Boeing Signs Master Agreement with CRI

New Computer Acquisition to Enhance CRI Software Development

A Publication of Cray Research, Inc.

CHANNELS

Vol. 2 No. 2

The CRAY-1 Serving an International Community

Seventeen countries have access to a CRAY-1 Computer System at the European Centre for Medium Range Weather Forecasts (ECMWF) in Reading, England. These 17 Member States pool their resources in a cooperative effort to make 4-10 day weather forecasts scientifically and economically feasible.

letter from the editor

The European Centre for Medium Range Weather Forecasts (ECMWF) is an intergovernmental organization of 17 European Member States. The fact that ECMWF has five official languages (Dutch, English, German, Italian, and French) suggests the international flavor of the organization. Two-thirds of the staff members are from countries other than England, the host country.

In addition to specific qualifications attached to a particular post, fluency is required in one of the three working languages of the Centre (French, English, or German). Member State representatives are appointed to work at the Centre for a limited time. They then return to their respective countries with meteorological information made available through the pooling of economic, academic, and computer resources at ECMWF.

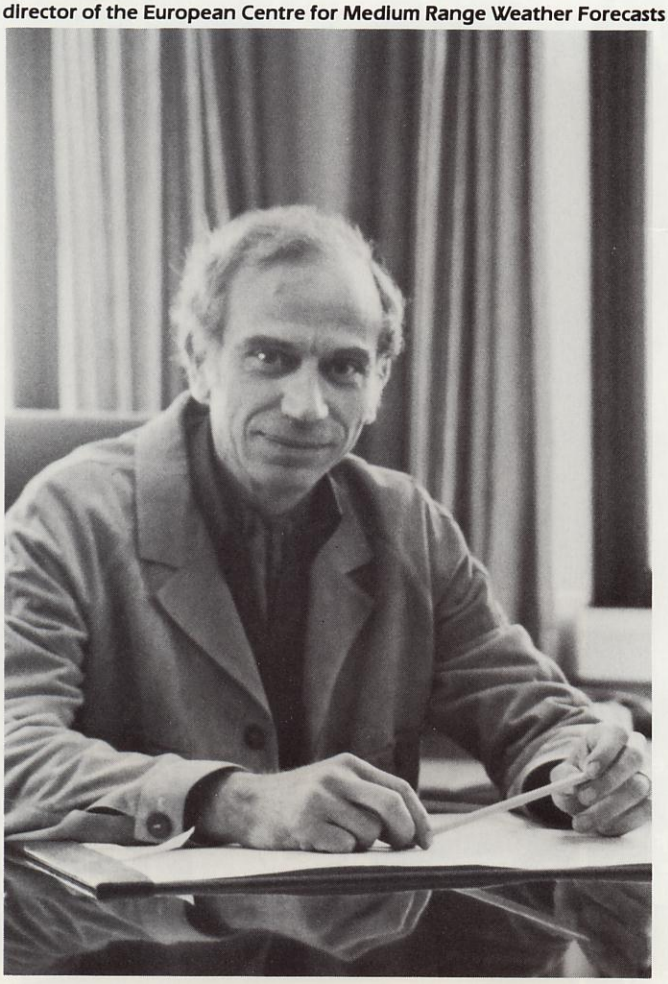
In 1977, two years after the ratification of the Centre's Convention, the ECMWF Council decided that the main component of the Centre's computer network should be a CRAY-1 Computer System. The Council's decision was particularly significant in that it made CRAY-1 computing power available to 17 European countries for the first time.

The Member States' joint meteorological efforts have since resulted in the successful preparation of medium range weather forecasts, of importance in such diverse areas as planning offshore oil drilling and estimating supply and demand for food and energy. The wide geographical scale of benefits obtained by having reliable medium range forecasts offers excellent incentive for Member States to cooperate on an international basis. □

—**M.C.C.**

input/output

Jean Labrousse,
director of the European Centre for Medium Range Weather Forecasts



The present issue of **Channels** is devoted to describing the activities of the European Centre for Medium Range Weather Forecasts (ECMWF). This intergovernmental organization (at Shinfield Park, near Reading, U.K.) produces 2-week weather forecasts, distributing daily forecasts to the 17 meteorological offices of the countries funding the Centre. ECMWF makes 25% of its computer facilities available to the Member State representatives for research in their respective meteorological fields.

Created by a Convention signed in 1973, the Centre started operation at the end of 1975. The annual budget of the Organization is about $14 million dollars. It employs 150 staff of whom about half are scientists.

On August 1, 1979, ECMWF began distributing 7-day weather forecasts to the Member States. The first results, as assessed by the ECMWF staff and the meteorologists of the Member States, show that the forecast quality compares very favorably for the first four days with the forecasts produced by other meteorological centres. Systematic comparisons with other centres of forecasts beyond four days are not yet possible since only a limited number of such forecasts are available. Based upon the limited results, the ECMWF forecasts have been found to be superior.

In 1971, a study by the European Economic Community showed that if the quality of forecasts for 6-days ahead was comparable to the quality of the available 2-day forecasts, the ratio between the economic benefit and the Centre's cost would be four to one. ECMWF has yet to reach this goal, but results to date indicate that the Centre's forecasts for 4-5 days ahead are as reliable as the 2-day forecasts produced ten years ago.

ECMWF's main task will now be to reach what can be considered as the reasonable limit of medium range forecasts, that is, for two weeks ahead. □

—**J.L.**

The CRAY-1 Serving an International Community

ECMWF's Goal

The objectives of the European Centre for Medium Range Weather Forecasts (ECMWF) are fourfold: the development of numerical models of the atmosphere for the preparation of weather forecasts, the collection of data necessary to prepare such forecasts, the production of forecasts on a daily basis, and the distribution of resulting analyses and forecasts to Member States.

Accordingly, the research efforts at ECMWF are focused on developing appropriate numerical models, while the efforts in the operations department are devoted to implementing the necessary computing system and the programs for operationally collecting and handling the data of the numerical models.

Reliable weather forecasts for a week or so ahead are of great economic value. The cost-benefit is estimated at approximately $300 million per year.

Almost every industry can benefit in terms of planning; most particularly, the agriculture, transportation, construction, shipping, and energy industries.

The CRAY-1 at ECMWF

In October 1978, a CRAY-1 was installed at the newly constructed ECMWF headquarters in Reading, England. A million word memory CRAY-1 Computer System replaced a half-million word machine leased from Cray Research since November 1977.

The CRAY-1 at ECMWF is used to meet the Centre's main objective of developing numerical simulations of the atmosphere with a view to preparing reliable forecasts. The Centre's CRAY-1 deals specifically with the computing load of the analysis and with the forecast itself. It is linked to a Control Data Corporation CYBER 175. Both machines run 24 hours a day, 7 days a week.

Geoff Brewer, Cray Research U.K. staff, at CRAY-1 Computer System console.

There is a general feeling of satisfaction with the CRAY-1 at ECMWF. In order to produce a 10-day forecast within a few hours, nearly 2-million elements of data have to be incremented at each time step. A CRAY-1, capable of carrying out many tens of millions of instructions per second, has made feasible highly complex 10-day forecast models.

"The system is performing very well," said Robert Brinkhuysen, head of ECMWF's Computer Division until the recent appointment of Geerd Hoffman. "Hardware and software are both proving very reliable. The overall scheduled availability has been exceptional."

ECMWF's decision to purchase a CRAY-1 Computer System in February 1979 was based largely on the CRAY-1's proven reliability.

"Nobody quite expected it two years ago," claimed Rob Brinkhuysen. "We had our initial doubts, but besides the excellent reliability, our service from Cray Research has been excellent. Peter Appleton Jones (previous director of Cray U.K., and present vice president of Cray Research marketing) recruited highly qualified support staff."

Peter Gray, ECMWF's Operating Systems Section manager, also commented favorably on the Cray Research full-time analyst support: "It takes time to break someone in. It's great to have the long-term assignment support."

Both Brinkhuysen and Gray mentioned that ECMWF can always use more computing power and ECMWF looks forward to the advent of future Cray Research products.

The First Step

ECMWF came into full force in 1975, although the Council of Ministers of the European Communities issued the initial proposals for cooperation in scientific and technical research in 1967.

A group in meteorology addressed the proposals in 1969 by submitting a report proposing the idea of a joint meteorological computing and research center, equipped with advanced data processing facilities and engaged in medium range weather forecasts.

An expanded group began work culminating in a 1971 report considering all aspects and advantages of establishing a joint European meteorological project. This report led to the writing of the Convention establishing the European Centre for Medium Range Weather Forecasts.

One month prior to the signing of the Convention, in 1973, the ECMWF planning committee accepted the United Kingdom's offer to act as host Member State and to provide the permanent headquarters and equipment for the Centre.

The site provided by the U.K. government is an attractive wooded setting at Shinfield Park, about three miles south of Reading in the Royal County of Berkshire. The government contracted for the 1 1/2 acre building, which houses an Office Block, a Conference Block, and a Computer Hall.

The Computer Hall

The Computer Hall was designed to house the largest computer system under consideration for acquistion by ECMWF.

In examining possible computer systems, ECMWF quickly realized that one computer could not meet all the Centre's requirements. For example, whereas the forecast process requires intensive computing power and only rudimentary file-handling processes, such aspects as preprocessing and postprocessing require computer systems with well-developed and reliable file-handling techniques and software.

Therefore ECMWF sought a hierarchical computer system: a main computer which would deal with the great burden of the forecast computation, front-ended by another computer dealing with general file handling, and the control of the entire cycle.

After careful deliberation, ECMWF chose a CRAY-1 main computer, front-ended by a CYBER 175. The dominating factor in choosing the CRAY-1 Computer System was the forecast cycle itself, in which the same computations have to be made at every level and every grid point of the model at every time step.

ECMWF's first model calculates 1.6-million values at every time step, each result requiring up to 200 calculations.

The quarter acre Computer Hall now houses over $16 million worth of computing equipment.

The CRAY-1 Computer System at ECMWF.

The ECMWF Forecasting System

ECMWF's Meteorological Operational System (EMOS) can be divided into six major processes: data acquisition, preprocessing, analysis, forecasting, postprocessing, and dissemination of results.

Additionally, there are such aspects as the real-time operational supervision, control and scheduling of all the programs in the system, the graphic display of results, and systematic archiving of the data.

Basically, these processes comprise two categories in the ECMWF forecasting system. The first of these categories includes the analysis and forecast processes, which require the CRAY-1's computing power. The second category includes the remaining processes (data acquisition, preprocessing, postprocessing, graphics, and overall control of the system), which are more involved with data manipulation and file handling, and are therefore programmed to run on the CYBER 175.

Data Acquisition

The top priority at ECMWF is the operational production of medium range weather forecasts, that is, forecasts up to a period of 14 days ahead. Therefore a prerequisite for success is an accurate definition of the initial state, in the format required by the model.

The input data used to determine the initial state consists of all the observational data obtained from the World Weather Watch observation systems. The extent and accuracy of this observational data determines the accuracy of the specification of the initial state.

The World Weather Watch receives meteorological observations throughout each day from surface stations, ships, radio-sonde stations, satellites, aircraft and automatic buoys. These observations are transmitted on the Global Telecommunications System in coded format. Up to 30,000 daily reports of pressure, temperature, wind and humidity are received by ECMWF, via a link from the Bracknell Regional Telecommunications Hub.

Preprocessing

The preprocessing subsystem includes decoding, checking and quality control of the meteorological data received, the establishment of a data base, and the subsequent extraction of data for the analysis scheme.

Once the data is decoded and checked for errors, it is stored in an observation data base. The base occupies about one-half million words per day in its packed form. It then forms a central store of reports, available for statistical studies.

Analysis Cycle

The analysis cycle defines the current state of the atmosphere by using observed and predicted data. This provides the basis on which the future state of the atmosphere can be calculated.

The analysis cycle encompasses data assimilation; analysis of wind, geopotential and humidity fields; and initialization.

Data Assimilation

The ECMWF assimilation cycle is sometimes described as an

The CYBER 175 is front-ended by and linked to subsystems handling the telecommunications network with Member States, the local network of terminals, and graphics equipment.

A vital part of the complete system is the CRAY/CYBER link. All access to the computing system is handled via the CYBER 175. All permanent storage of information is also managed on this front-end, leaving the CRAY-1's 300-million word secondary storage capacity available for temporary files only.

The ECMWF Computer Hall.

"intermittent, six-hours, forward scheme," because it is based upon a 6-hour analysis-forecast cycle, which progressively assimilates all the observations taken during the course of the day.

Every 6-hours, all the available observational data for 3-hours either side of the hour being analyzed is used to "correct" a set of first guess fields (the forecast from the previous cycle) to produce the analysis fields—this is the actual analysis step.

Analysis

For practical application in ECMWF's forecasting system, the analysis cycle is global and uses all input data available operationally that is passed from the reports data base by the preprocessing system.

Each complete analysis cycle takes about 30-40 minutes on the CRAY-1.

Initialization

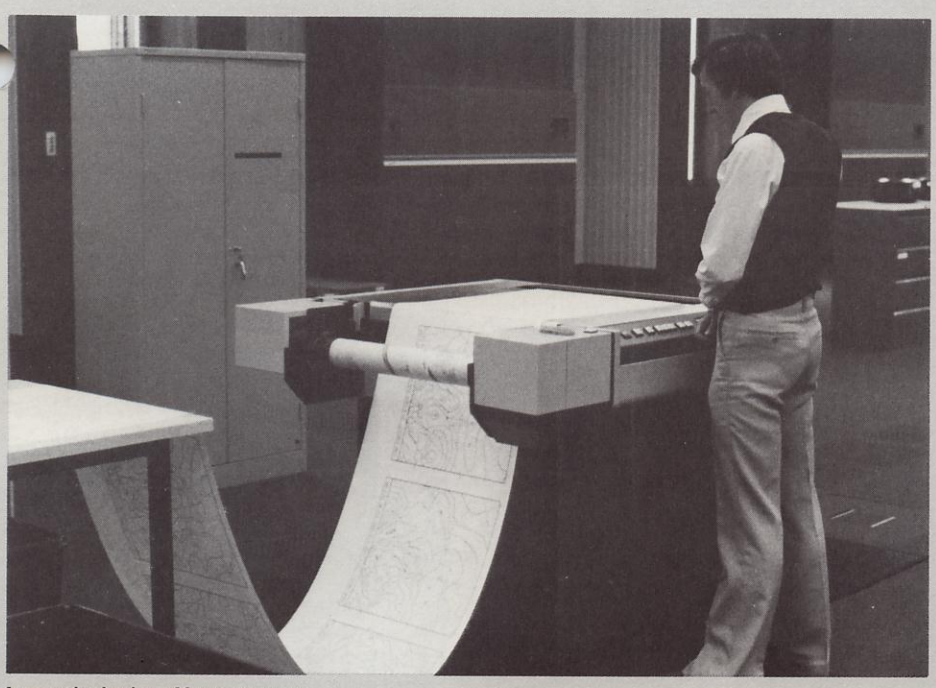
Once an analyzed field is obtained, initialization of the field is necessary to eliminate any small-scale imbalances between wind, temperature and geopotential that are more harmful than useful to the forecast model. These imbalances are carefully removed, leaving the maintream information unaltered. This step takes only one to two minutes on a CRAY-1.

Forecasting

The medium range forecast is started from these initialized fields. However, in order to carry out each progressive analysis (at 6-hour intervals), a specific 6-hour forecast is run to provide the first guess fields for the next cycle. This is the forecast step.

The entire procedure is carried out four times a day, thus progressively assimilating all the daily observations. The main daily operational 10-day forecast is run starting from one of the four sets of initialized fields produced during the day.

With respect to the CRAY-1, the forecast starts from an analyzed and initialized field, and continues forward until the 10-day forecast is completed. Each 6-hours of forecast time, a file containing all the predicted products is produced and passed to the postprocessing phase.



Automatic plotting of forecast results.

The data assimilation cycle is completed by using the prediction model to make a 6-hour forecast to the next analysis time. The entire process is then repeated. In this way, observations for the entire day are assimilated into the operational prediction scheme.

The analysis step is very demanding of computer resources, which is why it is run on the CRAY-1. The present ECMWF forecasting scheme makes very efficient use of the CRAY-1's vector-processing capabilities.

Postprocessing and Dissemination of Forecast Products

At the end of each 6-hour analysis or forecast step, fields of data arrive on the CYBER 175 from the CRAY-1. The system must transform and restructure the data into forms suitable for systematic visualization on a screen, automatic plotting of charts, and transmission of files to the

Medium Range Forecasting

The time scale implied by the term "medium range forecasting" is 4-10 days. However, the data flow in ECMWF's system and the logical functions to be performed are very similar to those used in short-range numerical prediction (that is, 1-3 days). Therefore, the design of ECMWF's overall forecasting system and the flow of meteorological information resembles that conventionally used in any other numerically oriented center.

Despite this resemblance, there obviously are constraints imposed on the system by the time scale of the forecasts carried out at ECMWF. These result from the strong relationship between scale and predictability: the longer the period of the forecast the more important becomes the use of sophisticated numerical models.

Operational forecasting tests started in August 1979 and 10-day forecasts have been run five days per week ever since. A selection of these forecasts has been sent to Member states.

The ECMWF staff stress that the forecasts of today should not be seen as the "final product." Currently, the data cut-off time is very early (around 5:30 p.m.). Studies are underway to determine the optimal cut-off time, with a view to including 6:00 p.m. and possibly even some 12:00 a.m. data. In addition, many improvements to the various modules of the operational unit are being implemented.

The international aspect of ECMWF is emphasized and recognized as being of particular significance because the majority of the ECMWF product and service users are to be found in the Member States.

telecommunications computer according to the requirements of each Member State.

Several thousand fields of analyses and forecasts are disseminated to Member States each day.

At the heart of the postprocessing system is a data base containing all the data fields in a relatively fixed format, readily accessible for the different uses. Once the post-processing data base has been constructed, products can be displayed locally or disseminated to Member States.

For dissemination to Member States, some fields of data may be converted to a polar stereographic form and stored in a subdata base containing data in this format. From these data bases, the products requested by Member States are extracted and encoded using a version of a GRID code. The products in this encoded form are then disseminated to users over the telecommunications network linking ECMWF and Member States.

Graphical Aspects and Local Display of Data and Results

During the ECMWF operational cycle, a monitor evaluates how each day's operational cycle is proceeding, examining input data and output results to check the overall standard of the meteorological data processing and see that meteorological consistency is maintained.

Graphic display of forecast results.

Several facilities are included in the general ECMWF forecasting scheme to ensure proper supervision of the coverage and quality of input data, to see that all salient features are included in the analyses, and to determine if realism is maintained.

Archiving of Observational and Processed Data

The archive of forecast results is of considerable value to ECMWF in the long-term assessment, evaluation, and improvement of the forecasts and to Member States in applying the forecasts.

Data Implementation

All data represent the state of the atmosphere. Output is basically produced in a graphic form, which can be produced on plotters, visual display units, or film. Although the Centre looks at the graphic representation, only the numerical output is sent to the Member States. As a result, the ECMWF medium range forecasts can only have a beneficial effect if the meteorological services in the Member States are scientifically and technically prepared to appropriately use the Centre's output.

As Jean Labrousse, director of ECMWF, points out, "The Centre produces the fields (heights, temperatures, winds, etc. at various levels) which characterize the atmosphere, but Member States must establish and implement their own methods of interpreting these fields for different applications."

Determining what can be done with the numerical output sometimes poses a problem to the staff of Meteorological Offices in Member States. The forecasts are produced for every 6-hour period, up to 240-hours ahead, and the total number of output products is in the order of 3000.

ECMWF's Organizational Structure

The current expenditure at ECMWF is about $14 million per year. Each Member State makes yearly contributions in proportion to its Gross National Product. In turn, each Member State is entitled to two representatives on the Council (ECMWF's intergovernmental body). The Council convenes twice yearly to make decisions on budget and general policy matters.

The ECMWF Conference Hall.

ECMWF output is made available to users in the Member States in a coded grid point form with the expectation that this data will be converted locally into graphic form for manual inspection and interpretation. An alternative is to use the forecasts as input to various local forecasting schemes.

ECMWF Operational and Computing Activities

ECMWF has built up an efficient and well-balanced computer complex with its CRAY-1 Computer System, CYBER 175 front-end and Regencentralen RC8000 telecommunications system as main components, all linked via high-speed channels.

In addition to the data acquisition link to Bracknell, telecommunication links between ECMWF and the meteorological offices of the Member States are currently being formed.

The first of the medium-speed links, to the Swedish Meteorological and Hydrological Institute in Norrkoping, was fully inplemented in December 1979 and operates—according to reports received from Sweden—to the complete satisfaction of the users of both the forecast products and the remote batch services of ECMWF.

In early 1980, two medium-speed links to Germany and Denmark were implemented. Low-speed links have been established to Yugoslavia, Turkey, Italy, Spain, France, Greece, and the Netherlands.

Along with the completion of the design, acquistition, and implementation of the ECMWF computer system, a complex operational forecasting unit, including a sophisticated global forecasting model, has been designed and implemented. □

This year, one of the most significant changes at ECMWF has been that Member States' personnel have begun using the Centre's computing facilities, either by visiting the Centre or by using Remote Job Entry (RJE) links. The Council decided that 50% of the CRAY-1 capacity is to be used for operational purposes, 20% for research by the Centre, and 25% for research by Member States.

Time has been allocated to the Member States according to the results of a questionnaire designed to gauge demand. The Member States were assumed to require the CYBER 175 only to support the work done on the CRAY-1. Practical allocation of capacity is done on a project-by-project basis. Each project is assigned an account code and an allocation. Regular summary reports are required.

Training

An important objective at ECMWF is to assist in advanced training for scientific staff of the Meteorological Offices of the Member States.

By making an effort to represent themselves among the ECMWF staff, Member States have representatives who will return to their national Meteorological Offices with valuable meteorological training.

Visits to the Centre by forecasters from Member States also help ensure that there is a general awareness of the full range of products available from the Centre and of their applications.

In the way of formal instruction, ECMWF offers training courses and a graduate program for Member States' personnel. Information concerning these offerings is sent to the Member States, and nominations to attend are requested.

An Exercise in Cooperation

Given the complexity of preparing medium range weather forecasts on a routine basis, the amount of scientific work and the computer resources required are beyond those generally available in meteorological offices at a national level. The establishment of the European Centre for Medium Range Weather Forecasts has led to the sharing of technical and economic resources on an international basis.

The 17 Member States now look forward to improving their analyses and forecasts and to sharing a wide geographical scale of benefits. ■

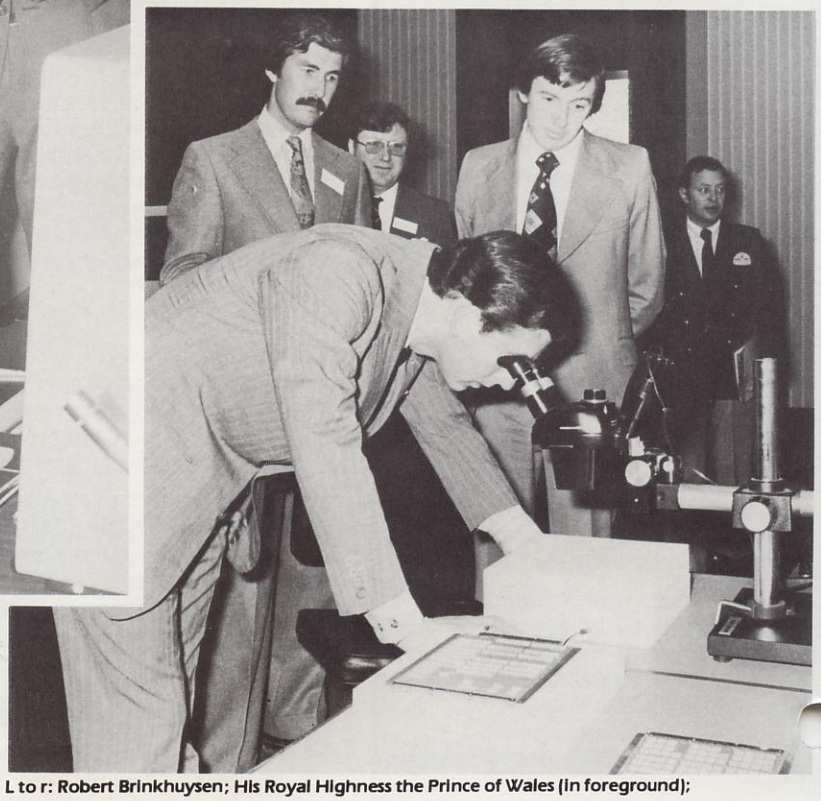
Prince Charles visits ECMWF

In accordance with the agreement between the U.K. and the other participating countries, the U.K. government transferred the headquarter building and site to the intergovernmental organization on June 15, 1979.

Prince Charles toured the ECMWF facilities and presented the Centre with a plaque commemorating the day's events. □

L to r:
Dr. A.C. Wiin-Nielsen, former director of ECMWF His Royal Highness the Prince of Wales; Jean Labrousse, director of ECMWF; Robert Brinkhuysen, former head of ECMWF's Computer Division; Inge Beck, ECMWF staff (seated).

L to r: R. Mittner, vice president of ECMWF Council; Jean Labrousse; His Royal Highness the Prince of Wales; Robert Brinkhuysen; Inge Beck, (seated).



L to r: Robert Brinkhuysen; His Royal Highness the Prince of Wales (in foreground); Geoff Brewer, Cray Research U.K. staff.

software release **summary**

This article summarizes major changes made in the 1.08 version of Cray Research software, released in April, 1980. Major changes were made to the Cray Operating System (COS) and the Cray FORTRAN (CFT) Compiler.

COS

The new **Job Classes** feature gives sites greater control over how jobs are initiated in COS. Each job entering the system is assigned to a class based on its job card parameters. The system's Job Class Structure determines which class has priority; what the maximum number of jobs for each class is; and which classes are disabled.

COS now includes linkages that provide for the initiation and control of **interactive** jobs and data transfers between the CRAY-1 and front-end terminals. This feature is available only where supported by the front-end system. When it is supported, the logged-on user may specify a dataset to be interactive; an interactive dataset is transmitted to and from a terminal attached to a front-end station.

Reprieve processing has been implemented, allowing the user to attempt recovery from job step abort errors or to perform clean-up functions before completing the abort. The **ENDRPV macro** is available for returning to job step termination processing.

Two new control statements, **CALL** and **RETURN,** allow users to manipulate control statement files. CALL instructs COS to begin reading control statements from the indicated dataset, while RETURN returns control back to the caller.

The new **NA parameter** on the SAVE, ACCESS, ADJUST, MODIFY, and DELETE control statements specifies whether an error is to cause the job to abort.

A new parameter on the LDR control statement and on the INCLUDE and EXCLUDE directives provide the capability to **selectively load** modules from a dataset.

The **DUMPJOB macro** request causes the current job image to be written to a specified local dataset.

Ten new system action request macros can be used as **debugging aids.** The user may selectively read or write information during a program run to aid in the debugging process. The macros in this group include: SNAP, DUMP, INPUT, OUTPUT, FREAD, FWRITE, UFREAD, UFWRITE, SAVEREGS, and LOADREGS.

CFT

The CFT character set now includes **lower-case** letters.

Character data has been added to the list of CFT data types. Character data is represented by a string of ASCII characters delimited by apostrophes or quotation marks.

POINTER, a new CFT statement, furnishes base addresses for variables or arrays.

Reprieve processing, now fully implemented, allows the user to attempt to recover from what normally would be an abort condition. This recovery is initiated by a call to the library routine SETRPV.

CFT level I/O is now possible with unblocked datasets. The U parameter on the ASSIGN control statement declares a dataset to be unblocked.

Two new CFT callable library routines have been added. **REMARKF** produces a logfile message. A format label and up to 12 variables can be passed. **DUMPJOB** creates an unblocked dataset that contains the user job area image. This data is suitable as input to the DUMP or DEBUG programs. □

Cray News from Around the World

On the left of the main entrance is the 40,000 square foot addition to the Cray Research Corporate Headquarters in Mendota Heights, Minnesota. This addition, completed in March 1980, brings the Headquarters' total available space to approximately 60,000 square feet.

Cray Research has opened new sales offices in **Pittsburgh,** Pa., **Albuquerque,** N.M., and **Chicago,** Ill.

New CRI subsidiaries formed in 1979 include **Cray Research GmbH,** Munich, Germany, and **Cray Research Japan, Limited,** Tokyo, Japan. **Cray Research France,** is a new subsidiary located in Mondreville, France.

June marked the delivery of a CRAY-1 Computer System to **Mitsubishi Research Institute,** a service bureau in Tokyo, Japan. Mitsubishi's half-million word system will make Cray Research hardware and software available to a diversified range of customers, for both commercial and scientific applications.

A new software product for the CRAY-1 Computer System is **MSC/NASTRAN,** a 3-dimensional structural analysis program developed and maintained by the **MacNeal-Schwendler Corporation** of Los Angeles, California. MSC/NASTRAN can be applied to problems with significantly increased degrees of freedom by employing the fast computation section of the CRAY-1 and up to 4 million 64-bit words of high-speed memory.

MSC/NASTRAN will be available for CRAY-1 Computer Systems in October.

Cray Research recently signed leasing agreements with **Lawrence Livermore Laboratory, ARCO Oil and Gas Company,** and **GETIA** (an economic group formed by Electricite de France and Cie Internationale de Services en Informatique).

GETIA and Lawrence Livermore Laboratory each signed for a CRAY-1 S/1000 Computer System. ARCO Oil and Gas Company leased a CRAY-1 S/2300 Computer System.

On-site testing of the CRAY-1 Computer System delivered to **Century Research Center Corporation** (CRC), Tokyo, Japan was completed on schedule. The half-million word system was accepted in March.

CRC is a leading service bureau specializing in scientific and engineering applications.

Boeing Computer Services Company (BCS), Seattle, Washington, is scheduled to receive a CRAY-1 Computer System in July. BCS will use the system for general engineering support at Boeing and will offer time-sharing services to commercial users. □

Boeing representative signs CRI contract for a CRAY-1 Computer System. L to r standing: Jim Harris, director of CRI Field Engineering; Tom Lotzer, assistant to the vice president of CRI Marketing; Dick Russell, CRI National Account manager for The Boeing Company; Bruce Kasson, CRI National Sales director; Peter Appleton Jones, vice president of CRI Marketing; Mary Ahrens, CRI Corporate Planner; Jim Gregerson, Subcontracts and Procurement manager for Boeing Computer Services. Mike Dickey, director of CRI Product Management and Support; Margaret Loftus, director of CRI Software Development; L to r seated: Jim Rederer, director of CRI Contracts Administration; Bob Kromm, Subcontract manager for Boeing Computer Services.

Boeing representative Jim Gregerson (on right) presents Peter Appleton Jones, vice president of CRI marketing, with a model Boeing 747 airplane.

Amdahl 470 V/7 B to Increase Productivity

During April an Amdahl 470 V/7 B computer system was installed in the new computer room at Cray Research corporate headquarters in Mendota Heights, Minnesota.

The Amdahl acquisition marks a major step forward in CRI's ability to handle the increased activity in software development and benchmark computing. The Amdahl 470 is expected to accommodate the growth in these areas for at least the next four years.

The new system will satisfy several needs. It will improve software development productivity by increasing access to the CRAY-1 Computer System in Mendota Heights. It will also provide field analyst access to the CRAY-1 via a COMTEN 3650 front-end connected to the Amdahl system. Finally, CRI expects that the acquisition will improve benchmarking capabilities.

The COMTEN equipment acts as a concentrator to support Remote Job Entry (RJE) stations and dial-up lines. These facilities will allow CRI greater capacity in supporting users.

The Amdahl 470 V/7 B acquisition is part of the long-range commitment by Cray Research to support software development, benchmarking, and CRAY-1 users. □

L to r: Ken Shindeldecker, Cray Research Computer Operations manager; Margaret Loftus, director of Cray Research Software Development; Peter Appleton Jones, vice president of Cray Research Marketing

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