SCIENCE

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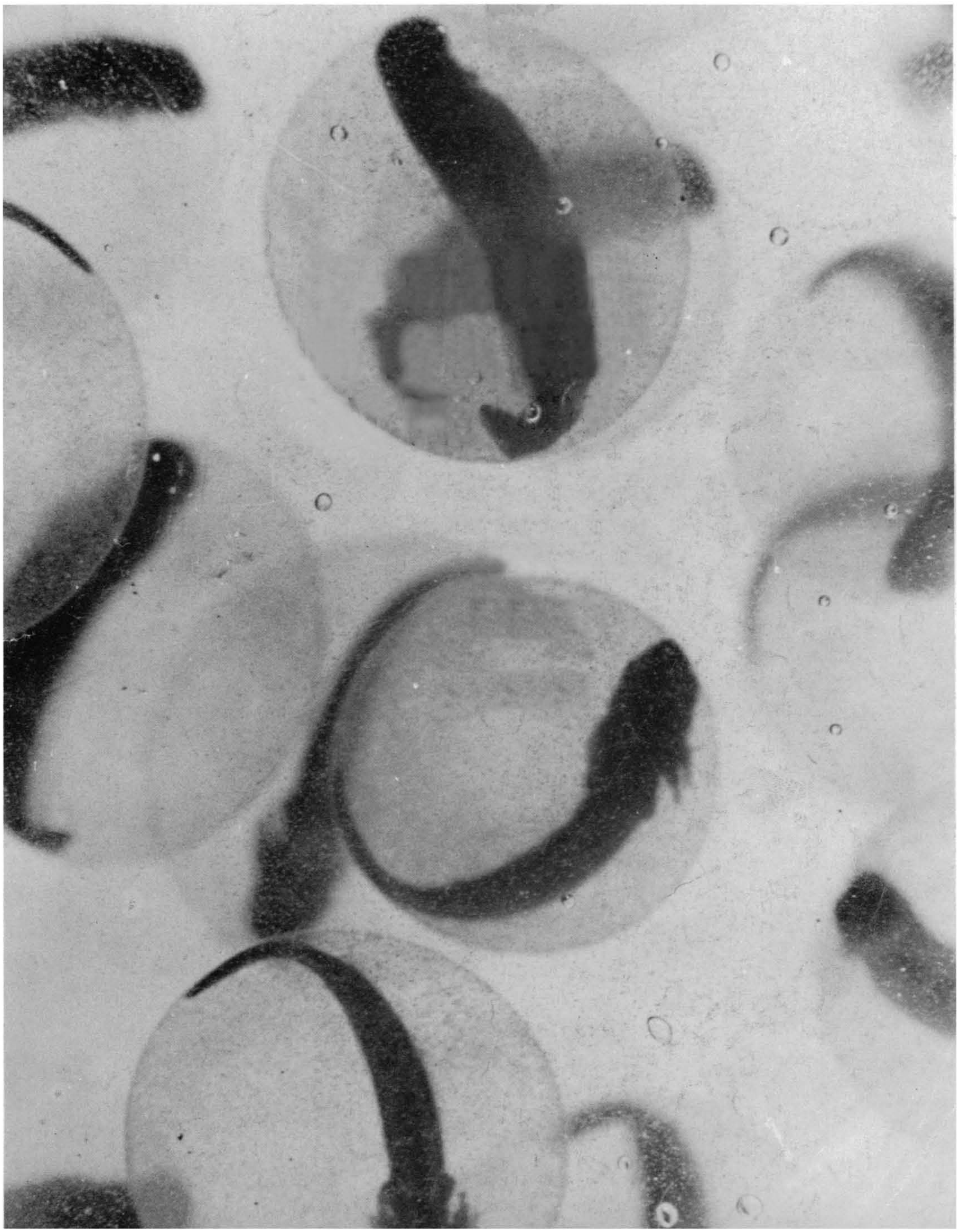

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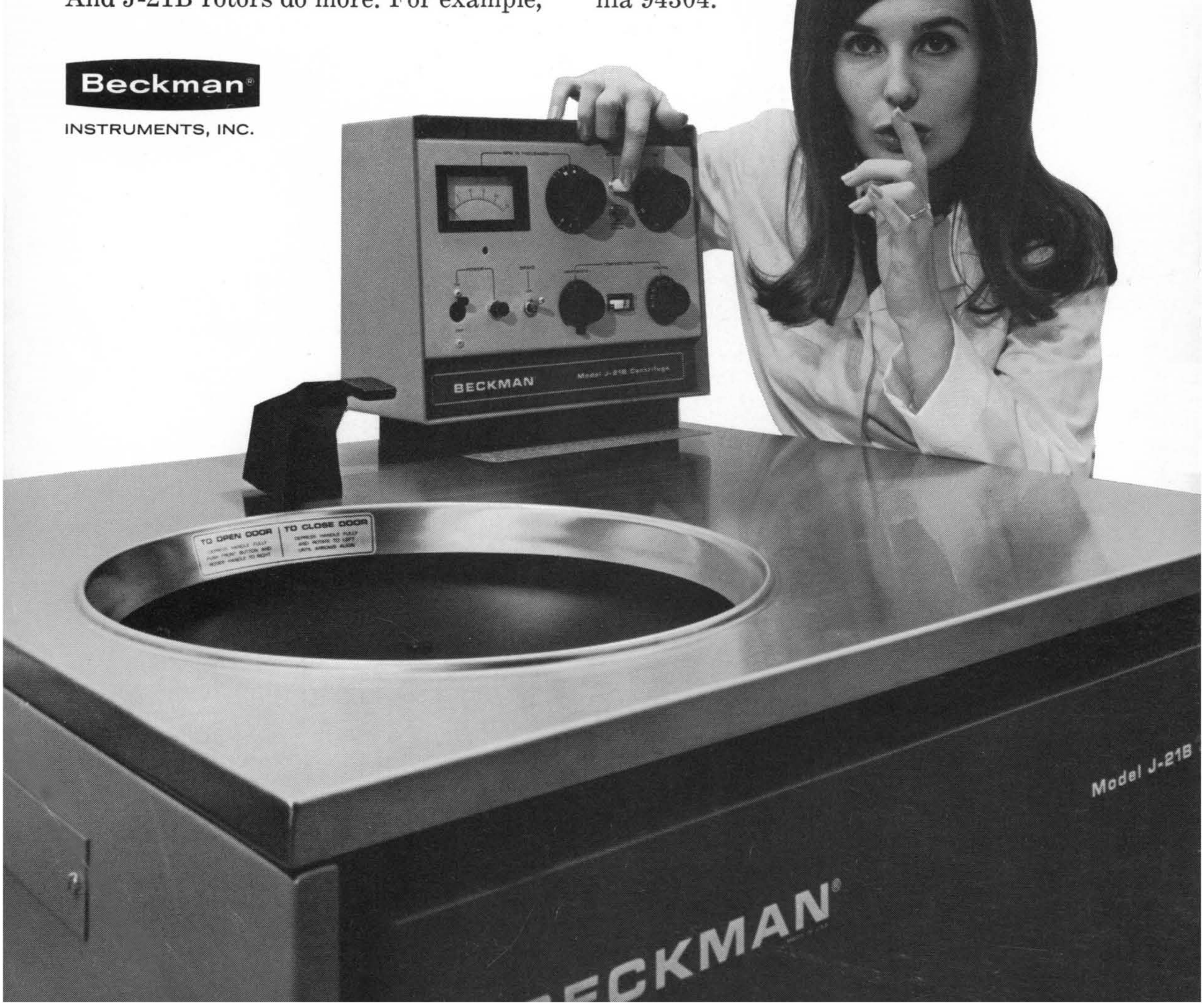
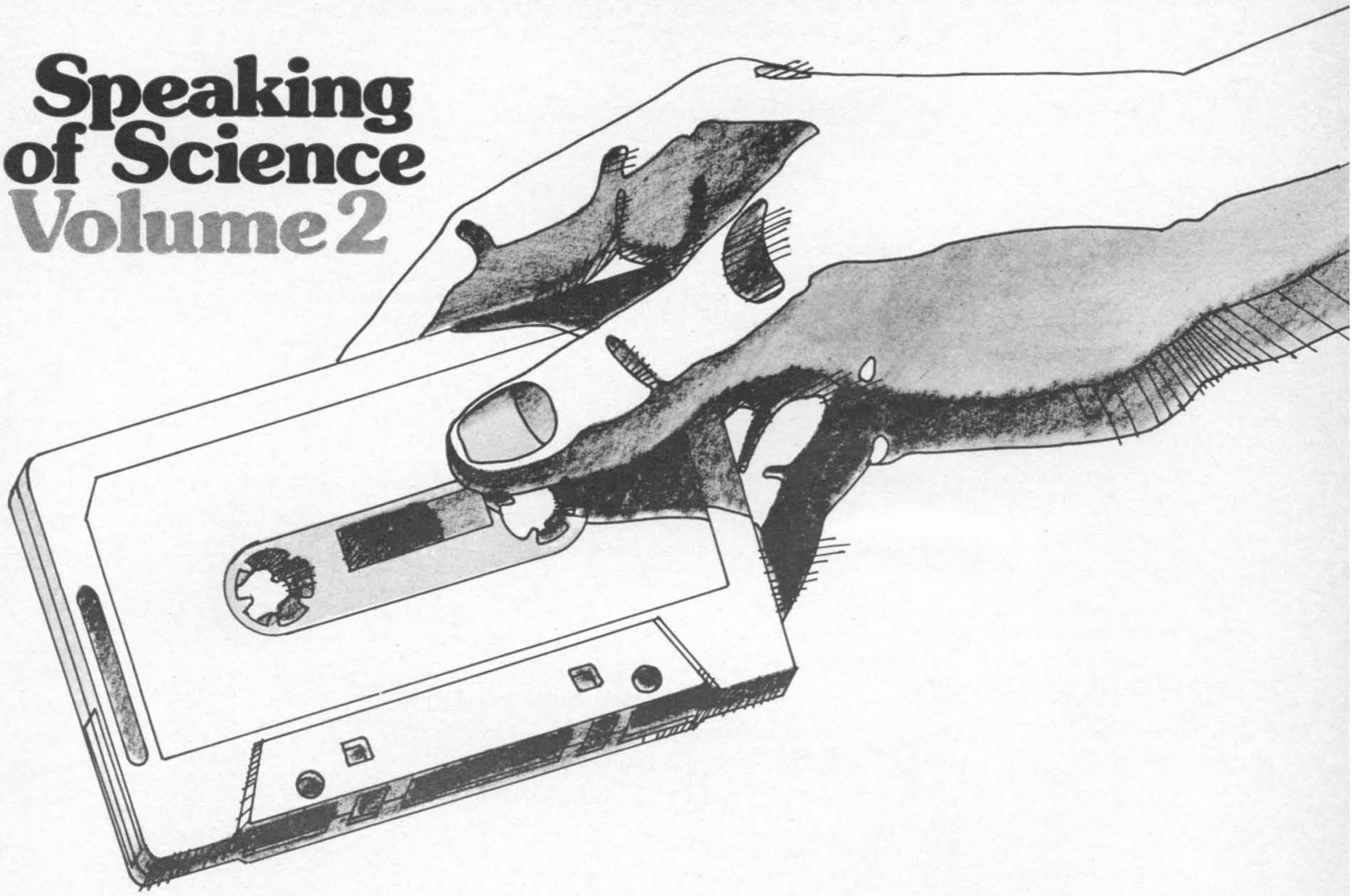


Speaking of Science Volume 2



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REPORTS

SAN FRANCISCO MEETING

COVER

Embryos of the salamander *Ambystoma maculatum* in their gelatinous envelopes. Embryos are about 9 millimeters in length. The grey cast of the matrix is due to a mutualistic alga *Oophilia amblystomatis* (Chlorophyceae), which increases the survivorship and rate of development of the embryos. See page 1305. [Henry M. Wilbur, Duke University, Durham, North Carolina]

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Underground Gasification of Coal

In principle, it should be possible in many places to obtain most of the energy and chemical values of coal in a clean form without sending men underground and with minimal disturbance to the environment. An oxidizing agent is pumped down one hole to support partial combustion of coal, and products (including H_2, CO, CO_2) are obtained from another.

The technology of underground gasification is about a century old. Activity peaked between 1945 and 1960. The process was almost competitive with other energy sources, but it could not compete with low-cost petroleum. The oxidizing agent, air, was cheap, but it included N_2, which diluted the products. These were useful when burned locally in large installations. One of the problems of underground gasification is to obtain suitable communication between the input and output holes. In most of the earlier installations, underground mining preparation was involved.

The situation has changed. Liquid hydrocarbons and natural gas (methane) have become scarce and expensive. Drilling techniques have evolved, and preparation for gasification need not involve underground labor. Perhaps most important, the technology for producing oxygen has become efficient and cheap, thus oxygen rather than air could be employed as the oxidant.

Last month, I visited an experimental installation of the U.S. Bureau of Mines at Hanna, Wyoming, 85 miles northwest of Laramie. The oxidant employed there now is air. The project leader, L. A. Schrider, gave figures on the composition of the output gases, which were being generated in substantial volume. They included, in percent by volume, H_2 (21.40); CH_4 (4.5); CO (9.0); CO_2 (17.1); N_2 (46.4); H_2S (0.11); and others (1.5). Had the oxidant gas been oxygen and had the CO_2 and H_2S been scrubbed, the product gas would have consisted largely of H_2, CO, and CH_4.

Mixtures of H_2 and CO have very interesting potentialities. Depending on the composition and on the pressures and catalysts employed, the following reactions can readily be conducted: $CO + 3H_2 \rightarrow CH_4 + H_2O$; $CO + 2H_2 \rightarrow CH_3OH$ (methanol); and, by Fischer-Tropsch reaction, $n\text{CO} + (n+1)H_2 \rightarrow C_nH_{2n+2} + nH_2O$. Methanol is a possible substitute for gasoline, and C_nH_{2n+2} represents a series of hydrocarbons. Another alternative is to use the H_2 for reaction with coal underground to form CH_4.

Underground gasification is not applicable everywhere, and there are possible problems, including contamination of groundwater and subsidence of the surface. The most attractive sites seem to be the thick coal seams of the West, especially those deep underground where conventional mining is hazardous if not unfeasible.

During my visit to Wyoming, I found the gasification project well directed and the personnel devoted and eager to move ahead. On a snowy, windy day, with temperatures far below freezing, the staff was outside working for extended periods. Morale was high.

Performance in Washington, D.C., is in painful contrast to that in Wyoming. The Office of Management and Budget has been slow to release appropriated funds to increase coal research by the Bureau of Mines. Expenditures for underground gasification have been considerably less than $1 million a year. Lack of funds has impeded procurement of instrumentation, delayed tests with O_2 as the oxidant, and even threatened stoppage of the experiment.—PHILIP H. ABELSON