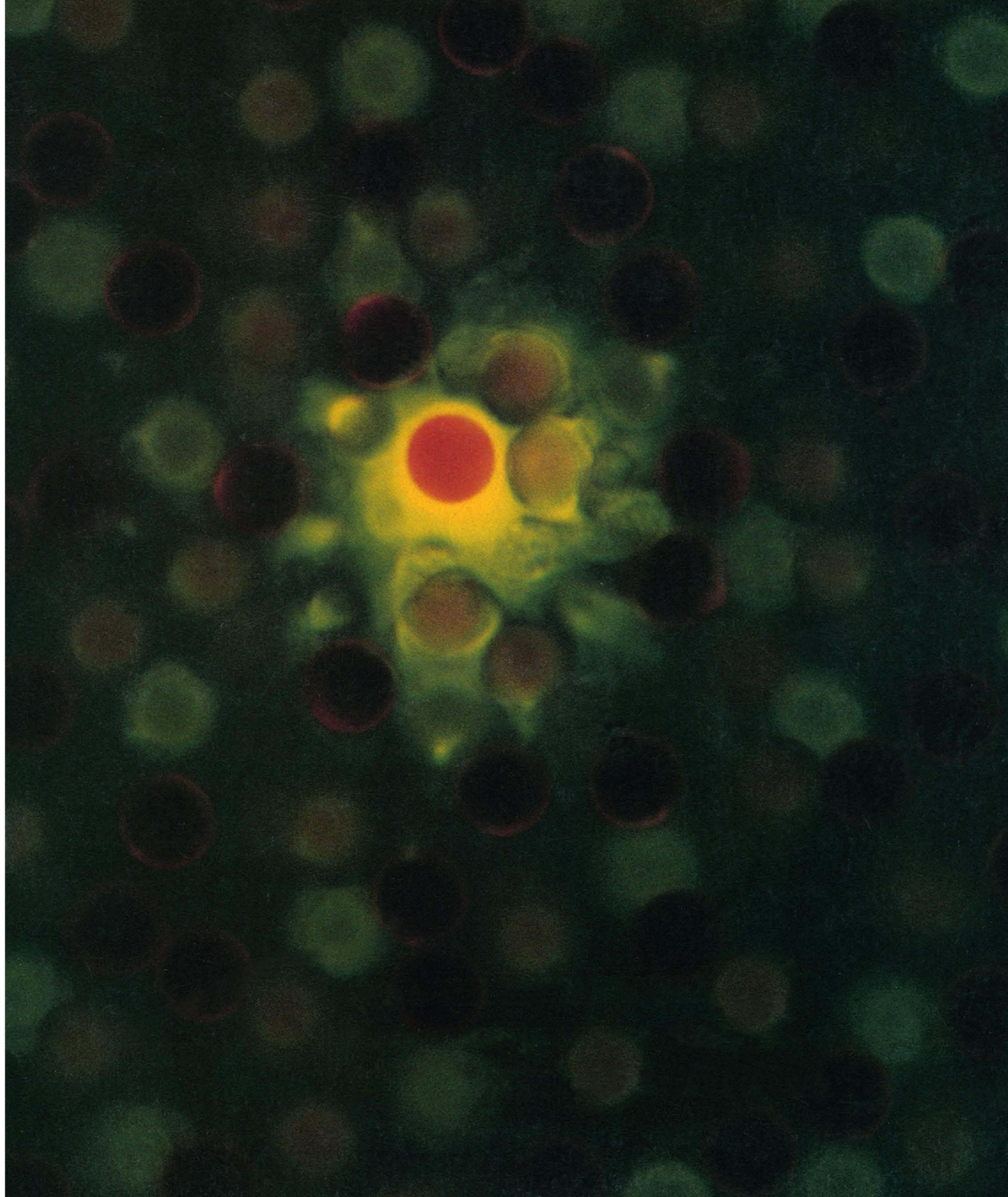


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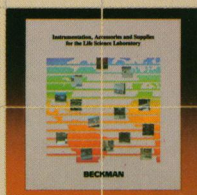
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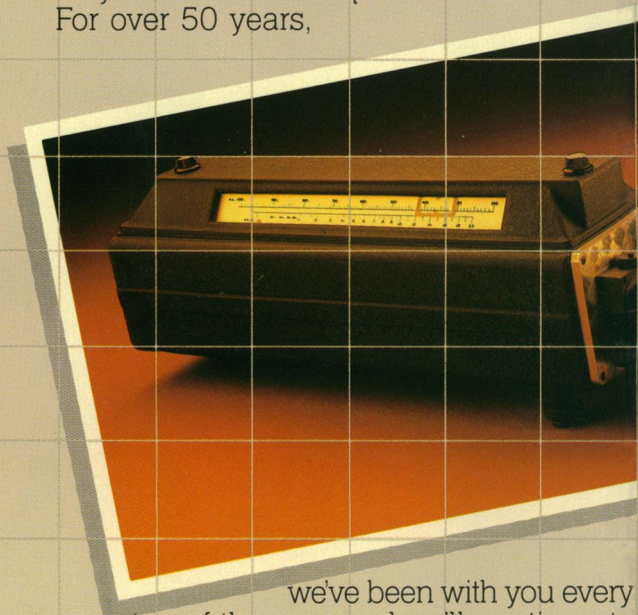
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COVER

Mythical chinthe standing guard at the entrance to a pagoda, along the road from Mandalay to the remote Pondaung Hills of western Burma. Near the village of Mogaung in 40-million-year-old sediments of the Pondaung Formation a new fossil jaw of the earliest known higher primate, *Amphipithecus*, was discovered recently. This fossil substantiates the view that southeast Asia was the center of anthropoid origins. See page 756. [R. L. Ciochon, Department of Anatomical Sciences, State University of New York, Stony Brook 11794]



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Long-range transport of pollutants

Prevailing winds carry air pollutants northeastward from smelting operations in Arizona, Nevada, New Mexico, and Utah, and at sites more than 1000 kilometers away sulfate concentrations in acid precipitation vary directly with the amount of sulfur dioxide emitted by the smelters (page 859). Oppenheimer *et al.* compared SO₂ emissions data obtained from smelters and from state air quality control agencies with 4 years of precipitation data collected from sites in Colorado, Arizona, Wyoming, and Idaho. Emissions varied throughout the test period, and sulfate in precipitation varied in parallel. Thus the sulfate in precipitation could be linked to the emissions from smelters. Electric power plants and smelters are responsible for more than 90 percent of the total SO₂ emissions in the intermountain region, with most coming from the smelters. Predictive models describing the long-range transport of pollutants may be tested with the use of these data.

Chronology of Peruvian cave dwelling

Guitarrero Cave in the Peruvian Andes is an archeological site that has yielded clues about early textiles and plant cultivation in South America (page 864). Artifacts and charcoal found in the cave—well preserved because the atmosphere is dry—have now been dated by accelerator mass spectrometry, which uses an atomic particle accelerator in the measurement of minute amounts of radioactive carbon in samples. The new dating resolves discrepancies in the apparent ages of artifacts that had been dated by conventional disintegration counters; these results leave little doubt that ancient occupation of the cave occurred. Lynch *et al.* conclude that about 12,500 years ago the cave may have been occupied for a short time, but the major period of occupation was 2,500 years later, between 9,500 and 10,000 years ago. That occupation did not exceed 500 years and may have been as short as one generation.

Pathophysiologic effects of cachectin

Cachectin, a hormone produced by macrophages (phagocytic cells of the immune system), causes fat cells to lose fat, mediates shock caused by bacterial infections, and has subsequently been found by the Cerami group to be the same substance as tumor necrosis factor, which causes tumors to regress (pages 867 and 869). Torti *et al.* showed that in culture cachectin directly interfered with fat production: it disrupted the processing of genetic information used for making enzymes that are essential to fat synthesis. Lipids did not accumulate in fat cells that had cachectin added, and cellular responses that promote mobilization of stored lipids and release of free fatty acids from fat cells may have been stimulated. Over time, this combination of

effects would deplete cellular energy reserves and could account for the development of cachexia—malnutrition and general ill health—which typically accompanies cancer and infections. Beutler *et al.* showed that cachectin also mediates the effects of endotoxin, a toxic substance produced by many bacteria; endotoxin had earlier been shown to induce secretion of cachectin by macrophages. Mice could be protected from the lethal effects of endotoxin if treated with antibody reactive with cachectin. The results suggest that by antagonizing the effects of this substance, therapeutic benefit may be gained in naturally occurring cachexia and shock.

Color coordination: the eyes have it

Color vision depends on cones, the photoreceptors in the vertebrate retina that are sensitive to light of different wavelengths (page 874). Most cones of the red-eared turtle, a vertebrate from which much information about color vision has been obtained, contain an oil droplet filled with a colored pigment that absorbs light of a particular wavelength (cover). Ohtsuka studied droplet color in relation to the color of light absorbed. Monochromatic light in the visible range—between 420 and 700 nanometers—was flashed at cones; cells sensitive to specific wavelengths responded electrically, and cell voltage responses were measured with a microelectrode. Green light stimulated cones with yellow droplets, blue light those with clear droplets, and red light those with either red or pale green droplets and double cones (those pairs in which one cone has an orange droplet and the other has none). Although only one member of the double cone had a droplet, both responded, and the responses were independent. This coordination of droplet color with spectral sensitivity provides a morphologic basis for studies of color vision.

Localized brain injury in encephalitis

Experimental viral encephalitis produced in mice by a coronavirus may be similar to the parkinsonism or shaking palsy that sometimes develops after encephalitis in humans; the same brain regions—the substantia nigra and the subthalamic nucleus—are damaged in both (page 877). Other coronaviruses are known to cause central nervous system diseases in animals but only flu-like illness in humans. Fishman *et al.* injected animals with the virus and found that viral components generally became localized in the brain in vacuoles of nerve and other cells. Cell damage was most extensive in the sickest animals. The mouse model may contribute to an understanding of aspects of von Economo's encephalitis, another disease of unknown etiology that damages the substantia nigra and subthalamic nucleus and which was, around 1920, the major cause of human parkinsonism.

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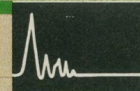
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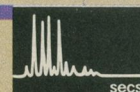
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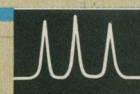
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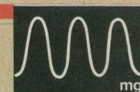
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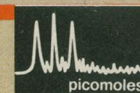
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LETTERS

High Energy Physics

As one of the "four other eminent particle physicists" referred to in R. Jeffrey Smith's article (News and Comment, 14 June, p. 1295), I write to protest the distortions and imputed motives appearing in his story and elsewhere in the pages of *Science* in recent months about the project known as the SSC (Superconducting Super Collider). Far from being an organizer of a "hard sell" symposium at the annual AAAS meeting, I responded to a request from Rolf Sinclair, a functionary of the AAAS, to participate in a general interest symposium organized by him, with the assistance of Stanley Wojcicki. Despite the pressures as one of the physicists trying to carry out the R&D necessary to make the SSC a feasible scientific instrument at the lowest possible cost, I responded out of a sense of duty (as I do to similar calls from other scientific societies) to inform fellow scientists about recent progress in high energy physics and the scientific justification for the SSC.

Smith's account makes one question whether he actually attended the symposium, or only the AAAS-arranged press conference the previous day. If he did take the time to attend the symposium, he heard me and others discuss the status of our field, the progress of the SSC R&D program, and the challenges of doing experiments at such a facility. Among the audience of a 100 or fewer was a skeptical high school chemistry teacher who, after some early hard questioning, ended the symposium with thanks to the chairman and speakers for a clear and organized presentation of the scientific issues. Perhaps this is evidence of the efficacy of our "hard sell for the SSC," but I prefer to interpret it otherwise.

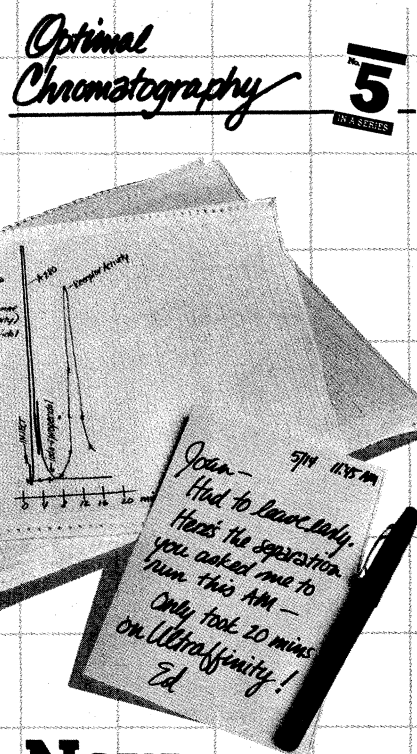
Smith refers to an earlier article by David Dickson (News and Comment, 24 May, p. 968) about the presently vague plans at CERN for a hadron collider in the Large Electron-Positron Collider (LEP) tunnel—a tunnel, incidentally, that is only now being dug. Dickson's uncritical reporting of European statements, repeated by Smith, on comparative costs of the so-called Large Hadron Collider (LHC) and the SSC is not what I expect of good science journalism. Neither is the use of such statements as the SSC's "estimated \$4- to \$6-billion cost." The only serious cost estimate of the SSC was made in the Reference Designs Study in the spring of 1984. There the cost of the accelerator and its central

laboratory was calculated to be between \$2.7 and \$3.0 billion, depending on the style of magnet chosen, in fiscal-year 1984 dollars, including 25% contingency. No revision of those figures has occurred. Other costs have been quoted, but they refer to different things and in different currencies. For example, the often quoted \$6 billion dollars is a figure in "then year" (cheaper) dollars, with an estimate for inflation over a ten-year period and refers to the accelerator plus all preconstruction R&D and other costs, a full complement of detectors, and computers. For Congress, such a number may well be appropriate and useful, but it is *not* an upward revision of the original \$2.7 to \$3.0 billion.

Dickson's piece distorted the U.S. position on international cooperation, stating that the Europeans received a chilly reception when they asked for our cooperation to build the LHC in the LEP tunnel. Since the LHC is still an idea being kicked around the European Laboratory for Particle Physics (CERN), and since, to my knowledge, no request for U.S. participation has been made in any official way, it is grossly unfair to imply a lack of willingness to cooperate. International cooperation is a complex, many-faceted issue. From our point of view, the Europeans' reply to our suggestions for cooperation on the SSC—"We are too fully committed for the next five years with LEP at CERN and HERA [Hadron-Elektron-Ring-Anlage] at DESY [Deutsches-Elektronen-Synchrotron] to give you more than moral support"—is disappointing, but reasonable. Let *Science* not say the Europeans refuse to cooperate!

The last paragraph of Smith's article is particularly offensive, with its sarcastic talk of "a long-running sales campaign" and its accusation of lobbying by the Universities Research Association. The URA is an association of 56 research universities, created in the mid-1960's to serve as the administrative umbrella for Fermilab and now entrusted by the Department of Energy to administer the R&D phase of the SSC, as its parameters and viability are established. The URA maintains a minuscule organization in Washington. The funds go to the science.

If articles like Smith's are the only thanks I get for responding to a request from the AAAS, I know what to do in the future. *Science* would serve the scientific community better if it addressed the scientific need for the SSC on its merits. The project is expensive. Scientists in other fields have legitimate concerns. Particle physicists understand those con-



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Dr. G. Neil (Upjohn)

■ Successes and Failures of Previous Efforts to Develop New Drug Leads from the Sea

Prof. K. Rinehart (U. of Illinois/SeaPharm)
Dr. A. Bossi (NIADDK)

■ Recent Advances in Chemistry, Biology and Engineering Pertinent to Marine Pharmaceuticals

Prof. R. Moore (U. of Hawaii)
Prof. K. Nakanishi (Columbia U./Suntory Foundation)

■ Research for Bioactive Compounds from Marine Sources in Japan and Europe

Prof. Y. Hirata (Meijo Univ.)
Prof. I. Kitagawa (Osaka Univ.)
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Prof. K. Nakanishi

■ Industrial Research Programs in the U.S.

Dr. L. Crawley (American Cyanamid)
Prof. R. Moore
Mr. J. C. Torres (SeaPharm)

■ Government Supported Research in the Marine Pharmaceutical Area

Dr. D. Attaway (NOAA)
Dean J. Goyan (U. of California-San Francisco)
Dr. W. Raub (NIH)

Friday, October 25, 1985 — Half Day

■ Future Perspectives in the Marine Pharmaceutical Area

Prof. A. Leaf (Harvard)
Dr. M. Boyd (NCI)

■ Funding for Basic, Developmental and Clinical Research

Mr. M. Collins (DSV Partners)

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sediment in a few centuries, is hydroelectricity truly renewable energy? What about the ecological, aesthetic, and recreational value of natural lakes, free-flowing rivers, gorges, rapids, waterfalls, and wilderness? Think of the extinct rapids beneath the reservoirs of the Snake and Colorado rivers. We may dismantle the transmission lines, but the dams and the sediment behind them are forever.

ROBERT J. CARSON

Department of Geology,
Whitman College, Walla Walla,
Washington 99362

How Much for Research?

Leonard Sagan (Letters, 21 June, p. 1382) argues that no causal relationship has been demonstrated between mortality and wealth. But mortality is not the sole measure of health. It is undeniable that wealth has something to do with the quality of life while it is being lived, and although we may not have been able to extend its length by expenditure of funds, it is unquestionable that we have been able to improve its quality, both in terms of lower morbidity and greater mental health. But the question is not whether we should spend or not spend on research. The question is how much. When does one reach a point of diminishing returns? Anyone asking for research funds should be able to tell the funding source what minimum value society will gain from answering the question his or her experiments address. That this is not an unreasonable requirement is demonstrated by the fact that such questions are asked and answered daily in industrial research.

B. J. LUBEROFF

48 Maple Street,
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The Fajada Butte Solar Marker

Zeilik (Reports, 14 June, p. 1311) adds to the published data (1, 2) indicating that site 29 SJ 2387 at Chaco Canyon, New Mexico, did not work as described by Sofaer *et al.* (3, 4). However, one of Zeilik's conclusions does not follow from his argument, and he also omits an important ethnographic fact.

Zeilik concludes that 29 SJ 2387 was probably a sun shrine and states, "The turns in the spiral could then mark out a rough planting calendar" (p. 1312). Arguing earlier against the use of 29 SJ 2387 as an accurate solar calendar, he correct-

ly cites ethnographic accounts to show that Pueblo sun-watching sites are (i) usually unmarked and (ii) easily accessible to the Sun Priest. These same accounts and others (5) also note that planting times and dates for other subsistence activities are set using sun-watching stations. Zeilik notes that these calendars are much more accurate than the Fajada Butte feature. The same is true for known prehistoric Anasazi solar alignments (5), making 29 SJ 2387 unnecessary. Furthermore, the difficult access to Fajada Butte that makes the butte an unlikely place for sun-watching also makes it an unlikely location for any calendrical marker, even a "rough" one.

Finally, like Sofaer *et al.*, Zeilik does not mention that among the Pueblos spirals represent water or serpents (1, 6), not the sun. "Sun and water are necessary elements for farming, but they are distinct elements in Puebloan symbolic systems. Serpents are associated with both sun and water . . . but are similarly distinct" (1). Ethnographically there is little to indicate that 29 SJ 2387 is Pueblo; by extension, other than because of its location at Chaco Canyon, the designation of 29 SJ 2387 as Chacoan Anasazi remains unproved. The slabs and other geological features are probably natural (1, 2), not cultural, and the two spiral petroglyphs could be Navajo.

JONATHAN E. REYMAN

Anthropology Program, Illinois
State University, Normal 61761

References

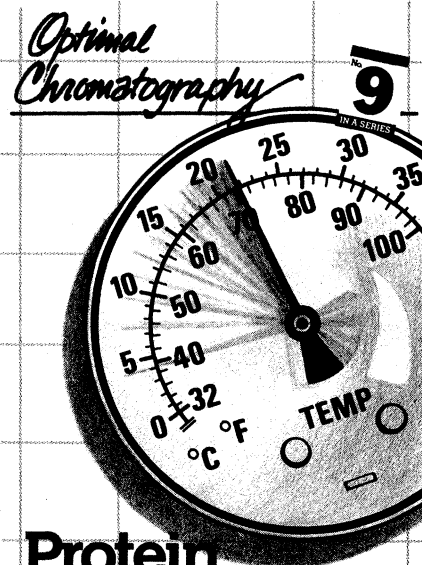
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Iowa, Not Ohio

John K. Smith and David A. Hounshell wrote a fascinating account (Articles, 2 Aug., p. 436) of Carothers' career at DuPont. They erred, however, in identifying my affiliation in 1928 as Ohio State University. I was then, and remain to this day, a professor at Iowa State University.

HENRY GILMAN

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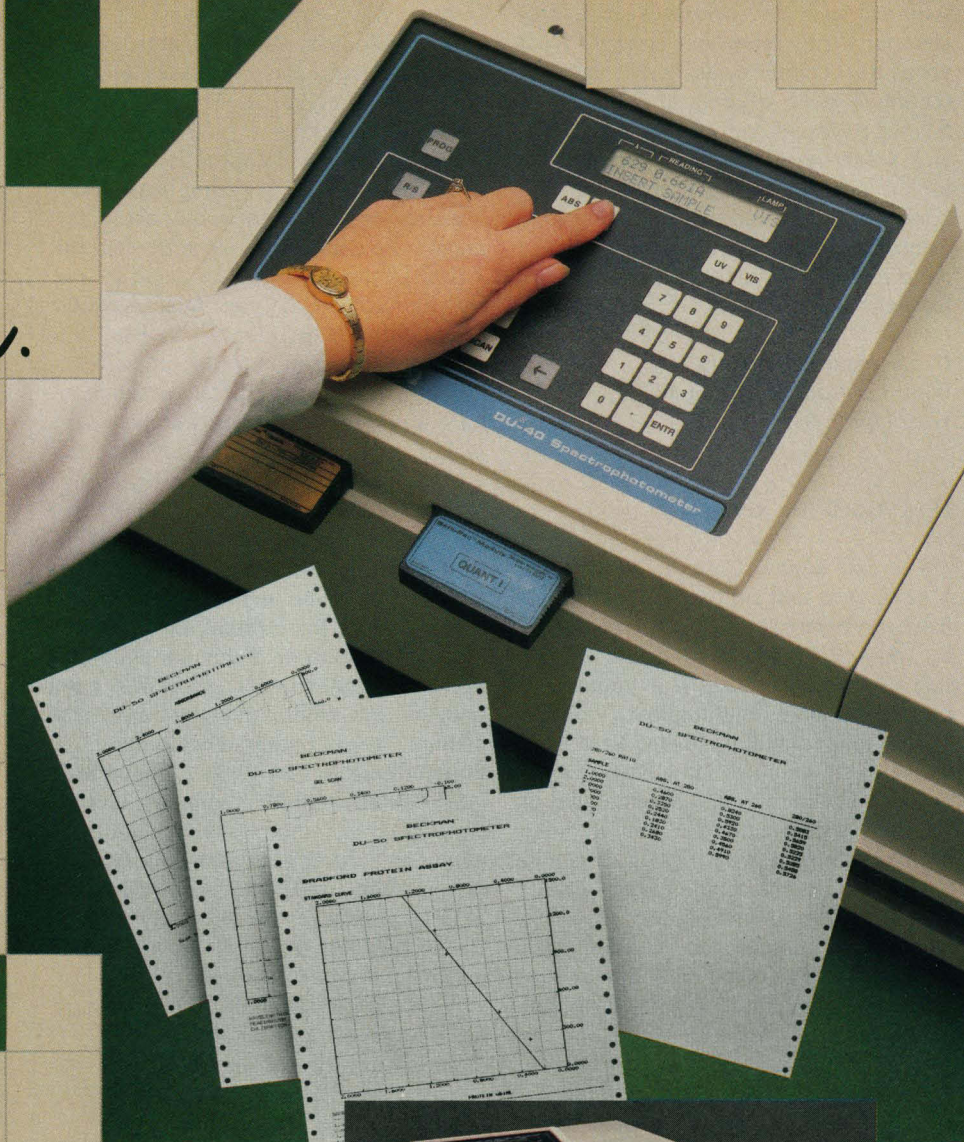
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Technologies for Clean Use of Coal

In the domain of policies related to energy, this country has many problems, including acid rain and costs of imported oil. A recent report from the Department of Energy's Energy Research Advisory Board is a rich source of information on these matters.* The document lists 13 to 15 categories of technologies under development for clean use of coal. In describing their status, the report indicates that progress is being made and that federal co-funding of demonstration facilities would expedite diminution of acidity of rain. Substitution of coal for oil could also be increased.

Coal-fired utility boilers are responsible for 70 percent of the SO₂ and 20 to 25 percent of the NO_x emitted in this country. The boilers east of the Mississippi account for 16 million tons of SO₂ and 4.5 million tons of NO_x. Only about 10 percent of the boilers are subject to New Source Performance Standards. The current technology for reducing pollution, flue gas desulfurization (FGD), is costly; it reduces energy conversion efficiency, and the usual sludge is a potential polluter of ground water. A new technology, Limestone Injection Multistage Burner (LIMB), appears to be markedly superior to FGD. The LIMB technology is based on injection of a sorbent—limestone, for example—directly into the furnace and its subsequent reaction with SO₂ leading to dry calcium sulfate. The LIMB technology is relatively low cost, both for retrofit and operation. It can reduce both SO₂ and NO_x by 50 to 60 percent for retrofit applications.

The procedures used to achieve reduction of NO_x in the LIMB technology are of possible broad application in industrial and other combustors that emit large amounts of NO_x. In the LIMB technology, the major burning occurs in a primary stage. Reduction of NO_x is accomplished in a second combustion zone that is made reducing in nature, by, for instance, injection of natural gas. The combustion is completed after the second zone at temperatures at which little NO_x is formed.

The major coal seams of the Midwest have sulfur contents on the order of 3 to 4 percent and around 10 percent ash. Usually more than half the sulfur is in the form of pyrite (FeS₂), a heavy mineral. When coal is ground down to small particles, the noncoal pyrite and ash can largely be removed through physical methods such as flotation of coal on a heavy liquid. A slurry of 60 percent coal particles and 40 percent water can be moved by pipeline. Demonstrations of use of a slurry with particles about 100 micrometers in size as a substitute for residual oil have been conducted. When the coal is ground to about 40 micrometers or less, performance as an oil substitute appears to be very promising. The total use of oil products in utility and industrial boilers is about 2 million barrels per day. Many utility boilers ordinarily fired by oil are now idle. A lower cost substitute for oil would restore their usefulness. An alternative to coal slurries is the use of two-stage combustion—that is, the coal is gasified in one burner and the gases oxidized in a second boiler previously used for oil or natural gas.

For new industrial and utility boilers, the emerging best technology is fluidized bed combustion. This method is currently being employed successfully in many small- to moderate-sized applications. It leads to low emissions of SO₂ and NO_x and has the potential of superior energy efficiency. The utilities are in the process of testing it as a retrofit in installations of about 100-megawatt capacity.

To expedite practical application of clean use of coal, full-scale demonstration plants must be built and operated. Private industry, the Electric Power Research Institute, and the Environmental Protection Agency have taken initiatives in this matter. In view of the importance of the clean use of coal, the current budget of about \$60 million for DOE support of the many efforts seems small. DOE should reexamine its budgetary priorities.

—PHILIP H. ABELSON

*Energy Research and Advisory Board, *Clean Coal Use Technologies* (DOE/S-0036, Department of Energy, Washington, D.C., June 1985), vols. 1 and 2.

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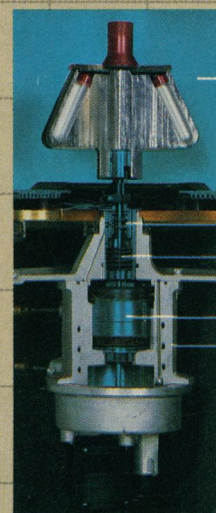
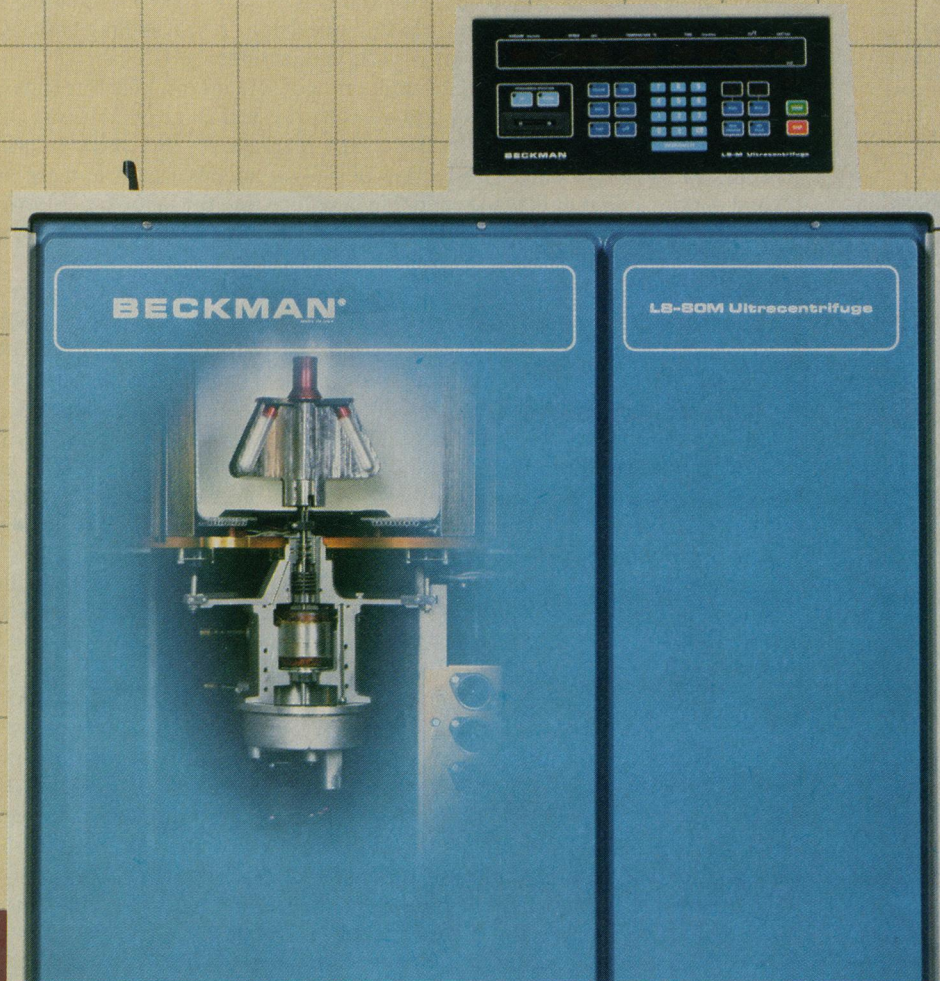
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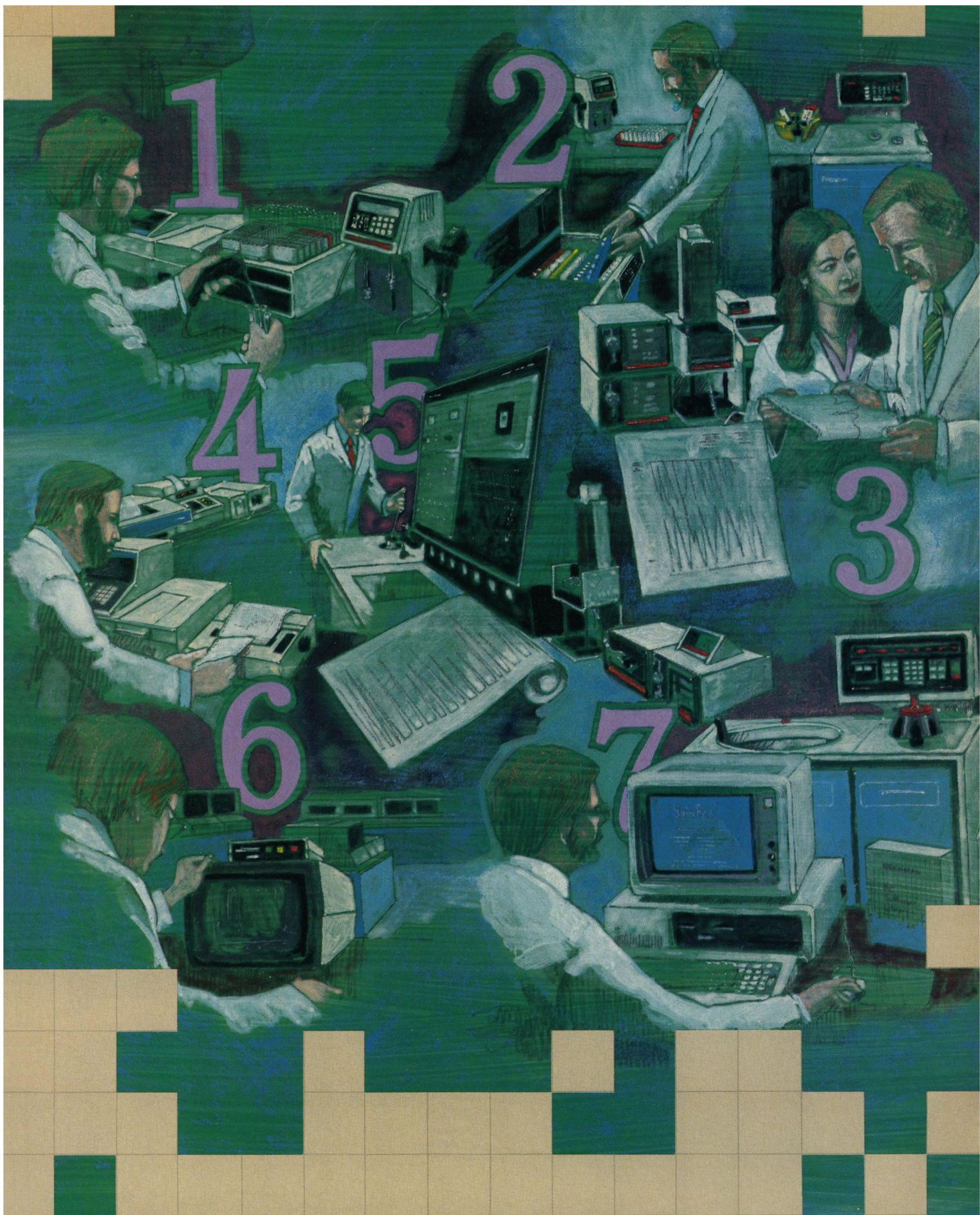
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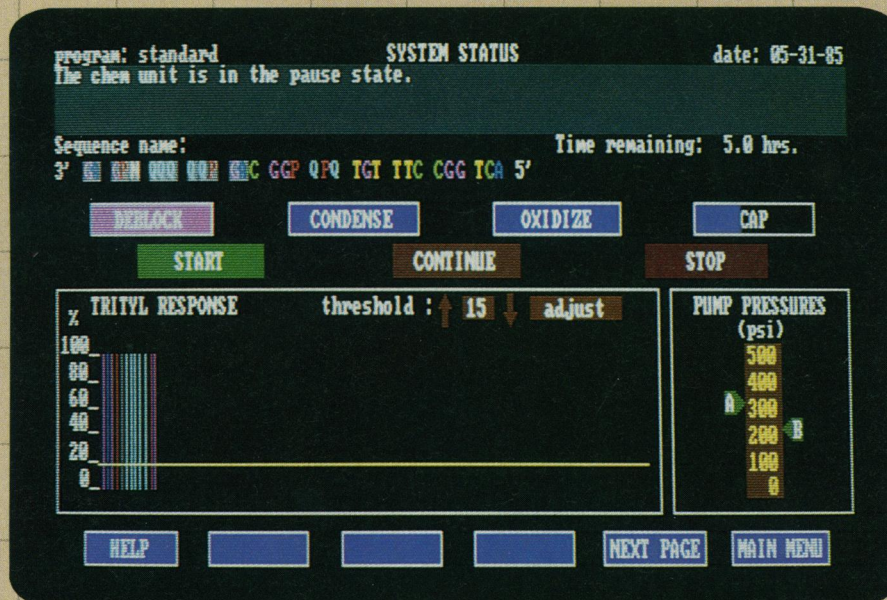
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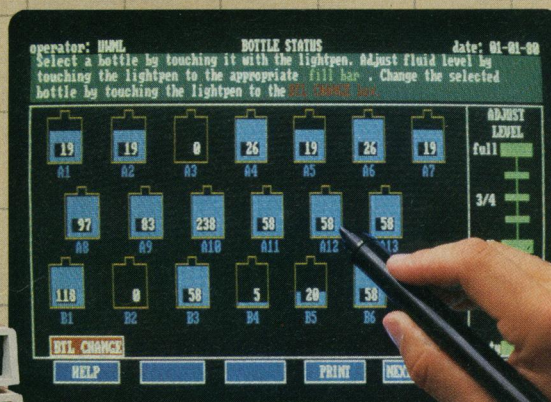
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☐ \$ 75 Partial registration (registration materials and sessions only)
☐ \$ 35 Student registration—full-time graduate and undergrad. only (registration materials and sessions only)

Separate Meal Tickets: ☐ Lunch, Thursday, 10 October (\$18) ☐ Lunch, Friday, 11 October (\$18)

All registrants will receive program, registration badge, and copies of background papers. Preregistration and payment must be received by 16 September to ensure receipt of preliminary materials; registrations received after this date will be held at the AAAS Registration Desk in The Shoreham. **Refund policy:** Advance registration fees and meal tickets will be refunded for cancellations received by 7 October; no refunds will be made after this date.

Charge to my ☐ VISA or ☐ MASTERCARD. Number _____ Expiration Date _____

Cardholder's signature _____

Mail registration form to: AAAS, Forum '85 Registration, Dept. FR
1333 H Street, N.W., Washington, D.C. 20005

Shoreham Hotel Reservation

AAAS Forum '85 • 10-11 October 1985

(Reservations received after 9 September cannot be guaranteed)

Send confirmation to:

Name _____ Street _____

City _____ State _____ Zip _____ Telephone No. _____

Other occupants of room: Name _____ Name _____

Room: ☐ Single (\$105)* ☐ Double (\$125)* ☐ Twin (\$125)* *Add 10% D.C. sales tax and \$1 occupancy tax.

Arrival: Date _____ Time _____ **Departure:** Date _____ Time _____

Be sure to list definite arrival and departure date and time. Check-in time is 3:00 p.m.; check-out time is 12 noon.

Special housing needs due to handicap _____

Enclose separate check, made out to The Shoreham, for first night's room deposit **or** indicate major credit card number:

Credit Card Name _____ Number _____ Expiration Date _____

Cardholder's signature _____

Mail hotel reservation form to: Reservations, The Shoreham, 2500 Calvert Street, N.W., Washington, D.C. 20008