

tions in the United States; part two includes a geographical list of personnel and institutions in Canada; and part three provides a similar list for Mexico. Parts four, five and six are delegated to an alphabetical index of colleges and universities in the three countries, and part seven is an alphabetical index of personnel.

Progress in Time Sharing

IN August 1966, the Computer Board was set up under the chairmanship of Professor B. H. Flowers to carry out, on the basis of planned development, the proposals for providing computers in British universities and research councils in the light of the Flowers Report of January 1966, and for ensuring that the facilities provided were fully used. The five Board members are Professor C. E. H. Bawn of Liverpool University, Professor Gordon Black of the National Computing Centre, Professor D. J. Black of Edinburgh University, Mr J. K. Steward of ICI, and Lord Halsbury; Mr L. S. Rutterford is secretary to the Board.

In accordance with the recommendations of the Flowers Report, which suggested the expenditure of a total of £17.68 million over a period of five years for the provision of computer hardware in universities, a regional centre is now being set up in Edinburgh. This is one of the three suggested centres—London, Manchester and Edinburgh—at which large computers with special facilities are to be installed for the general use of universities in the areas. The concept of a multiple access time sharing system at Edinburgh is, however, an additional feature which was not visualized at the time of the report. In comparison with the actual cost of the hardware, additional costs of consoles and software to furnish the multiple access systems are small and will not represent a major item of expenditure above that recommended by the Working Group. The University of Edinburgh will soon be taking delivery of a British computer, the English Electric 4/75. Several agencies have contributed to the cost of the computer and the software: these include the Computer Board, the Ministry of Technology and various research councils, particularly the Agricultural Research Council. The cost has not yet been settled, but the total so far committed is about three-quarters of a million pounds. Development of the system is being shared by the university and the manufacturers. Whether or not multi-access systems will be established at the two other centres has not yet been decided.

The University of Newcastle upon Tyne has already taken delivery of an American IBM 360/67 multi-access computing system which was installed in October and is currently undergoing tests. When operational, use of the machine will be shared by Newcastle and Durham Universities. £575,000 of the total cost of the computer was provided by a grant from the Computer Board. Communication terminals will be available in various departments of both universities and satellite computers can be attached to the central computer.

Research workers in two universities are developing their own multi-access facilities by building on to existing computers already at their disposal. Thus a smaller computer providing these facilities has been developed at Edinburgh University under Professor D. Michie for application to medical research work. This is based on the Elliott 41/20 model which was delivered

in early 1966. The software has been produced in the university, but the cost of salaries and expenses was covered partly by the MRC, partly by the SRC and partly by the university itself. There are twenty consoles connected to the system, any eight of which can be used simultaneously. In addition there are two remote consoles which are attached by telephone: one is at the National Institute for Medical Research at Mill Hill and the other is at the Department of Social Medicine at Edinburgh. The system involving the twenty consoles has been operational since this summer, but the two remote consoles will not become operational until the end of the month.

Serious work on multi-access systems at Cambridge began at the end of 1964 with the design of a multiplexor to attach to the Titan computer. Development of the hardware was a joint exercise between the university and International Computers and Tabulators, Ltd. The cost of the consoles and multiplexor was met by the SRC while the disc store, which represented the major item of expenditure, was ultimately paid for by the Computer Board. By November this year the multi-access computing service was running at more than a hundred hours a week. At present there are about twenty-five consoles and between sixty and seventy regular users: most of the consoles are in the mathematical laboratory, but there are others in the engineering laboratory, the chemical engineering and the medical psychology laboratories. Workers at Cambridge maintain that the multi-access system has greatly increased the productivity of its users, and has materially diminished the demand for specially rapid service through the ordinary computing system.

Indeed, multiple access computing systems are very much a subject of objective research and exploration in leading British universities concerned with computer science. Applications for the time sharing systems are being considered by the Computer Board, which has in mind the linking up of computer systems in various universities, particularly in the south-west—to provide a complex computer network.

Despite the advantages of a multi-access system which gives a large number of users immediate access to the large computing system and which allows intimate contact between the worker and the tool as well as providing—in principle—quick and easy programme development, several problems have to be overcome. For example, considerable difficulties have arisen at Newcastle in connexion with the software and the system is far from satisfactory. Similar difficulties have been encountered in the USA with the same model. Evidently, the most economic arrangement has yet to be worked out.

Environmental Research

THE Natural Environment Research Council enters its second year in a better state of organization than in its first. The report of the council for the year ending March 31, 1967 (HMSO, 11s.), describes what has been happening. Broadly, the council seems to have been digging itself in as a permanent part of the Civil Service, by setting up a headquarters (from which it has since moved), establishing specialist committees, and defining the details of recruitment and employment of staff. Scientifically, the council is making an attempt to originate policies of its own, and organize

more cohesively the research programmes it is responsible for. Already there are some signs that the divisions between disciplines which the council inherited have softened, although the establishment of separate committees to serve the separate arms of the council's activities is bound to preserve some of the distinctions.

The council is responsible for research in the United Kingdom which is concerned with the environment. This covers geology, oceanography, the Nature Conservancy, the Antarctic Survey, hydrology and forestry, and each of these broad areas has been provided with an advisory committee to establish policy and make recommendations about grants. The total income of the council over the year was just over £5¼ million: the table shows how this income was distributed among the competing interests:

Institute of Geological Sciences	£1.34 m	25.60 per cent
Nature Conservancy	£0.96 m	18.40
National Institute of Oceanography	£0.65 m	12.40
University grants	£0.68 m	13.04
University training awards	£0.44 m	8.33
Meteorological Office	£0.08 m	1.46
Hydrological Research Unit	£0.08 m	1.45
Grant aided laboratories	£0.70 m	13.30
Administration	£0.17 m	3.32

The main force of reorganization has so far been felt in the Institute of Geological Sciences (formerly the Geological Survey). Here a much wider research programme has been agreed, and the institute will be responsible for geological investigations of the continental shelf. The discovery of natural gas in the North Sea, and the increasing importance of the exploitation of sand and gravel, have stimulated this new development. During the summer of this year the first investigation was made, in the north Irish Sea, and preliminary work has also been done off Scotland and in the Moray Firth. There is a good chance that the institute will be moving out of London at some time in the future, although so far it has been impossible to find anywhere suitable. Difficulties of accommodation in London have proved "the most hampering factor for smooth progress during 1966" the report says, but the situation has been eased by the leasing of another building in Princes Gate, not far from the museum.

The Nature Conservancy has also undergone a complete reorganization since the coming of the council. The research has been regrouped into eight groups which the council has decided to call Habitat Teams. Each is responsible for a different habitat—Monks Wood Research Station looks after lowland grasslands and grass heaths, and wildlife in the agricultural environment, for example, while hill grasslands are the responsibility of the group at Bangor, and wetlands that of the group at Edinburgh. One of the council's principal preoccupations since the Torrey Canyon incident has been the study of coastal ecology, and this will be studied by the team at Furzebrook until the research station at Norwich is complete. One interesting conclusion reached by the Unit of Grouse and Moorland Ecology during the year was that grouse stocks can be considerably improved by burning small fires all over the grouse moors. The survey shows a direct correlation between the number of fires started and the grouse stocks, and the report suggests that by better management many of the Scottish grouse moors could be brought back to their former glory.

The most fashionable part of the council's work is that in oceanography. The Ministry of Technology, the report says, "is concerned to identify technological developments which can make use of any spare capacity of the Atomic Energy Research Establishment (Harwell) that may arise in the near future". The report then goes on to suggest that the ministry is thinking of turning Harwell's attention towards the technology of the sea and the sea-bed, and that this was the reason for the conference on the subject at Harwell in April this year. But the report makes clear that it intends to remain the prime co-ordinator of marine scientific research in Britain and to encourage the ministry to plan the commercial exploitation of the research findings. In other words, if oceanography is to be promoted to a major research industry by the British Government, the council has no intention of being outmanoeuvred by Harwell. It is clear, though, that more research vessels are going to be needed; the council recommends that a new vessel primarily intended for biological research, and for use by the Scottish Marine Biological Association and the universities, should be built. The Institute of Geological Sciences will need a new dual-purpose vessel, again to be used in conjunction with the universities, and two smaller vessels will be needed for coastal work. Finally, the council has made provision for a two-man submersible, capable of operating at 100 fathoms, with a support vessel. It would be surprising if the development of just such a craft by a British firm (see *Nature*, last week, **216**, 845; 1967) can have been entirely coincidental.

Apart from the ecology and geology of the coastline, and the geology of the continental shelf, the other major new development described in the report is in the hydrology and biology of inland waters. This will be done, the report says, by building up the Hydrological Research Unit so that it can carry out a comprehensive programme of research into all the factors affecting water balance in catchments, and develop an effective means of co-ordinating work in hydrology being done elsewhere. As if to demonstrate that this is more than a fine phrase, the council points out that the research effort of the unit has more than doubled since the council took over responsibility for it two years ago. And the council now intends to treble the present research effort by 1970.

All this has not been done without a marked expansion of the administrative side of the council. When the report went to press the staff was some seventy-five, and since then a further expansion to almost 100 has occurred. As a result of this expansion, the council was forced to move out of its offices in State House, and has now taken over eight floors in Alhambra House in Charing Cross Road. Even this, however, seems to be barely adequate for the council's purposes.

Research for Industry

THE Ministry of Technology is to set up industrial units in British universities to help industry by providing commercial consultancy and research services. For a start, the units will be established in four universities, at the College of Aeronautics at Cranfield and at the Risley establishment of the Atomic Energy Authority. The ministry has made a launching grant of about £1 million to get the units started, on the condition that