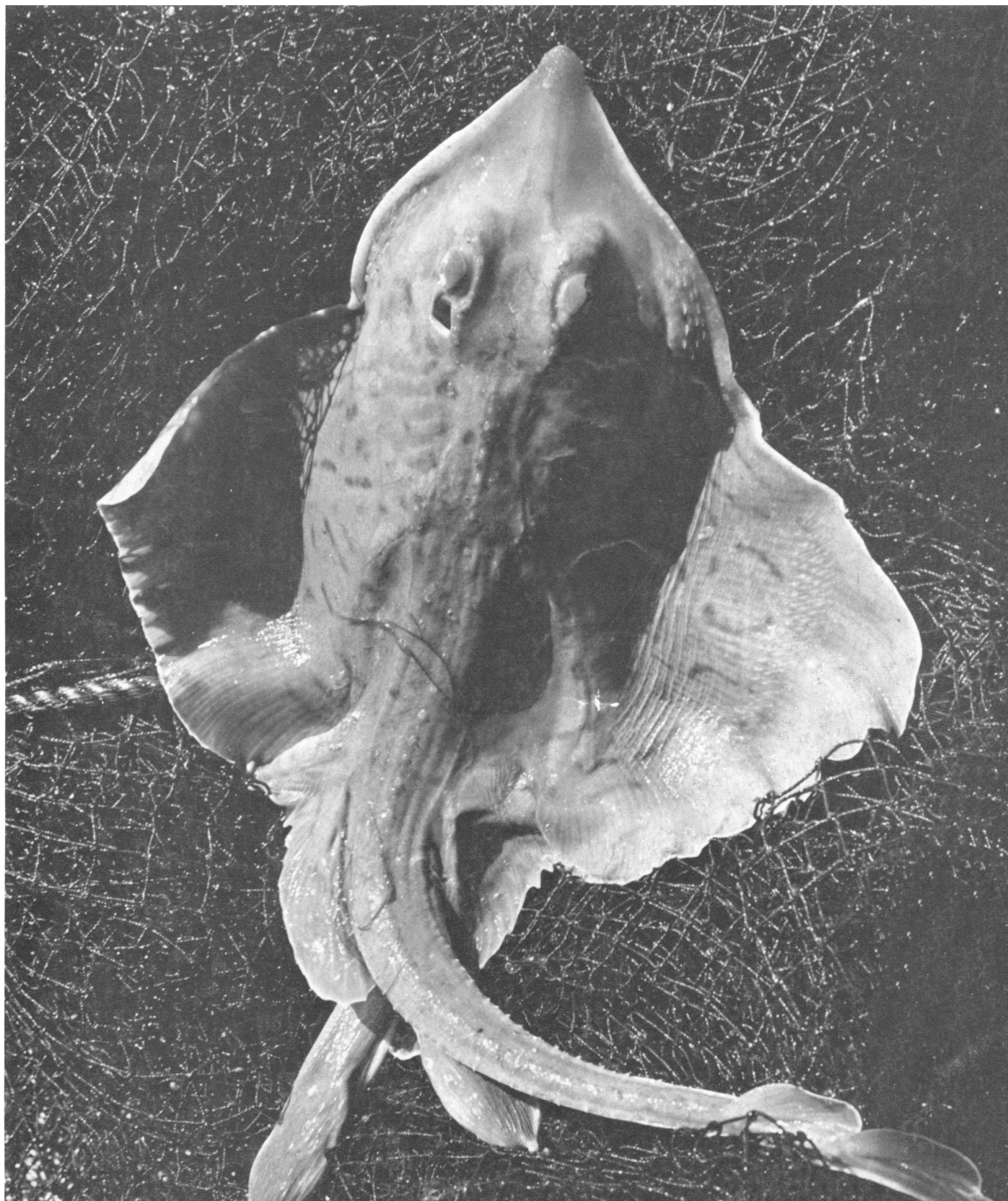


SCIENCE

4 October 1974

Vol. 186, No. 4158

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



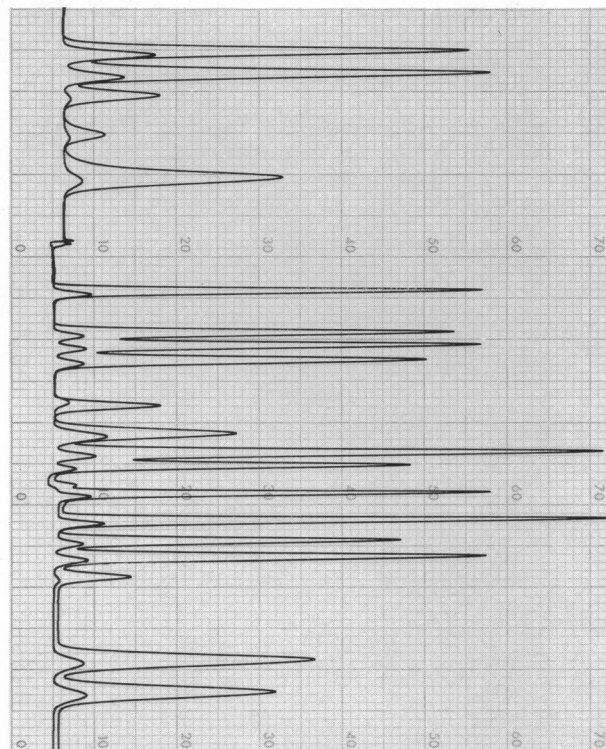
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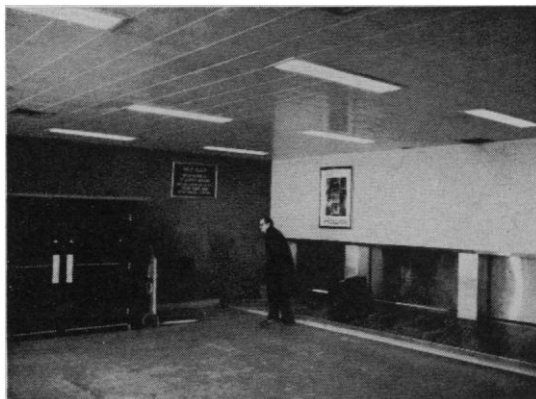


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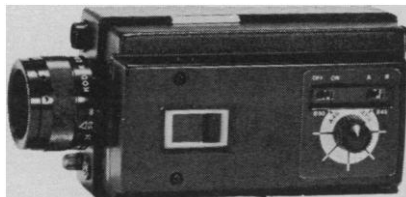
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Volume 186, No. 4158

SCIENCE

LETTERS	Public Confidence in Science: <i>C. Z. Nunn</i> ; Understanding Science: <i>G. W. Tresselt</i> ; Familiar "Analysis": <i>G. Rosegger</i> ; <i>N. G. Anderson</i>	9
EDITORIAL	Circum-Pacific Energy and Mineral Resources	11
ARTICLES	Trilobites and the Origin of Arthropods: <i>J. L. Cisne</i>	13
	Skin Lipids: Their Biochemical Uniqueness: <i>N. Nicolaidis</i>	19
	A Policy for Investment in Biomedical Research: <i>D. R. Challoner</i>	27
NEWS AND COMMENT	Pollution and Public Health: Taconite Case Poses Major Test	31
	"Excessive Bureaucracy" Found in R & D at EPA	32
	Strategic Weapons Policy: CED Urges Stronger Hand for Congress	37
RESEARCH NEWS	The 1974 Fields Medals (I): An Algebraic Geometer	39
	Rous Sarcoma Virus: A New Role for Transfer RNA	41
	Element 106: Soviet and American Claims in Muted Conflict	42
BOOK REVIEWS	Woman, Culture, and Society reviewed by <i>N. L. Gonzalez</i> ; Particle-Interaction Physics at High Energies and Hadron Physics at Very High Energies, <i>J. D. Jackson</i> ; Philosophy of Biological Science, <i>S. J. Gould</i> ; Books Received	43

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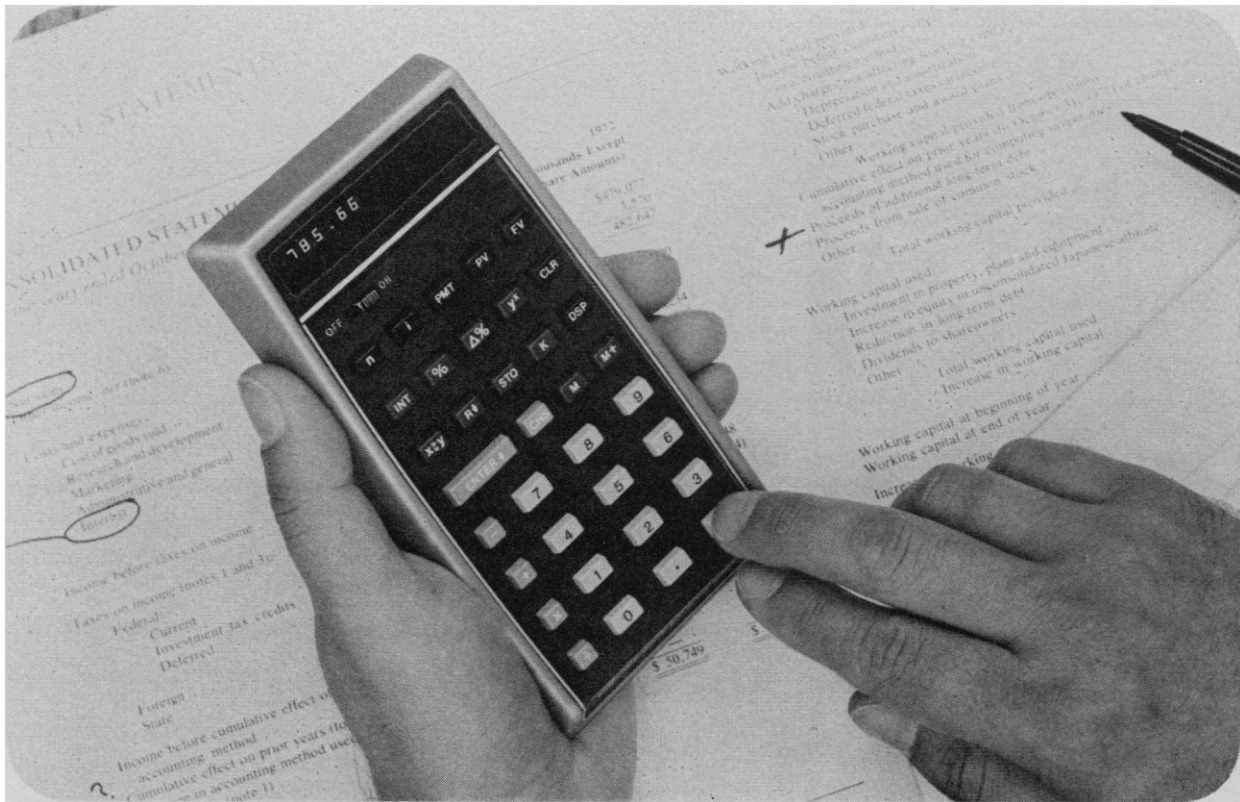
REPORTS	Rod and Cone Pathways in the Inner Plexiform Layer of Cat Retina: <i>H. Kolb and E. V. Famiglietti</i>	47
	Earthquakes and the Rotation of the Earth: <i>D. L. Anderson</i>	49
	Thermal Blanketing: A Case for Aerosol-Induced Climatic Alteration: <i>S. B. Idso</i>	50
	The Spiral Interplanetary Magnetic Field: A Polarity and Sunspot Cycle Variation: <i>L. Svalgaard and J. M. Wilcox</i>	51
	Phosphate Release and Sorption by Soils and Sediments: Effect of Aerobic and Anaerobic Conditions: <i>W. H. Patrick, Jr., and R. A. Khalid</i>	53
	Serum Globulin in Myasthenia Gravis: Inhibition of α -Bungarotoxin Binding to Acetylcholine Receptors: <i>R. R. Almon, C. G. Andrew, S. H. Appel</i>	55
	Urea Tolerance as a Molecular Adaptation of Elasmobranch Hemoglobins: <i>J. Bonaventura, C. Bonaventura, B. Sullivan</i>	57
	Methionine Adenosyltransferase Deficiency: New Enzymatic Defect Associated with Hypermethioninemia: <i>G. E. Gaull and H. H. Tallan</i>	59
	Human Chromosome 21 Dosage: Effect on the Expression of the Interferon Induced Antiviral State: <i>Y. H. Tan et al.</i>	61
	Morphine and Ethanol: Selective Depletion of Regional Brain Calcium: <i>D. H. Ross, M. A. Medina, H. L. Cardenas</i>	63
	<i>Technical Comments: More on Seasonal Variations in Goldfish Learning:</i> <i>B. W. Agranoff and R. E. Davis</i>	65
MEETINGS	Pulsar Radiation Mechanisms: What Are the Critical Experiments?: <i>R. N. Manchester</i>	66

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COVER

Freshly captured clearnose skate (*Raja eglanteria*). Hemoglobins from this and other elasmobranch species show molecular adaptations to the high concentrations of urea normally found in their blood. See page 57. [Ken Susman and Tom Fisher, Duke University Marine Laboratory, Beaufort, North Carolina]

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.



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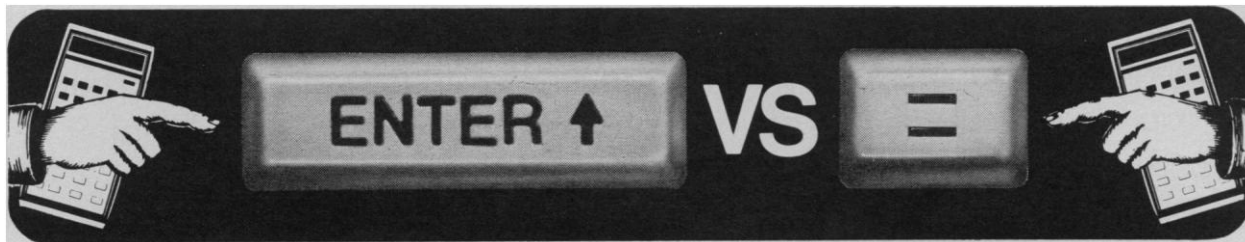
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Western Electric Reports:

An inside look at crystal growth.

Engineers at Western Electric's Engineering Research Center have developed an improved method for controlling the growth of the crystals used in light emitting diodes (LED's). The new technique represents one more step toward low-cost, mass produced LED's.

LED's have found many uses in telecommunications equipment as illuminators, indicator lamps and numeric displays. They consume very little power and last from 10 to 100 times longer than the devices they replace.

LED's used in the Bell System are made from gallium phosphide (GaP) single crystals. Economical processing using standard-sized fixtures requires crystals of uniform diameter. But because GaP single crystals must be grown inside a high pressure vessel, monitoring and controlling crystal growth has been a problem.

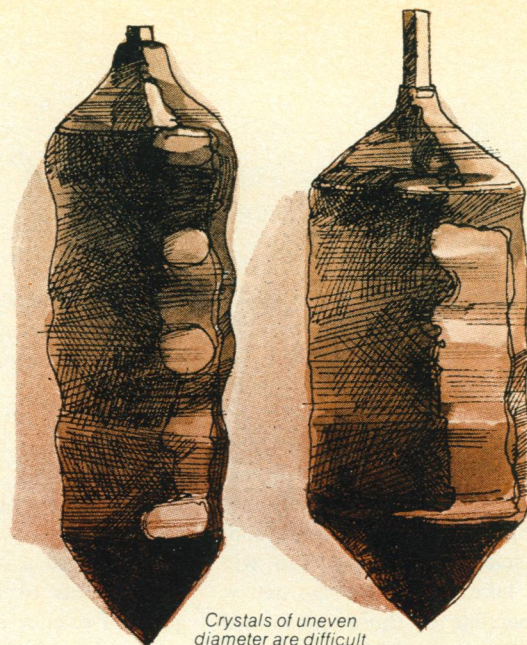
Previously, crystal growth could only be monitored visually. The halo surrounding the growing crystal was observed through closed circuit television. Since the halo would expand and contract with the diameter of the growing crystal, it provided some measure of control. But phosphorous vapors condensing on the viewing window partly obscured the halo, making precise control difficult.

The new monitoring technique is similar to the use of a fluoroscope in medicine. X-ray imaging provides an unobstructed view of the meniscus formed where the solid crystal meets the liquid melt. Western Electric engineers have correlated the height and angle of this meniscus to the crystal's growth condition. This is useful because a change in the shape of the meniscus signals a change in the temperature of the melt *before* it is manifested as a change in the crystal's diameter.

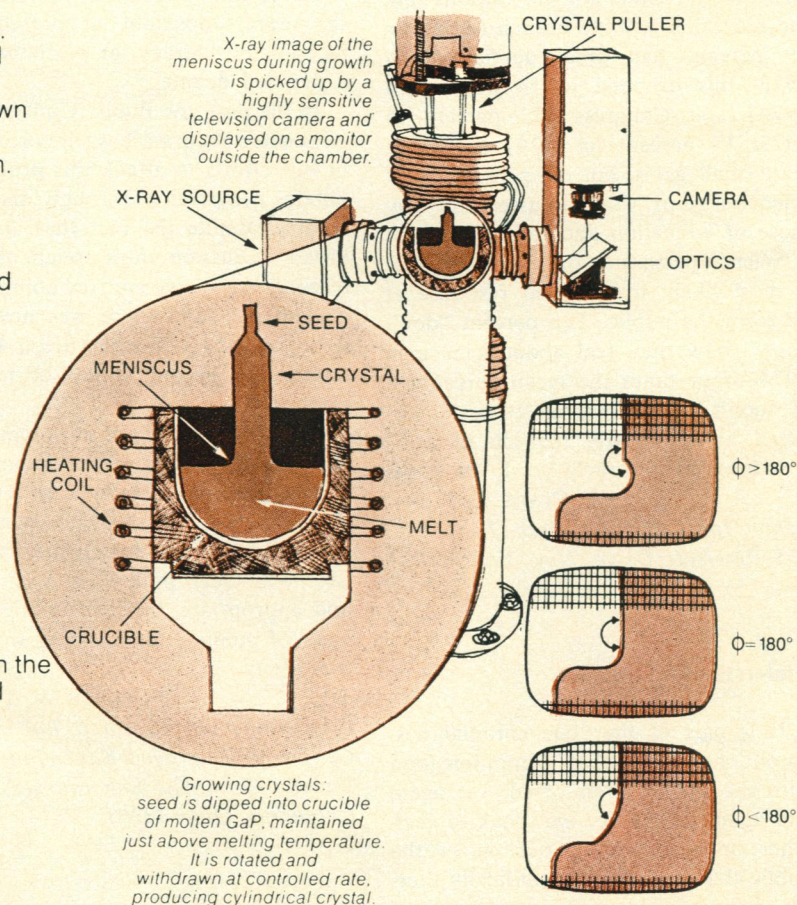
A change of just 4° in the liquid-solid contact angle can be observed, allowing adjustments to be made in either temperature or pulling rate to maintain uniform growth.

X-ray imaging is in production use at Western Electric's plant in Reading, Penn.

Benefit: X-ray imaging of the meniscus of a growing crystal has permitted a marked improvement in the monitoring and control of crystal growth. It helps insure high yields of uniform diameter crystal wafers for processing into LED's.



Crystals of uneven diameter are difficult to process economically and efficiently. X-ray imaging now yields crystals of a diameter within a tolerance of $\pm 1/16$ inch.



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Circum-Pacific Energy and Mineral Resources

Before raw materials can be utilized, they must be found and the magnitude of the resources evaluated. These tasks are the function of economic geologists. When this particular clan gathers, formal speeches are not fully revealing. However, much additional information can be gleaned from private conversations. The recent Circum-Pacific Conference on Energy and Mineral Resources* in Honolulu provided an unusually good window on prospects for future supplies. Registrants included geologists from more than 50 countries.

On the agenda for the conference were many excellent papers. A significant phenomenon was the ubiquity of competent native geologists in countries throughout the Pacific rim. In an earlier period such competence was confined to the advanced countries, which were able to drive hard bargains in the exploitation of the world's resources.

The papers devoted to mineral resources indicated a vista of abundance. Both formally and informally, there were many reports of new discoveries and extensions of existing deposits. Optimism was partly based on the effectiveness of geochemical and geophysical tools. The concept of plate tectonics and the images obtained from the Earth Resources Technology Satellite have helped order and stimulate the thinking of economic geologists. They now know better where and how to look for minerals.

The picture with respect to energy was neither so clear nor so cheery. Some oil is being found off the coast of East Asia and in the vicinity of Indonesia. In the headwaters of the Amazon in eastern Peru there are substantial reserves of oil. The total quantities reported, while significant to the nations involved, are not great in comparison with current world consumption.

Many papers were devoted to geothermal energy. This was to be expected, for the circum-Pacific region has been picturesquely termed the Rim of Fire. Some indication of the possible magnitude of potentials was provided by D. Hadikusumo and L. Pardyanto of Indonesia. They pointed out that, in their country, there are many hundreds of volcanoes and hot springs. They estimated that, by the year 2000, Indonesia might be enjoying an installed capacity of 60,000 megawatts of electricity based on its geothermal resources.

Thus one had the impression of substantial energy potential. However, other papers indicated that there may be a long road between potential and fulfillment. Much or even most geothermal energy is associated with hot water heavily loaded with salts of various kinds. Some are corrosive; others clog pipes when the water is cooled.

A small sample of the problems to be encountered was provided by a description of results of drilling near the Hawaiian crater Kilauea, from which frequently emerges lava at a temperature of about 1200°C. The drill hole was pointed toward the predicted location of a hot pool of lava. In the first 490 meters, some of the temperatures encountered were lower than those at the surface. About 500 meters below the surface and 500 meters above sea level, the drill encountered rocks fully saturated with water having a salinity greater than that of seawater. The hole bottomed at 160 meters below sea level, and the maximum temperature noted was 137°C.

The world does not now face acute shortages of mineral resources. They are abundant, and techniques for exploitation are well developed. In contrast, energy resources are either limited or the techniques for using them are not established.—PHILIP H. ABELSON

* General chairman of the conference was Michel T. Halbouty of Houston, Texas. Selected papers from the conference are to be published in a memoir.



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