-milk bottle, which has a smaller capillary, may be substituted for the Babcock bottle. Either bottle may be obtained at a cost of 80 cents and holds about 50 ml of mercury.

L. L. ENGLISH

ALABAMA POLYTECHNIC INSTITUTE

SPECIAL ARTICLES

EARLY CHANGES IN THE CEREBROSPINAL FLUID OF MONKEYS NASALLY INSTILLED WITH THE VIRUS OF POLIOMYELITIS

MICROSCOPIC examination of the cerebrospinal fluid from cases of epidemic poliomyelitis in man reveals an increase in the number of the white cells present. This change in the composition of the fluid is employed as a means of arriving at a diagnosis of suspected poliomyelitis in instances in which no muscular impairment is detectable.

A similar increase in the number of white cells present in the fluid arises in monkeys (*Macacus rhesus*) in which the virus of poliomyelitis has been instilled into the nasal cavities.[1] Advantage was taken of this interesting fact to determine the relation of the increase in cells to the appearance of symptoms of infection in the monkey. The cerebrospinal fluid was withdrawn by cistern puncture, just before instillation of the virus, and at intervals of 48 hours afterwards. This interval was chosen in order to avoid too frequent puncture and to insure an adequate flow of the fluid. Two instillations of virus, consisting of a suspension of glycerolated spinal cord and medulla of monkeys succumbing to acute, experimental poliomyelitis, were made on successive days.

The preliminary cell counts of the fluid of normal monkeys gave values as low as 12, but usually of from 20 to 30 cells per cubic millimeter. At the end of the first 48 hours, an increase of cells was already apparent in some, but not in all the monkeys receiving virus by the instillation method; the cell counts were around 70. At the expiration of the second 48-hour period, the rise in the count was more general, the cells fluctuating between 100 and 300 per cubic millimeter.

Up to this time, the instilled monkeys presented no detectable signs of infection. Beyond this period, depending on the potency of the virus and the susceptibility of individual animals, symptoms consisting of fever, ataxia and muscular weakness arose; and, as a rule, the cell count increased still further with the onset of symptoms. In passing, it should be stated that globulin also appeared in the altered cerebrospinal fluid.

Hence a similarity is found to exist, in advance of all other detectable signs of infection, between the changes arising in the cerebrospinal fluid of the nasally instilled monkeys and that yielded by cases of preparalytic poliomyelitis in man. On the other hand, it is obvious that the monkey is less responsive than are children to the presence of the virus in the nervous system, since, in contrast to children, during the early or preparalytic stage of infection, the animals remain to all appearances in a normal state.

The evidence is now strong that the virus ascends from the nasal membranes to the olfactory lobes of the brain, and then continuously by nerve conduction to the midbrain and spinal cord.[2] The early involvement of the cerebrospinal fluid in the pathological process, before any systemic effects of infection ap-

[1] S. Flexner, SCIENCE, 77: 413, 1933.

[2] S. Flexner and P. F. Clark, *Proc. Soc. Exper. Biol. and Med.*, 10: 1, 1912; H. F. Faber and L. P. Gebhardt, *idem*, 30: 879, 1933; *Jour. Exp. Med.*, 57: 933, 1933.

pear, takes on, therefore, special significance for the pathogenesis of poliomyelitis in man and the monkey.

The virus has not been detected in the cerebrospinal fluid withdrawn by lumbar puncture from cases of epidemic poliomyelitis. Since the virus as originally present in human nervous tissues is of low infectivity for monkeys, the failure to induce disease in those animals by the inoculation of the fluid is not conclusive evidence of its absence from the fluid. The virus employed for the experimental, nasal instillation is highly potent for monkeys. Hence the altered cerebrospinal fluid withdrawn from the animals so inoculated was injected intracerebrally into *Macacus rhesus* monkeys, and the procedure was followed by an accelerating injection 8 days later.[3] No detectable pathological effects arose in these animals.

The conclusion to be drawn is that in man and the monkey the virus of poliomyelitis, even in small amounts, does not pass from the infected nervous tissues into the cerebrospinal fluid. The cellular changes in the fluid represent, therefore, a reaction of the nervous system to injury; they are not the result of the presence of the virus in the fluid itself.

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THE LONG AND SHORT WAVE-LENGTH LIMITS OF PHOTOSYNTHESIS

DURING the past few years we have developed a method of studying photosynthesis in various portions of the spectrum that seems to give reproducible and accurate results without interference from the secondary effects of the different wave-lengths. The method consists of a preliminary adjustment of the plant to the radiation intensity to be used. Then the actual determinations are made by exposing the plant to a steady source of one portion of the spectrum for two hours, determining the amount of carbon dioxide used, followed by exposure to such an intensity of a second portion of the spectrum that the amount of carbon dioxide used is the same as in the first case. Under these conditions the relative efficiencies of the two radiations are inversely proportional to their intensities. The advantages of this experimental procedure are that the plant is acclimated to the low radiation intensities which it receives during a determination, the exposure to an isolated portion of the spectrum is short and that, under these conditions, the amount of photosynthesis in the two determinations is probably the same.

The limits of photosynthesis were determined in the following manner. The plants were exposed to radiation well within the limits and then to radiation about half of which was within the limit and half just outside. From the relative efficiency of this latter radiation the limit was calculated on the assumptions that the limit of photosynthesis was sharp, the amount of photosynthesis was a function of the number of quanta and not of the energy of the radiation and that the quantum yield was constant. Further investigation of these points is being conducted. The table given below is typical of the results obtained with Norway spruce in determinations of the long wave-length limit.

Expt. No.	Efficiency	Experimental error
	Per cent.	Per cent.
50	40.5	16
51	41.6	5
52	40.6	4
53	44.1	6
54	46.3	4

Weighted averages of these and similar determinations gave the following results. An experimental error of 4.25 per cent. would result in an error of 50 Å.

Tree	Efficiency	Limit of photosynthesis
	Per cent.	Å
Norway Spruce I	42.8	7430
Norway Spruce II	40.5	7380
White Pine III	39.7	7340
White Pine IV	41.5	7390
Norway Spruce I	65.4	4660
Norway Spruce II	65.2	4660
White Pine I	66.1	4650
White Pine II	73.3	4490

A complete account of this work will be published elsewhere.

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BOOKS RECEIVED

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[3] S. Flexner, SCIENCE, 74: 520, 1931; 77: 413, 1933.