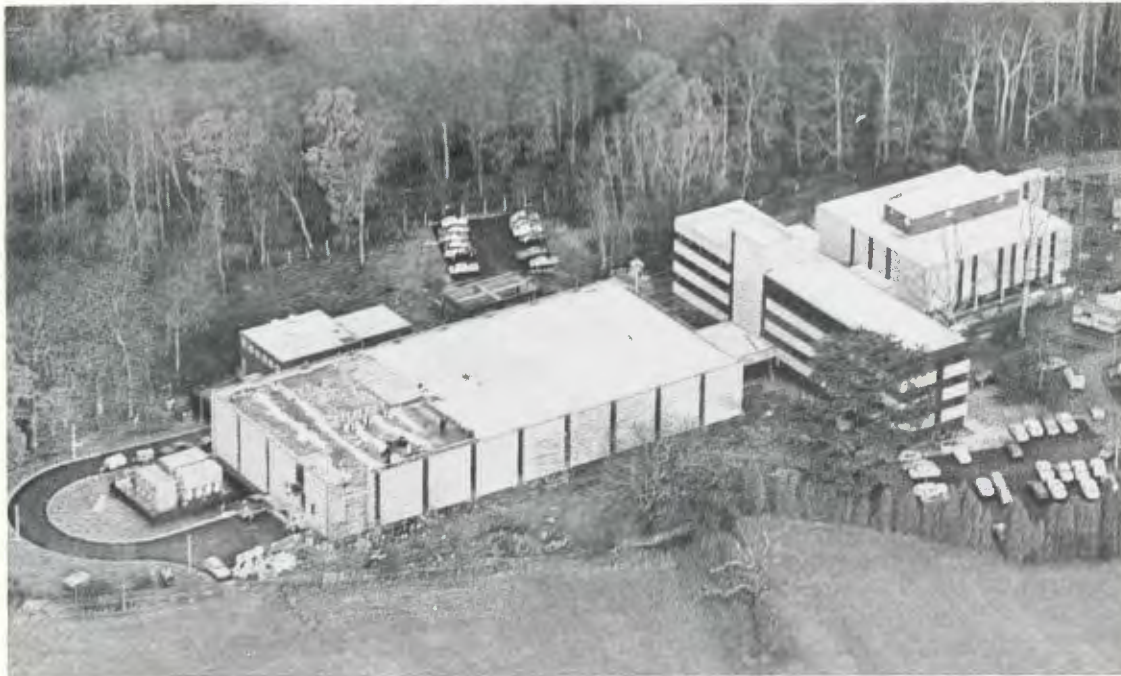


Annual Report 1978



European Centre for Medium Range
Weather Forecasts



Contents

Foreword	1
Introduction	3
Historical Note	6
Research Department	8
Operations Department	12
Administration Department	18
Education	24
Visiting Scientists	25
The Council and its Committees	26
The Staff Committee	29
Annex 1 : Staff at 31 December 1978	30
Annex 2 : Members of the Council	31
Annex 3 : Finance Committee	32
Annex 4 : Members of the Scientific Advisory Committee	33
Annex 5 : International Meetings attended by Members of Staff	34
Annex 6 : Publications by Members of Staff	37
Annex 7 : ECMWF Publications	38
Annex 8 : Scale of Contributions by Member States	40



Prof. Lauri A. Vuorela, President of the Council.

Foreword

The year of 1978 has seen several important steps taken in the progress of the European Centre for Medium Range Weather Forecasts towards its main goals. I would mention among these the installation of the interim computer system of the Centre in temporary premises at Rutherford Laboratory, succeeded by the installation of the permanent main and front-end computers in the computer block of the Centre's new permanent headquarters; the conclusion of a contract for the telecommunications system of the Centre; the production of a number of experimental forecasts, using the Centre's first prediction model; and last, but not least, the installation of the Centre and its staff in its permanent headquarters building at Shinfield Park, Reading.

Additionally the linking of the Centre's two computers has been achieved and a scheme has been adopted for the regulation of use of computer time on the Centre's computer system by the Member States, to be put into force in 1979. In the education field, the Centre once again held a highly successful scientific seminar.

I can, therefore, confidently say that the progress made by the Centre has been impressive, and most encouraging for the future. We can look forward to entry into the operational forecasting phase with assurance.

As President of the Council, and speaking on behalf of the Centre, I would like to give thanks to all those who have contributed to the development of the Centre during this year. Our gratitude is due particularly to the Government of the United Kingdom and its contractors for their successful efforts to provide the Centre with the major part of its permanent headquarters according to schedule. I would also like to thank my colleagues in the Council and its Committees for their contribution to the Centre's progress, and, of course, the Director and his staff for their invaluable work throughout the year.

Lauri A. Vuorela

Introduction

Shinfield Park

The most significant event during 1978 was the occupation of the new buildings at Shinfield Park. Although the total building complex will not be finished before 1979 it became clear during the summer of 1978 that the computer hall and the office building could be made ready for use while construction work continued on the conference building. It was therefore decided that the whole staff should move from the temporary headquarters in Bracknell to Shinfield Park and that the computers should be installed in the new building at the same time. The combined operation was accomplished in the last few days of October and the staff began their work in the new building on November 1 1978, exactly 3 years after the date on which the Convention establishing the Centre came into force.

Computers

The prototype CRAY-1, installed at the Rutherford Laboratory for the use of the Centre, was replaced by CRAY-1, Serial No. 9, at the time of the move while the CDC CYBER-175 was transferred from Rutherford to Shinfield Park. We would like to take this opportunity to express to the Director of Rutherford Laboratory and his staff our appreciation of the assistance given in housing the Centre's interim computer installation for a year.

Both computers passed the preliminary acceptance tests shortly after installation. The long term tests were begun during 1978, but will not be completed before well into 1979.

Telecommunications

The Operations Department has continued its work on the implementation of the telecommunication system. While the telecommunications computer, to be delivered by A/S Regnecentralen (Denmark), being a subcontractor to Service in Informatics and Analysis (UK), itself a subsidiary of a French company, has not yet been delivered, considerable progress has been made in the development of the software and in the establishment of the network between the Centre and the Member States. The Council of the Centre adopted a minor modification to the future plans for the telecommunications network at its session in November, 1978.

Use of Computer System by Member States

Another significant decision during 1978 was the adoption by the Council of the recommendations prepared by an Advisory Committee on the Use of the Centre's Computing System by the Member States (Chairman, Mr. F. Bushby, U.K.). It was decided that 25% of the time available on the system should be allocated for use by the National Meteorological Services of the Member States. A formula for the distribution of the time among the Member States was adopted, taking into account not only the size of financial contributions but also a differentiation of small and larger projects. Use of the computer system by certain Member States began in 1978 but the full implementation of the scheme must await the establishment of the telecommunications network.

First Operational Model

The Research Department completed its design of the first operational model during the year. In addition to definition of the numerical procedures and specification of the parameterisation prescriptions for the various physical processes it has also been necessary to design the procedures to be used for analysis and initialisation for the global model. All the elements of the forecasting procedure have been tested during the year and the completed first operational model is ready for use in 1979 when operational forecasting is scheduled to begin.

Quality of Forecasts

The first and major objective of the Centre is to produce medium-range weather forecasts for the use of the Member States. The time limit for these forecasts has been defined as 10 days, which should be understood as an estimate of the upper limit for predictability using the present observational network and the latest prediction model. Ten-day forecasts represent, therefore, a goal toward which the Centre is striving. Evaluation and verification of weather forecasts is a notoriously difficult problem because it is necessary to know for which purpose the forecast will be used. The forecasts from the Centre will be used for many purposes, depending on the Member State which receives them. In spite of these difficulties, and using a variety of verification procedures, it has been demonstrated, as a result of preliminary tests, that the forecasts produced using the Centre's first operational model contain valuable information for up to about one week ahead. The period of validity for a given forecast depends both on the season and on the type of meteorological circulation pattern in the initial state. We must acknowledge that the Centre faces a very difficult problem in extending the validity of the operational forecasts up to a 10 day period or beyond. This problem must necessarily be the central research theme for the Centre in the coming years.

GARP Activities

It is generally believed that the errors in the initial state due to the sparseness of the meteorological network and the lack of observations themselves are a major source for the errors in the forecasts and thereby one of the factors determining the practical limit of predictability. It is also considered that the atmospheric prediction models of today, including a sufficiently high resolution in the horizontal and vertical directions, a well behaved numerical scheme, and good parameterisation of the major physical processes, are sufficiently accurate for an improvement in the forecasts to be reflected from a better definition of the initial state. It is primarily for this reason that the Centre is vitally interested in the First GARP Global Experiment (FGGE), or the Global Weather Experiment, as it is also called. This experiment was launched in December 1978 and will last for about one year, including two special observation periods. As agreed by the Council, the Centre is committed to produce global analyses for each day of the FGGE period in a delayed mode (III-b data analyses) depending on the data collection centres (II-b data) in Sweden and in the USSR. The preparation of the III-b analysis procedure, closely linked to the development of the Centre's own global analysis scheme, was completed in 1978 by the temporary FGGE section established at the Centre for this purpose.

Seminar and Training

The annual Seminar in 1978 was devoted to the interpretation of numerical forecasts in terms of weather forecasts. It was well attended, and the results of the Seminar as well as the major presentations are published by the Centre in the Seminar Proceedings Series.

The preparatory work for another element in the Centre's training programme was carried out in 1978. It was decided that the Centre should undertake to run a meteorological training course of three months' duration for up to 12 visiting scholars, for the purpose of familiarising meteorologists from the Member States with the various aspects of the medium-range prediction problem. The general nature of the course, the procedure for selection of the visiting scholars and other conditions were approved by the Council during 1978.

International Activities

The Centre has continued its exchange of technical and scientific information with research and operational institutions working on similar problems throughout the world. The Director and the Head of the Research Department have continued to participate in the GARP planning processes during the year. Following the visit to the Centre by a small delegation from the Hydrometeorological Service of the USSR in 1977 the Director

and the Heads of the Operational and Research Departments paid a return visit to the USSR (Moscow and Armenia) in January 1978.

**Further
information**

The introduction to this annual report highlights the major events of 1978. More detailed description can be found in the sections which follow.

Historical Note



The Chairman of the Committee of Permanent Representatives to the European Communities.

At a time when the Centre's move into its permanent headquarters marks the imminence of its entry into an operational state, it is perhaps appropriate to look back to the occasion of the launching of the project. On 11 October 1973, representatives of fifteen European States, in the forum of the Committee of Permanent Representatives to the European Communities, signed the Convention establishing the European Centre for Medium-Range Weather Forecasts. A sixteenth State also signed the Convention on 22 January 1974. This occasion was itself the culmination of several years of work on the drafting of the Convention, in which nineteen European States participated.

On 1 November 1975, the Convention, having been ratified by 13 Member States, entered into force and the Centre became an inter-governmental organisation in its own right.



Sir Michael Palliser, Permanent Representative of the U.K. to the European Communities.



Mr. E. Cazimajou, Deputy Permanent Representative of France to the European Communities.



Mr. E.M.S.A. Sassen, Permanent Representative of the Netherlands to the European Communities.



Mr. G. Bombassei Frascani de Vettor, Permanent Representative of Italy to the European Communities.



Mr. B. Dillon, Permanent Representative of Ireland to the European Communities.



Mr. E. von Sydow, Head of the Mission of Sweden to the European Communities.

Research Department

Structure and Responsibilities

The Research Department is divided into two parts, a Data Division and a Model Division. The Data Division is mainly concerned with the collection and analysis of meteorological data and forecast verification, whereas the Model Division has the responsibility for the development of the Centre's forecast models.

The Data Division consists of three sections, namely Diagnostics, Data Assimilation and FGGE, with the following responsibilities:

- Diagnostics
 - Development of diagnostic and verification systems for numerical models; construction and maintenance of the research data bases.

- Data Assimilation
 - Development of the basic formulation of methods of objective analysis and initialization for the Centre's prediction models; carrying out studies of observing systems to assess the meteorological observing network requirements.

- FGGE
 - Planning, development and production of the FGGE level III-b data set.

The Model Division consists of two interrelated sections, Numerical and Dynamical Aspects and Physical Aspects. These sections have the following responsibilities:

- Numerical and Dynamical Aspects
 - Development of the basic dynamical and numerical formulation of the Centre's forecasting models.

- Physical Aspects
 - Development of parameterization schemes to account for the sub-grid scale processes in numerical models.

Main projects

The efforts of the Research Department during 1978 have been concentrated on two main projects; the evaluation of the data assimilation scheme and the evaluation of the forecast model, both of which are being developed for operational forecasting.

Data assimilation

The development of the statistical interpolation analysis and the non-linear normal mode initialization scheme progressed well during 1978. Data assimilation schemes for the Centre's grid point and spectral models have been developed from these two components. Data assimilation experiments using a 9-level 3.75° (grid) adiabatic version of the Centre's grid point model were run using 6 days of observations from the Data Systems Tests data base. Observations were inserted for every 6 hours in the model. Subjective and objective comparisons with analyses from other Centres were encouraging. The technique of normal mode initialization contributed to the success of this experiment. Preparations were made for high resolution (1.875°) experiments early in 1979, including analysis of humidity and the full grid point model.

Semi-implicit Schemes

A long series of experimental semi-implicit integrations to 10 days using the global grid point model were completed. These included low and high

resolution adiabatic integrations and integrations with three physical parameterization packages of differing complexity. When the initial data is balanced, using a normal mode initialization scheme, the correlation between the explicit and semi-implicit integrations is excellent and the differences between the two schemes only become significant after the ninth day (time step ratio 5:1). Most of the experimental integrations with the grid point model are now performed with the semi-implicit scheme.

Models During 1978 it was decided to develop a spectral model for research as an alternative to the grid point model for the operational forecasting system. By the end of 1978 some preliminary experimentation had been carried out with this model. It is intended, towards the end of 1979, to compare this model on an operational basis with the grid point model.

Forecast experiments The Diagnostics and Physical Aspects Sections were heavily involved in finalising the verification and parameterization schemes for the grid point model and in conducting the first major series of forecast experiments. The purposes of these experiments were to get a preliminary indication of the forecasting skill of the model and to study the importance of the formulation of the physical parameterization.

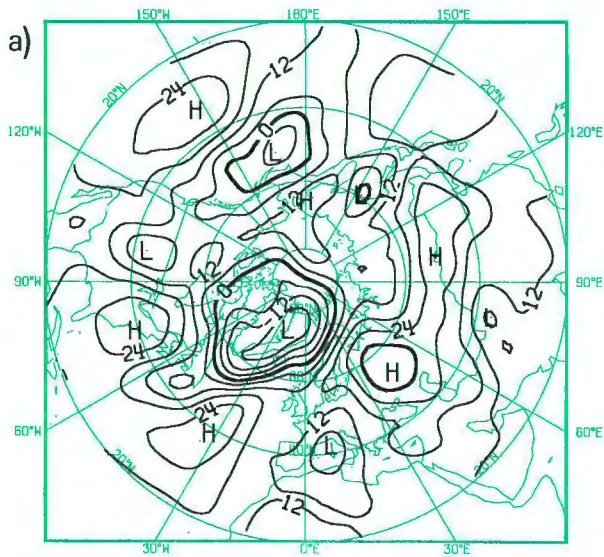
The global data used for the experiments were prepared by the National Meteorological Centre, Washington, as part of their Data Systems Tests for August 1975 and February 1976. This data was supplemented by stratospheric analyses from the British Meteorological Office.

The experiments with the August 1975 data are still in progress and so we confine ourselves to a discussion of the February cases. Forecasts to 10 days were made for eight cases (February 3, 6, 9, 12, 15, 18, 22, 25) with two forecast models. (The finite difference scheme and spatial resolution was the same for both models, an enstrophy conserving scheme, on a 1.875° latitude/longitude grid with 15 levels). One model used the physical parameterization described by Miyakoda *et al.* (1969) (the GFDL Princeton Schemes) while the second used the parameterizations described by Tiedtke *et al.* (1979 publication).

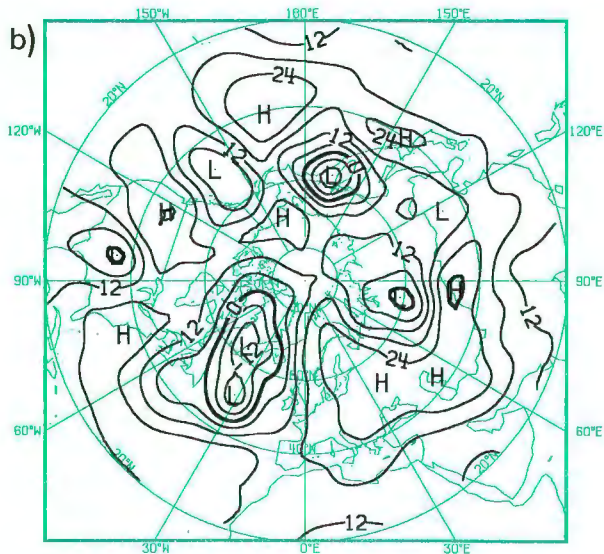
The results of the experiments were evaluated both subjectively and objectively.

Synoptic evaluations indicated that these forecasts provided useful guidance on the evolution of the large scales of motion out to, typically, five to six days. The period of study was of interest because, through the month, there was a marked tendency for blocking over Europe. The manner of development or of weakening of these blocking systems seemed to be reproduced quite well in the first half of the forecasts. An example of a particularly successful six-day forecast for Europe is illustrated in Figure 1 by maps of 1000 mb contours and 850 mb temperature anomalies. Here both models correctly forecast the development of an intense blocking high over Europe and the establishment of a strong southerly flow over the eastern Atlantic. The low level, 850 mb, temperature anomaly forecasts for Europe and the Atlantic are good and would have provided useful guidance.

Standard objective verification does not reveal any significant difference between the two models investigated, and we shall, therefore, only show the results from the model using the parameterization developed at the Centre (Tiedtke *et al.* (1979 publication)). A variety of objective verification measures has been explored but here we show the root mean square error of the 1000 and 500 mb heights for the area north of 20°N . Figure 2 shows the average (over seven cases) score. The vertical lines indicate the variability in the score as calculated from each individual forecast. The



a) Analysis Day 0 (1976/2/15 0 GMT)
1000mb Contour Interval 6 dam



b) Analysis Day 6 (1976/2/21 0 GMT)
1000mb Contour Interval 6 dam

c) Forecast Day 6 (1976/2/21 0 GMT)
1000mb Contour Interval 6 dam

d) Analysis Temperature Anomaly
Day 6 850mb Interval 4°C

e) Forecast Temperature Anomaly
Day 6 850mb Interval 4°C

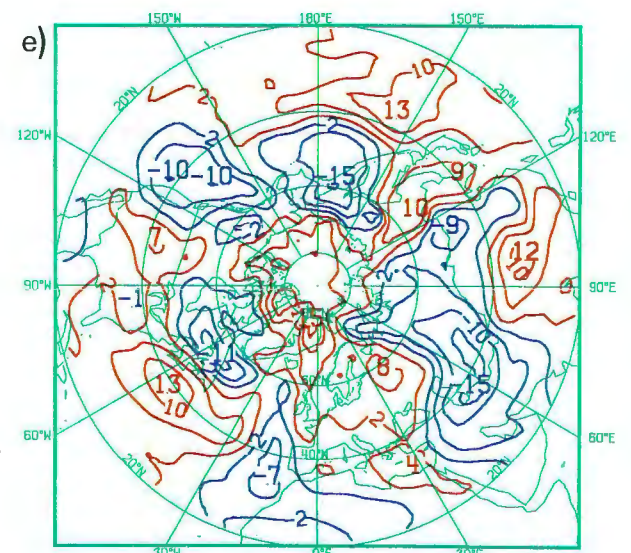
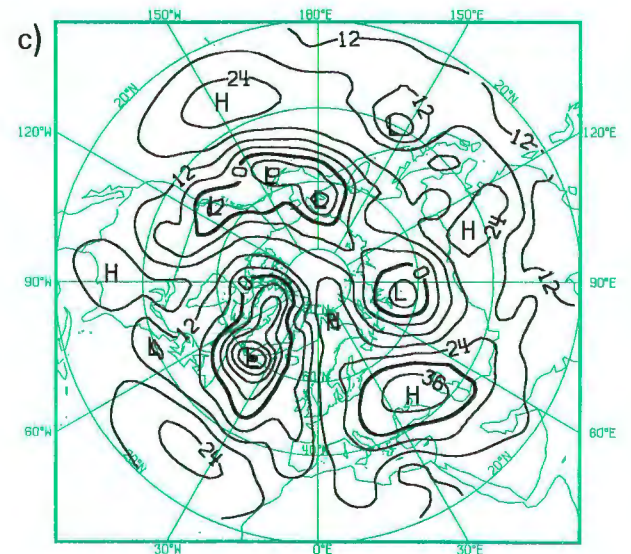
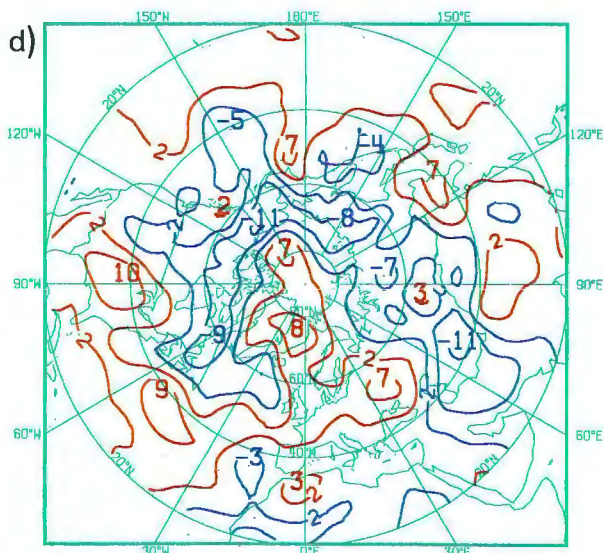


Fig. 1 Six-day forecast

horizontal dashed lines show climatology (labelled norm). At 500 mb the model scores better than climatology for the first six days and for the surface the corresponding figure is 5 days. A large variability in the forecast quality from day to day is observed at the end of the forecast period.

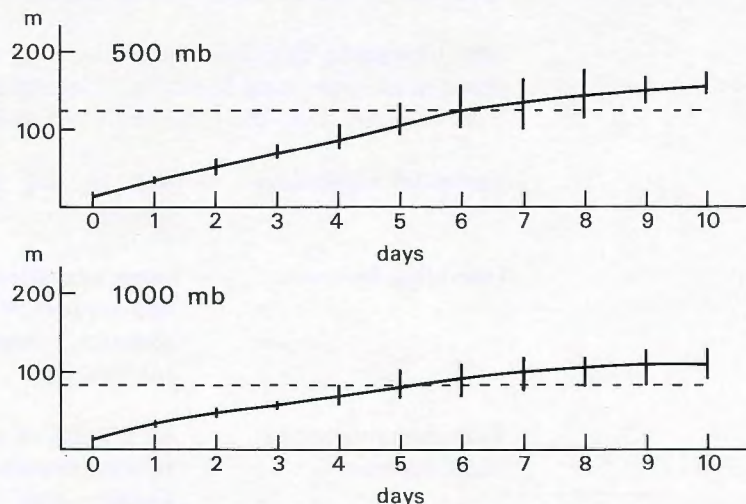


Fig. 2 Root mean square error of forecast, north of 20°N

Thus subjective and objective evaluations agreed that for this not very large, and dependent, data set there was useful skill in the forecasts for up to five or six days.

Study of the forecast errors between the sixth and tenth days indicates that a substantial part of the error is quite systematic in its behaviour, that it is of large horizontal scale and is common to both numerical models. The Centre will concentrate its research efforts over the next years on identification of the cause of this systematic error.

**FGGE Activities
(First Garp
Global Experiment)**

During 1978 the ECMWF FGGE activities progressed from the planning stage into a pre-operational test stage. Both low and high resolution trial analyses were made, using input data from the FGGE build-up year, provided by the level II-b Space-based and Special Observing Systems Data Centre in the special FGGE format. The data assimilation scheme used is a pre-operational version of ECMWF's own data assimilation cycle consisting of a multivariate statistical interpolation, a non-linear normal mode initialization and the Centre's grid point model.

The first trials looked promising and further development and refinements are now taking place, aiming at a start of level III-b production by the summer of 1979.

**Scientific Co-
operation with
Member States**

Active co-operation with scientific Centres in the Member States continued throughout the year. The Centre's staff visited many Research Centres in Europe and established co-operative projects with two institutes.

A special workshop was held at the Centre from 23-25 October 1978, on the Parameterization of Cumulus Convection. Proceedings and recommendations from this workshop will be published early in 1979.

Operations Department

Structure and Responsibilities

The Operations Department is divided into two parts – one concerned with computing and other technical facilities, the other with the operational meteorological problems. These are formally known as the Computer Division and the Meteorology Division, respectively.

The Computer Division comprises four sections, namely, Computer Operations, Operating Systems, Telecommunications and Graphics, and User Support, with the following basic tasks and responsibilities:

- Computer Operations – day to day operation of the computer system.
- Operating Systems – implementation, maintenance, development and support of the basic software (operating systems, compilers, utilities), of the computer complex.
- Telecommunications and Graphics – all aspects of the communications facilities, telecommunications network linking the Centre and the Member States, the implementation and support of graphics system.
- User Support – assisting users in all aspects of use of the Centre's computing facilities and in programme development, maintenance of programme libraries, training and documentation.

The Meteorology Division is divided into two sections – Meteorological Applications and Meteorological Operations. These sections have the following basic tasks and responsibilities:

- Meteorological Applications – programming and implementation of the full meteorological operational cycle required to sustain the daily production of medium-range forecasts in real time.
- Meteorological Operations – monitoring and evaluation of the operational cycle from a meteorological point of view, including checks of consistency of input data and forecast results.

Main projects

Overall, in 1978, the work of the Operations Department has continued to be dominated by the various steps in the implementation of the computer system and development of a meteorological operational suite which together will support operational medium-range weather forecasting in 1979. Of prime importance has been the establishment of the final computer installation in the Centre's permanent headquarters at Shinfield Park and the introduction of a full service on this system. The other main activities have been the support of the interim computing service at the Rutherford Laboratory of the Science Research Council of the United Kingdom, and progress in the implementation of the operational forecasting suite itself.

Computing Facilities

The long process of invitation to tender for a computer system for the Centre, the evaluation of the tenders, the phased installation and interim service at Rutherford and finally installation at the new headquarters at Shinfield has almost been completed with the exception of some minor enhancements due in 1979. The Centre therefore now has available a powerful and versatile computer system well able to help fulfil its objectives; this will be at the heart of all operational activity. The computing system basically comprises three levels – the CRAY-1, a powerful “number cruncher”, front-ended by a CYBER 175, which has all the normal facilities offered by modern operating systems, to control the running of the operational forecast and other tasks and this, in turn, front-ended by smaller computers to control communications with Member States and the graphical output. The important step in 1978 was the transition from the interim service based at Rutherford Laboratory to the permanent service based at Shinfield.

In order that the Centre might make early use of the CRAY-1 and CYBER 175 computers, the Council had authorised temporary installation of a limited configuration of the systems at the Rutherford Laboratory. Under this arrangement the CRAY-1 was available to the Centre from November 1977, and the CYBER 175 from the end of January 1978. With the start of this service on the CYBER 175, the CDC 6600 service, which had been used by the Centre from August 1975 at John Scott House, ceased. The disadvantage of not having a computer in close proximity was allayed by the connection of RJE (remote job entry) terminals and a network of VDUs in the Centre’s premises in Bracknell to the CYBER 175 and the CRAY-1 via staging on magnetic tape. With this arrangement, supplemented by a courier service, it was possible for Centre staff to work mainly from Bracknell. However, the machines were controlled by Centre operators working at Rutherford. During the period of the interim installation at Rutherford, the Centre made extensive use of the available computing time. In particular the Research Department was able to carry out a long series of trial forecasts and Operations Department staff were able to familiarise themselves with the operating systems of the computers, including the CYBER terminal system INTERCOM. A highly encouraging feature that emerged during this period was the availability and reliability of the systems. The CRAY-1 average overall availability was more than 95%, a highly satisfactory figure in view of the fact that this machine was the prototype. As implied by this overall availability figure, the CRAY-1 software was adequate and sufficiently reliable, although some shortcomings were noted, and enhancements in both the CRAY operating system and Fortran compiler were sought. The operation of the CYBER 175 was also highly satisfactory and the average overall availability during its service at Rutherford was more than 99%. The processing speed of the CYBER 175 was also well up to expectation.

Permanent Installation of Computer System

Computer operations on the CYBER 175 at Rutherford ceased on 29 September. The CYBER was removed and installed in the new headquarters building of the Centre at Shinfield Park and provisional acceptance of an enhanced configuration and new releases of software took place from 5-7 November. A new CRAY-1, the Centre’s own mainframe, serial number 9, was delivered to the Centre’s permanent headquarters on 24 October and provisional acceptance of this took place from 8-10 November. At the same time the service on the CRAY-1 at Rutherford ceased. Following this, a full computer service seven days per week, 24 hours per day, started in the new headquarters, despite a considerable shortfall in staff.



The CRAY-1 Computer, installed in the Computer Block of the Centre's permanent headquarters at Shinfield Park.

The linked System

The next step in the establishment of the permanent installation took place on 8 December, when the full linked configuration, CRAY-1, CYBER 175, link hardware and software was provisionally accepted and went into trial service. This early availability of the linked systems was substantially aided by the interim installation of the CRAY-1 and CYBER adjacent to each other at the Rutherford Laboratory, providing the manufacturers with good facilities to help solve the technical problems of linking the systems. The availability of the link greatly facilitates the use of the CRAY-1; the previous use of the magnetic tape system, although in general adequate, did not permit transfer and back-up of large files and thus users had to select carefully what input to and output from the CRAY-1 was required.

For the one and a half months in 1978 of its service at the Centre's permanent headquarters the reliability of the CRAY-1 has been 99%; in particular the CRAY-1 software has improved both in terms of facilities offered and reliability. None of the breaks in CRAY-1 service since November 1978 can be ascribed to software faults. Both the CRAY-1 and CYBER are expected to complete the final acceptance trials early in 1979. After this no additions or changes are planned for the CRAY-1, but some additional peripheral equipment (primarily disc and tape units) will be added to the CYBER in 1979, in addition to establishing the connections to telecommunications and graphics sub-systems. Further, a detailed evaluation of the whole computer complex is planned for 1979 in order to optimise overall performance and to balance the configuration.

Telecommunications

The contract for the supply of the telecommunications system was signed on 14 March with Service in Informatics and Analysis (SIA) Ltd. (UK) to supply the necessary software, with A/S Regnecentralen (Denmark) as sub-contractor providing the hardware centred around an RC8000 computer. The system will be linked to the CYBER 175 and will control the communication lines to Member States using manufacturer-independent communications protocols. The protocols that have been adopted are based on internationally recommended and approved standards where available. For some levels of the protocols a certain amount of internal development was necessary but full liaison with the international effort in this field has been maintained. The facilities to be provided are the transfer of files for the acquisition of meteorological data and dissemination of

forecast results via low and medium speed lines, and a remote batch service for Member States connected by medium speed lines. There was steady progress on the telecommunications project during 1978 and the design of the software was completed. To assist in development and testing, hardware was temporarily installed in SIA premises in London and a hardware connection to SIA's CYBER successfully established. There has also been technical co-operation between the Centre, SIA and the United Kingdom Meteorological Office, and arrangements for setting up a test link early in 1979 were made.

It is expected that the telecommunications system will be installed in the Centre's Headquarters in the spring of 1979.



Signature of contract with SIA for the Centre's telecommunications system: Mr. G.W. Pick, SIA; Mr. J. Labrousse, ECMWF; Dr. A.C. Wiin-Nielsen, Director, ECMWF; Mr. R. Daniel, SIA.

Since the signature of the contract with SIA and detailed specification of the software, much of the necessary technical information giving precise descriptions of the protocols, network interface software and advice on implementation was distributed to Member States. Additionally a seminar reviewing ECMWF's protocols was arranged in May by the Centre at the request of Member States.

The Centre has also acted as agent on behalf of Denmark, the Federal Republic of Germany and Sweden to provide a link package for use with Regnecentralen terminal equipment at the remote end of medium speed connections with the Centre. A contract was placed with SIA and the work is planned for completion in August 1979.

Graphical Facilities

Throughout 1978, graphical output continued to be provided by the Varian Statos plotter, operating off-line. In March contracts were placed with Sintrom Ltd. to supply Versatec electrostatic plotters, and with Systems Reliability Ltd. for the on-line interface of these to the CYBER 175. Delivery of one plotter and interface took place in December and acceptance is expected in early 1979. The existing contouring software can be used in conjunction with the Versatec plotters. However, conversion of this software to support the operation of graphical display terminals went ahead in 1978.

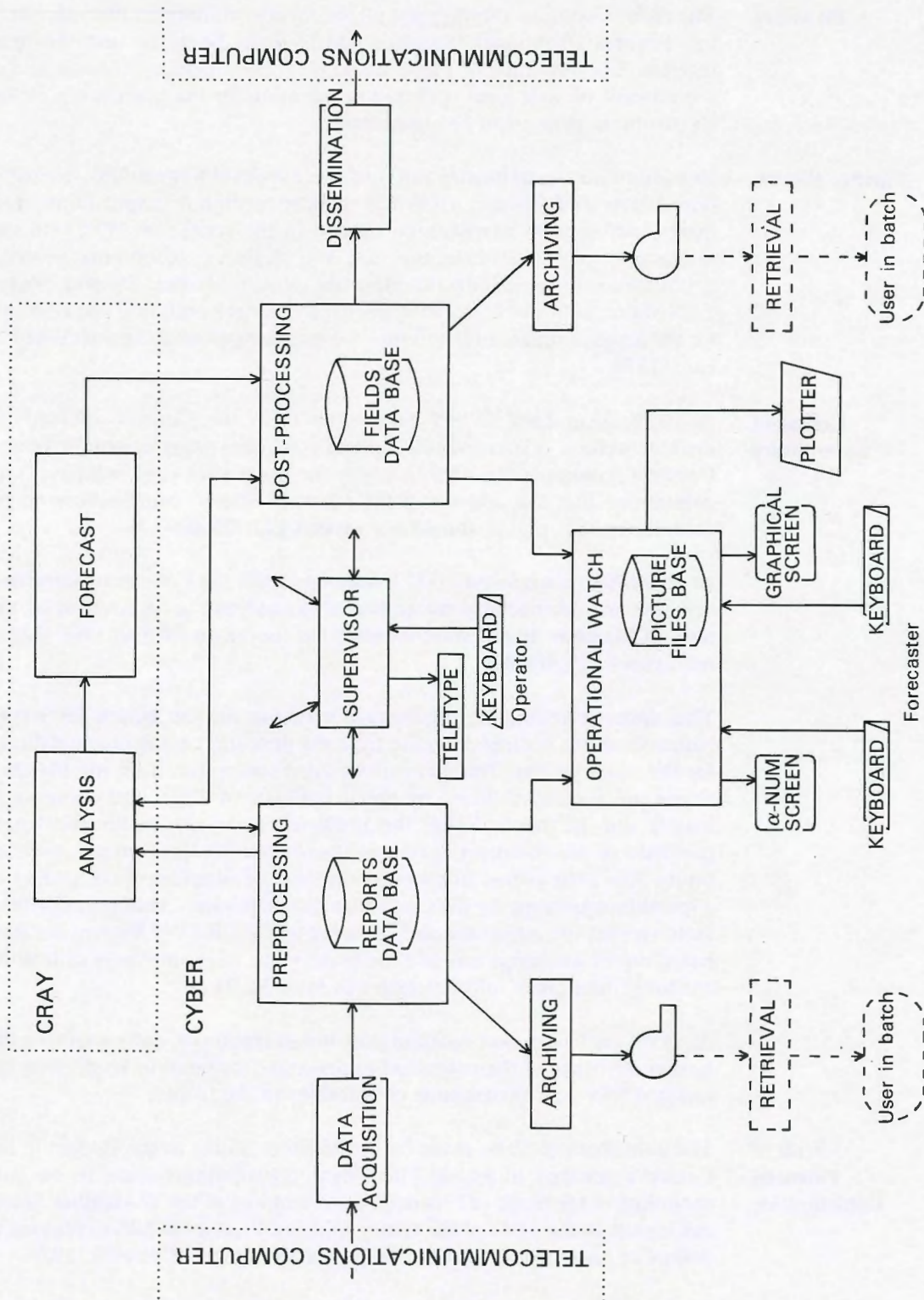
User Support

As the Centre had two mainframes available for use during most of 1978, there was a major requirement to advise Centre scientists and programmers on the use of the computing facilities and to provide assistance in programme development. The User Support Section of the Operations Department has provided an advisory service, consultancy, training courses when needed, detailed documentation (including a regular "Computer Newsletter") and programme and sub-routine library support. Plans have been made to extend this support to users in Member States who will begin to use the Centre's computer facilities in 1979.

**Implementation
of Operational
Forecasting**

Work on the preparation of the suite of programmes making up the complete operational forecasting system at the Centre has been divided into a number of individual sub-processes (that is, acquisition of observational data and numerical products, overall supervision/monitoring/control of the suite of programmes). Work on all aspects proceeded according to schedule. In particular, the detailed arrangements for the acquisition of synoptic meteorological data from the United Kingdom Meteorological Office via the Centre's telecommunications procedures, were completed. For the decoding and checking of data, programmes from the French National Meteorological Service were adapted and most types of data can now be decoded. The structure of, and methods of access to, the "reports data base" were designed, coding was completed and some testing has been carried out. Design and programming of the processing, dissemination and archiving of forecast products is well advanced. Programmes for the display and correction of observational data that is too corrupt for automatic handling were written and tested.

Regarding other aspects of the progress towards operational forecasting, the amount of observational data currently available on the Global Telecommunications System was examined in relation to the Centre's operational needs. Considerable thought was given to the real-time monitoring of the Centre's operational system that will be necessary from a meteorological point of view to ensure adequate data input and realistic and consistent forecast output. Study began of methods which could be used to assess objectively the meteorological value of the Centre's forecast. Output from many of the trial forecasts made by the Research Department was also examined from a synoptic point of view to gain experience in the meteorological characteristics and behaviour of the numerical model. This in turn led to consideration of methods by which the meteorologically valuable content of the forecasts, such as cyclone tracks, anomalies and their rate of change, may best be displayed at a later stage.



Diagrammatic illustration of the sub-processes and data flows in the planned Meteorological Operation System at ECMWF.

Administration Department

Structure The Administration Department of the Centre comprises four sections, i.e. Finance, Personnel, Supplies and General Services, and the Secretariat. The activities of these sections in 1978 included routine tasks, recruitment of additional staff and preparation for the installation of the Centre in its permanent headquarters.

Finance Section In addition to the implementation of the Financial Regulations, preparation of the draft Budget 1979 and updated ceiling of expenditure estimates, the Section has been concerned in the course of 1978 with the acquisition of a mini-computer for the Centre's accounting system, negotiations on tax and excise questions (V.A.T., Import Duties), tender evaluations, and the financial aspects of contracts, notably the contract for the lease-purchase of the Centre's computer system to be concluded in early 1979.

Ceiling of Expenditure At its Session held on 8-9 November 1977, the Council adopted an updated ceiling of expenditure estimate for the implementation of the Centre's programme of activities over the years 1978-1981 inclusive, and determined that the amount of the Member States' contributions to be paid during that period should not exceed £22,779,880.

At its 8th Session held on 21-22 November 1978, the Council updated this estimate and decided that the ceiling of expenditure to be covered by the total of Member States' contributions for the years 1979 to 1982 should not exceed £22,884,000.

This updated ceiling of expenditure estimate for the period 1979-1981 inclusive shows a slight decrease from the previous ceiling of expenditure for the same period. The estimated contributions due from the Member States are thereby reduced by about £850,000 (4.77%). The decrease is mainly due to the fact that the proposed arrangement for the lease-purchase of the computer system is based on a five year period, and not on the four year period foreseen at the time of adoption of the ceiling of expenditure estimate by the Council at its 6th Session. Another influential factor is that the computer costs relating to the CRAY-1 System are now based on the exchange rate of £1 = \$1.85 while in the previous ceiling the exchange rate taken into account was £1 = \$1.70.

As in the past computer costs and the remuneration of staff constitute the largest elements of the estimated expenditure foreseen to implement the updated four year programme of activities of the Centre.

Scale of Financial Contributions The contributions to be made by the Member States to the Budget of the Centre amounted to £4,838,750. These contributions were to be paid according to the Scale of Financial Contributions of the 17 Member States calculated on the basis of the Gross National Product (GNP) expressed in dollars of each of the Member States for the years 1971, 1972, 1973.

During 1978 contributions from Member States towards the Centre's budget were paid in the sum of £4,650,323.75. Outstanding contributions from previous years and to the 1978 Budget at the end of 1978 amounted to £138,403.58. Fourteen out of the 17 Member States party to the Convention had paid all their annual contributions. The highest contributions towards the Budget 1978 were, as in 1977, from the Federal Republic of Germany, France, Italy and Great Britain (69.69% of the total contributions).

In November 1978 the Council adopted a new Scale of Financial Contributions, based on the GNP of the Member States in 1974, 1975 and 1976. This scale will be applied to the contributions from the Member States to the budgets for 1979, 1980 and 1981. The Scale of Contributions applicable in 1978 is shown in Annex 8.

Budget

The Budget 1978 of the Centre was adopted by the Council at its sixth Session held on 8-9 November 1977. The approved total amount of expenditure and revenue for the year 1978 was £5,348,550 with an increase of 80.09% over the estimated total of the 1977 Budget of the Centre. The increase over the budget of the previous year was, inter alia, due to the need to furnish the new headquarters of the Centre, an adjustment in the remuneration of staff and recruitment of new staff members, the acquisition of the Centre's computing system and inflation, reflected mainly in the appropriations for operating expenditure. Expenditure was mainly covered by the Member States' contributions to which were added the proceeds of taxation, staff contributions to the pension fund and other minor revenue, e.g. refunds of taxes and bank interest.

During 1978, the financial needs of the Centre were for the most part to cover operating expenditure, of which the appropriation for the remuneration of the staff constituted the largest part of the budget. The computer costs for the rental and maintenance of the interim and final configuration of the Centre's computer system exceeded £2,200,000.

Investment expenditure in 1978 covered mainly the furnishing of the new headquarters in Shinfield Park. The cost of furniture and technical equipment to be installed at Shinfield Park was estimated at around £400,000.

Details of the estimated figures of the Budget 1978 which take into account transfers of funds authorised during the year are tabulated below:

	Revenue	Expenditure	
		Commitment Appr.	Payment Appr.
Title I – Revenue	5,348,550		
Title II – Investment expenditure		15,000	443,000
Title III – Operating expenditure		151,500	4,905,550
Totals	5,348,550	166,500	5,348,550

The expected surplus to be returned to the Member States at the end of the financial year amounts to about £1,072,900.

Supplies and General Services

The Supplies and General Services Section has, in the course of 1978, had the major task of preparing for, and carrying out, the transfer of the Centre from its four sets of temporary accommodation in Bracknell and at the Rutherford Laboratories to the new permanent headquarters building at Shinfield Park, Reading. This task involved working in close co-operation with the U.K. Government Property Services Agency (PSA) and J. Laing Construction Ltd. in order to ensure that the Centre's building and installation requirements for its new headquarters were satisfied.



M.J. Hislop, PSA; R. Brinkhuysen, ECMWF; F.R. Martin, Director Defence Services, PSA; D. Marriott, PSA; J. Labrousse, ECMWF; J. Smith, PSA; S. Johnson, PSA; T. Atkey, ECMWF; C. Kidby, PSA; K. Good, John Laing, (Main Contractor).

The staff of the Centre moved into the Office Block of the new building at the end of October, and the last items of equipment were moved from Rutherford into the Computer Block in mid-November. Work continued after that date on the completion of the Conference Block. It is expected that this will be handed over to the Centre in early 1979.

The Section has also, of course, carried out its regular tasks of applying tendering and contract procedures for goods and services, administration



Computer Block, Shinfield Park, with Office Block in background.



Office Block, Main Entrance and Conference Block, Shinfield Park.

of internal services and management of the library, archives and reproduction service. In the course of the year the Centre issued 8 invitations to tender, which resulted in 41 replies from tenderers.

Contracts Contracts were concluded for a wide range of services and equipment, such as maintenance of plant equipment, security arrangements for the Centre's buildings, carpets, fittings and furniture, and, in particular, for the acquisition of the Centre's telecommunications system from Service in Informatics and Analysis Ltd. (SIA). This contract, involving expenditure amounting to approximately £350,000, also contains a maintenance agreement covering the equipment acquired.

Library With the move to Shinfield Park, the Centre's Library was at last installed in purpose-built accommodation, and with the provision of plentiful racking and shelving, cataloguing equipment, and readers' desks, optimum use of the Centre's library has been made possible. At the end of 1978 the number of volumes in the library exceeded 800. The Centre also subscribes to about 80 journals, and receives others through an exchange scheme.

Personnel Section The section has continued with its task of implementation of staff legislation, staff management, payment of salaries, allowances and expenses incurred on duty, and recruitment. This last task has again been considerable, since the number of staff has increased during 1978 by approximately 50%.

Staffing The table of staff requirements for 1978 contained 124 posts. By 31 December 1978, there were 115 staff members, 2 consultants and 1 visiting scientist at the Centre, leaving 9 vacant posts at the end of the year. During 1978 a total of 45 new staff members joined the Centre while 11 left, all but one being non-U.K. nationals. Nevertheless, the balance of geographical distribution among the staff slightly improved over the year and there are firm expectations that an even better distribution will be achieved during the year 1979. By 31 December 1978 nationals of 13 Member States were represented among the Centre's staff. (See Annex 1 for details of the staffing at 31 December 1978.)

European School

In September 1978 a new European School was opened in Culham (nr. Oxford), in principle to accommodate the children of staff working on the so-called JET project, these being nationals of the 9 EEC countries. The Centre is grateful for the co-operation received from the relevant U.K. authorities, the Board of Governors of the European Schools and the headmaster of the Culham school, since, although they are not "entitled" children, i.e. children who have the automatic right to attend the school, children of Centre staff members have been admitted to the school without exception. The headmaster has demonstrated his intention to continue with this policy of admission of Centre children. In November 1978 the Council, in adopting the Budget 1979, approved the payment of a subsidy for the provision of transport to the school.

Medical Health Insurance and Social Security

No progress was made in obtaining a medical insurance additional to the National Health Scheme of the host country. The problem is still under review by the Finance Committee.

Negotiations continue with the U.K. Government in order to achieve exemption from compulsory contributions to the United Kingdom Social Security Scheme for U.K. nationals, as is already agreed for staff members who are non-U.K. nationals. Because the Pension Scheme of the Centre is compulsory for all staff resident staff are still affiliated to two different schemes. There are signs that progress may be expected in the negotiations with the U.K. authorities.

Since the Pension Scheme of the Centre only provides for an invalidity pension for staff members recognised to be permanent total invalids, no provision for coverage in cases of permanent partial invalidity exist. Since the Centre does not have a sickness/invalidity insurance, this leaves an important gap in the social security cover given by the Centre to its staff. The problem is aggravated by the fact that Centre staff are employed on fixed-term contracts. In the present situation a former staff member could suffer unacceptable hardship on expiry of his contract. The Council was made aware of this problem at its November session and has requested the Finance Committee to consider the question and report back. The Centre is studying possible alternative solutions and will make proposals to be considered by the Finance Committee as early as possible in 1979.

Co-ordinated Organisations

The Centre has still not been admitted to the Co-ordinated Organisations. After the Director had written to the Chairman of the Co-ordinating Committee requesting that, in accordance with the decision taken by the Council, the Centre join the Co-ordinated Organisations, the Co-ordinating Committee, in its 130th Report dated 19 March 1976, recommended that the Councils of the 5 Co-ordinated Organisations give favourable consideration to the Centre's request to join the co-ordination system. Since then, the Councils of only 3 of the 5 Organisations have approved this recommendation.

The Council of the Centre, being informed by the Director of this situation at its November session, adopted a resolution requesting the Governments of the Member States to take steps to ensure that the question of accession by the Centre to the Co-ordinated Organisations system be put on the agenda of the Council meeting of NATO and OECD as soon as possible, and that the decision on this subject, when taken, be of a positive nature.

Secretariat

The Administration Department provided secretarial assistance at the sessions of the Council and its Committees during 1978. In addition it served the Working Group on the Financial Regulations, set up by the Finance Committee following a request by the Council that draft revised Financial Regulations be prepared for its consideration. This Working

Group held three sessions in 1978, on 30 May-1 June, 13-14 July and 6-8 December. A draft of proposed revised Financial Regulations was to be submitted to the Finance Committee following the third session. The Linguists section produced documentation in the working languages of the Centre for the Council, Finance Committee and Working Group sessions, in addition to translations of scientific reports and other texts.

Education

The Centre arranged a fourth seminar on the subject "The interpretation and use of large-scale numerical forecast products" at the Meteorological Office College at Shinfield Park between 4-8 September 1978. The seminar was attended by about 40 participants from the Member States in addition to the lecturers and Centre staff.

The main lectures were given by Dr. P. White, U.K. Meteorological Office, Dr. R. Pielke, University of Virginia, U.S.A., Dr. O. Lönnqvist, Swedish Meteorological Office, Dr. W. Klein, National Weather Service, NOAA, U.S.A. and Dr. D. Söderman, Finnish Meteorological Institute.

Dr. P. White and Dr. R. Pielke reviewed the development of mesoscale models and discussed their use for local and regional forecasting. Dr. Lönnqvist and Dr. Klein described methods for the automatic interpretation of numerical forecasts and statistical forecasting of local weather by means of model output statistics. Dr. Söderman also dealt with statistical methods for local forecasting and in addition discussed possible uses for ECMWF forecast products.

Contributions on individual topics were given by members of the Centre's staff who also presented the Centre's planned forecasting system.

Proceedings of the Seminar have now been published and distributed to delegates and the Member States.

Visiting Scientists

During 1978 the Research Department had three visiting scientists:

Dr. B. Machenhauer, from the Institute for Theoretical Meteorology, University of Copenhagen, Denmark.

Dr. R. S. Seaman, from the Australian Numerical Meteorology Research Centre, Melbourne, Australia.

Dr. D. Williamson from the National Center for Atmospheric Research, Boulder, Colorado, U.S.A.

The Council and its Committees



Professor L.A. Vuorela, President of the Council, Council Session, London, November 1978.

Council Sessions

In 1978 two sessions of the Council took place, on 4-5 May and 21-22 November respectively.

Elections

At the 8th session of the Council, in November, the Council unanimously re-elected Professor L. Vuorela (Finland) as President and Mr. R. Mittner (France) as Vice-President for a third term of one year.

Finance Committee

Four sessions of the Finance Committee took place in 1978. The membership is given in Annex 3.

At its Session held in January 1978, Mr. J.J.M. Jurgens (Netherlands) was elected Chairman of the Finance Committee and Mr. P.P. Wrany (Federal Republic of Germany) was elected Vice-Chairman. Upon the resignation of Mr. Jurgens as a result of a change of post Mr. P.P. Wrany became Chairman of the Committee in October and Mr. H. Fontijn was elected Vice-Chairman at the same time.

Scientific Advisory Committee

The Scientific Advisory Committee met twice in the course of 1978, on 9-10 February and 17-18 August. It reviewed the progress of the Centre's scientific activity and endorsed the strategy being followed by the Centre.

Advisory Committee on Use of the Centre's Computer System by the Member States

The Advisory Committee on the use of the Centre's Computer System by the Member States, established by the Council in November 1977, met twice in the course of 1978, on 16-17 February and 14 September, at the Centre's temporary headquarters in Bracknell.

The Committee was composed of delegates from the Federal Republic of Germany, France, Italy, Yugoslavia, Austria, Sweden and the United Kingdom. Mr. F. Bushby (U.K.) was elected Chairman.

The recommendations of the Committee were considered at the eighth session of Council in November and adopted as a basis for allocation of computer time for a trial period of two years. The basic rules governing



French delegation: Mr. du Chaxel, Miss Martin-Sané



Belgian delegate: Mr. Vandenplas, with the President of the Council.



Greek delegate: Dr. Bassiakos, Yugoslavian delegate: Dr. Radinović.



United Kingdom delegate: Dr. Mason, with Dr. Bengtsson, Head of the Research Department.



Austrian delegate: Dr. Cehak, with Mr. Labrousse, Head of the Operations Department.



Mr. F. Bushby, Chairman of the Advisory Committee on the use of the Centre's Computer System by the Member States, Dr. J.R. Bates, Chairman of the Scientific Advisory Committee, and the Director.

the allocation are that at least 25% of the available CPU time on the CRAY-1 computer should be made available to Member States and that, of this time, a maximum of 10% may be allocated for "special projects" approved by Council, 35% of the remainder should be divided equally among Member States and 65% proportionally according to their financial contribution to the Centre. Upon completion of its task the Advisory Committee was disbanded.

**Advisory
Committee on matters
related to
communications
between ECMWF
and Member
States**

One session of the Advisory Committee on matters related to communications between ECMWF and Member States took place in 1978, at the Headquarters of the Deutscher Wetterdienst in Offenbach in September.

Recommendations updating the plan for the implementation of the telecommunications network (as approved by Council at its sixth session in November 1977) were submitted to and approved by Council at its eighth session in November. Questions relating to the code and format in which Member States wished to receive the Centre's forecast products were also carefully considered at the Advisory Committee session.

**Technical Advisory
Committee**

At its November session, the Council established a Technical Advisory Committee. This will be a permanent body and will, among other tasks, take over the duties of the Advisory Committee on matters related to communications between the Centre and the Member States. All Member States are members and are invited to participate in the work of this new Advisory Committee.

Staff Committee

After developing, during the first two years of the Centre's existence, as the Centre itself developed, the Staff Committee by 1978 was recognised as an established part of the life of the Centre with the function of representing the interests of the staff.

Throughout the year regular meetings were held by the Committee with the Director, Head of Administration and Head of Personnel. At these meetings the Staff Committee voices the staff's views and is consulted on proposed measures affecting the staff. Equally important are the informal contacts maintained by the Committee with the management of the Centre. Committee representatives have also participated in the activities of various Working Groups, such as that established to prepare for the move to Shinfield Park.

An Annual General Meeting was held in September 1978 at which Rules of Procedure for the Staff Association were provisionally adopted. Following these Rules an election was held in October for the renewal of the Staff Committee.

The Staff Committee was unable to send representatives to meetings of Co-ordinated Organisations bodies and in particular to meetings of the Standing Committee of Staff Associations of the Co-ordinated Organisations (CPAPOC) in the first part of 1978, since the funds allocated for this purpose in the 1978 Budget had been blocked by Council. The staff felt, however, that this was unacceptable since their salary scales, allowances and benefits and the pension scheme were all determined by Co-ordinated Organisations bodies. It was found that a large majority of staff were prepared to contribute to a fund to cover the cost of sending representatives to Co-ordinated Organisations meetings until such time as funds are made available again from the Centre's budget. In September, therefore, attendance at CPAPOC meetings was resumed.

Annex 1

Staff at 31 December 1978

Director	A.C. Wiin-Nielsen	Denmark
Head of Research Department	L.O. Bengtsson	Sweden
Head of Operations Department	J. Labrousse	France
Head of Administration Department	W.D. von Noorden	F.R.G.

Distribution of staff by grade and nation

	h.g.*	Grade				Total
		A	B	C	L	
Belgium		2				2
Denmark	1	1				2
F.R.G.		10	4		1	15
Spain		1				1
France		8	2		1	11
Ireland		4	1			5
Italy		4	2			6
Yugoslavia		1	1			2
Netherlands		2	1			3
Austria		2				2
Finland		2				2
Sweden		3				3
United Kingdom		27	28	6		61
Totals	1	67	39	6	2	115

* Hors grade

2 consultants and 1 visiting scientist were also employed by ECMWF at 31 December 1978.

Annex 2

Members of the Council

President	L.A. Vuorela	Finland
Vice-President	R. Mittner	France
	A. Vandenplas	Belgium
	M. Deloz	Belgium
	O. Nielsen	Denmark
	L.B. Asmussen	Denmark
	E. Lingelbach	F.R.G.
	H.G. Schulze	F.R.G.
	P. Gonzalez-Haba	Spain
	R. du Chaxel	France
	A. Bassiakos	Greece
	P.M. Austin-Bourke	Ireland
	R. Ferraris	Italy
	M. Mariani	Italy
	D. Radinović	Yugoslavia
	A. Lambasa	Yugoslavia
	H.C. Bijvoet	Netherlands
	J. Jurgens	Netherlands
	K. Cihak	Austria
	R.A. da Costa Carvalho	Portugal
	G. Simmen	Switzerland
	E. Marthaler	Switzerland
	D. Söderman	Finland
	O. Lönnqvist	Sweden
	B. Gellstedt	Sweden
	Y. Daylan	Turkey
	B.J. Mason	U.K.
	C.P. Lynam	U.K.
	R. Schneider	WMO Observer

23
10

Annex 3

Finance Committee

Chairman: J.J.M. Jurgens (Netherlands)*

The Finance Committee is composed of representatives of those four Member States paying the largest contributions to the Centre, and representatives of three other Member States designated by the remaining Member States. In 1978 the Committee was composed as follows:

i) *Those paying the largest contributions:*

Federal Republic of Germany
France
Italy
United Kingdom

ii) *Those designated by the remaining Member States:*

Ireland
Yugoslavia
Netherlands

At its 8th session held in November 1978 the Council took note that the above membership remained unchanged for the following year.

*Replaced, following his resignation, by Mr. P.P. Wrany (Federal Republic of Germany) as from 3 October 1978.

Annex 4

Members of the Scientific Advisory Committee

The Scientific Advisory Committee is composed of the following members selected by the Council in their personal capacity:

Chairman:	J.R. Bates	Ireland
Vice-Chairman:	F. Mesinger	Yugoslavia
	F.H. Bushby	U.K.
	B. Döös	Sweden (and WMO representative)
	E. Eliassen	Denmark
	K. Hasselmann	F.R.G.
	E. Holopainen	Finland
	J. van Isacker	Belgium
	P. Morel	France
	S. Palmieri	Italy
	C. Schuurmans	Netherlands
	F. Wippermann	F.R.G.

At its November Session the Council appointed Dr. H. Reiser (F.R.G.) to fill the place vacated by F. Wippermann at the end of his term of office.

Annex 5

International Meetings attended and visits made by Members of Staff

1978

22-28 January	Visit to Hydrometeorological Service, Moscow	A.C. Wiin-Nielsen J. Labrousse L. Bengtsson
23-27 January	Visits to Météorologie Nationale, Paris and Deutscher Wetterdienst, Offenbach to assess use of CDC operating systems in an operational environment	D. Dent T. Stanford
5-15 February	Visits to Minneapolis for CRAY/CDC meetings and Mobil, Houston, Texas	P. Gray A. Stormer
13-15 February	ACM Symposium on Computer Network Protocols, Liège	P. Quoilin K. Wilke
16-17 February	Meetings of International Network Working Group, Liège	P. Quoilin
27 February - 10 March	7th Session of the Commission for Atmospheric Sciences, Manila	L. Bengtsson
21-22 March	Visit to Copenhagen for discussions with A/S Regnecentralen	J. Labrousse F. Königshofer
28 March - 7 April	Fourth session of the CBS Working Group on the Global Data Processing System, Geneva	R. Newson
29-31 March	Visit to Météorologie Nationale, Paris, for discussions on implementation of data decoding/ checking and other operational aspects	J. Hennessy P. O'Sullivan
3 April	CBS Working Group on Global Data Processing Systems, Geneva	L. Bengtsson
8-10 April	WGNE Meeting, Washington	L. Bengtsson
10-14 April	ECODU Conference, Liège	R. Brinkhuysen N. Storer
10-24 April	Visit to CRAY, Minneapolis and VIM Conference at Albuquerque, New Mexico	P. Gray L. Bertuzzi
12-14 April	US GARP Committee, FGGE Meeting, Boulder, Colorado	L. Bengtsson
19-21 April	Visit to SMHI, Norrköping, for detailed discussions on quality control methods and other operational aspects	J. Martellet B. Norris
20-21 April	Advisory Group for Satellite Information Co-ordination, Rome	G. Larsen
12-16 June	First session of the WMO EC Intergovernmental Panel's Working Group on the FGGE Data Management, Shinfield Park	L. Bengtsson P. Kallberg S. Uppala

14-16 June	Visit to Météorologie Nationale, Paris, to discuss graphical application problems	P. O'Sullivan H. Watkins
19-21 June	ECODU Board Meeting, Baden-Baden	R. Brinkhuysen
19-23 June	WMO Symposium on boundary layer physics applied to specific problems of air pollution, Norrköping	J.-F. Louis
9-20 July	Visit to Minneapolis for CRAY/CDC Meetings	P. Gray
6 August - 5 September	Work with CDC on link development, Minneapolis	R. Dixon
17-24 August	Visit to Météorologie Nationale in Paris, CERN in Geneva, Deutscher Wetterdienst in Offenbach	E. Walton
21-25 August	R.M.S., A.M.S. and D.M.G. joint conference on Meteorology over the Tropical Oceans, London	K. Arpe A. Hollingsworth J.-F. Louis
29 August - 1 September	EGS Fifth Meeting (Geophysical Fluid Dynamics) in Strasbourg	S. Tibaldi
13-15 September	Fourth International Conference on very large Data Bases, Berlin	M. Miqueu
17-20 September	Fourth Session of Communications Advisory Committee, Offenbach	J. Labrousse R. Newson
20-23 September	ACM Meeting on Graphics, Bologna	A. Lemaire
24-30 September	Visit to CRAY User Group, Princeton, New Jersey	T. Stanford
27 September - 4 October	JOC Study Conference on Parameterization of extended cloudiness and radiation for climate models, Oxford	J.-F. Geleyn
8-14 October	CRAY factory trial and tripartite meeting (CRAY/CDC/ECMWF), Minneapolis	P. Gray A. Storner
9-13 October	ECODU - 26th Conference, Baden-Baden	R. Brinkhuysen
9-13 October	WMO/CBS Information Planning Meeting on Codes, Messages and Identifiers, Geneva	J. Labrousse R. Newson
16 October - 3 November	Visits to NCAR, CDC and CRAY Research in Minneapolis and VIM Conference in Boston	A. Lea
17-20 October	RA VI Meeting, Prague	A. Woods
24-27 October	Seminar on Data Base Structures and Access Methods, Amsterdam	J. Chambers
1-18 November	Visit to UCLA, Berkeley, California, NCAR, and participation in CBS VII in Washington	J. Labrousse
5-8 November	European Network Users Workshop and visit to Météorologie Nationale, Paris	P. Quoilin K. Wilke

20-24 November	Second session of the WMO EC Inter-governmental Panel's Working Group on the FGGE Data Management, Moscow	P. Kallberg S. Uppala
27 November - 2 December	CAS, Working Group on Weather Prediction Research, Peking	L. Bengtsson
8-9 December	ECODU Communications Committee, Paris	F. Königshofer
12 December	Royal Society, conference on "Middle Atmosphere as observed from balloons, rockets and satellites", London	K. Arpe A. Simmons

Annex 6

Publications by Members of Staff

- Burridge, D.M. "A Fast Poisson solver for large grids."
Temperton, C. (Accepted for publication in the Journal of Computational Physics).
- Geleyn, J.-F. "An economical analytical method for the computation of the interaction
Hollingsworth, A. between scattering and line absorption of radiation."
(Accepted for publication in Beiträge zur Physik der Atmosphäre).
- Labrousse, J. "Le Centre Européen pour les prévisions météorologiques à moyen
Louis, J.-F. terme."
Geleyn, J.-F. (Published in La Météorologie, Sept. 78 Series VI, No. 14).
- Savijärvi, H. "The interaction of the monthly mean flow and large-scale transient
eddies in two different circulation types. Part III: Potential vorticity
balance."
Geophysica, Vol. 15, No. 1, pp. 1-17, 1978.
- Temperton, C. "A Fast Poisson solver for an octagonal domain."
Published in Computers, Fast Elliptic solvers, and Applications. ed.
U. Schumann, Advance Publications, 1978.
- Temperton, C. "Direct methods for the solution of the discrete Poisson equation: some
comparisons."
(Accepted for publication in the Journal of Computational Physics).
- Tibaldi, S. "Cyclogenesis in the lee of the Alps: A Case Study."
(with A. Buzzi) Q.J.R. Met. Soc., 104, 271-287, 1978.
- Wiin-Nielsen, A. "On Nonlinear Cascades of Atmospheric Energy and Enstrophy in a
(with T.-C. Chen) two-dimensional spectral index", Tellus 30, 313-322, 1978.

Annex 7

ECMWF Publications

Internal Reports (Research Department)

1976

- No. 1 User's Guide for the GFDL Model

1977

- No. 2 The Effect of Replacing Southern Hemispheric Analyses by Climatology on Medium Range Weather Forecasts
- No. 3 Test of a Lateral Boundary Relaxation Scheme in a Barotropic Model
- No. 4 Parameterization of the Surface Fluxes
- No. 5 An Improved Algorithm for the Direct Solution of Poisson's Equation over Irregular Regions
- No. 6 Comparative Extended Range Numerical Integrations with the ECMWF Global Forecasting Model 1: The N24, Non-Adiabatic Experiment
- No. 7 The ECMWF Limited Area Model
- No. 8 A Comprehensive Radiation Scheme designed for Fast Computation
- No. 9 Documentation for the ECMWF Grid-Point Model
- No. 10 Numerical Tests of Parameterization Schemes at an Actual Case of Transformation of Arctic Air
- No. 11 Analysis Error Calculations for the FGGE
- No. 12 Normal Modes of a Barotropic Version of the ECMWF Grid-Point Model
- No. 13 Direct Methods for the Solution of the Discrete Poisson Equation: Some Comparisons
- No. 14 On the FACR (I) Algorithm for the Discrete Poisson Equation
- No. 15 A Routine for Normal Mode Initialisation with Non-Linear Correction for a Multi-Level Spectral Model with Triangular Truncation
- No. 16 A Channel Version of the ECMWF Grid-Point Model

1978

- No. 17 A Comparative Study of Some Low Resolution Explicit and Semi-Implicit Spectral Integrations
- No. 18 Verification and storing with empirical orthogonal functions
- No. 19 Documentation of the ECMWF Spectral Model
- No. 20 A Study of the effect of an interactive radiation scheme on a medium range forecast

Technical Reports (Research Department and Directorate)

1976

- No. 1 A Case Study of a Ten Day Prediction

1977

- No. 2 The Effect of Arithmetic Precision on some Meteorological Integrations
- No. 3 Mixed-Radix Fast Fourier Transforms without Reordering
- No. 4 A Model for Medium-Range Weather Forecasting – Adiabatic Formulation
- No. 5 A Study of some Parameterizations of Sub-Grid Processes in a Baroclinic Wave in a Two-Dimensional Model
- No. 6 The ECMWF Analysis and Data Assimilation Scheme – Analysis of Mass and Wind Fields
- No. 7 A Ten Day High Resolution Non-Adiabatic Spectral Integration: A Comparative Study
- No. 8 On the Asymptotic Behaviour of Simple Stochastic-Dynamic Systems

1978

- No. 9 On Balance Requirements as Initial Conditions
- No. 12 Data Assimilation Experiments
- No. 14 On Initial Conditions for Non-Hydrostatic Models

Other Publications

Operations Department

- | | |
|-----------------|---|
| Petersen, K. | Users Guide for ECMWF Contour Packaging, 1977 |
| Königshofer, F. | ECMWF's Telecommunications |
| Quoilin, P. | Procedures, 1978 |
| Wilke, K. | |

Research Department

The Parameterisation of the Physical Processes in the Free Atmosphere, ECMWF Seminar, September 1977.

The Interpretation and Use of Large-Scale Numerical Forecast Products, ECMWF Seminar, September 1978.

Annex 8

Scale of Contributions by Member States*

Belgium	3.43%
Denmark	2.02
Federal Republic of Germany	25.56
Spain	4.40
France	18.48
Greece	1.23
Ireland	.52
Italy	11.11
Yugoslavia	1.72
Netherlands	4.41
Austria	1.97
Portugal	.82
Switzerland	2.97
Finland	1.29
Sweden	3.93
Turkey	1.60
United Kingdom	14.54

Total:	100.00%
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*The applicability of this scale expired on
31 December 1978