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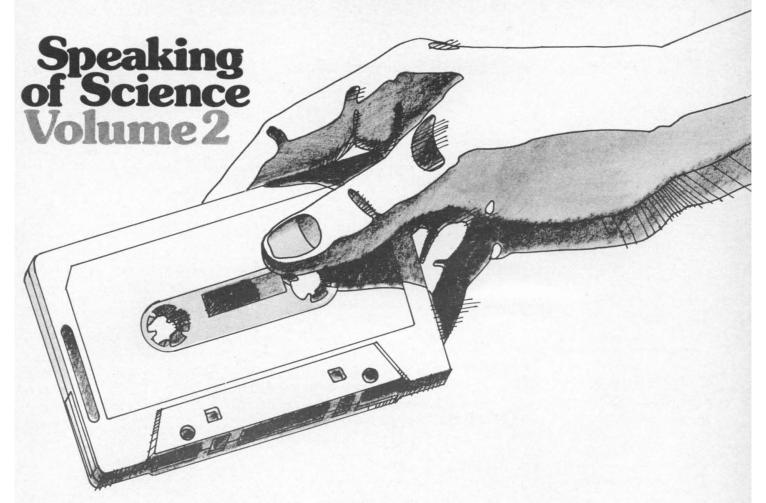
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COVER

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]

Research Opportunities in the United Kingdom

The Harwell and Culham Laboratories of the United Kingdom Atomic Energy Authority have openings for research scientists and engineers to join in the programmes described below.

AT HARWELL

The Laboratory is engaged in a wide and expanding programme of applied research topics and contracts, a continuing range of underlying studies and research in support of the advanced UK reactor programme. Within this wide range these are the areas where we have special needs:-

Chemistry

fission and radiation chemistry; techniques of fuel reprocessing; high definition analysis; the life history of pollutants in the atmosphere.

Chemical Engineering

surveying and modelling waste control problems; heat transfer; two phase flow studies; investigation of separation processes.

Computing Science

real time and multiprocesser systems, language development, computer networks, information retrieval, compiler development. A major facility is a multi-access IBM 370/165.

Electronics

instrumentation and measurement including data processing and systems applications.

Materials

fracture; radiation damage; corrosion; fabrication and testing techniques.

Metallurgy

development of new alloys, ceramics and composites for high temperature and other high demand applications.

Physics

nuclear structure studies, NDT and materials physics, neutron beam studies, application of nuclear physics techniques, radiation physics and spectroscopy, liquid physics, Mössbauer, applied optics.

Theoretical Physics and Mathematics

atomic and molecular theory; theory of fluids and heat transfer; electronic theory of solid materials; theory of radiation damage, defects and dislocations; computer modelling; numerical analysis, applied mathematics, operations research.

AT CULHAM

The expanding fusion research programme is conducted in association with laboratories in continental Europe together with a continuing programme of contract research in associate topics. Some of the main activities are as follows:-

Basic Physics of Plasmas

Wave propagation study, the growth of instabilities, non-linear plasma physics, plasma turbulence and anomalous diffusion, diagnostics, laser scattering and spectroscopy.

Physics of Plasma Confinement

the moderation of containment of high temperature plasma for various magnetic field geometries and in the rapid magnetic compression of plasmas.

Fusion Reactor Science

theoretical and experimental studies of technological problems arising in the design of plasma physics experiments and conceptual design studies of fusion reactors, surface physics, super conducting technology.

Theoretical studies of High Temperature Plasma

research in magneto-hydrodynamics, plasma kinetic theory and a wide range of related topics in theoretical physics.

Computational Physics and Computer Science

the facilities include an ICL system 4/70 computer, with on-line access and graphical display and use of an IBM 370/165 at Harwell. Research and development on fluid dynamics and energy applications.

Laser Science

research and development work on new lasers and laser systems for industrial and fusion research applications.

If you feel you can contribute to one of these areas or that your interests are closely related we should like to hear from you. Appointments will be to three-year Fellowships or, in suitable cases, to the permanent staff. Travel expenses to the UK will be paid for successful candidates and their families.

For application forms and more details about your area of interest write to:The Senior Recruitment Officer (A),
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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 H₂, CO, CO₂) 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, H₂ (21.40); CH₄ (4.5); CO (9.0); CO₂ (17.1); N₂ (46.4); H₂S (0.11); and others (1.5). Had the oxidant gas been oxygen and had the CO₂ and H₂S been scrubbed, the product gas would have consisted largely of H₂, CO, and CH₄.

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, $nCO + (n+1)H_2 \rightarrow C_nH_{2n+2} + nH_2O$. 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 O₂ as the oxidant, and even threatened stoppage of the experiment.—Philip H. Abelson

