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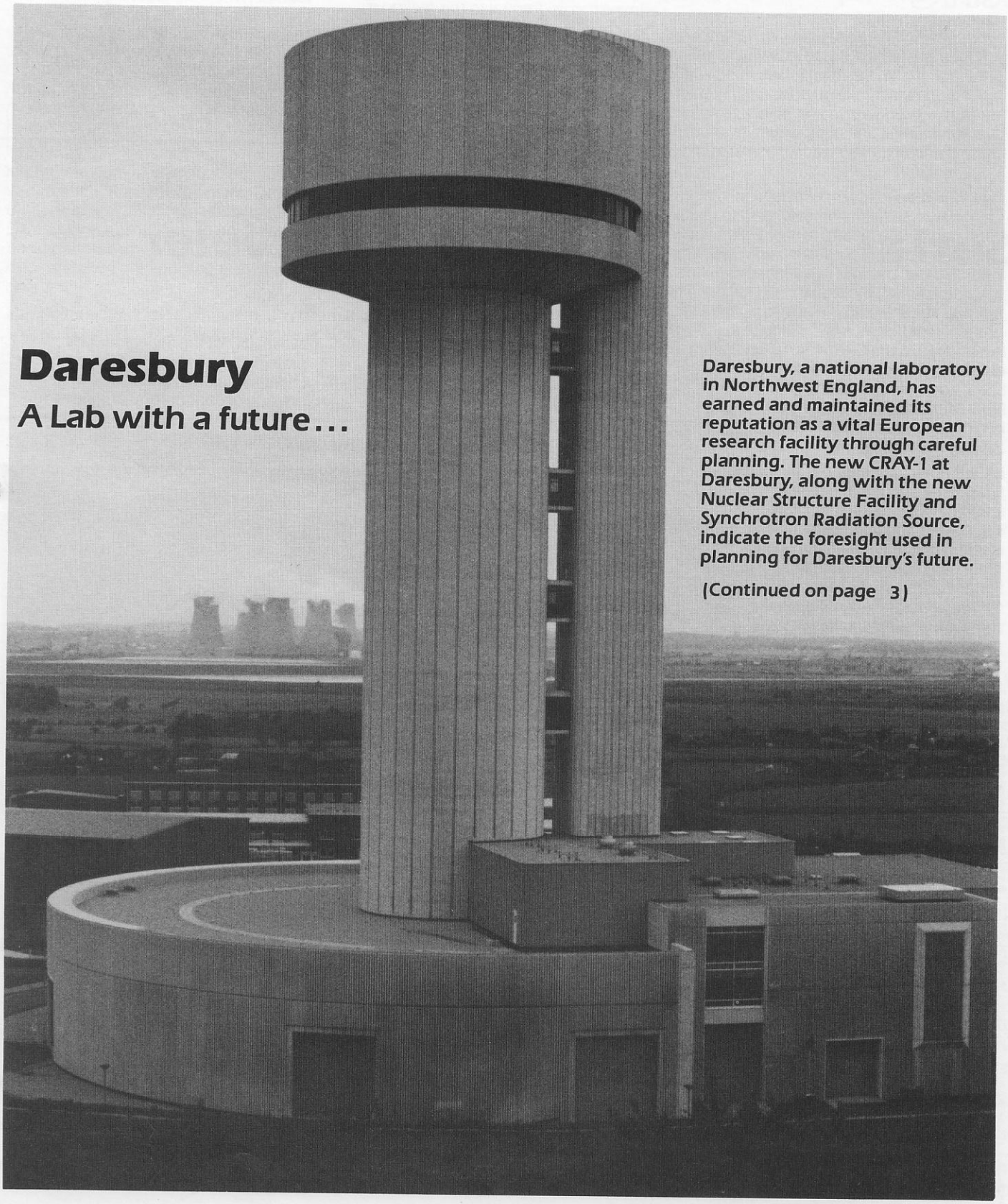


Daresbury

A Lab with a future...

Daresbury, a national laboratory in Northwest England, has earned and maintained its reputation as a vital European research facility through careful planning. The new CRAY-1 at Daresbury, along with the new Nuclear Structure Facility and Synchrotron Radiation Source, indicate the foresight used in planning for Daresbury's future.

(Continued on page 3)

letter from the editor

While visiting Daresbury, I was extremely impressed with the facilities and struck by the high level of interest and enthusiasm exhibited by the diverse staff.

There is a strong esprit de corps among the Daresbury physicists, electronics and computer experts, engineers, technicians, craftsmen, and administrators. Central to this feeling is the knowledge that the work being done at the lab will help provide scientific advances in many fields.

Scientists throughout the British Isles can access the Daresbury computer network, either directly at the lab or through any of a number of universities and research institutes. Thus, the CRAY-1 at Daresbury is servicing a multitude of scientific disciplines, providing the computing capability necessary to support the links between the growing experimental programs and the theoretical studies. ■

—M.C.C.

Serial 1 . . . . . World Traveler

In March 1976 the CRAY-1 Serial 1 was installed at the Los Alamos Scientific Laboratory (LASL), in Los Alamos, New Mexico. This marked the beginning of Serial 1's extensive travels for diverse applications.

LASL is noted as being the site of the first CRAY-1 and the initial prototype testing. For six months following installation, Serial 1 underwent rigorous testing to verify workload speed and reliability demands. Performance threshold criteria were formally established in three areas: scalar-processing speed, vector-processing speed, and reliability. The CRAY-1 met or exceeded all performance criteria.

In September 1977 LASL replaced Serial 1, a half-million word memory system, with the CRAY-1 Serial 4, a full million-word memory system with automatic error correction. Thus Serial 1 left LASL to travel to the preliminary headquarters of the European Centre for Medium Range Weather Forecasts (ECMWF) in Bracknell, England. Serial 1 was shipped from CRI's Hallie Lab (in Chippewa Falls, Wisconsin) via New York, arriving in the U.K. during October, 1977.

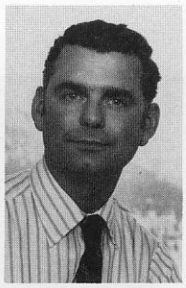
ECMWF used Serial 1 at the Rutherford National Laboratory in Bracknell until October, 1978, when a full million-word system was delivered to the Centre's new headquarters in Reading, England. The delivery of this upgraded mainframe sent Serial 1 to a U.K. government customer who was awaiting delivery of a million-word system.

After seeing this customer through the interim, Serial 1 was shipped to the north of England for the Science Research Council's national laboratory at Daresbury (the feature topic of this issue of **Channels**).

Since June 1979, the Daresbury Lab has applied the CRAY-1 Serial 1 to its multi-faceted scientific environment. Disciplines benefiting from the availability of the Serial 1 include: protein crystallography, theoretical chemistry, atomic and molecular physics, oceanography, engineering, statistical mechanics and molecular dynamics, astrophysics, solid state physics, plasma physics, and nuclear theory. ■

Daresbury Laboratory overlooks the farming areas of Warrington, England. The circular building on the left houses the Synchrotron Radiation Source

input/output



G. Stuart Patterson, President, Cray Laboratories, Inc.

G. Stuart Patterson, Jr. is president and chief operating officer of Cray Laboratories, Inc., in Boulder, Colorado. Prior to joining Cray Research, he headed the national scientific computing facility located at the National Center for Atmospheric Research (NCAR). Holder of a PhD in fluid mechanics and degrees in chemical and nuclear engineering, Patterson's principal scientific interests are in the area of modeling turbulent flows.

It is my pleasure to introduce this issue of **Channels** devoted to describing the activities of the Daresbury Laboratory of Britain's Scientific Research Council. Scientific work at Daresbury encompasses many areas, but those that will particularly benefit from use of a CRAY-1 include astrophysics, nuclear theory, oceanography, and engineering, to mention only a few.

Having recently come to Cray Research from a laboratory sponsored by the U.S. National Science Foundation (the National Center for Atmospheric Research), I am well aware of the symbiotic relationship between computing and science. Frequently, the installation of the latest generation of scientific computer has permitted scientists to make a quantum leap forward in their ability to simulate nature. On the other side of the coin, long range computing needs as projected by scientists, have encouraged and stimulated computer designers to advance the technology as far as practical.

Cray Laboratories, the recently formed research and development subsidiary of Cray Research, has the mission to advance large scale scientific computing. It is an exciting and challenging task, requiring not only an appreciation of what new technologies and approaches can be used, but also an appreciation for the needs of users years into the future. Laboratories such as Daresbury, which is on the leading edge of science and scientific computing, make important contributions to this process. ■

—G.S.P.

L to r: Prof. Alick Ashmore, director of Daresbury Laboratory, Seymour Cray, founder of Cray Research, Inc., and Dr. Brian Davies, head of Daresbury's Computer Systems and Electronics Division

(continued from page 1)

A Commitment to Scientific Development

Daresbury is one of the two main laboratories for the Scientific Research Council, a national organization in the United Kingdom; the second major SRC Laboratory is the Rutherford Laboratory near Oxford. Daresbury Laboratory recently signed a two year leasing for a CRAY-1. The CRAY-1 supports the Science Research Council's many groups of scientists throughout the UK and two major new experimental facilities at Daresbury: the Nuclear Structure Facility and the Synchrotron Radiation Source.

In addition to the new facilities, Daresbury has a new direction. For some time, the emphasis at the Daresbury Lab was on High Energy Physics. Christopher Henfrey, Cray representative, commented, "With the High Energy Physics Research being moved to CERN (Centre European de Researche Nucleare, in Geneva Switzerland), Daresbury's new emphasis will be on a very broad scientific front and promises a very bright future." **(continued on page 4)**

Cray representative Christopher Henfrey

(continued from page 3)

Professor Alick Ashmore, Daresbury's director, commenting on the Lab's goals in the 1978 Daresbury Annual Report, said, "Computing is required for almost every scientific research activity and the Daresbury facilities are intended to be available to any university research group with a good scientific case. The aim is to provide support that will enable users with comparatively little instrumental experience to use them effectively and on an occasional basis."

"It's important for the science of this country to have access to a machine such as the CRAY-1. We can always use more computing power; there's no need to suppose that this is the limit."

Always with an eye to the future, Professor Ashmore affirms his strong commitment to keeping Daresbury competitive in the global research arena. "It's important for the science of this country to have access to a machine such as the CRAY-1. We can always use more computing power; there's no need to suppose that this is the limit. In contracting for a CRAY-1, we wanted to ensure in some way that there wouldn't be a sudden gap in our research efforts. Now we would like to plan for continuous development."

Professor Ashmore further stated that he expected nearly every university in the country to use the network services within the next few years because the Lab's research efforts cross nearly all scientific disciplines. Currently plans for the CRAY-1 include work in such areas as protein crystallography, atomic and molecular physics, astrophysics, nuclear theory, oceanography, and engineering. In many of these areas, the CRAY-1 allows an increase in the dimensionality of models and the introduction of dynamics into problems which have thus far been treated statically.

The Push for the CRAY-1

The case for the CRAY-1 moved fairly quickly when it became clear that the Council might be in a position to make a substantial investment in the computer and that Cray Research had an available machine.

Christopher Henfrey pointed out that in addition to Professor Ashmore, who presented the scientific case for the CRAY-1 to the Council's Science Board, Dr. Brian Davies was also instrumental in the CRAY-1's coming to Daresbury. Dr. Davies, head of Daresbury's Computer Systems and Electronics division, and Professor Phillip Burke, head of the Theory and Computational Science division, mustered support from scientists all over the country.

The scientific case for the CRAY-1 was examined in detail by a task force, which concluded that the availability of the CRAY-1 would open up new and worthwhile areas of research, and that without such a computer, workers in some disciplines would not be able to compete in the international field.

Two earlier Science Research Council studies also supported the case. The 1972 Roberts report examined the computing needs of physics and related fields and concluded that there were a number of important physical problems that could not be handled adequately by existing machines (IBM 360/195 and CDC 7600) because they required higher processing speeds and larger amounts of memory and disk storage than were then available. The Roberts report advocated the acquisition of a machine of the most powerful class available.

In 1975, Professor Phillip Burke submitted a report summarizing the use of the Science Research Council's central computers and analyzing future large scale computing requirements. This report recommended the purchase of a new computer with vector processing capabilities and the conventional processing power of at least a 360/195. At the time of the report, the CRAY-1 had come on the market and was identified as the machine best suited to meet the immediate demand and the requirements for future growth.

In light of the Science Research Council studies and the examination of the scientific case for the CRAY-1, Daresbury signed a two year contract for the CRAY-1.

The CRAY-1 Network

Aside from having to make a new double door leading into the computer room in order to move in the CRAY-1, installation at Daresbury went quite smoothly. Acceptance testing was completed on June 15, 1979 and the CRAY-1 went live the following Monday, June 18.

"The aim is to provide support that will enable users with comparatively little instrumental experience to use them effectively and on an occasional basis."

Daresbury's existing computing system and the communication network facilities are available to support the CRAY-1. An IBM 370/165 will serve as front-end to the CRAY, and software to connect the IBM and CRAY computers is being developed.

The 370/165 is connected to a communications network that provides links to several remote workstations. The Science Research Council network is based on the Daresbury and Rutherford computers using PDP-11 switch and Camac interface equipment. Camac is an international standard and is widely used for on-line data acquisition.

Currently, the largest remote center workstations linked directly to Daresbury are at Manchester University and Liverpool University. Other universities with direct access include Lancaster, Sheffield, Glasgow, and Queen's in Belfast. There is also a link to the Institute of Oceanographic Sciences in Bidston.

Eight additional direct links to Daresbury are planned, including York, Warwick, and New Ulster University at Coleraine. Many more sites can access Daresbury using workstations linked to Rutherford, where 360/195 computers have access to Daresbury

through a specially provided switching unit or through a nodal processor being developed.

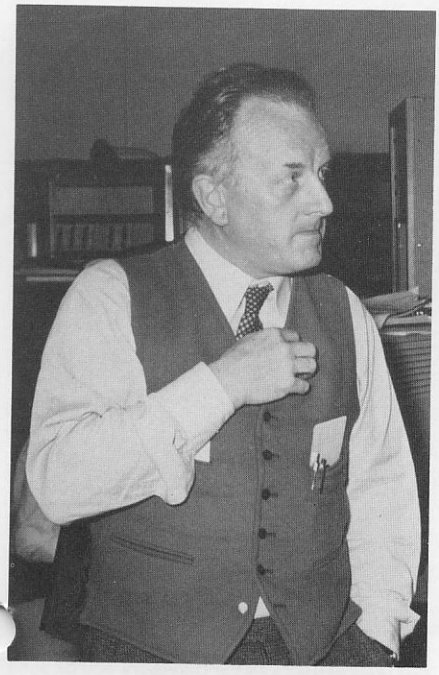
Additional workstations can be added to the network if necessary. Dial-up connections to Daresbury for terminals and workstations are available. Presently about 30 universities use the network and more have access. Users can dial into the time sharing system or travel to the nearest workstation. Time sharing services are currently provided to about 500 outside users.

User Support

The growing number of new users of the computing services has increased demands on the support services. Courses for new users have been given both at Daresbury and at a number of universities. Daresbury personnel have also visited several universities to discuss the use of the computing services with potential users and to demonstrate the use of terminals and workstations.

Several new chapters of the Computer Users' Guide have been published. The text of the Users' Guide is stored on disk on the 370/165 and can be consulted by users from anywhere on the network.

As an attempt to provide better information flow between the computer management and the users, a new series of Computer Representatives meetings has been started. So far the meetings have attracted good support from both new and existing users.



John Hopkins, head of Daresbury's Operations Group

L to r: Cray field analyst Mostyn Lewis and Cray customer engineer Lyn James on-site at the Daresbury Laboratory

Potential CRAY-1 Users

On May 21, 1979 at a meeting organized by Daresbury scientists, Dr. Brian Davies described the CRAY-1 service to potential users. He emphasized that the Science Research Council (SRC) is looking to the CRAY-1 to bring about scientific "breakthroughs."

Applications for CRAY-1 time from SRC people are sent to the appropriate subject committee to judge scientific worth and need for the CRAY-1. Applications from other research councils are coordinated by the computing facilities committee of the SRC.

Daresbury's Future

Daresbury's future looks bright. In the past few years the Lab has grown in size and prestige. Daresbury's new broadly-based emphasis, its new facilities, and its increased computing services have all contributed to the rapid expansion of the Scientific Research Council's communications network.

Although Lab director Professor Ashmore feels that the network would be expanding regardless of the CRAY-1, he notes that the CRAY-1 is an important factor behind the rapid expansion of the network system. The CRAY-1 will also be a key factor in helping U.K. scientists remain competitive in the international field of computational science. ■

The CRAY-1's First Users

Drs. Richard James and Althea Wilkinson ran the first program on the CRAY-1 at Daresbury on Wednesday, June 20.

Dr. James and Dr. Wilkinson are both involved in the large scale simulation of galaxies at the University of Manchester Department of Astronomy. "Our work involves a numerical simulation of galactic evolution and is currently directed toward the study of spiral structure," stated Dr. James. Dr. Wilkinson is also particularly interested in eliptical models and she hopes to look into multiple galaxy interactions.

Dr. James had optimized his program for the CDC 7600, with an improvement of 2-3 over the pre-optimized running speed. He is very excited about the possibilities presented by the Fast Fourier Transform (FFT) subroutines on the CRAY-1 and plans to improve his program's execution rate by performing many FFT's simultaneously using the parallel approach method.

Dr. James has already divided his program into loops that the CRAY FORTRAN compiler picks up, recognizes as vector operations, and processes accordingly. Drs. James and Wilkinson expect to gain considerably more than most users in terms of computation time because the techniques used in their studies can make maximum use of the vector processing features of the CRAY-1. These galactic calculations use established particle-mesh procedures which have become highly developed during recent years. The CRAY-1 improves on these established procedures by allowing smaller meshes to be used, resulting in a more precise coverage of parameter space.

Dr. James emphasized that only a small portion of the computational techniques were developed by his department at Manchester University. He gave credit to Professor R. W. Hockney, Department of Computer Science, University of Reading: "Hockney has done more in this area of research than anyone else in this country."

Five types of output are generated from the galactic program: analytical, orbital and graphical information, information for generating displays (print plots), and information for contouring.

In summary, Dr. James stated what he considers the overriding advantage of the CRAY-1: "The CRAY-1 offers the facilities to get the code going and to extract the data directly. The data can then be used straight away—this will be great!"■

L to r: Dr. Howard Sherman, head of Daresbury's User Services Section, Dr. Althea Wilkinson and Dr. Richard James, first users of the CRAY-1 at Daresbury, and Dr. John Woulds, head of Daresbury's User Support Group

Cray News from around the World

In August, the University of California's **Los Alamos Scientific Laboratories** (LASL), Los Alamos, New Mexico, ordered its second CRAY-1 Computer System. Installation of this CRAY-1 at LASL, under the University's prime contract with the U.S. Department of Energy, is scheduled for the fourth quarter of 1979.

Los Alamos Scientific Laboratories is the site of the first CRAY-1 Computer System installation. The CRAY-1 Serial 1, a half-million word memory system, was installed at LASL in March 1976. That system was replaced by a full million-word system in September 1977.

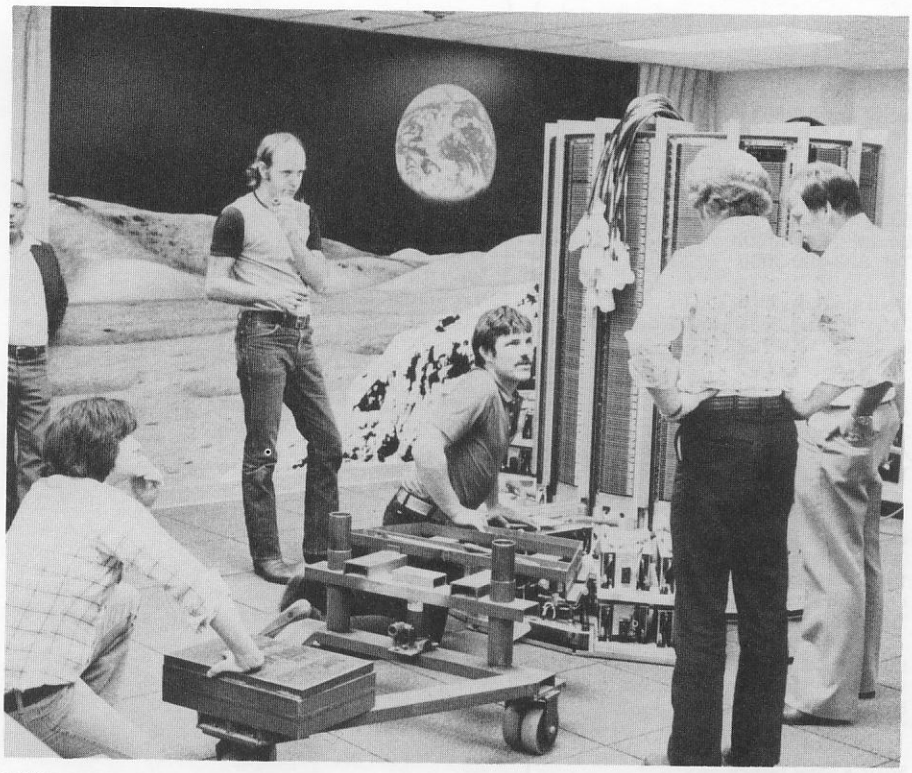
Mitsubishi Research Institute of Tokyo, Japan ordered a CRAY-1 Computer System in October. The system is scheduled for installation in the third quarter of 1980. Mitsubishi Research Institute is a leading scientific, engineering, and corporate services consulting firm in Japan.

In September a CRAY-1 Computer System was installed at the **Max Planck Institute** for Plasma Physics (IPP) in Munich, West Germany. IPP will use the CRAY-1 to support its plasma physics program and a number of other general scientific areas.

Also in September, a one million word memory CRAY-1 Computer System was installed at **Bell Laboratories,** in Murray Hill, New Jersey. Work at Murray Hill Laboratory, the company's administrative headquarters, includes basic research, and the design and development of electronic devices for communications equipment and systems.

During the third quarter **Cray Research** took occupancy of its new printed circuit board production facility in Chippewa Falls, Wisconsin. This 5,400 square foot building is expected to be fully operational in the fourth quarter.

In October Howard G. Sachs was appointed vice-president of engineering for **Cray Laboratories,** the research and development subsidiary of Cray Research Inc. Mr. Sachs is based at the subsidiary's Boulder headquarters and is responsible for the design and development of future products. ■



CRAY-1 at Bell Laboratories, Murray Hill, N.J.

A Note on the S Series...

The October 22 announcement of the CRAY-1 S Series of Computer Systems was a result of CRI's commitment to technical growth and a response to the demand from users for field upgradable CRAY-1 computer systems.

To meet the specific needs of users, the S Series offers a choice of twelve models, which can all be upgraded by adding more memory or incorporating a more powerful I/O Subsystem. It is possible to upgrade all the way to the Model S/4400, with a maximum of four million words of memory and four I/O processors.

The incorporation of an I/O Subsystem, a Cray Research product specifically designed to complement the CRAY-1 CPU requirements, significantly enhances I/O throughput to front-end computers and to mass storage devices. The power of the I/O Subsystem relates directly to the number of I/O Processors it contains. Two, three, or four I/O Processors may comprise the I/O Subsystem. With each addition of another I/O Processor, significant increases in mass storage capacity or the ability to drive peripheral devices is achieved.

A primary feature of the I/O Subsystem is the incorporation of a Memory Channel link to Central Memory. This channel allows maximum transfer rates of approximately 850 Mbits per second.

CRAY-1 Computer Systems are meeting challenges in areas such as weather forecasting and climatology, petroleum research, nuclear research, national defense, medical research, economic analysis, and aerospace design.

Now, because the CRAY-1 allows greater quantities of data to be processed and derives results more quickly, solutions are not only possible but more economically practical as well. ■

CRAY RESEARCH, INC.

SALES OFFICES

Eastern Regional Sales Office
10750 Columbia Pike, Suite 602
Silver Spring, MD 20901
Tel: 301-681-9626

≈

Central Regional Sales Office
5330 Manhattan Circle, Suite F
Boulder, CO 80303
Tel: 303-499-3055

Houston Sales Office
3121 Buffalo Speedway, Suite 400
Houston, TX 77098
Tel: 713-877-8053

Austin Sales Office
3415 Greystone, Suite 201
Austin, TX 78731
Tel: 512-345-7034

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Western Regional Sales Office
Sunset Office Plaza
1304 Concannon Boulevard
Livermore, CA 94550
Tel: 415-447-0201

Los Angeles Sales Office
101 Continental Boulevard, Suite 456
El Segundo, CA 90245
Tel: 213-640-2351

Seattle Sales Office
536A Medical Dental Building
2728 Colby Avenue
Everett, WA 98201
Tel: 206-259-5075

INTERNATIONAL (SUBSIDIARIES)

Cray Research (UK) Limited
James Glaisher House
Grenville Place
Bracknell, UK
Tel: 44-344-21515
TLX: 848841

Cray Research GmbH
Wartburgplatz 7
8000 Munich 40
West Germany
Tel: 49-89-3630-76
TLX: 05213211

Cray Research Japan, Limited
Shin Aoyama Building, West 1661
1-1 Minami-Aoyama 1-chome
Minato-ku, Tokyo 107 Japan
Tel: 81(03)403-3471

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