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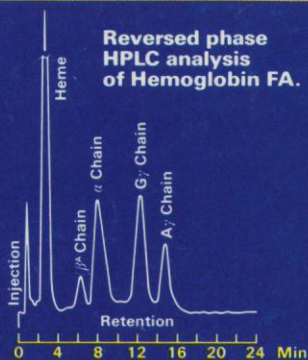
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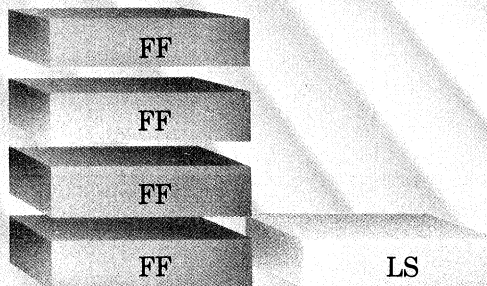
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COVER Heliotropically oriented subtidal columnar stromatolites in Hamelin Pool, Shark Bay, Western Australia. These stromatolites, forming in about 2 meters of water and built by a diatom-dominated microbial community, are inclined toward the north as evidenced by the inclined sunlight rays in the slightly turbid water. See page 1279. [S. M. Awramik, Department of Geological Sciences, University of California, Santa Barbara 93106]

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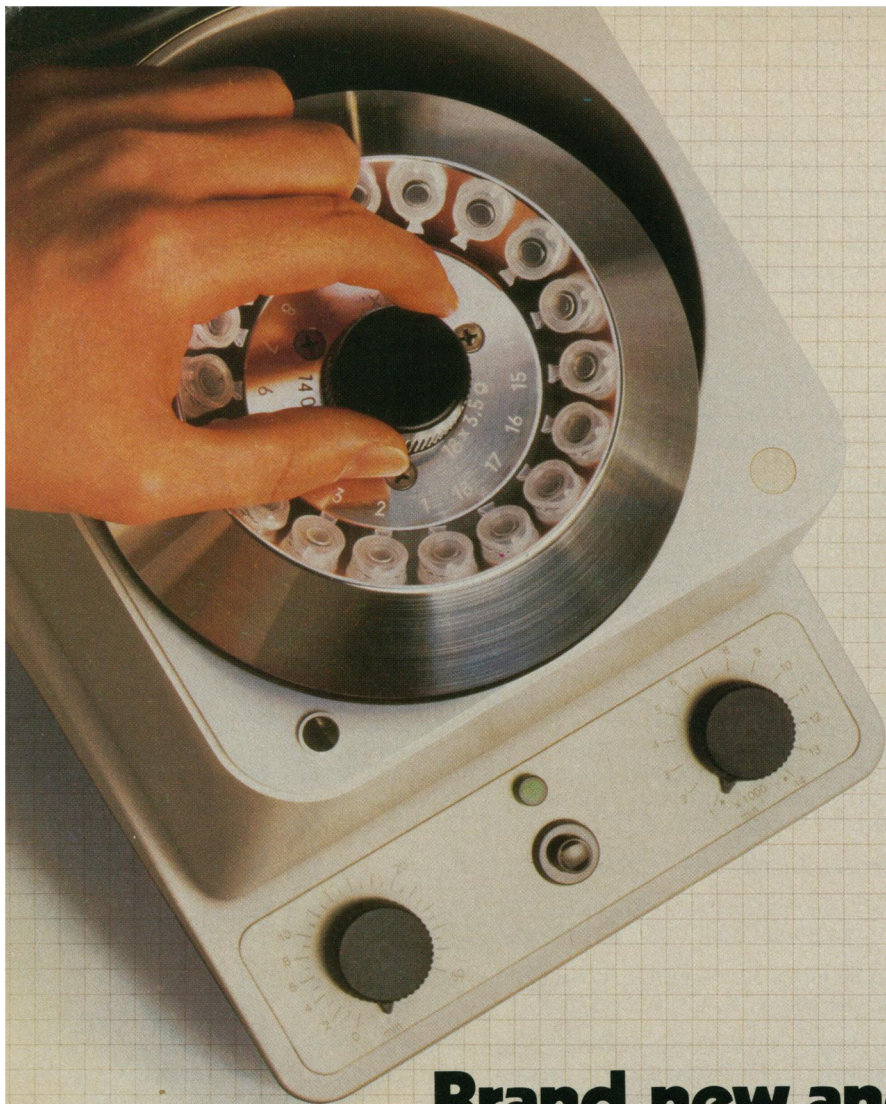
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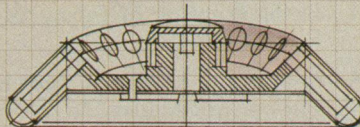
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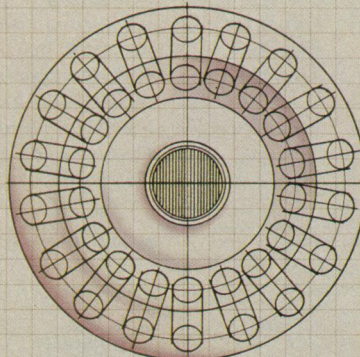
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This Week in SCIENCE

Pest management

THE production and widespread use of insecticides is not sufficient to control insect pests, because insects develop resistance to these compounds more readily than scientists can synthesize new ones (page 1255). In the last 40 years, only four major classes of pesticides have been developed—chlorinated hydrocarbons, organophosphates, carbamates, and photostable pyrethroids—and these have generally been used heavily-handedly without regard for ensuring their continued effectiveness over the long term. Hundreds of insecticide-resistant strains of agricultural pests have emerged from natural populations treated with pesticides. Brattsten *et al.* advocate an integrated pest management strategy in which insecticide use will be balanced with basic studies of how biological and environmental factors contribute to the development of resistance so that means may be discovered for avoiding or overcoming the problems of resistance.

Topography of Venus

PLANET Venus' highest mountain, Maxwell Montes, and the surrounding region have been mapped in fine detail by radar imagers and altimeters carried on two Russian spacecraft, Venera 15 and Venera 16 (page 1271). The Venera spacecraft orbited 1,000 to 65,000 kilometers above the surface of the planet for 8 months in 1983 and 1984; radar sensors recorded surface features through the dense carbon dioxide atmosphere. Signals sent back to Earth were processed into topographic maps and charts and are described by Alexandrov *et al.* Maxwell Montes, discovered in 1978, is situated on the continent Ishtar in Venus' northern hemisphere. At its peak, the mountain rises more than 11 kilometers above the surface east of the continent's central plain, Lakshmi. A large circular crater, Cleopatra Patera, on the western slope contains a second, smaller, circular crater. Folds fringing the Cleopatra Patera region appear to be covered by

volcanic or meteoritic materials, and numerous cone-shaped structures to the south appear to be volcanic in origin. Venus orbits closer to Earth than other planets and is about the same size as Earth. Venus may have experienced an early evolution similar to that of Earth, since geologic analyses show comparable structures on these two terrestrial planets.

Scant ant chromosomes

THE law of parsimony, a basic tenet of biology, has been met by the genetic system of a group of *Myrmecia pilosula* worker ants (page 1278). Nicknamed "bulldog" ants because of their stings and vicious attacks on adversaries (usually termites), these ants carry all the genetic material they need on a single pair of chromosomes. Despite their warlike, carnivorous behavior, they are "social" ants, living communally. The discovery of a colony of social insects with such a low chromosome number is unexpected, because social organisms typically have higher chromosome numbers than do their phylogenetic "sibling" relatives living solitary lives. Crosland and Crozier collected the unusual ants in a nature reserve near Canberra, Australia, and found that individual cells contained either a single chromosome (cells from males) or a single chromosome pair (cells from worker females). The economy of the ants' genetic system will be of obvious interest and value in genetic studies.

Stromatolites and sunlight

MICROORGANISMS requiring sunlight for growth and metabolism can construct stromatolites (cover)—domes, columns, cones, pillars, and tufts of organic and sedimentary material matted into layers—that orient toward the sun (page 1279). Living at fluid-sediment boundaries, the blue-green algae, diatoms, and flexibacteria that build stromatolites can

trap and bind and precipitate sediments that are flowing by. Awramik and Vanyo found that if winds or currents are not strongly influencing the growth of a stromatolite, orientation toward the sun can be quite marked. A number of modern stromatolites growing in hot springs in Yellowstone National Park and in the intertidal and subtidal waters of Hamelin Pool in Western Australia oriented toward the sun, with those in the Northern Hemisphere (Yellowstone) inclining southward and those in the Southern Hemisphere (Australia) inclining northward. A number of fossil stromatolites, formed by the activities of ancient microorganisms, also have shown heliotropism. Records retained in the laminae of fossil stromatolites provide paleontologic data that constrain geophysical models describing the past relations of Earth with the sun and the moon.

Anaplasmosis vaccine

EACH year, 50,000 to 100,000 cattle in the United States die of anaplasmosis, a rickettsial disease characterized by severe anemia, weight loss, abortion, and death (page 1299). A vaccine against the infectious agent that causes anaplasmosis is now under development by Palmer *et al.*, who isolated an immunogenic protein from the surface of the disease pathogen, *Anaplasma marginale*. Immunization with a subunit of the protein protected cows from doses of *A. marginale* that caused disease in unprotected animals. The subunit is a component common to numerous isolates of the pathogen from distant regions of the United States and abroad and thus has the potential to provide cross-protection against infection by related strains. These experiments open the way for production of large amounts of the immunogenic subunit by cloning techniques and constitute a step toward curbing a major infectious disease of cattle. Prevalent in tropical and subtropical regions, anaplasmosis has a significant economic impact in Western and Third World countries.

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Greenhouse Role of Trace Gases

Atmospheric scientists are emphasizing the role of trace gases as important factors in a future substantial global increase in temperature.* They estimate that, in 1980, trace gases contributed more than half as much to a greenhouse effect as did increased carbon dioxide.

From 1880 to 1980, CO₂ increased from about 275 parts per million (ppm) to 339 ppm. The principal relevant trace gases in 1980 were CH₄, 1.6 ppm; N₂O, 0.3 ppm; CCl₂F₂, 0.00028 ppm; CCl₃F, 0.00018 ppm; and O₃, which increased in the troposphere substantially over earlier values.

The key to effectiveness of the trace gases lies in their infrared absorption characteristics. They are transparent to most of the incoming solar radiation, but effective in absorbing outgoing earth radiation in the wavelength range 8 to 12 micrometers. That is the window through which a substantial fraction of the earth's heat ordinarily escapes. The earth's blackbody radiation is at a maximum in that wavelength region, and water is less effective as an absorber in that part of the spectrum.

Methane (CH₄) is at present the most effective greenhouse trace gas. Its concentration has been increasing about 1 percent per year since 1950. The total content in the atmosphere is about 5000 million tons. Methane is destroyed slowly, mainly in the troposphere, by the reactive OH. Residence time for CH₄ is 5 to 10 years. This implies an annual addition of at least 500 million tons to hold the level constant. Growth of 1 percent per year requires an extra addition on the order of 50 million tons. Principal sources of CH₄ appear to be ruminant animals, organic-rich sediments, and rice paddies. A complicating factor in estimating trends in CH₄ distribution is the competition of CO for OH. Emissions of CO have been increasing, and they destroy OH that otherwise might react with CH₄.

For a long time, nitrous oxide (N₂O) has been present in the atmosphere in substantially its current concentration. It has a residence time greater than 100 years. It is increasing at about 0.2 percent per year, with microbial interactions with fertilizers in soils and combustion of nitrogen-rich fuel likely sources. Destruction by stratospheric photolysis is the only known removal process. The contribution of N₂O to the greenhouse effect is about one-sixth that of CH₄.

The chlorofluorocarbons CCl₂F₂ and CCl₃F (freons) came into major use in the 1960's. Global emissions of them actually declined from the mid-1970's through 1982, but their long residence time, 120 years and 70 years, respectively, leads to a continuing buildup. In 1980, their contributions to a greenhouse effect were, respectively, one-third and one-fifth that of CH₄. Another halocarbon that could become important is C₂H₃Cl₃, which is used as a solvent. It has a residence time of about 10 years, and its concentration has been increasing at the rate of 8 percent per year. Much of the CCl₄ that has been produced is now in the atmosphere—mixing ratio 0.00013 ppm (about 3.6 million tons). Residence time of the chemical is 25 to 50 years. However, it does not absorb in the important region of the spectrum. Two other commercially significant halocarbons, C₂HCl₃ and C₂Cl₄, have short residence times and have thus no consequential greenhouse effects.

Climate modelers have great computational power at their disposal, but the atmospheric system is complex. Thus, estimates of a warming corresponding to the equivalent of a doubling of CO₂ have a range of 1.5° to 4.5°C. In addition, there is uncertainty about the timing of a warming. No one can be sure of the natural lag time in the response of the earth's physical and biological systems. Heat transfer from the oceanic surface waters to deeper waters could determine the rate at which the earth's climate equilibrates to a new energy budget. The other unpredictable is the behavior of humans. Experience tells us that extrapolation from the present is not a good guide to the long-term future. However, humans are increasing the concentrations of greenhouse gases, and ultimately major effects are likely to be manifest.—PHILIP H. ABELSON

*This editorial is based on testimony by Ralph J. Cicerone, director of the Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder, CO, before the Senate subcommittee on toxic substances and environmental oversight on 10 December 1985.

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was divided into four occupational zones. The one next to the new Polish territory was assigned to Russia and is still occupied by Russian troops. It was named East Germany. Geographically speaking, it represents the central part of the old German Reich with the capital of Berlin as its center. The Russian czars had little, if any, influence on the German population next to the Russian border. They certainly had none on the population of what is now East Germany.

After having been under Turkish domination, Hungary was liberated by the Habsburg dynasty, and from the beginning of the 18th century it remained under Habsburg control. There surfaced, however, some Magyar opposition. It flared up in the Revolution of 1848 which led to the short-lived Hungarian Republic. Russian and Austrian troops subdued it. In 1867 Hungary became a constitutional kingdom in union with Austria. The Austro-Hungarian dual monarchy was an acknowledgment of Hungarian parity with Austria. Under those circumstances there were few opportunities for the czars to exert their influence and to prepare Hungary for Russian domination.

Finally, the concept of Russia's growing influence, first under the czars, and then

under Soviet domination until, finally, effective control was reached, does not coincide with the historical record. It is important to realize that there was a lapse of a generation between the end of the czars (1917) and the beginning of Soviet rule in Eastern Europe in 1945. Furthermore, effective control was obtained only by military occupation.

ERNEST W. VOLKMANN
*Rural Delivery 5,
Post Office Box 226S,
Ligonier, PA 15658*

Response: In reply to Rochester, the original Rand monograph on which my article was based included estimates of the U.S. costs corresponding to the costs of the Soviet empire. In brief, the corresponding costs for the U.S. "empire" as a share of the U.S. gross national product were one-third those of the Soviet Union when its empire costs were calculated in dollars—and one-eighth when the Soviet empire costs were calculated in rubles—for the 1971–1980 period. For the single year 1980, the corresponding U.S. costs were approximately \$11 billion compared with \$41 billion and 42 billion rubles for the Soviet Union. Rochester's suggestion about including a cost-benefit

coefficient for each type of U.S. and Soviet empire expenditure is an interesting idea, although it would be difficult to translate into practice.

In reply to Dudley, by defining the terms "empire" and "imperialism" as I did, I sought to give them as precise and nonpejorative meanings as possible, to the extent that these quite ambiguous terms and concepts permitted. If one reads historical literature on, for example, the Roman, Ottoman, and British empires of the past, one finds that the terminology is usually much less precise than what I used in the *Science* article.

I would not take issue with Volkmann's review of the history of Soviet relations with Eastern Europe. Moreover, nothing in my article conflicts with his assertion that Soviet control in Eastern Europe was obtained by military occupation.

CHARLES WOLF, JR.
*Rand Graduate Institute,
Rand Corporation,
Post Office Box 2138,
Santa Monica, CA 90406-2138*

AIDS and Female Circumcision

Uli Linke's letter (17 Jan., p. 203) about AIDS in Africa suggests that contact with blood during intercourse may be an indirect consequence of the African practice of female circumcision. It then describes an extreme and rare form of female circumcision—infibulation. Infibulation is found only in a part of northeastern Africa (1), outside the region where AIDS has been reported, and is very different in its social and biological effects from the kind of female circumcision that is practiced more widely in Africa.

A secondary problem with the logic of hypothesizing that AIDS is transmitted by a traditional custom is that in Africa it appears to be primarily an urban disease, as it is in the United States. Traditional customs, such as female circumcision, have their origins in the rural sector. I think it would be more productive to look at data pertaining to life in African cities and to examine such phenomena as male labor migration, often described as being disruptive to marriage and family life.

MIKE BURTON
*Department of Anthropology,
University of California,
Irvine 92717*

REFERENCES

1. R. O. Hayes, *Am. Ethnol.* 2, 617 (1975).

NEW AAAS PUBLICATION

Scientists and Human Rights Present and Future Directions

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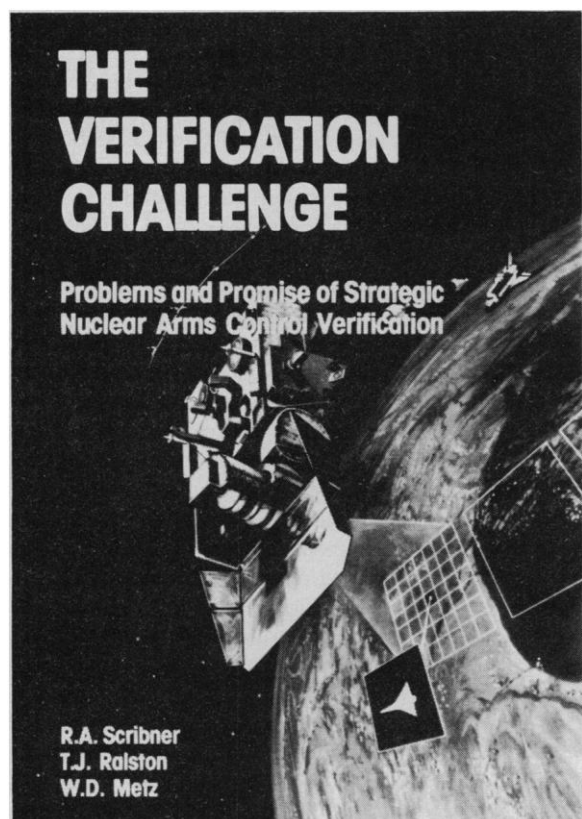
The second workshop report of the AAAS Clearinghouse on Science and Human Rights, a project of the AAAS Committee on Scientific Freedom and Responsibility, examines the activities of scientific societies in the human rights field. Workshop speakers also review mechanisms available within international intergovernmental organizations to address human rights violations of scientific and medical professionals.

Prepared by Kathie McCleskey, Senior Program Associate, AAAS Clearinghouse on Science and Human Rights.

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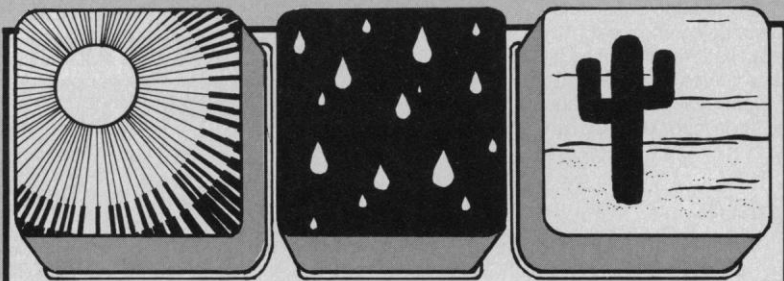
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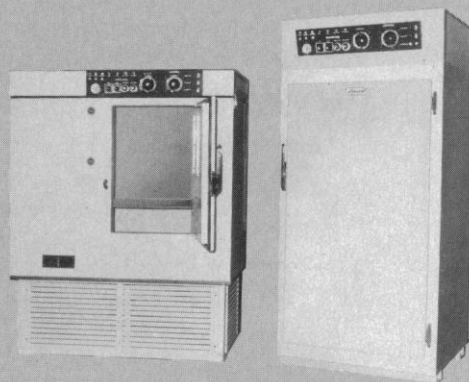
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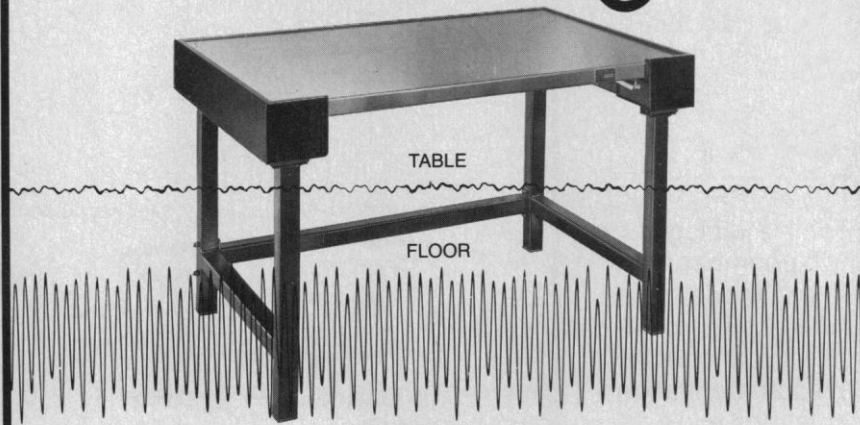
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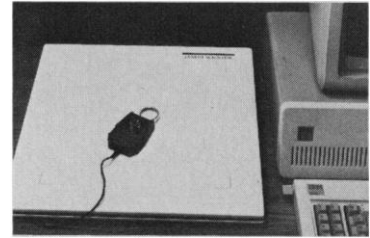
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AAAS Annual Meeting

Philadelphia, 25–30 May 1986

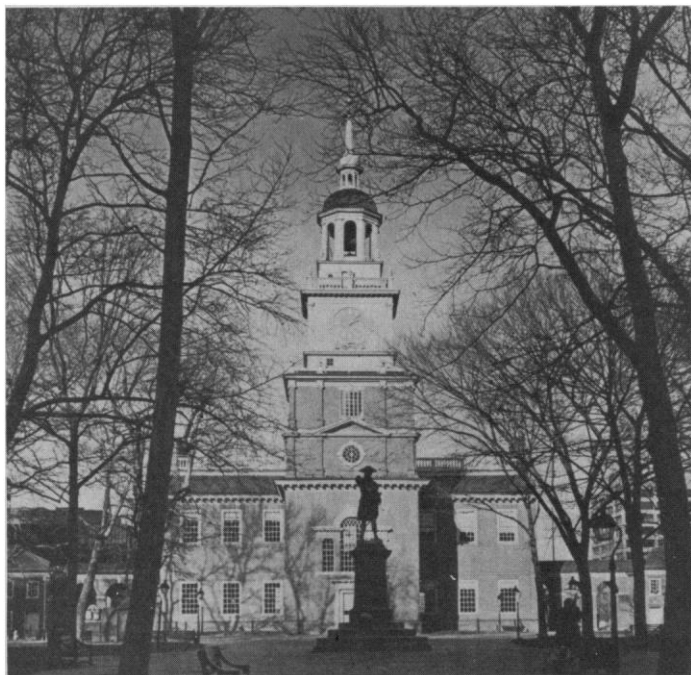
Tours

THE PHILADELPHIA ADVISORY COMMITTEE TO THE AAAS Annual Meeting is pleased to offer 15 tours organized especially for registrants. These tours are only a sampling of the many scientific and cultural institutions located in and around the City of Brotherly Love. We at AAAS are delighted to join our Philadelphia hosts in inviting you to visit as many of these exciting sights and places as possible.

1. **Philadelphia Museum of Art.** Sunday, 25 May, 11:45 am–2:15 pm (Limit: 48 persons)

The Philadelphia Museum of Art, America's third largest museum, with 10 acres of gallery space, is itself the finest example of Greco-Roman architecture in the country. The tour will concentrate on "Science and the Arts." The mutual concern of artists and scientists for understanding man and nature has often led them in similar directions in efforts to unravel the mysteries of life. This tour of the museum's collections will draw upon images created by artists over several centuries, ranging from Peter Paul Rubens to Thomas Eakins and Constantin Brancusi. After the guided tour, you will have one hour to explore the rest of the museum before returning to the hotel.

(Courtesy of Philadelphia Convention & Visitors Bureau)



2. **Fairmount Park Mansions.** Sunday, 25 May, 1:00 pm–4:00 pm (Limit: 48 persons)

Bus tour down the Benjamin Franklin Parkway—the Champs Elysees of Philadelphia—passing Logan Circle, the Franklin Institute, and the Academy of Natural Sciences. Then on to Fairmount Park, the world's largest municipal park, which contains many sculptures including Remington's "The Cowboy." You will then take a private tour of two of the restored Fairmount Park Mansions, returning via Kelly Drive, home of historic Boathouse Row.

3. **Morris Arboretum of the University of Pennsylvania.** Monday, 26 May, 1:00 pm–4:00 pm (Limit: 40 persons)

Located on the northwestern edge of Philadelphia, the Morris Arboretum comprises 175 acres of landscaped grounds, botanical laboratories, and a one-of-a-kind Victorian fernery. The visit, hosted by Arboretum director Dr. William M. Klein, will include highlights of a collection noted for its many mature specimens of Asian trees in a Victorian garden setting. Rhododendron bloom should be at its peak, together with native magnolias, American yellowwood, white fringe tree, and Chinese dogwood. Research programs, including ongoing work on the flora of Pennsylvania, will be described by staff members of the Willaman Botanical Laboratories.

4. **Walking Tour of Historic Philadelphia.** Monday, 26 May, 1:00 pm–4:00 pm (Limit: 96 persons)

Step back 200 years with knowledgeable guides for a delightful look at our past: Touch the Liberty Bell, see Independence Hall, Congress Hall, and State House Yard. Go past the Second Bank along cobblestoned Library Walk to Dolley Todd's House, an 18th-century garden, Carpenters' Hall, a "barrow" street, Franklin's Court, and picturesque Society Hill with its restored homes, "busybodies," 18th-century carriage steps, gardens, hidden walkways, and more.

5. **University of Delaware (Newark).** Tuesday, 27 May, 8:00 am–4:30 pm (Limit: 40 persons)

After a coffee reception, the tour starts with the Center of Catalytic Science and Technology, a research center specializing in single crystal surfaces, well-defined supported metals, supported metal and metal-oxide clusters, catalytic hydroprocessing, and spectroscopic methods for catalyst characterization. Next is the Center for Composite Materials, a national engineering research center for composite manufacturing science and engineering. After a complimentary lunch, the tour continues at the Institute of Energy Conversion, one of the world's largest thin-film solar-cell R&D laboratories.

6. The Franklin Institute Science Museum. Tuesday, 27 May, 1:00 pm–5:00 pm (Limit: 100 persons)

The Franklin Institute Science Museum explores a variety of topics including mechanics, aviation, shipbuilding, astronomy, earth sciences, optics, and mathematics. It includes the Fels Planetarium, a computerized state-of-the-art facility. This tour, conducted by Daniel L. Goldwater, Director of Exhibits and Chief Scientist, will focus on the museum's newest permanent exhibit: "Electricity and Electronics," which integrates historic artifacts and reconstructions with new technologies, such as a music synthesizer and a robot-controlled videocamera. Meet your tour guides at the 17th Street entrance of the Franklin Plaza Hotel for the walk around Logan Circle to the Franklin Institute.

7. University of Pennsylvania. Tuesday, 27 May, 2:00 pm–5:00 pm (Limit: 20 persons)

The University of Pennsylvania's data network and information services provide residence halls and campus, Philadelphia homes, and local area networks with services ranging from library catalog and literature search through departmental microcomputer labs to national networks and scientific computing facilities. The presentation will cover the architecture costs, progress, and the considerations that went into decisions in these areas.

8. E. I. du Pont de Nemours & Co. (Wilmington, Delaware). Wednesday, 28 May, 9:00 am–2:30 pm (Limit: 48 persons)

The tour of the du Pont Company's Experimental Station will include demonstrations and exhibits selected from current work in polymers, molecular biology, medical diagnostics, chemical synthesis, electronic materials, computer science, and engineering. This site is the company's main research location; cameras are not permitted. Complimentary lunch provided by du Pont.

9. Rohm & Haas Company (Spring House, Pennsylvania). Wednesday, 28 May, 9:30 am–2:30 pm (Limit: 36 persons)

The Rohm & Haas complex encompasses 10 modern buildings on a 140-acre site 20 miles north of Philadelphia. Demonstrations in-

clude the modern engine test facility, sophisticated capabilities for detecting and analyzing trace quantities of chemicals in terms of parts per trillion, and research in agricultural and coatings resins. Complimentary lunch provided by Rohm & Haas. **Note:** For this tour, registrants must submit in advance the name, address, and citizenship of each person for whom a ticket is purchased. Proof of identity is required on entering the facility; foreign nationals must show passports. Cameras are not permitted.

10. Fox Chase Cancer Center. Wednesday, 28 May, 1:00 pm–4:45 pm (Limit: 20 persons)

The Fox Chase Cancer Center, located on a 47-acre campus in Northeast Philadelphia, was formed in 1974 from the union of the American Oncologic Hospital and The Institute for Cancer Research. You will visit the research, administrative, and patient care facilities, including the Center's new nuclear magnetic resonance facility which houses the most powerful magnet commercially available.

11. Smith Kline & French Laboratories (Upper Merion, Pennsylvania). Thursday, 29 May, 8:30 am–12:30 pm (Limit: 96 persons)

Smith Kline & French Laboratories, the pharmaceutical division of SmithKline Beckman Corporation, will conduct tours of its new R&D facilities. Come meet outstanding men and women in science and learn about SK&F's programs, which are targeted at major therapeutic areas in gastroenterology, immunology, and cardiovascular, respiratory, anti-infectives, and anticancer research. A complimentary lunch will be provided. Cameras are not permitted.

12. The Wistar Institute. Thursday, 29 May, 2:00 pm–4:00 pm (Limit: 48 persons)

The oldest independent biomedical research organization in the nation, the Institute is famous for its contributions in aging, cancer, rabies, multiple sclerosis, and the relationship between diet and degenerative diseases. The theme of the program is "Fundamental Research in Cell and Molecular Biology." After welcoming remarks, the visitors will tour laboratories staffed by Institute scientists. Complimentary refreshments will be served.

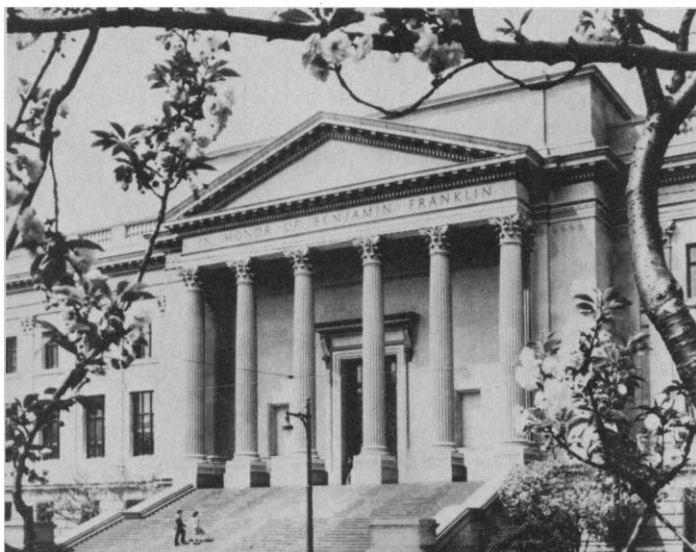
13. Candlelight Stroll. Thursday, 29 May, 7:30 pm–9:00 pm (Limit: 48 persons)

Relive Colonial days in picturesque Society Hill in the historic area of Philadelphia. Costumed guides recreate the customs and lifestyles of this old neighborhood of restored townhouses, 18th-century carriage steps, hidden walkways and courtyards, private gardens, historic churches, and more. You may return to the hotel in your bus at 9:00 pm or stay to enjoy the Headhouse Square activities and return on your own.

14. DNA Plant Technology Corporation (Cinnaminson, New Jersey). Friday, 30 May, 8:30 am–11:30 am (Limit: 30 persons)

A slide presentation describing biotechnology research will be followed by a tour of the research facility. The tour, featuring numerous laboratories and an extensive greenhouse complex including a state-of-the-art tropical greenhouse, will be of special significance to those interested in plant genetics and tissue culture. Cameras are not permitted.

(Courtesy of Philadelphia Convention & Visitors Bureau)



15. **Philadelphia Electric Company.** Friday, 30 May, 1:45 pm–4:15 pm (Limit: 48 persons)

The Philadelphia Electric System Control Center is the operating center for PECO's high-voltage transmission and generation network. A computer system known as SAMAC (system automatic monitor and control) provides information display and analysis

needed by the system operators. Two large Burroughs computers scan 42 remote terminals located throughout the P.E. system to obtain real-time system data. Live data is displayed on 37 color CRT monitors and is available to system analysis programs, the results of which are used to make the minute-to-minute operating decisions required for a large metropolitan utility. The SAMAC system is one of the outstanding engineering achievements of its time.

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Tours are limited to Annual Meeting registrants only. All tours depart from and return to the 17th Street entrance of the Franklin Plaza Hotel at the times indicated. Comfortable walking attire is recommended. Tour prices include transportation costs and any admission fees. Tickets will be mailed to you in early May. Orders received **after 9 May** will be held at the AAAS Ticket Desk at the Franklin Plaza Hotel. *Please order tickets for Sunday tours early enough so that they can be mailed to you.* Refund requests must be made by letter or telegram to the AAAS Meetings Office **before 16 May** and will be honored after the Meeting. No refunds will be made on cancellations received after this date. Handicapped registrants who need advance tour information or assistance should so indicate on the order form, or contact *Virginia Stern, AAAS Project on the Handicapped in Science, 1333 H Street, NW, Washington, DC 20005 (telephone: 202-326-6667).*

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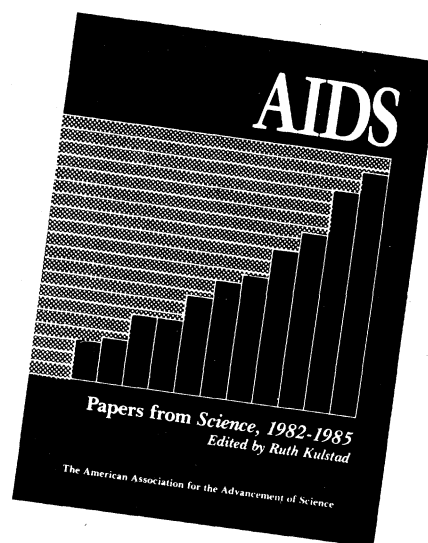
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