Each of these individuals was at the height of his professional career. Each was devoted to teaching and advising students at all academic levels ranging from undergraduate freshmen to doctoral candidates and postdoctoral associates. Each was of national and international stature. All were specializing in the study of complex properties of ionized gases or plasma, the so-called fourth state of matter. This field is known technically as theoretical plasma physics. It is estimated that over 99% of matter in the universe is in the form of plasma—hence its central importance in the upper atmospheres and magnetospheres of planets, the Sun, the interplanetary medium, and in almost all large astrophysical systems.

The senior of the deceased faculty members, and the one I knew best, was Christoph K. Goertz, age 47, a professor of physics with 18 years of service in the university. Soon after he completed his doctoral study at the University of Rhodes in South Africa, I offered him a position as a postdoctoral associate in my research group and he accepted. A year later he was appointed to the faculty. From 1973 to 1980 I enjoyed almost daily collaboration with him. My students and I were obtaining data on the magnetic properties, magnetospheres, and radiation belts of Jupiter and Saturn—both for the first time—with our apparatus on Pioneer 10 and 11. He brought a special insight to the interpretation of these observations. He went on to become an internationally recognized authority on the role of plasmas in natural systems. In 1989, he was appointed to a 4-year term as editor of the most important journal in the field of space physics, the *Journal of Geophysical Research–Space Physics*. Original research papers from around the world flow into his office here on a daily basis.

Faculty member Dwight R. Nicholson, age 44, had been a professor of physics and chair of the Department of Physics and Astronomy since 1985.

Dwight came to the University of Iowa in 1978. His performance within the department exceeded our most optimistic expectations. He had a strong teaching role at all academic levels and won our admiration for his quiet, but forceful, intellectual quality. He published many original papers in plasma physics, often with student collaboration, and wrote and published a widely used textbook, *Introduction to Plasma Physics*. He was nominated by his colleagues to chair the Department of Physics and Astronomy and was so appointed in 1985, and again in 1988 and 1991.

In addition to performing the administrative duties of this post, he continued to teach formal courses and seminars, guide the research of graduate students, and contribute to many national and international conferences.

Faculty member Robert A. Smith, age 45, an associate professor of physics, came to the department 2 years ago. He, too, was a theoretical plasma physicist with special competence in the analysis of plasma physical processes. He had been employed by a private contractor on behalf of the Naval Research Laboratory in Washington, D.C., and did his work within that prestigious laboratory. His role in our department, though regrettably brief, was a joy and an inspiration to colleagues and students.

For many years the Department of Physics and Astronomy has excelled in the broad field of space physics. This rather loosely defined term encompasses the observation of physical phenomena in space by means of equipment carried through and beyond the Earth's atmosphere by rocket-propelled vehicles. The original and primary emphasis of our work has been and continues to be experimental and observational. Collectively, we have served as principal investigators on over 40 space missions, ranging from satellites of the Earth and Moon to the first-ever flights past a comet and an asteroid and the planets Venus, Mars, Jupiter, Saturn, Uranus, and Neptune. We are now investigating the outer heliosphere far beyond Pluto's orbit. All of this work, as well as the preparation for new missions, is continuing at a vigorous pace under the leadership of other members of our faculty.

Much of the interpretation of the wealth of new data that we obtain falls in the realm of theoretical plasma physics. The unique talents and insights of Goertz, Nicholson, and Smith added greatly to understanding the significance of the observational results and, in many cases, went far beyond them to predict new phenomena and to suggest new experiments. This aspect of the work is being carried on by their junior associates here, and the department is now exploring possibilities for attracting others of kindred interests to our staff.

Meanwhile, as a matter of first importance, every effort is being made by colleagues, friends, and university officials to console and support the families of our fallen comrades and to ease their profound grief and trauma. Similar support is being given to eyewitnesses of the assaults and to students and close friends of the victims.

We can only trust that the father of all of us will give the survivors the strength to reassemble their shattered lives.—*James A. Van Allen, Department of Physics and Astronomy, University of Iowa. These remarks were delivered at the memorial service held at the University of Iowa on November 7.*

Note

Several memorial funds have been set up in memory of the victims of the shootings at the University of Iowa.

The funds and their addresses are:

Christoph K. Goertz, a scholarship fund at the UI Department of Physics and Astronomy, UI Foundation, Alumni Center, Iowa City, IA 52242; a fund for his children's education, Iowa State Bank & Trust Co., 102 S. Clinton St., Iowa City, IA 52244.

Dwight R. Nicholson, a scholarship fund at the UI Department of Physics and Astronomy, UI Foundation, Alumni Center, Iowa City, IA 52242.

Linhua Shan, general memorial fund, Iowa State Bank & Trust Co., 1023 S. Clinton St., Iowa City, IA 52244.

Robert A. Smith, the Jesse Smith Educational Fund, Trust Department, First National Bank, PO Box 1460, Iowa City, IA 52244.

SECTION NEWS

S E I S M O L O G Y

Editor: Thorne Lay, Earth Science Board, Applied Science Building, University of California, Santa Cruz, CA 95064; tel. 408-459-3164

TERRAscope and CUBE Project at Caltech

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The TERRAscope project of the California Institute of Technology began in 1988 and now has six very broadband seismic stations (PAS, GSC, PFO, SBC, ISA, and SVD) in southern California (Figure 1). The goal of TERRAscope is to provide high-quality broadband data needed for significant advances in both regional and global seismology. TERRAscope will replace the old Caltech seismographic network in southern California, which dates back to the 1920s. In many cases, new stations are deployed in cooperation with local institutions. The goal is to encourage involvement of both students and researchers in the operation of the stations and analysis of new data. The station PAS is a joint project between Caltech, the University of Southern California, the U.S. Geological Survey (USGS), and the Incorporated Research Institutions for Seismology (IRIS). The station SBC was deployed in cooperation with the University of California at Santa Barbara. The station PFO is operated jointly with the University of California at San Diego, and the station SVD was installed and is operated by the USGS. Except for SVD, all of the stations are equipped with a broadband Streckeisen STS-1 seismometer and Quanterra data logger with a 24-bit digitizer and a Kinemetrics FBA-23 strong-motion sensor. The station SVD has a Streckeisen STS-2 seismometer and a Guralp CMG-5 accelerograph. The project is funded mainly by grants from the L. K. Whittier Foundation and the Arco Foundation. In addition to the

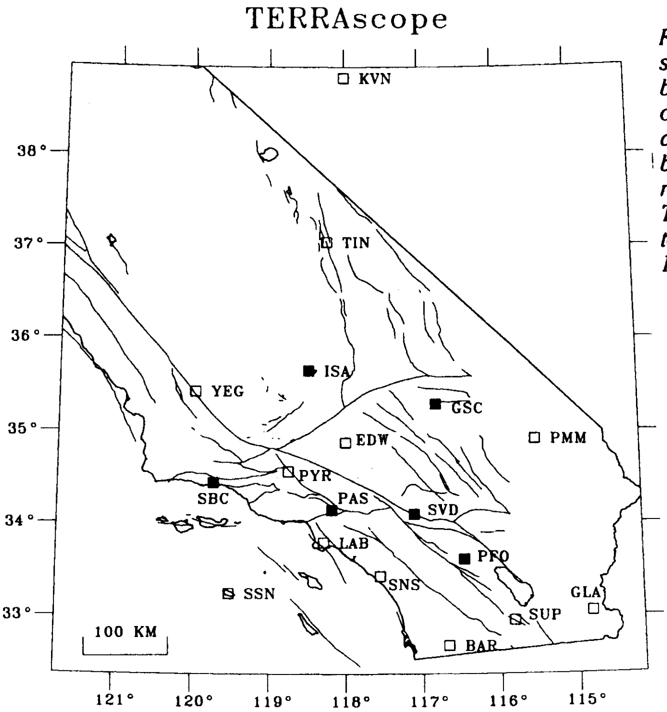

Fig. 1. TERRAscope stations. Solid symbols indicate stations operating as of February 1991. Open symbols indicate approximate locations of TERRAscope stations to be installed from 1991–1992.

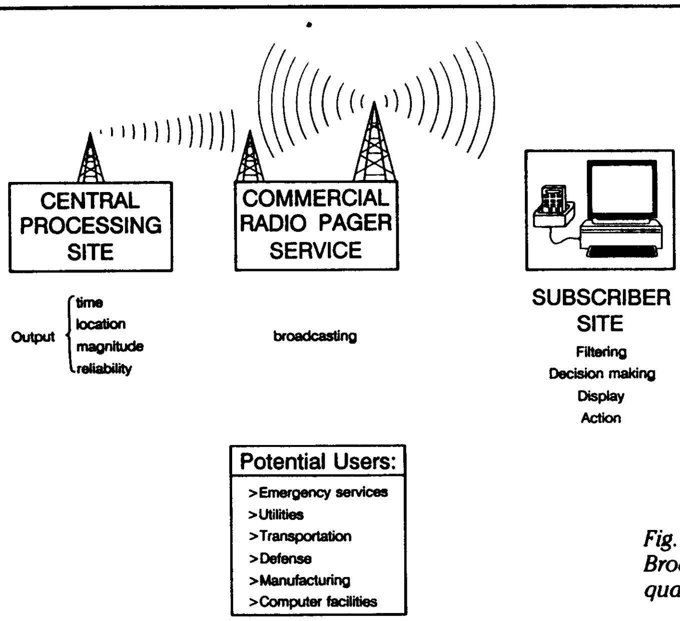

Fig. 2. Caltech/USGS Broadcast of Earthquakes (CUBE).

permanent stations, TERRAscope includes portable seismographs and Global Positioning System (GPS) receivers. We plan to deploy 12 more stations during 1991 and 1992.

TERRAscope complements and extends the capabilities of the existing 220 station (300 components) short-period Southern California Seismographic Network (SCSN). The data from TERRAscope will also be included in the SCSN data base used for generating the CIT/USGS southern California earthquake catalog. Because of their real-time capability and location in a populous earthquake-prone area, both networks enable seismologists to provide the public and State officials with timely information about significant earthquakes. The TERRAscope stations are included as a subnetwork of the global seismographic network operated by IRIS, and the U.S. National Seismic Network (USNSN), operated by the USGS. TERRAscope data recorded on tape cartridge at each station are available from the IRIS-DMC upon request. For further information, please contact: tim@iris.edu.

For quick and efficient data access, an automatic dial-up data retrieving system called Caltech Gopher (adapted from the IRIS Gopher system) has been implemented. The Caltech Gopher receives mail from NEIC for teleseisms and the SCSN with origin time, location, and magnitude for regional events. The Gopher retrieves data from all six TERRAscope stations for these events. The TERRAscope data reside in an FTP anonymous account (seismo.gps.caltech.edu; password: "your e-mail address") at the Caltech Seismological Laboratory, and are available to users through Internet. Usually the data are available within 30 minutes after a regional event and several hours after a teleseism. In the near future a new version of the Gopher software will be installed, which will also make some of the Gopher data available directly from the IRIS-DMC Gopher. When the Data Center of the Southern California Earthquake Center begins full operation in early 1992, it will take over the distribution of earthquake data from southern California, including both TERRAscope Gopher data and continuous data from the tape cartridges. The data will also be available from IRIS-DMC, and future improvements and changes in data access will be posted on the IRIS-DMC bulletin board.

The TERRAscope data have been extensively used for various research projects such as waveform modeling of regional events, development of energy-magnitude scale, inversion of close-in displacement seismograms, study of non-earthquake events, determination of mantle structure beneath southern California, and determination of the Los Angeles basin structure.

To have the data available for immediate analysis following a major event, we are testing two real-time telemetry systems. One is a satellite telemetry system that is being installed in cooperation with the USNSN. The other is based on data transmission over telephone lines or radio links and a local real-time data collection system developed by Adebahr Systemtechnik.

Rapid determination of seismic source parameters after a large earthquake is very important for mitigating seismic hazards. After a damaging earthquake, the emergency operations undertaken in the first hours can be crucial to save lives and protect property. These operations must be able to take into account the earthquake's characteristics—the location, depth, size, mechanism, and rupture direction all directly control the extent and distribution of damage. If the seismic source parameters can be quickly and accurately determined after a large earthquake, they can be used effectively, in conjunction with information on the site and macro seismic data, to determine the resulting damage pattern.

With such considerations in mind, Caltech and USGS initiated a pilot project, Caltech/USGS Broadcast of Earthquakes (CUBE) (Figure 2), under CaltechUs Earthquake Research Affiliates program. This is a cooperative research project between Caltech, USGS, and several transportation and utility companies that aims to develop a sophisticated realtime seismic information system using SCSN and TERRAscope. The participants in this project are actively involved in the research using a radio pager-computer display system. The feedback from these participants helps Caltech seismologists to improve the system, thus contributing to seismic hazard reduction and promoting the advancement of seismology.

For example, on June 28, when the magnitude 5.8 Sierra Madre earthquake rocked Pasadena and much of the Los Angeles area, the participants in this project obtained the real-time information from SCSN in about 7 minutes, updated by more detailed information from TERRAscope, which allowed researchers to make a head start in isolating areas of potential damage.—*Hiroo Kanamori and Egill Hauksson, Seismological Laboratory, California Institute of Technology, and Tom Heaton, USGS, Pasadena, Calif.*

GEOMAGNETISM & PALEOMAGNETISM

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Magnetism of Quaternary Sediments

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Magnetism of Quaternary sediments was the topic of a well-attended symposium held during the 13th INQUA (International Union of Quaternary Research) congress in Beijing, China, August 2–9. More than 40 papers were delivered by scientists from Belgium, England, France, Germany, Japan, New Zealand, Sweden, Switzerland, Taiwan, the United States, the Soviet Union, Yugoslavia, and other countries. The host country contributed to a productive session that was part of the first large scientific meeting to take place in Beijing after the June 4, 1989, upheaval.

Nearly half of the studies focused on paleomagnetic and rock magnetic properties of loess in Alaska, Central Asia, China, and New Zealand. Magnetostratigraphic polarity dating was done at some sections in the western (Shaw et al.) and central Chinese loess plateau (Bai and Hus; Wang and Evans; Yue). The interpretation of the polarity pattern found in the western loess plateau still is not unambiguous. In the central part, certain polarity boundaries, such as the Brunhes/Matuyama (B/M) boundary, are found in slightly different stratigraphic positions (Hus et al.; Yue). In deep-sea sediments the lock-in depth of natural remanent magnetization (NRM) at the B/M boundary seems to be a linear function of sedimentation rate (de Menocal et al.). Although the magnetization process in the Chinese loess is not well understood, detailed records of polarity transitions have been reported for the B/M and the Jaramillo R→N transition (Ma et al.; Rolph).

Studies of the variations of low-field susceptibility and its frequency dependence observed in the central Chinese loess plateau have become very popular because of their enormous potential for continental paleoenvironmental reconstructions. The connection between susceptibility and paleoclimate is not well understood in detail (Hus et al.; Heller and Bronger), but a broad correlation with paleoclimate and pedogenesis is obvious. The susceptibility signal contains strong spectral peaks at 400 ky, 100 ky, and 40 ky (Evans et al.), indicating astronomical influence on the formation processes of the Chinese loess sequence. The strong susceptibility enhancement in paleosols (that is, during warm paleoclimate periods) is attributed mainly to pedogenesis (Zhou et al.; Liu et al.) that may vary locally but also may be influenced generally by monsoonal variations (An et al.). In young soils on Californian terraces the enhancement also clearly depends on time (Verosub and Singer). Susceptibility variations in loess from the middle-Rhine area in Germany closely resemble—like those in China—the marine oxygen-isotope record (Hambach et al.).

In addition to the presence of maghemite (Maher et al.), two forms of magnetite of probably inorganic and organic origin have been identified as major carriers of the rock magnetic signature of Chinese loess (Maher and Zhou). These minerals vary in concentration and grain size from ultrafine (superparamagnetic) up to 100 μm, but change very little in chemistry (Rolph et al.; Liu et al.; Oldfield et al.).

Time series analysis of magnetic parameters in Alaskan loess also shows response to orbital forcing, but susceptibility highs and lows show a reverse correlation to paleoclimate as compared to Chinese loess (Begét et al.; Crumley et al.). This is explained by reduced deposition and oxidation of magnetic minerals during warm periods. Pedogenic weathering often inhibits the search for short polarity events such as the Blake event in New Zealand loess (Pillans).

A large number of geomagnetic field excursions during the Brunhes epoch, which apparently can be correlated across large distances, is recorded in Central Asian loess (Lazarenko et al.) and also in Arctic and Subarctic marine sediments (Bleil et al.). A number of short events preceding and postdating the Jaramillo subchron are observed in sediments of the Osaka Group in Japan (Maenaka). Lava flows and lacustrine sediments around the Yatsugatake mountains in central Japan of B/M age also record several short events never before noticed (Aida et al.).

High-precision paleomagnetic data obtained from volcanic ashes of the Tokai Group fluvio-lacustrine sediments are used for constructing isoclinic and isogonic maps of Japan for the Pliocene and early Pleistocene (Nakayama). Magnetostratigraphic correlation is used successfully to date moraine systems in Patagonia (Mörner) and glacial terraces in Slovenia (Vidic and Larson), uplifted marine strata in New Zealand (Roberts et al.), lacustrine sediments at Caravaca in Spain (Mörner et al.), or the mammal-bearing lacustrine Nihewan Formation in North China (Li et al.). On a finer age scale, relative paleointensities can be used for correlation of Holocene lacustrine sequences in the western United States (Verosub), which in turn may be tied to the marine records (Verosub and Negrini).

Reducing conditions occur in many lacustrine formations, causing iron sulfides to form authigenically. Sediments from Western Siberia that carry greigite aggregates are strongly magnetic (Gnibidenko). Greigite grain sizes depend on environmental changes in a pre-Eemian lake in Switzerland (Forster et al.), and Plio-Pleistocene mudstone sequences in Taiwan contain complex assemblages of greigite, pyrrhotite, and magnetite that are related to lithological variations caused by rapid subsidence of the sedimentary basin (Horng et al.). Sedimentary environment changes due to lake transgression and regression are responsible for susceptibility variations observed in very young sediments from Kunming basin in South China (Huang and Liu).

NRM inclination shallowing in recent sediments is related to the development of sediment fabric that can be resolved easily and accurately when measuring anisotropy of magnetic susceptibility (AMS). Compaction and drilling direction influence AMS and direction of paleoinclination (Rochette et al.). Since anisotropy ratios and inclination errors are strongly correlated in deep-sea sediments, quantitative methods have been proposed to correct the inclination records (Collombat et al.). High-deposition rates, transient density currents, dilute slurries on the sediment surface and strong overload in varved clays of proglacial lakes of western New York result in decrease of remanent inclination and increase of magnetic foliation (Brennan).

Copies of the abstracts published in the INQUA abstract volume may be obtained from Friedrich Heller, Institut für Geophysik, ETH Hönggerberg, CH-8093 Zürich, Switzerland.—*Friedrich Heller, Institut für Geophysik, Zürich, Switzerland*

Paleomagnetic, Rock Magnetic Workshop

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A total of 52 paleomagnetists, rock magnetists, and structural geologists met for the 5th annual Northeastern Paleomagnetic and Rock Magnetic Workshop, held at Erindale College, University of Toronto in Mississauga, Ontario, on November 1–2. The attendees came from as far away as Lamont-Doherty Geological Observatory, N.Y.; University of Massachusetts, Amherst; Lehigh University, Bethlehem, Pa.; and Memorial University, St. John, Newfoundland; as well as from the University of Michigan, Ann Arbor; University of Windsor, Ontario; Sapphire Instruments, Ruthven, Ontario; University of