mode and reading current directly from the meter in microamperes. No output current flows unless the pushbutton is depressed. This prevents the accidental exhaustion of the biological voltage source.

Although it is instructive for students to watch the change of membrane voltage during varying current-flow, experiments that require the continual assessment of short-circuit current become tedious. The *C* mode will cause the frogometer automatically to clamp a region to a predetermined voltage. Clamping occurs when the depression of the pushbutton allows current to flow from the amplifier output and through the microammeter to the output terminals of the frogometer. With a gain of 1,000 the typical frog skin may be clamped to zero to within a few 10ths of a millivolt. The presence of the input electrode compensator circuit allows clamping to voltages other than zero. As a simple example, assume the electrodes are imbalanced by 20 mV, red (#1) electrode negative. By adjusting the indicated 20 mV to 10 mV with the compensator, one requires the clamping current to drive the membrane to 10 mV (red side positive) instead of zero. With use of the compensator the clamping voltage can be adjusted from (E_{IB} + 60) to − (60 − E_{IB}) mV, where E_{IB} is the electrode imbalance voltage in millivolts.

Following time-dependent voltage changes or short-circuit current changes is easier with a recorder. A phone-jack output has been included in the frogometer; this essentially substitutes the external recorder for the panel meter. Inexpensive recorders with low input impedances can be used; the frogometer protects the biological voltage source from overloading.

Capabilities and Costs

The frogometer has been used in the required cell-biology course for sophomores at the University of Oregon for two years. The students seem responsive to and challenged by the experiments. We have been using the instrument to perform experiments somewhat similar to those described by L. Packer in *Experiments in Cell Physiology* (1967: Academic Press, New York) p. 191 ff. The instruments constructed in the science services electronics shop of the University of Oregon cost about $250 each for parts and labor. The parts, including the amplifier, cost about $180. This is much less expensive than a potentiometric recorder that would not have voltage clamping ability.

Acknowledgments.—Don Kitselman and the electronics shop of Science Services, University of Oregon, made the layout of components and constructed and tested the 16 frogometers on which the article is based. The circuit diagrams were drawn by Shiela Finch. The photographs were taken by Harrison Howard and Carol Cogswell. The cost of the frogometers was supported by grant GY-5153 from the National Science Foundation.

N.S.F. SUMMER INSTITUTES

High school teachers will study such subjects as ecology, environmental assessment, the population explosion, and the nation's need for power and its impact on the environment at 1972 summer institutes supported by the National Science Foundation.

To assist schools to improve their effectiveness of instruction in science and mathematics, NSF has awarded grants totaling $13.7 million for summer institutes for secondary-school teachers of science and mathematics. The grants support 274 institutes that provide study opportunities for 10,000 high school teachers throughout the country.

The institutes, to be conducted by 190 colleges and universities, usually last from six to eight weeks. A typical institute enrolls about 40 participants and includes laboratory or field work, lectures, discussion sessions, and seminars.

For each participating teacher NSF provides a stipend of up to $75 a week, with supplementary allowances for dependents and travel. Participants pay no tuition or fees.

A *Directory* listing institutions offering summer institutes for secondary-school teachers and supervisors may be obtained by a postcard request to Summer Study Program, Division of Pre-College Education in Science, National Science Foundation, Washington, D.C. 20550. Applications must be submitted to the various institutes by March 1, 1972.

ONE MAN'S PROTEST

A steelworker in the Jones & Laughlin Steel Corp.'s Cleveland plant was suspended when he refused to dump oil, solvents, and other wastes into the Cuyahoga River, according to United Press International. But Gilbert Pugliese got the backing of his United Steelworkers of America (AFL-CIO) local, which threatened a wildcat strike at the plant unless the company reinstated the employee immediately. Jones & Laughlin rescinded the five-day suspension and paid Pugliese for lost time. "I'm surprised and elated," said Pugliese, "over the kind of support I got from my fellow workers, the union, and the public."

Beautify Your Waterfront

Dozens of beautification ideas are presented in a 68-page publication, *Waterfront Renewal,* dealing with urban waterfronts and what has been done with them in Wisconsin. Write to the Bureau of State Planning, Wisconsin Department of Administration, 1 W. Wilson St., Madison.

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