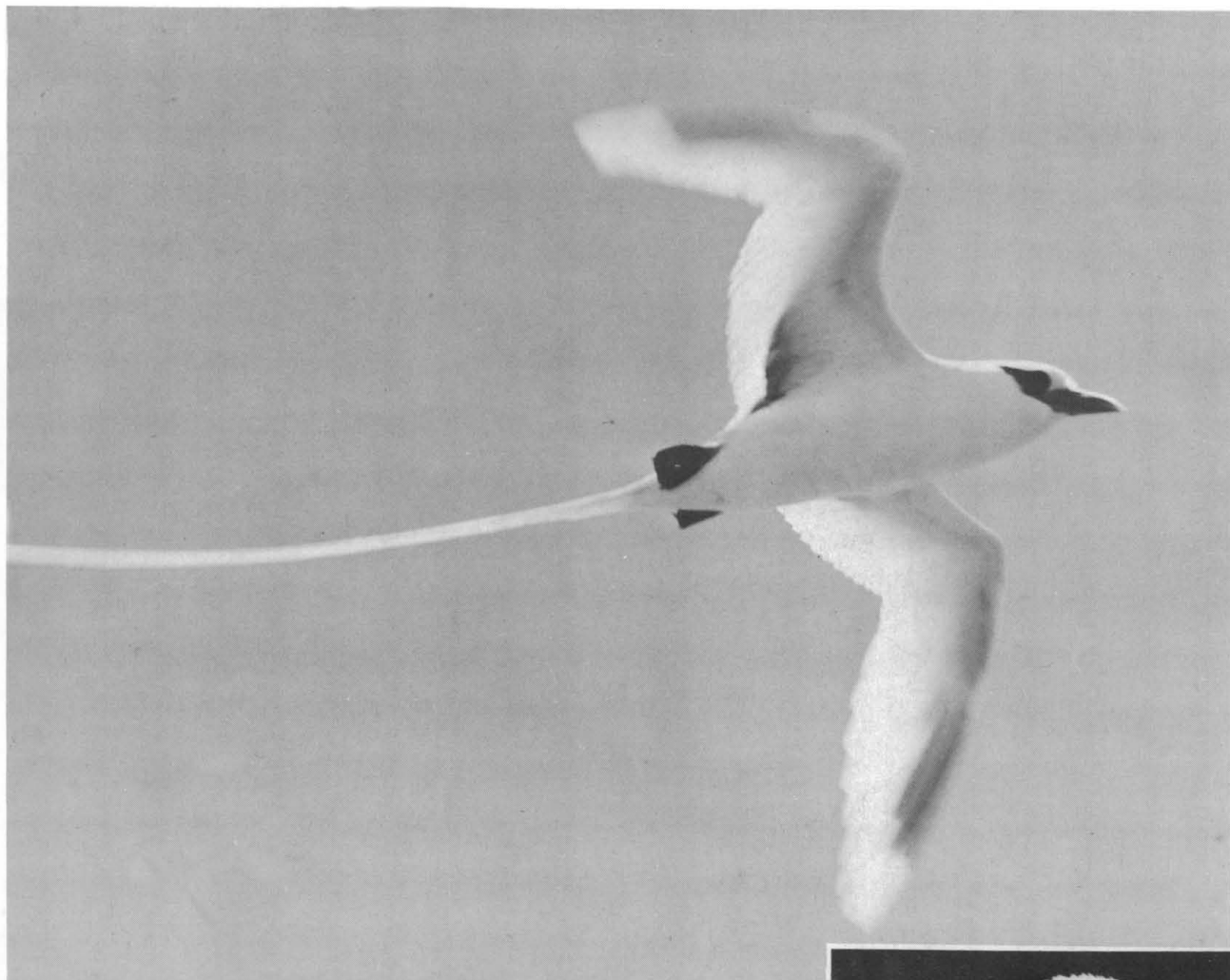


SCIENCE

7 July 1967

Vol. 157, No. 3784

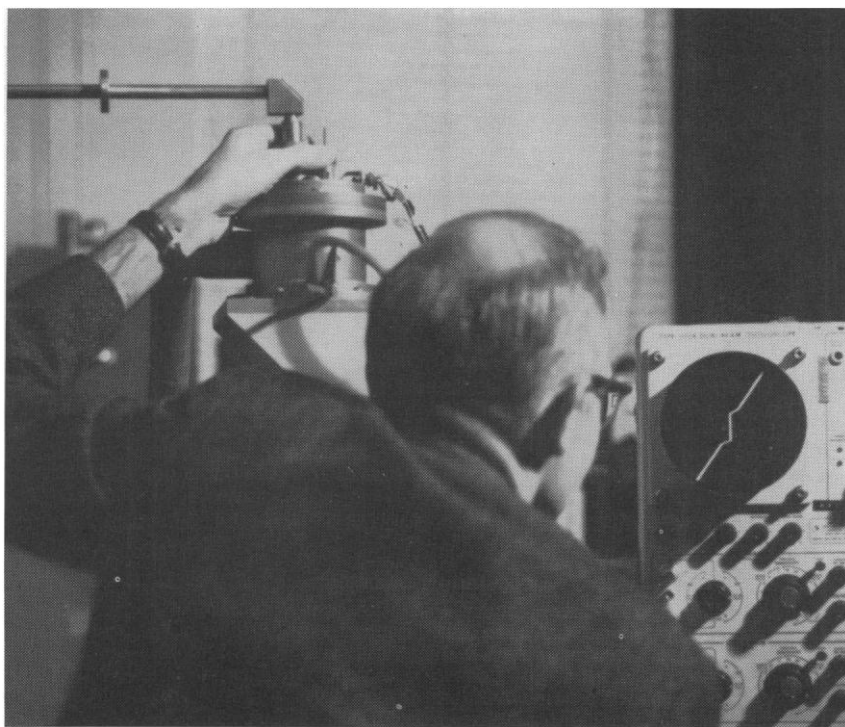
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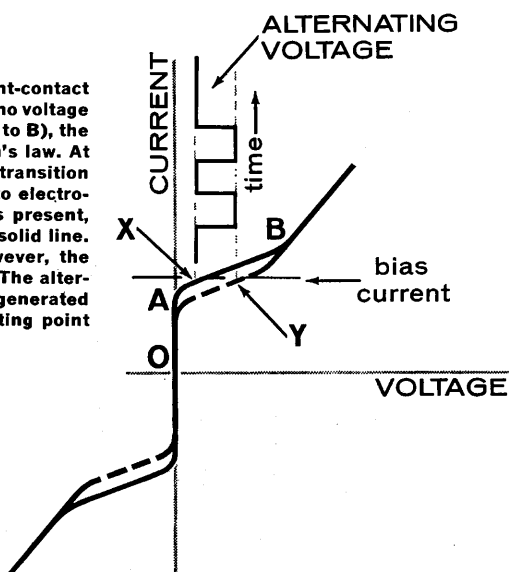
Report from
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A fast-acting detector of infrared light



Bell Laboratories research physicist C. C. Grimes adjusts contact pressure in cryogenic apparatus in which infrared radiation is detected by a superconductor point-contact junction. Oscilloscope shows the junction's voltage/current characteristic (graph below) derived by passing a low-frequency sinusoidal current through the junction. The junction, submerged in a dewar of liquid helium, exhibits a sharp increase in voltage in the presence of electromagnetic radiation. Infrared signals enter from left through the horizontal light pipe (above left hand) and are reflected down toward the junction.

Behavior of a superconductor point-contact junction. A direct current flows at no voltage (origin O to A). After transition (A to B), the curve approximately follows Ohm's law. At a constant bias current within the transition region, the junction is sensitive to electromagnetic fields. When no field is present, the junction characteristic is the solid line. In the presence of infrared, however, the characteristic is the dashed line. The alternating voltage (square wave) is generated as the radiation shifts the operating point of the junction from X to Y.



If two sharp points of superconductor are lightly pressed together, a small direct current can be made to flow between them at zero voltage . . . much as if they were a single piece of superconductor. But, if the current (controlled by external circuitry) is increased beyond a certain critical value, the contact changes electrically and a voltage appears across it.

The critical current value (A on graph) is highly sensitive to external electromagnetic fields. Such fields cause the voltage to appear at a lower current. In this instance, then, the contact is analogous to a "Josephson junction" (after Brian Josephson of Cambridge University who predicted properties of superconductor contacts), and can act as a detector of electromagnetic radiation. Some time ago, a junction composed of thin films of superconductor separated by an oxide layer was shown to work at frequencies up to 25 GHz.

Now, at Bell Telephone Laboratories, researchers Charles C. Grimes, Paul L. Richards, and Sidney Shapiro have devised and demonstrated a superconductor point-contact junction that detects infrared signals . . . up to 1500 GHz. The present experimental form responds to infrared pulses as short as 0.1 microsecond and promises to operate at 1-nanosecond intervals. This has practical importance because heretofore there have been few devices that react as rapidly and as sensitively to submillimeter or far-infrared radiation (wavelengths from 100 to 1000 microns).

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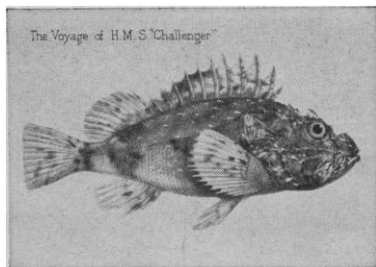
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COVER

(Top) White-tailed tropic bird, *Phaethon lepturus lepturus*; (lower left) adult sacred ibis, *Threskiornis aethiopica abbotti*; and (lower right) juvenile red-footed booby, *Sula sula rubripes*. These birds are among the hundreds of species of animals and plants whose habitat may be destroyed if plans proceed for establishing a communications center on the island of Aldabra, northwest of Madagascar. Among the animals affected would be the almost extinct giant land tortoise. See page 8. [Roger Gaymer, University of Bristol, Bristol, England]

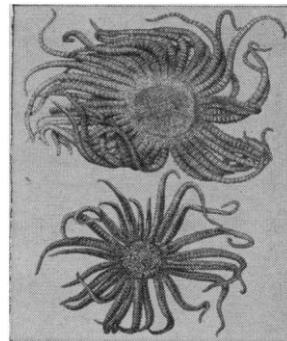
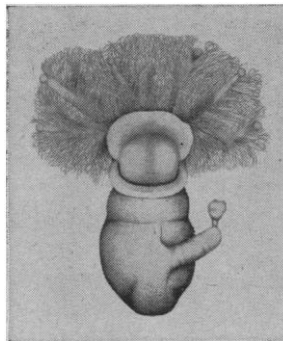
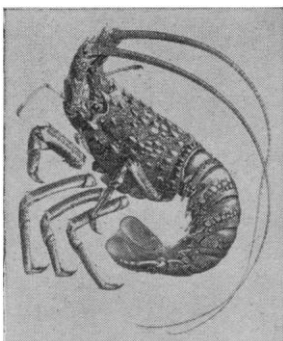
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Toward a better photo technology for ocean science

H.M.S. "Challenger," slightly over 2,000 tons displacement, left England in December of 1872, sailed and steamed 69,000 miles in the Atlantic, Antarctic, and Pacific under the scientific direction of Professors Wyville Thomson and John Murray, and returned to England in May, 1876. The Challenger Expedition Commission then put in 15 years of hard labor in Edinburgh preparing the findings for publication. Fifty large quarto volumes resulted. This brought oceanography into existence as a branch of organized science. Now it is said to be on the brink of a boom.

Now, among other advantages of our times, photography can make itself more useful to oceanographers. It can be made to work at abyssal depths, and it can release men from duty at the sketch pads on deck, and their sketches need no longer be redrawn on the lithographer's stone. Photographic recording



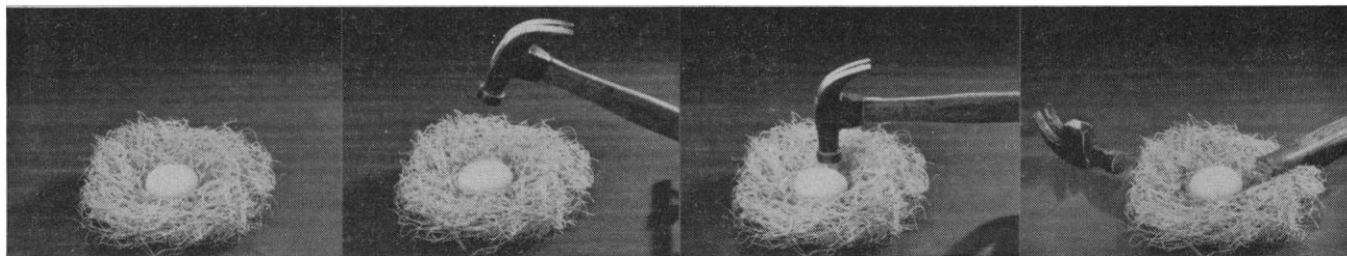
materials yield visual analog representations of the output of sensing devices that Sir Wyville and Sir John would covet. Their successors—no longer universal oceanographers but biologists, engineers, physicists, geologists, and chemists pursuing separate leads that have been opened to them and tracing the interconnections—have enough to think about in their specialties without involving themselves in the intricacies of finding the right photographic materials for their special environment.

This is an invitation to turn such questions over to us. A Kodak man has been put under orders to listen to oceanographers and either help them or put them in touch with someone else who can. His name is Sheldon Phillips; his phone number is 716-325-2000, extension 3221; and his address is simply Eastman Kodak Company, Rochester, N. Y. 14650.

Joke lays egg around world

Bless the endeavors of the many thousands of English teachers in this land to instill love for the language of Shakespeare and skill in its use. Bless also certain less traditional and less common current efforts to teach the generation who will have to make the year 2000 habitable how to communicate by photog-

raphy across the barriers to word-language. Compare the wit of Shakespeare's clowns with the following joke for reaching the minds of the young at Cape Dorset in Baffinland or the back country of Guinea or the schools of Grosse Pointe or Watts:



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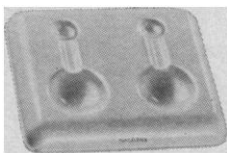
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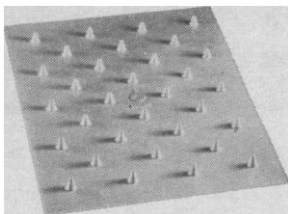
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the music of Beethoven will soon be an incomprehensible curiosity. If there is one thing that our age of electronic technology has done, it is to bring the symphonies of Beethoven to new millions of people, whose enjoyment shows no signs of abatement. Iltis finds cacophony in the music of Roger Sessions. But 150 years ago, the music critics objected to the dissonances in Beethoven's First Symphony, until 10 years later the turbulent music of the *Eroica* produced a new wave of complaints by other critics who then said that the earlier First Symphony was a model of formal excellence. Is it possible that these critics of Beethoven were the prototypes of Iltis?

Iltis doubts whether Dobzhansky remembers "what it was like to walk the dunes in solitude or to swim in the ocean." One might get a better idea of Dobzhansky's familiarity with solitude by attempting to retrace the remote montane journeys made by that redoubtable pursuer of *Drosophila pseudoobscura*.

THOMAS H. JUKES
*Space Sciences Laboratory,
University of California, Berkeley 94720*

Reference

1. R. H. Torrey, F. Place, Jr., R. L. Dickinson, *New York Walk Book* (American Geographical Society, New York, ed. 3, 1951), p. 301.

Can Aldabra Be Protected?

The proposed establishment of a joint U.S.-British communications center on the island of Aldabra between the northern tip of Madagascar and the African mainland demands that United States biologists act promptly under the auspices of the International Biological Program (see Revelle's editorial, 24 Feb., p. 957). This island is a veritable zoological curiosity shop which should be preserved in its natural state. The 60-square-mile (155.4 km²) atoll is virtually a living natural history museum, the home of an almost extinct giant land tortoise (*Testudo gigantea*) and of rare birds such as the red-footed booby and the flightless rail.

As long ago as 1871 Charles Darwin and others became involved in a similar (and successful) effort to prevent commercial development on the island. It is only one of two locations in the world where these great land tortoises still exist. In addition, about 10 percent of the ap-

proximately 170 species of plants on the island are found nowhere else.

Apparently the British and American governments want this island for a radio and tracking station, serviced by a 9000-foot (2.74-km) landing strip. Only about 100 people currently inhabit the island—certainly a fraction of the number that would arrive with the development of the communications center. It should be possible to locate these facilities elsewhere, either by contract with mainland nations, such as Tanganyika, or with the island of Madagascar, or on other islands to the east. It is suggested that the National Academy of Sciences join the Royal Society in Britain (which has already started to work on this problem) in urging their governments to select another site. While these negotiations may require unusually complicated international scientific cooperation, they would be worth every effort if the unique fauna and flora of this island are to be protected.

DONALD J. ZINN

*Department of Zoology,
University of Rhode Island,
Kingston 02881*

Rite of Penitence

Ethical problems involved in animal research have been discussed in *Science* from time to time. You might, therefore, be interested in the following item from *The Korea Times*, Seoul, Korea, of 30 May 1967:

A memorial service will be observed today at the National Institute of Health for animals killed in a series of medical experiments. Before the tombs of the animals, Buddhist monks will recite sutras and a celebrant will burn incense and offer wine, while the officials of the institute pay tribute to the memory of the animals. The service for the animals, according to Dr. Yu Il-pyong, director of the animal division, is aimed at assuaging the officials' sense of penitence over killing "innocent animals" rather than to console the dead animals.

"The workers here seemed to think that, by holding a memorial service, they can convince themselves they did not kill the animals out of malicious intention," said Dr. Yu.

The National Institute of Health, located in Pulgwangdong, conducts medical experiments on about 50,000 animals a year. Some are used to get preventive medicine and others for curative medicine.

JOHN W. MCCRARY
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Transient Fellows

Millett's letter (19 May) fails to consider the mobility of students and faculty. His table from National Science Foundation sources clearly shows that California, Massachusetts, and New York received 48.16 percent of the NSF fellowships while these states account for only 21.6 percent of the population. This analysis overlooks the fact that many recipients of these fellowships do not come from these states and do not remain there after their fellowships terminate. According to the Ohio State University Bulletin for July 1966, approximately 78 percent of the faculty of Arts and Sciences at Ohio State received their Ph.D. degrees from outside Ohio. Of these, about one in five was trained in California, Massachusetts, or New York. Thus Ohio is certainly benefiting extensively from Ph.D. programs elsewhere. About 84 percent of the graduate faculty at the University of Texas received their highest degrees out-of-state, and, of these, about 21 percent received their training in California, Massachusetts, or New York. These figures include both the sciences and nonsciences. The proportions are similar for the science faculties considered alone. I suggest that strict adherence to the practice of awarding grants and fellowships solely on merit will result in a reasonable distribution among states as the excellence of all universities continues to improve.

AUSTEN RIGGS

Zoology Department,
University of Texas, Austin 78712

Emotional Letters

I am dismayed, not by the causes and issues discussed, but at the amount of wild free emotion which is running around in your Letters columns. The 5 May issue contained letters by Iltis, Elmer, and Sager. Not one of these gentlemen adduces any data or new arguments to support his position, but merely emotes furiously. I presume that such letters will be received if any issues of importance are discussed, but must you publish them? In my opinion, even the Letters columns of a scientific journal should be restricted to those who think with their brains, not with their bowels.

S. W. BOWNE

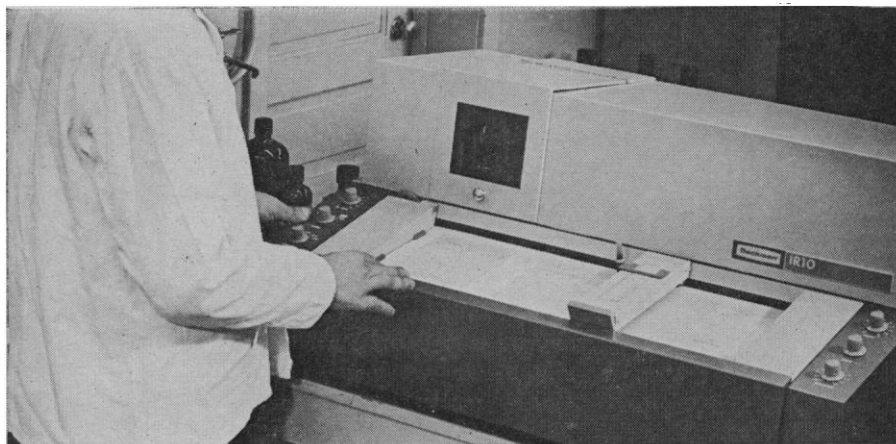
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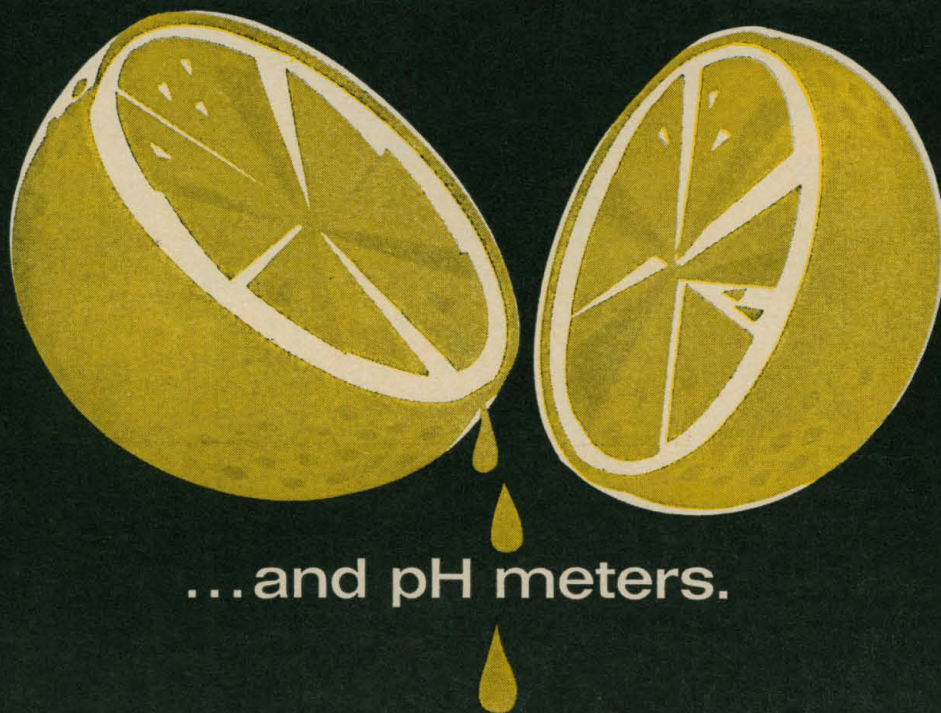
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*European Office: Lime Tree Farm, East Hagbourne, Berkshire, England. Telephone Didcot 3317

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EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Phone: 202-387-7171. Cable: Advancesci, Washington. Copies of "Instructions for Contributors" can be obtained from the editorial office. ADVERTISING CORRESPONDENCE: Rm. 1740, 11 W. 42 St., New York, N.Y. 10036. Phone: 212-PE 6-1858.

Dependable Supplies of Hydrocarbons

Reliable new sources of petroleum are under development. In northern Canada, through a \$235-million facility, the Athabasca tar sands, which hold 600 billion barrels of oil, are now beginning to be exploited. At Cresap, West Virginia, construction is beginning on a pilot plant designed to test a process for producing gasoline from coal at a cost of 11 cents per gallon. In Colorado a new facility is being planned to produce petroleum liquids from the Green River shale. This formation contains the equivalent of 2000 billion barrels of oil, of which about 80 billion barrels is recoverable under present economic conditions. Conventional sources of petroleum are being extended by discoveries from drilling on continental shelves. While additional sources of petroleum are being developed, proved reserves are adequate to meet present demand of about 4 billion barrels per year.

In the development of additional petroleum reserves, a present focus of interest is the Green River shale, which extends over 16,000 square miles in Wyoming, Utah, and Colorado. The richest parts of the shale contain 25 to 65 percent of organic matter. They also include unusual resources of carbonate minerals such as nahcolite (NaHCO_3) and dawsonite [$\text{NaAl}(\text{OH})_2\text{CO}_3$]. Dawsonite, an excellent potential source of alumina, constitutes as much as 25 percent of the weight of some parts of the oil-rich shale.

The organic matter occurs as a complex, high-polymer-like solid disseminated through the rock, which in polished section is reminiscent of mahogany. To produce oil it is necessary to pyrolyze the shale. To accomplish this quickly, temperatures of 500°C are required. At 300°C, pyrolysis would take some weeks.

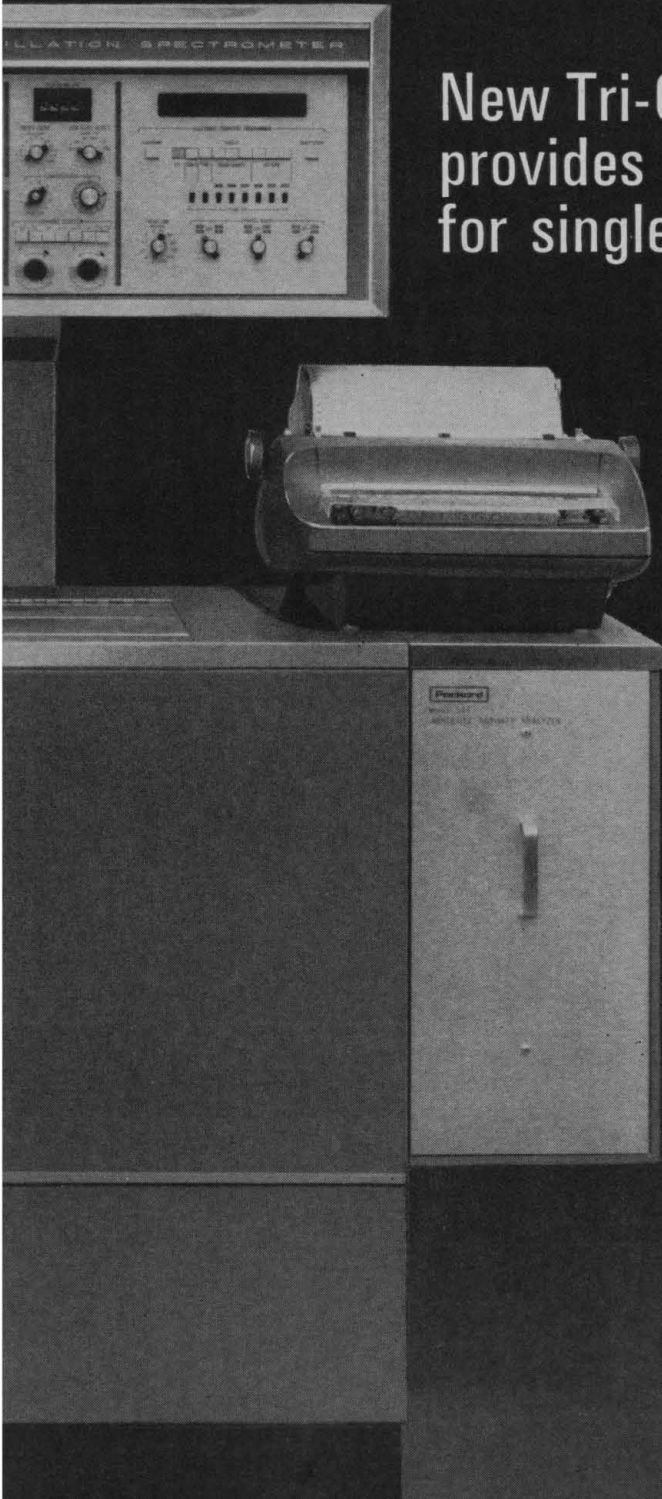
The processes ready for use involve mining the shale, breaking it up, retorting it, and disposing of the waste. To supply a tenth of the petroleum needs of this country would require the mining of about 2 million tons a day. The spent shale, which would be highly alkaline, would have to be disposed of so as not to ruinously pollute the Colorado River.

A possible alternative is development of methods for underground pyrolysis, which would leave the countryside relatively undisturbed and would minimize pollution. To accomplish this, methods must be found for increasing void space in the shale. Various means are under study, including underground detonation of nuclear devices. Other proposed methods include electrical fracturing and the use of chemical high explosive in pre-induced fractures. To investigate these and other problems, agencies of the Department of the Interior, including the Bureau of Mines and the Geological Survey, have proposed a 10-year oil-shale research and development program costing \$101 million.

Most of the resources of the Green River shale are located on public lands. Naturally, many individuals and corporations would like to acquire for a nominal sum a national asset that ultimately may be worth trillions of dollars, and this should not be permitted. Moreover, this country has seen enough of ghost towns and polluted streams from mining operations. Achieving optimum development of the Green River shale is a task worthy of our best minds. Some of them are to be found in government, and implementation of the proposed 10-year program is highly desirable. However, articulate, public-spirited citizens must also become involved if the public interest is to be adequately protected.

—PHILIP H. ABELSON

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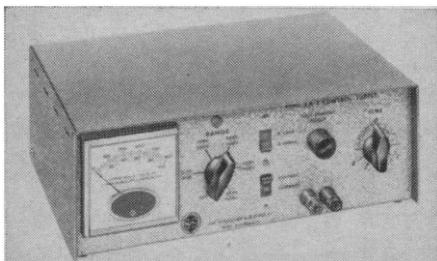
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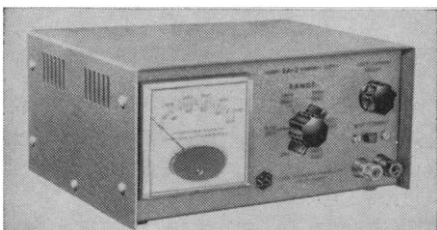
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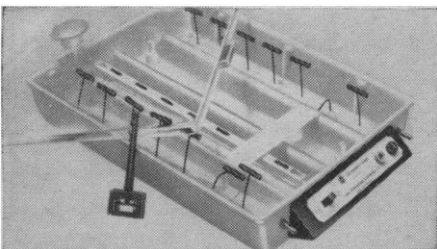
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acetylene reduction, even though the system was sensitive to oxidation and had to be protected with an inert gas during homogenization. When the gas mixture was 5 percent acetylene, 10 percent oxygen, and 85 percent helium, ethylene production proceeded linearly for 7 hours in *Myrica cerifera* and 2 hours in *Glycine max*. This parallels the time course of $^{15}\text{N}_2$ fixation for these tissues. Ethylene production was roughly equivalent to acetylene disappearance in *Myrica* ($5.8 \mu\text{M}$ as opposed to $5.0 \mu\text{M}$ per gram of fresh weight per 4 hours). Acetylene reduction, which could only be detected in nodulated roots, paralleled N_2 reduction patterns in other species of leguminous and nonleguminous plants. Acetylene reduction in homogenates supplemented with $\text{Na}_2\text{S}_2\text{O}_4$ and an ATP-generating system was only one-hundredth that of intact tissues on a comparative weight basis, a relationship not unlike that found for $^{15}\text{N}_2$ with *Myrica*.

R. V. Klucas (Wisconsin) described the use of a simple modification of the French pressure cell which permits disruption of nodules in the absence of air. Soybean root nodules broken anaerobically and exposed aerobically to $^{15}\text{N}_2$ fixed N_2 at reasonable rates.

Work on the primary products of nitrogen fixation in the root nodules of *Serradella* as studied with $^{15}\text{N}_2$ was summarized by I. R. Kennedy (University of Western Australia, Nedlands). Although the labeling patterns obtained were qualitatively consistent with the formation of amino acids and amides from ammonia in a single metabolic pool, a kinetic analysis suggested the occurrence of two or more internal ammonia pools in the early reactions of N_2 fixation. After 45 seconds of exposure to $^{15}\text{N}_2$, the label was in ammonia, glutamic acid, glutamine, aspartic acid, alanine, and asparagine; the asparagine was least labeled. The ammonia pool was saturated within 5 minutes, whereas amino acid and amide enrichment continued at a linear rate. Pulse labeling and displacement experiments with $^{15}\text{N}_2$ indicated that ammonia was a primary intermediate and that glutamic acid and glutamine were the primary amino compounds.

The informal gathering of the colloquium, which was similar to that of previous colloquia [*Science* 147, 310 (1965); *ibid.* 151, 1565 (1966)], provided an opportunity for an exchange

of current data and ideas between workers interested in the mechanism of biological nitrogen fixation, a timely topic of considerable theoretical and practical importance.

W. S. SILVER

Department of Bacteriology, University of Florida, Gainesville 32601

Retirement Crisis

Experts on aging attended a workshop, 3–5 April 1967, in Washington, D.C., aimed at conceptualization of the retirement crisis in developmental terms. The conference was a first and most important step toward stimulating systematic investigation of retirement as a period in human development. There is reluctance, or at least inertia, in perceiving development as life-long. From a life-history viewpoint, it is known, at least in general terms, where the retiring person “came from” developmentally. As yet unknown is the nature of the transition from the producer-adult stage to the end-of-life leisure stage. “Crisis” is used in the sense of a turning point in development that will markedly affect subsequent development.

The discussion strove to formulate researchable questions and hypotheses that will answer the question, “What is the retirement crisis?” Participants agreed that retirement is an amorphous concept that can be viewed as a process, an event, or a transitional period. Retirement as a homeostatic crisis was discussed from various viewpoints. Donahue (University of Michigan) raised the question, “What is the gestation period of retirement?” The general feeling was that few arrive at retirement without having thought about it. This raised the question of differences in occupations.

Eisdorfer (Duke University) listed the covariants age, health, sex, socioeconomic status, nature of job, and emotional balance as determiners of one’s subjective and financial readiness and preparedness for objective retirement.

The group turned to the meaning of work, Eisdorfer pointing out that this is a central issue of the retirement crisis. Medically, nothing is more damaging to the older person than retirement from activity, remarked Bortz (Lankenau Hospital). The concept of work as morally, physically, and financially necessary and good is being challenged, noted Eisdor-