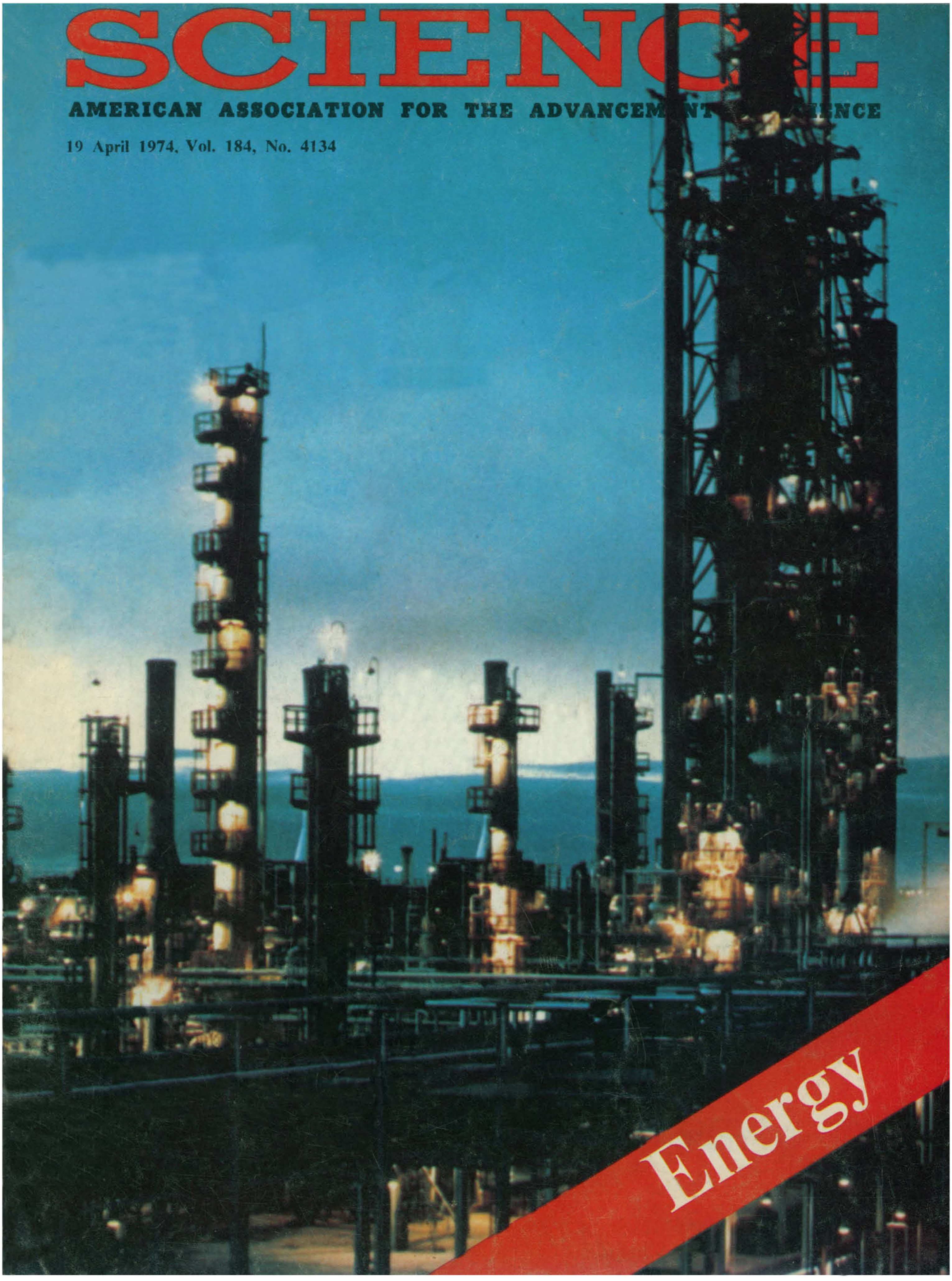
SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

19 April 1974, Vol. 184, No. 4134



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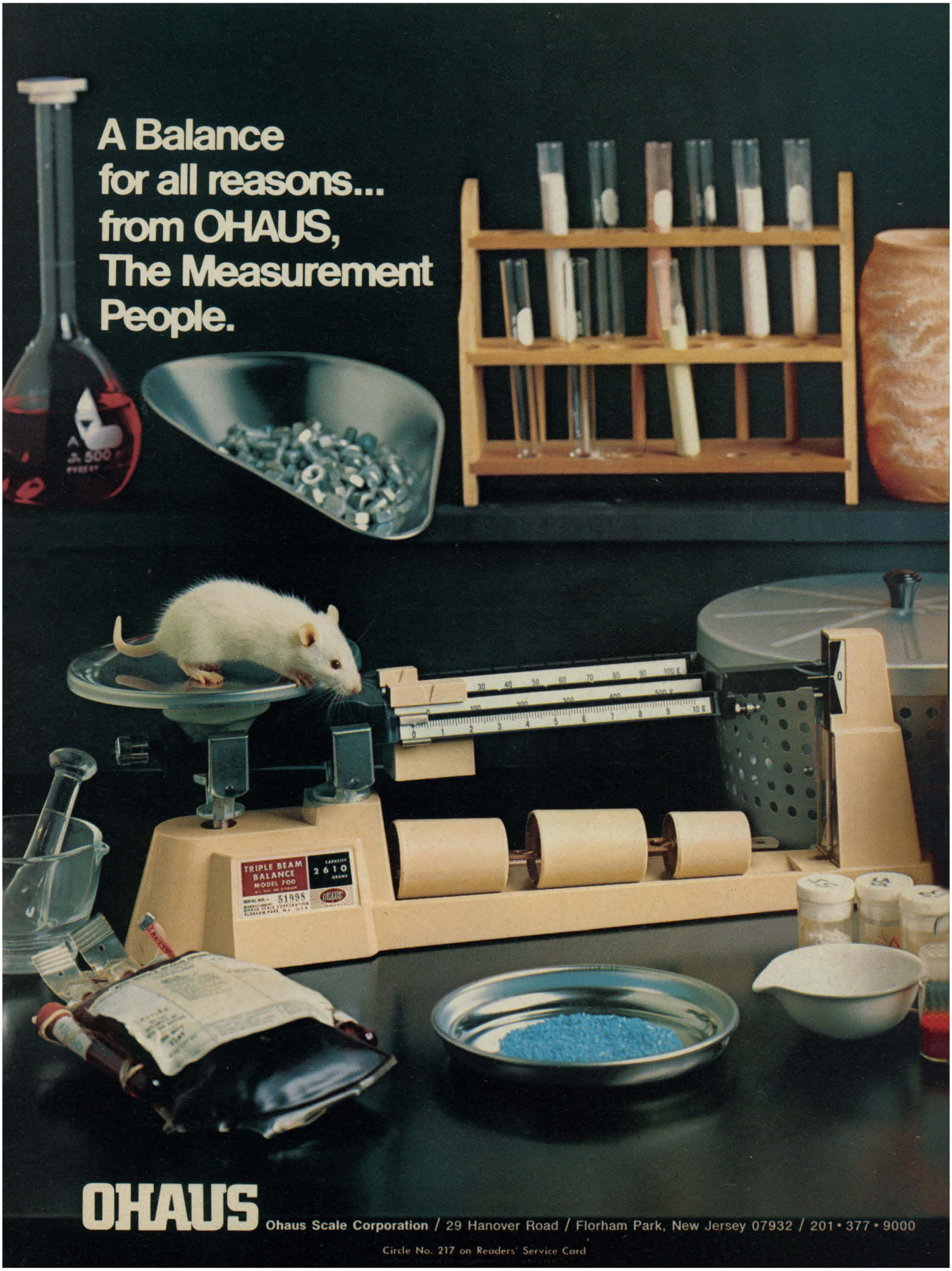
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19 April 1974

Volume 184, No. 4134

SCIENCE

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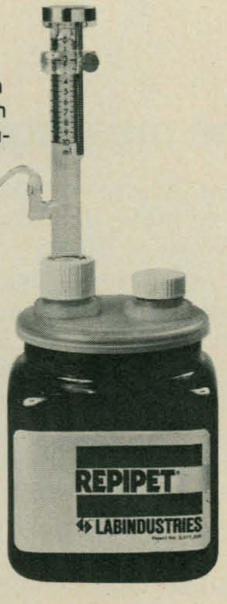

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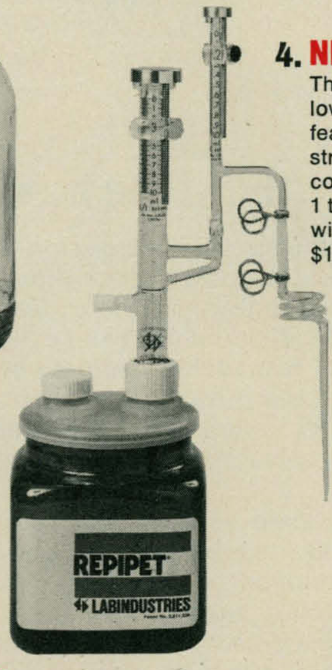

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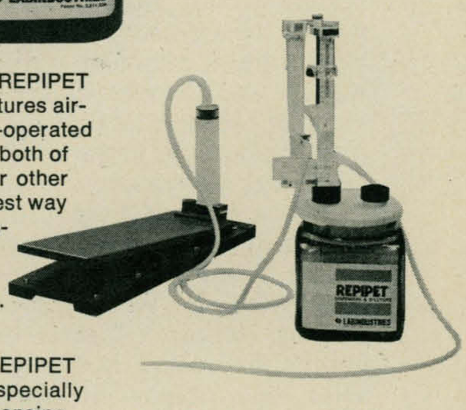

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5 The National Maritime Museum where you'll see John Harrison's chronometer.

6 The Oxford University Museum of the History of Science, which houses an unparalleled collection of scientific instruments dating back to 250 A.D.

7 The chambers in which Roger Bacon spent the last 14 years of his life.

Cambridge. **8** The rooms of Isaac Newton at Trinity College.

9 The home of Francis Crick who, along with J.D. Watson, won the Nobel Prize for the discovery of the double helical structure of DNA.

10 The ante-chapel of Trinity College where you'll ponder the works of four of Trinity's illustrious sons: Sir Francis Bacon, Sir Isaac Newton, Isaac Barrow and William Whewell.

11 The Cavendish Laboratory Museum.

12 Sheffield, where you'll tour an 18th-century industrial village—complete with homes, factories, machinery and the like.

13 The Royal Scottish Museum in Edinburgh.

14 Glasgow University and a look at the work of William Thomson, Baron Kelvin.

Norway. **15** Kon-Tiki and a visit with Thor Heyerdahl.

Upsala, Sweden. **16** The Apothecary shop in which Carl W. Scheele discovered oxygen.

17 Linnaeus' house and garden.

Copenhagen. **18** The Post and Telegraph Museum for a reconstruction of Hans Christian Oersted's discovery of the magnetic properties of an electric current in wire.

19 The island of Ven where Tycho Brahe built the last naked-eye observatory.

Haarlem, the Netherlands, boasts **20** The Teyler Museum and an enviable collection of scientific apparatus from all over Europe.

Leyden. **21** The National Museum of the History of Science. **22** The telescope through which Christian Huygens discovered Saturn's rings. **23** Anton von Leeuwenhoek's microscopes. **24** Fahrenheit's thermometers.

Scheveningen. **25** The Gemeente Museum houses the world's very best collections of musical instruments and a history of acoustics.

26 Antwerp's Folklore Museum, where you'll study witchcraft, popular medicine and herb lore.

Bruges. **27** The Hospital of St. John with its 13th-century ward and 15th-century dispensary.

Brussels. **28** The Museum of Venerable Art.

Paris. **29** Laboratoire Curie.

30 The Institut Pasteur.

31 Le Conservatoire National des Arts et Métiers contains memorabilia and apparatus of such scientists as Pascal, Lavoisier, Gay-Lussac, Volta, and Becquerel.

32 The College de France, the scene of work by Magendie (established experimental physiology), Laënnec (the stethoscope) and Claude Bernard (physiology).

33 The Museum of Natural History.

34 The École Polytechnique.

35 Basel, Switzerland, the home of Paracelsus.

Bern. **36** Einstein's rooms.

Como, Italy. **37** Museo Alessandro Volta.

Milan. **38** Museo Nazionale della Scienza e Technica Leonardo da Vinci.

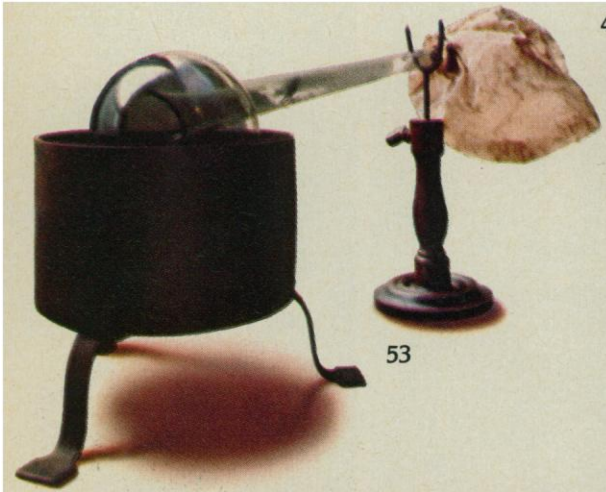
Marconi's wireless work is to be seen in our next stop, **39** Bologna.

Florence. **40** The Instituto Museo di Storia della Scienza. Galileo's telescopes. Next, a visit to **41** the house in which Galileo was imprisoned from 1633 to his death in 1642.

42 More Galileo in Pisa. The leaning tower was made to order for his earthshaking experiments on the nature of falling bodies.

43 Rome. The Accademia Nazionale de Lincei in the Palazzo Corsini.

44 The Academie Nationale de France.



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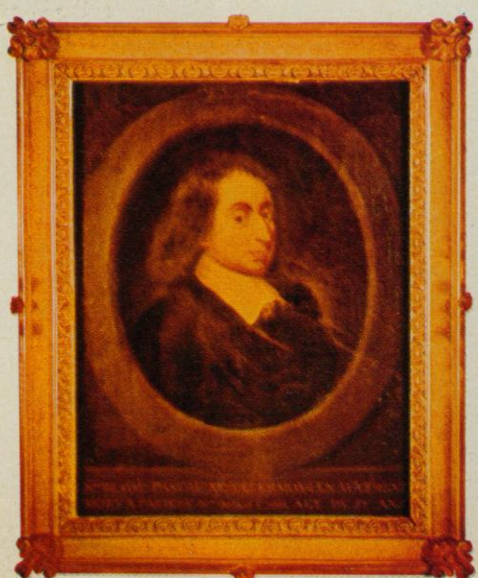

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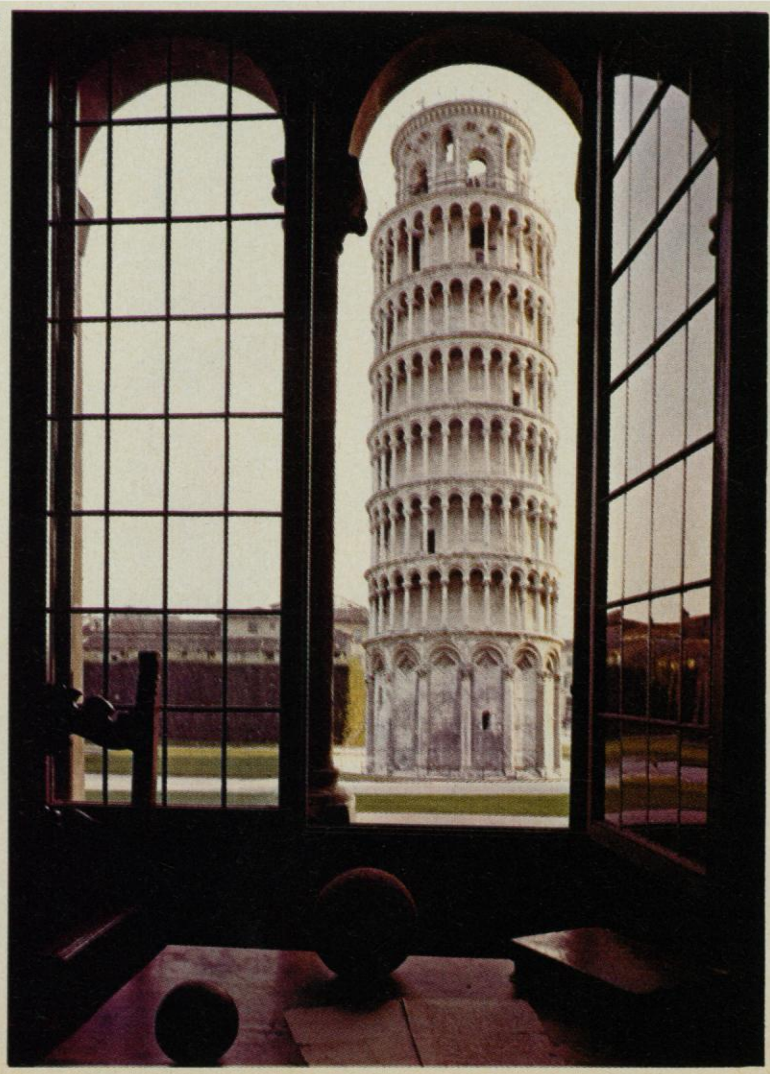

45 The observatory of the Collegio Romano, where Jesuit astronomer Father Angelo Secchi (1818-1878) made the first spectroscopic survey of the heavens.

46 Museo Copernico ed Astronomico where Polish Astronomer Nicolas Copernicus did much of his early work.

47 Naples. The Zoological Station.

48 University of Padua. The anatomical theater was built in 1594 by Fabricius of Acquapendente, a pioneer of the comparative method of anatomical research and discoverer of valves in the veins.

Vienna. **49** The Pharmakognostiches Institute, which houses a museum of 10,000 items of scientific interest.

50 A reconstructed apothecary, laboratory and print shop in the Technisches Museum fur Industrie und Gewerbe.

Czechoslovakia. Gregor Mendel did his landmark work in genetics in a **51** monastery in Brno.

Still in Prague. **52** Charles University where you will visit the rooms in which Einstein, Ernst Mach and Philipp Frank taught and worked.

Germany. Munich. **53** The Deutsches Museum. Reconstruction of the laboratories of Lavoisier and Liebig.

54 The werner von Siemens institute, where electrical engineering and research are traced from 1850.

Heidelberg. **55** The Deutsches-Apotheken Museum, an ancient castle packed with apparatus and drugs, vessels and relics.

56 The Deutsches-Roentgen Museum in Remscheid preserves Roentgen's apparatus, including a 1905 X-ray lab.

57 The Deutsches Gesundheitmuseum in Cologne.

Berlin. **58** Chemistry Institute, where Otto Hahn split the uranium atom in 1938.

East Berlin. **59** The Robert Koch Museum. Koch, co-father of modern bacteriology, used glass slides to grow cultures until his assistant, Julius Petri, invented the glassware that carries his name.

60 The home and garden of Alexander V. Humboldt.

61 The library of Max Planck.

62 Charité Hospital where Rudolph Virchow, founder of cellular pathology, first described leukemia.

Cracow, Poland. **63** Collegium Majus for a look at the telescopes of Copernicus.

A jet to Rumania and a drive to Cluj for a visit to **64** an 18th-century apothecary shop.

Greece. **65** The Lyceum, where Aristotle taught from 355 B.C. until just before his death. **66** Plato's Academy.

Istanbul. **67** Pergamon where Galen practiced medicine.

Bombay. **68** The Tata Institute of Fundamental Research, devoted to nuclear research, computer science, molecular biology, radioastronomy, and mathematics.

69 The Bhabha Atomic Research Center is India's national center of research for the peaceful use of atomic energy.

70 The Yoga Institute. Here you can learn Yoga culture, technique and scientific discipline.

Russia. **71** Academy of Sciences in Leningrad. Pavlov's lab.

72 The Anthropological and Ethnographical Museum.

73 The Mendeleyev Research Institute.

Moscow. **74** The National Economic Achievements Exhibition.

Tokyo. **75** The Kitasato Institute, founded by Baron Shibasaburo Kitasato who isolated the agents which cause bubonic plague and dysentery.

You're back on American soil when you visit **76** the Hawaii Volcano Observatory.

To wind up your trip we want to give you the opportunity to see any four labs in the U.S. **77, 78, 79, 80** which hold particular interest for you. We will do our level best to arrange a visit for you to four labs of your choice.

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1. This sweepstakes is only open to those employed in medical, educational, or industrial fields who normally work with labware. Or who supervise or administer a laboratory. Or who purchase or stock labware.

2. To enter, complete this official entry blank, or, on a plain 3 x 5-inch piece of paper, hand print your name, address, and field of activity.

3. Enter as often as you wish, but each entry must be mailed separately to: Around the World in 80 Labs, P.O. Box 1730, Blair, Nebraska 68009. Entries must be postmarked by September 30, 1974 and received by October 15, 1974.

4. One winner from each of the three fields of activity—industry, education, and medicine—will be picked from among all entries received in random drawings conducted by the D.L. Blair Corp., an independent judging organization. Decisions of the judges are final. Winners will be notified by mail. Winners will travel in a group departing on a date to be selected by Corning Glass Works. Departure is estimated to be between the months of May and July, 1975 for a trip duration of 30 days. Corning Glass Works reserves the right to modify trip itinerary as a result of conditions prevailing at time of prize award. No substitution for prizes permitted. Entrants must be residents of U.S.A.

5. This sweepstakes is void where prohibited, taxed or restricted by Federal, state or local laws and regulations. Employees of Corning Glass Works, its advertising and sweepstakes agencies, dealers, and their families are not eligible. Federal, state and other taxes, if any, are the responsibility of the prize winners.

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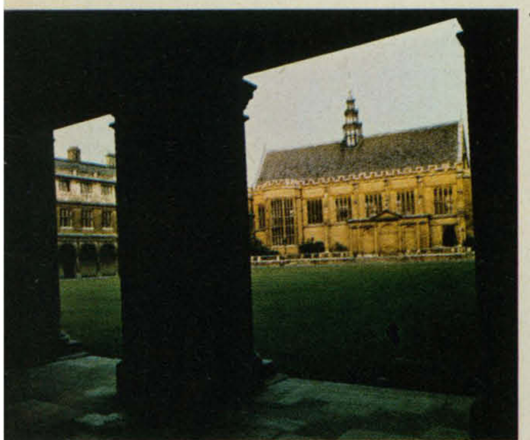

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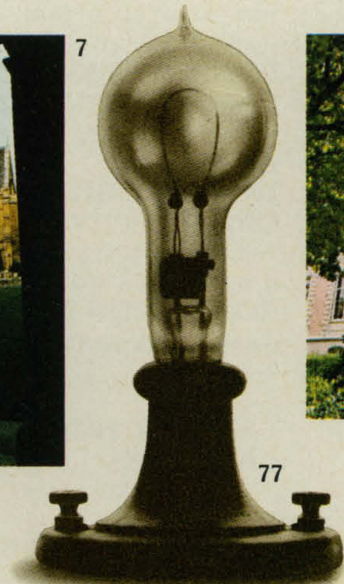

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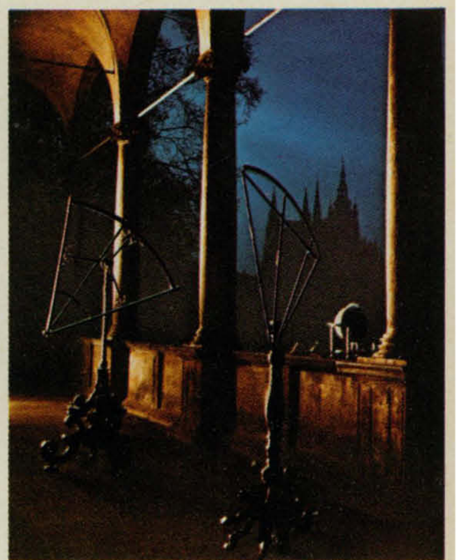

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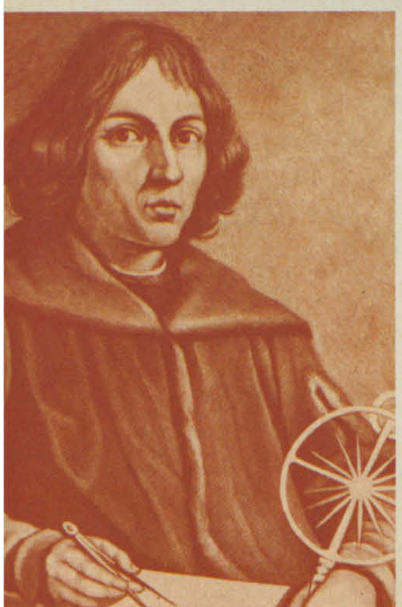

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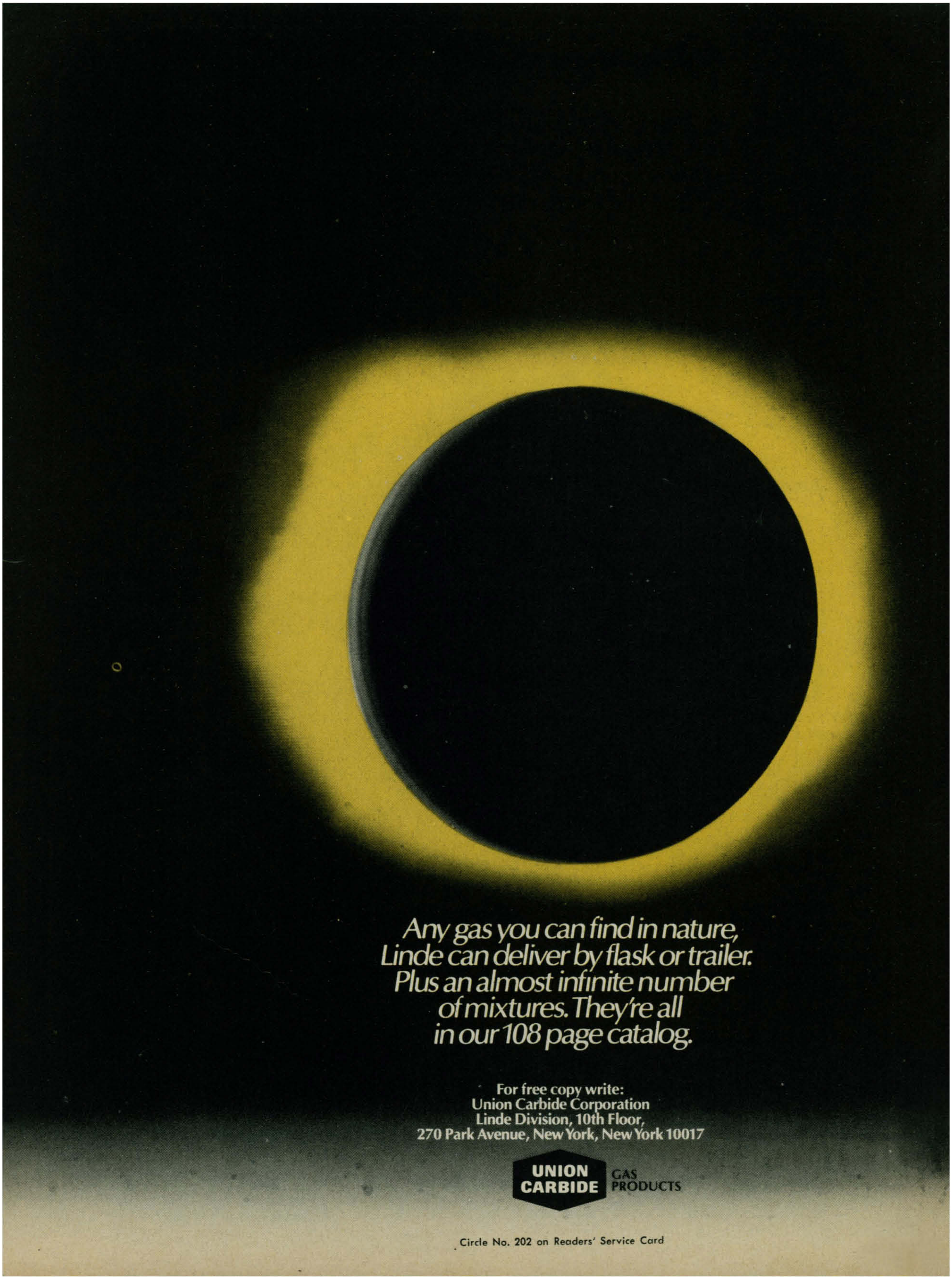
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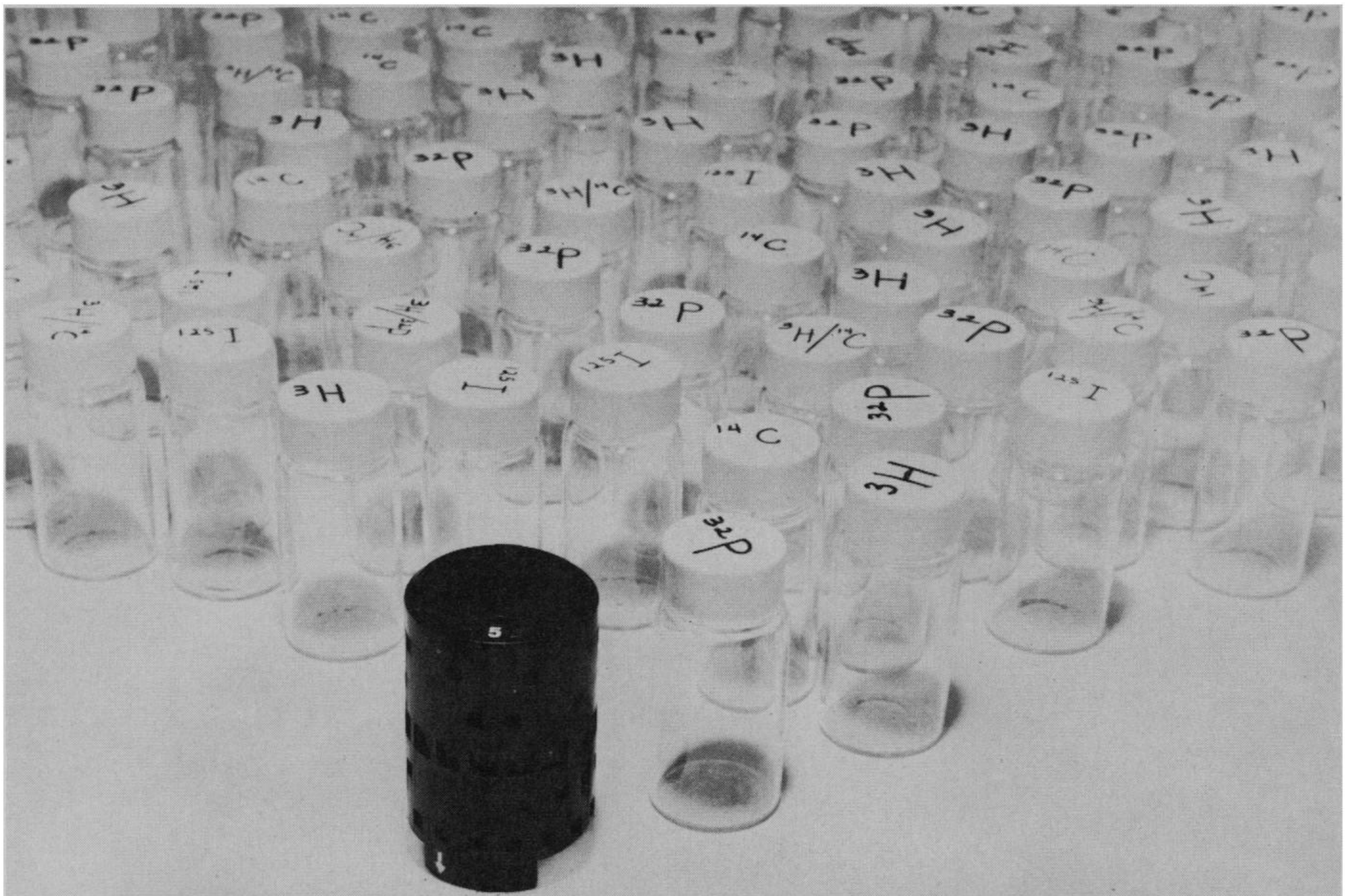


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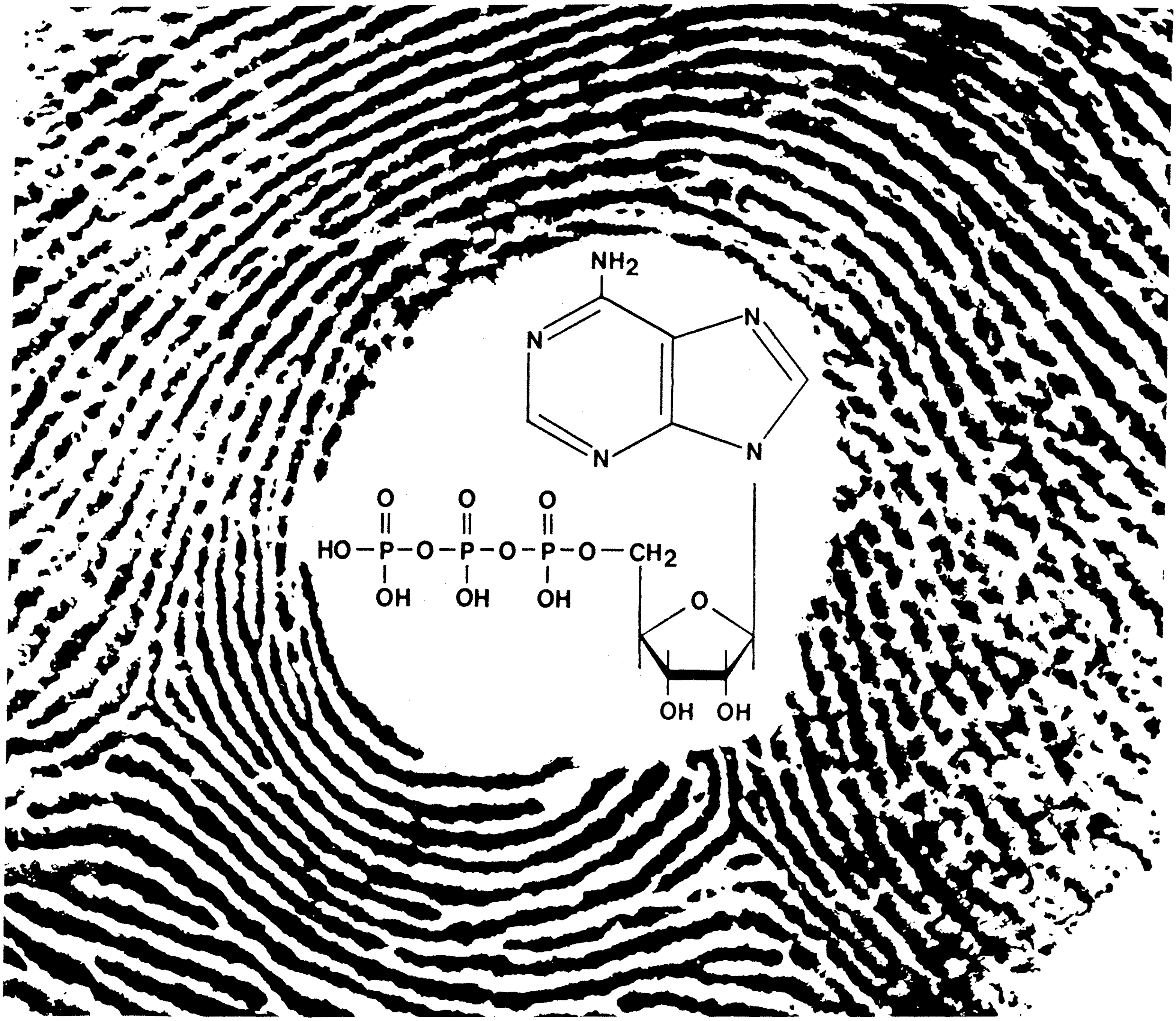

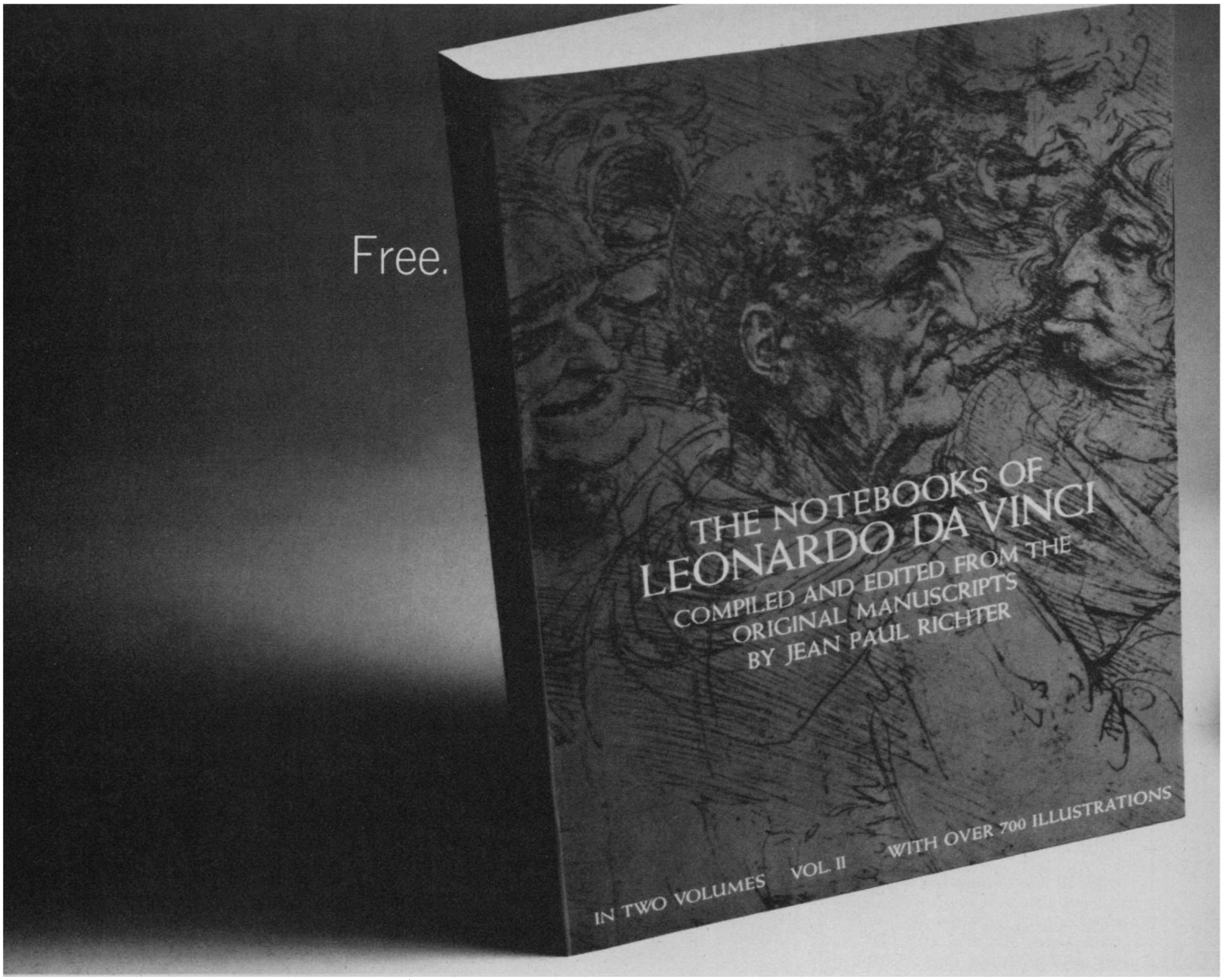

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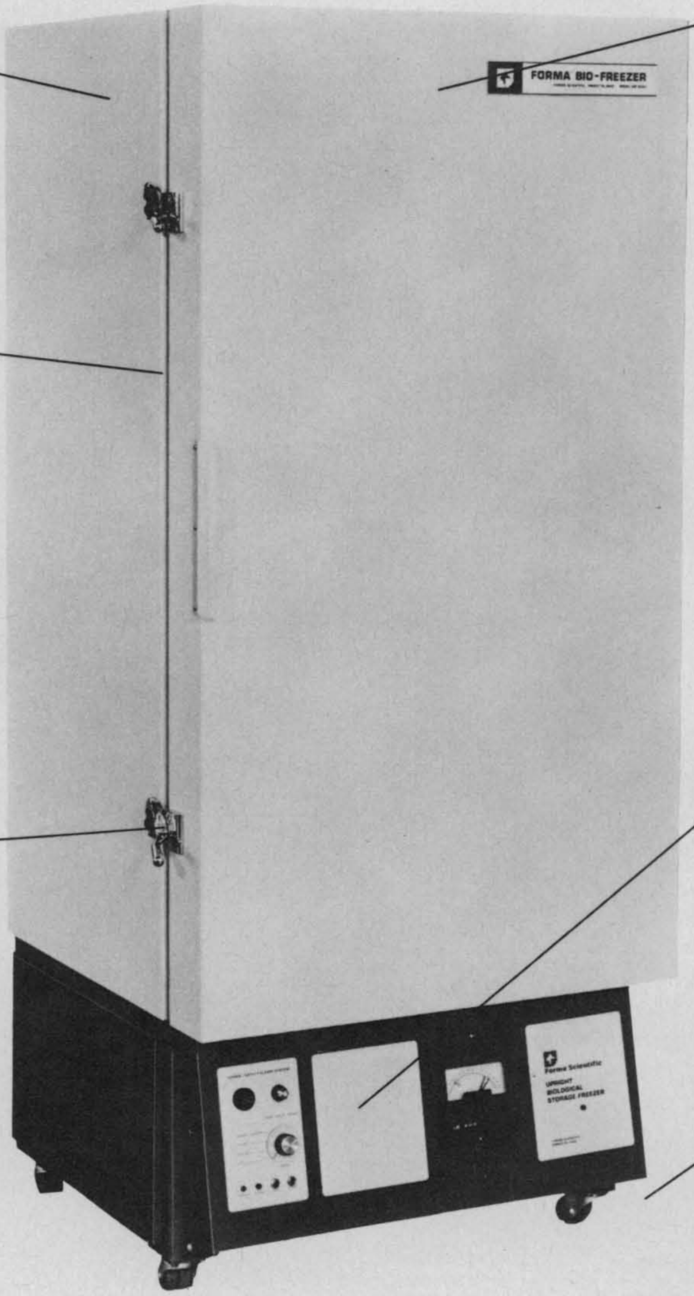

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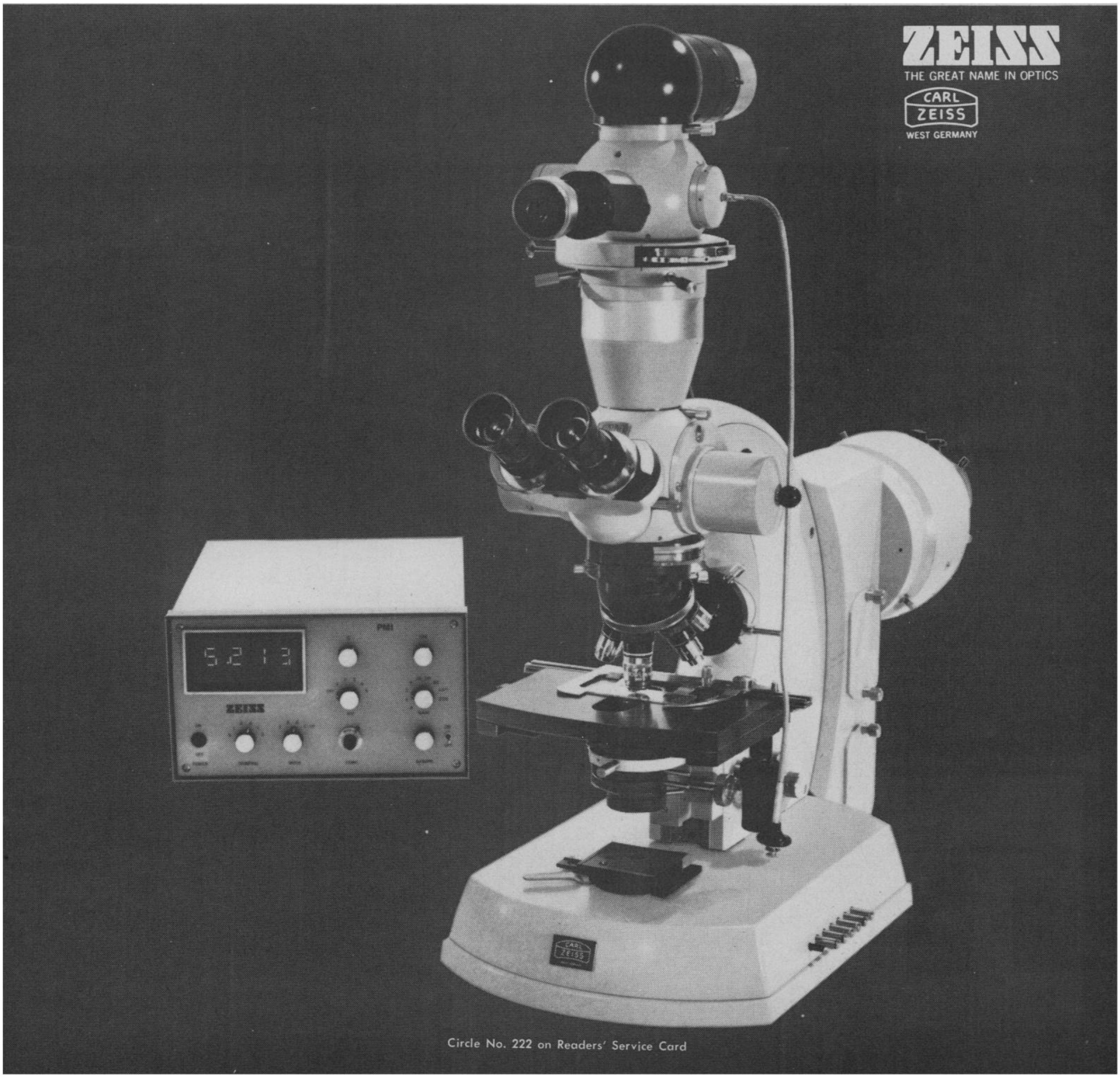

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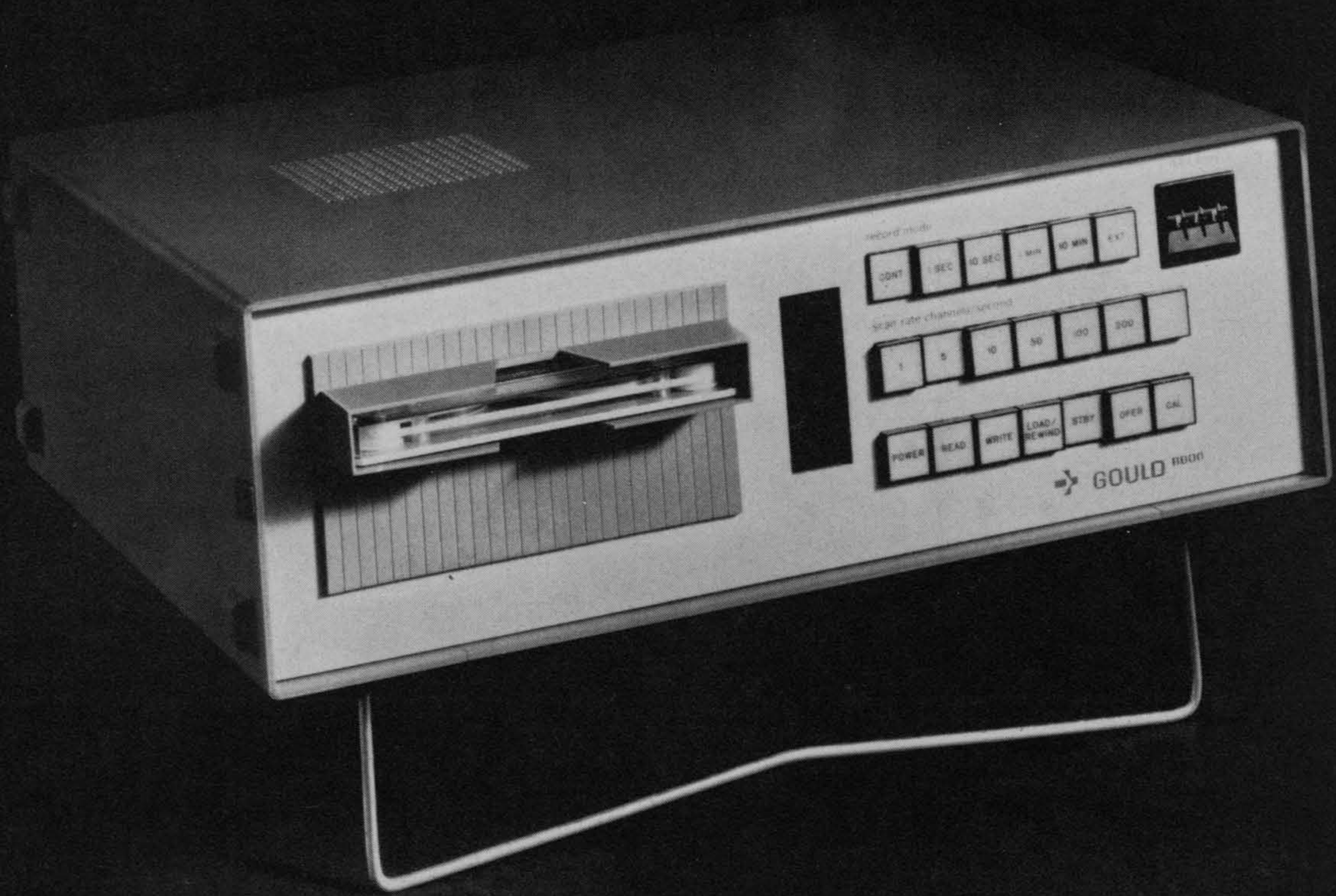

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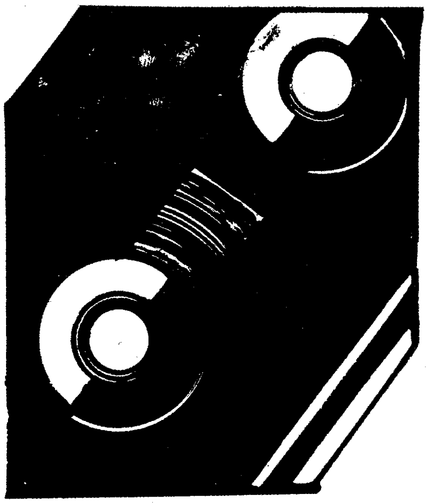

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THE BOOK

Energy and the Future

Energy and the Future, a new and authoritative AAAS book, takes a long-range look at energy. Based in part on the recent series in **Science**, this book surveys current and future sources of energy and describes the relevant technologies. It also assesses their potential environmental problems and identifies the technical obstacles to their development. The broad scope and balanced perspective of **Energy and the Future** make it a valuable resource for anyone wishing to explore the scientific and technological basis of the energy dilemma.

BY ALLEN HAMMOND, WILLIAM METZ, AND THOMAS MAUGH, II

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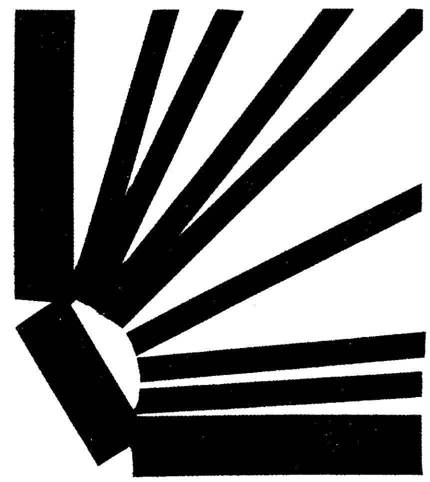

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19 April 1974, Volume 184, Number 4134

SCIENCE

Gasoline

Recently, Professor Marvin Paul of the City Colleges of Chicago suggested to *Science* that we devote an entire issue to energy. The idea was received with skepticism, but consultation with readers scattered across the United States caused us to proceed. The decision was taken February 4. Publication of the issue at this time was made possible by unusually good cooperation of both contributors and staff.

The content of this issue was chosen to present material relevant to important public decisions of the next few years. Some such topics have been recently treated in *Science** and repetition here was unwarranted. Other topics will be dealt with later.

One important matter not covered specifically in the following articles is gasoline and the automobile. Special notice seems desirable, for those long lines at the service stations are telling us something. When people are willing to appear at 5 a.m. at a station that is not scheduled to open until 8 a.m., they convey a message about the importance that many people attach to their automobiles. In part the attachment is economic. To many people, auto transportation is essential to their livelihood. In part the attachment is emotional, as Kenneth Boulding suggests in an article in this issue. Whatever the source of the demand, it would be politically impossible to force people this summer to get along on supplies as limited as those of February 1974. In future years as people adjust, as they change to vehicles consuming less gasoline, the acceptable level of supplies may drop. For this year and probably the next few years, a minimum acceptable daily consumption averaged over the whole year is about 6.2 million barrels a day or about 5 percent less than we consumed in 1973. Such a level would entail tension and grumbling.

With present-day refinery practice, a demand of 6.2 million barrels a day for gasoline fixes a minimum value for the input of crude oil. In typical instances, 48 percent of the crude petroleum is converted to gasoline. Thus to supply the minimum demand for gasoline, something like 13 million barrels of petroleum must be processed. Our total consumption of oil and its products has been averaging about 17 million barrels a day and our total production of crude oil and condensate has been about 11 million barrels a day. These figures indicate the central importance of gasoline consumption in dictating needs for crude oil. They also show that, in order merely to obtain enough gasoline, large quantities of gasoline or crude oil must be imported. There are, of course, other important uses of the gasoline chemicals in oil that will increase the lower limit on our need for oil.

Because of the central role of gasoline in energy problems, especial efforts should be made both to decrease demand and increase supply. Had we been driving smaller, less gas-consuming cars, there would have been no energy crisis. Some other forms of transportation consume less gasoline, and their use should be encouraged.

In principle, the oil companies could increase the yield of gasoline from crude oil. This would require changes in refineries. Today about 10 percent of the energy of crude oil is used in providing heat for the refining processes. In principle, this heat could be furnished by coal. Through more intense input of hydrogen in the cracking process, larger yields of gasoline could be obtained. One refinery expert has guessed that yields might be raised to as high as 75 percent from the present 48 percent. Such a shift would entail other shifts in the product patterns and in the consumption of hydrocarbons.

The barriers to increased yields are costs and time, but these can and should be overcome. Petroleum is too important to be used merely as a source of heat.—PHILIP H. ABELSON

* For a list of selected material related to energy that has appeared in *Science*, see page 386 of this issue.

The most sensible way to help solve the energy shortage is to generate more electricity.

More, not less. And from coal.

Ridiculous? Hardly.

It is, rather, a logical conclusion after cold analysis of America's plight, and energy resources.

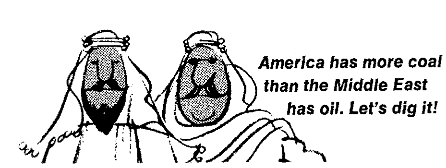
And it's based on these truths:

1. We do have an energy crisis. More specifically, we have an oil and natural gas crisis.
2. We need to take a hard look at all the fuels we have, then make it possible to use each wisely for its most critical use.
3. America has a vast amount of coal—about half the world's known supply, or enough to meet our energy needs for 500 years.
4. Coal should be used instead of oil to generate electricity wherever practical, thereby saving a staggering amount of oil.
5. Electricity generated by coal can be used instead of oil and gas for countless energy needs, with a few exceptions—such as some forms of transportation.
6. The result will be still more savings of oil and gas, which can then be diverted to more critical uses where there is no suitable substitute.

One of the most crucial applications for electricity is in heating. We must heat our homes and offices and there's no more efficient way than with the electric "Heat Pump" system—for it is an energy multiplier that actually delivers up to two times* more energy than it takes to power the device.

So you see, the most sensible way to help solve the energy shortage is to generate more—not less—electricity. And from coal.

You can quote us on that.



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How the remarkable Heat Pump works. All air contains a measure of heat, even in temperatures well below freezing. The heat pump doesn't produce heat, it transfers heat. It absorbs heat from the outside air and discharges it inside the house at the temperature desired. Simple, efficient and a real contribution to energy conservation. That's the heat pump—the energy multiplier.

*The precise amount depends on the climate in which it is used.

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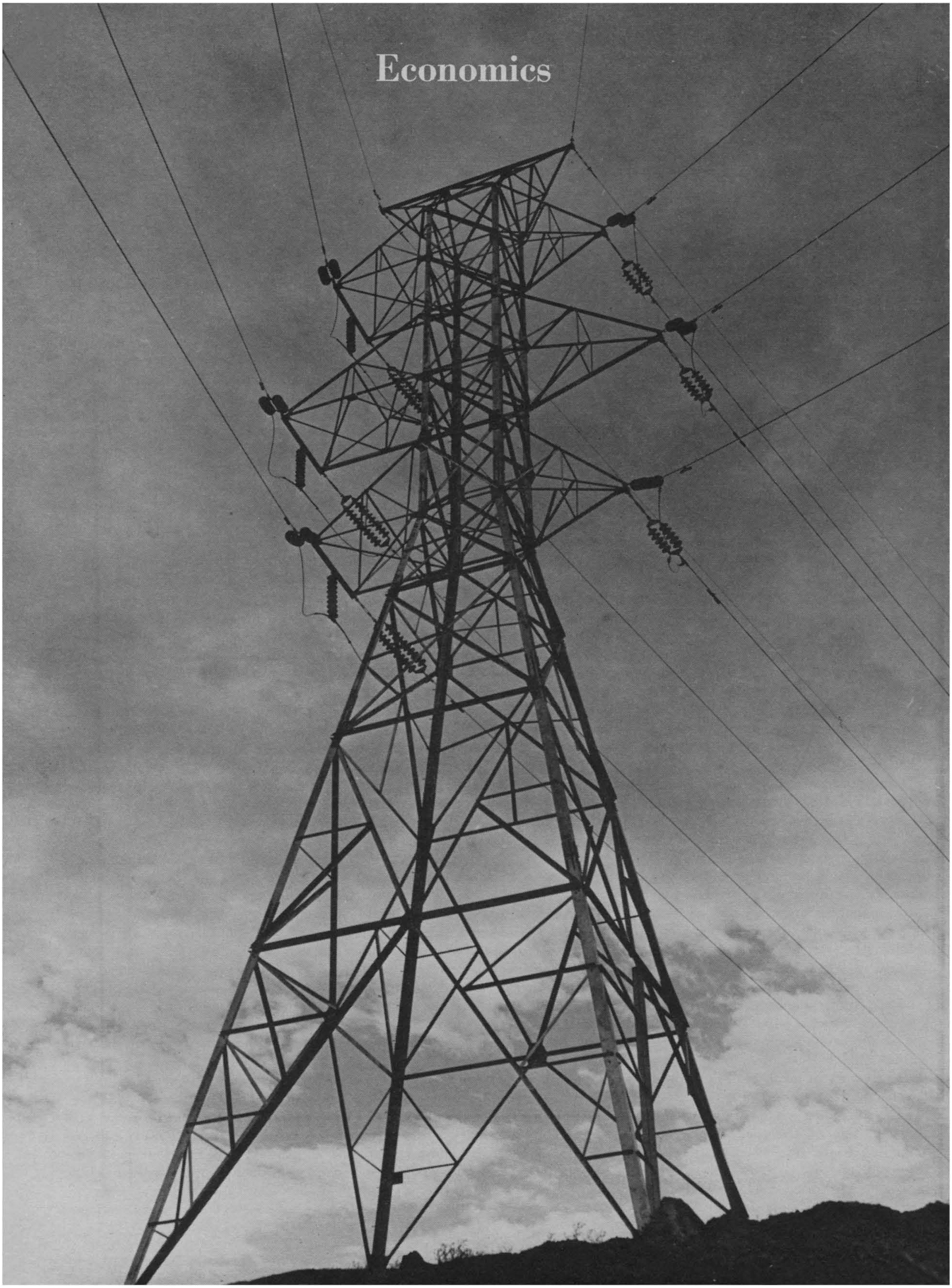
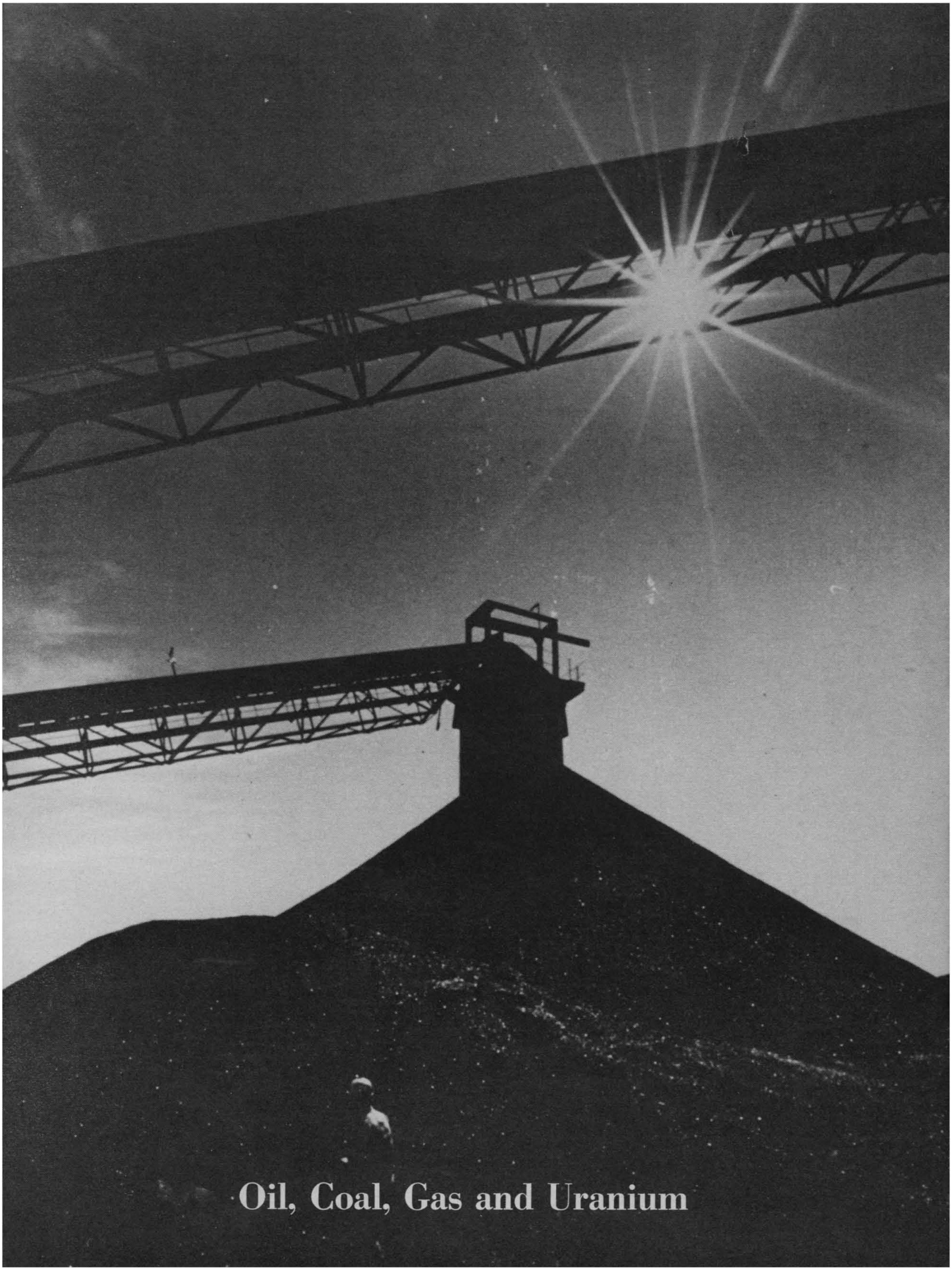
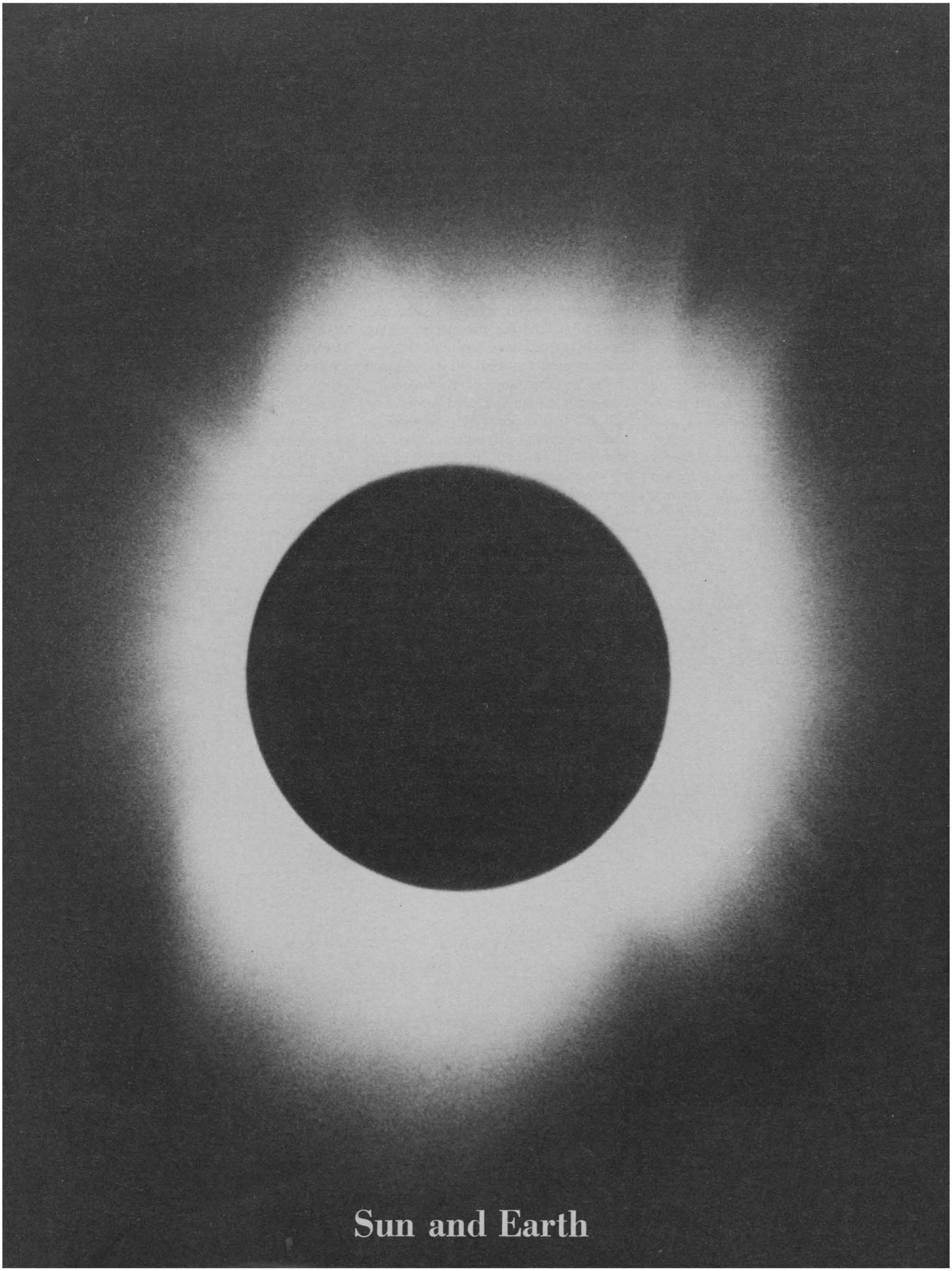
Policy

Economics




Oil, Coal, Gas and Uranium



Sun and Earth

"Nuclear Safety: Atomic Energy Commission Report Makes the Best of It," **179**, 360 (1973).
"Nuclear Safety (IV): The Barriers to Communications," **177**, 1080 (1972).
"Nuclear Safety (III): Critics Charge Conflicts of Interest," **177**, 970 (1972).
"Nuclear Safety (II): Years of Delay," **177**, 867 (1972).
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N. Hawkes, "Energy in Britain: Shopping for a New Reactor," **183**, 57 (1974).
C. Holden, "Energy: Shortages Loom, But Conservation Lags," **180**, 1155 (1973).
D. Shapley, "Law of the Sea: Energy, Economy Spur Secret Review of U.S. Stance," **183**, 290 (1974).
J. Walsh, "Electric Power Research Institute: A New Formula for Industry R & D," **182**, 263 (1973).
"Britain and Energy Policy: Problems of Interdependence," **180**, 1343 (1973).

Group III: Staff-Written Articles—Research News

Energy and the Future, a AAAS book by Allen Hammond, William Metz, and Thomas Maugh II contains 22 articles that take a long-range look at energy. The book is based on a series of articles in *Science*, $4.95 ($4.45 members' price) paperbound. $9.95 ($8.95 members' price) casebound. Titles are as follows:

"Energy from Fossil Fuels"
"Gasification: A Rediscovered Source of Clean Fuels"
"Power Gas and Combined Cycles: Clean Power from Fossil Fuels"
"Magnetohydrodynamic Power: More Efficient Use of Coal"
"Nuclear Energy"
"Fission: The Pro's and Con's of Nuclear Power"
"Breeder Reactors: The Future of Nuclear Power"
"Alternative Energy Sources"
"Geothermal Energy: An Emerging Major Resource"
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"Fuel from Wastes: A Renewable Energy Source"
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"Energy Transmission"
"Transmission Lines: Three New Ways to Carry Electricity"
"Fuel Cells: Dispersed Generation of Electricity"
"Hydrogen: Synthetic Fuel of the Future"
"Energy Conservation"
"Conservation of Energy: The Potential for More Efficient Use"
"Energy Needs: Projected Demands and How to Reduce Them"
"Energy and the Future: Research Priorities and Energy Policy"

Additional Articles on Energy Topics

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W. D. Metz, "Ocean Temperature Gradients: Solar Power from the Sea," **180**, 1266 (1973).
A. L. Hammond, "Dry Geothermal Wells: Promising Experimental Results," **182**, 43 (1973).