needs". In a section on submersibles, the committee says it has been difficult to extract statements from industry about their needs, and "the needs of the oil industry have been equally hard to identify in detail". This lack of enthusiasm suggests either that industry is being lackadaisical about golden opportunities or that everything is fine the way things are. The committee proposes to find out by, for example, commissioning a study from the Construction Industry Research Association on underwater construction. And early next year a systems analysis study of fishing which is being prepared by Hawker Siddeley Dynamics, Ltd, for the Ministry of Technology, should be available.

The hawks will be disappointed that oceanology includes not only submersibles but mundane things like dredging and cargo handling. The seabed in the English Channel and the North Sea is such that the extraction of sand and gravel is quite probably where money will be made, in the short term at least. An economic study of dredger operation and manufacture, prepared for the committee by the Programmes Analysis Unit of the Ministry of Technology, will be ready early next year. The committee is also concerned with the safety of offshore platforms, and a contract for a study is to be placed next year. But the review leaves the impression of bringing together a spectrum of diverse topics related only by their connexion with the sea, and of course this is really all there is to oceanology. Meanwhile, Overseas Containers, Ltd, still determined to move from Tilbury to Antwerp, might be glad that the committee is considering "some problems arising in relation to container ships".

SCIENCE POLICY

Three Busy Years

THE Science Policy Research Unit at the University of Sussex is making its presence felt in science policy. The unit's third report, now published, shows that in addition to research in industrial innovation, science policy in developing countries and social studies of science, members of the research staff have played an important part in the work of the Organization for Economic Cooperation and Development (OECD), Unesco and several government departments and international agencies. The bulk of the unit's research seems now to be supported by contracts and grants from these bodies.

The unit is approaching the study of research and innovation in industry from a new angle. Instead of trying to analyse the reasons for success in innovation, the unit is concentrating on the causes of failure. The technique is to study pairs of attempted innovations, one of which has been relatively successful while the other failed (judged in market terms); comparisons between each case history should throw some interesting light on the innovation process. Another project, sponsored by the Engineering Industry Training Board, is an attempt to predict the effects of changes in technology on manpower and training requirements for a small number of selected occupations. For example, the unit is studying the way in which changes in the technology of batch production machining may affect labour requirements. The outcome may help the EITB to modify its manpower demand extrapolations.

An investigation of science policy in developing countries, sponsored by the Ford Foundation, sets out to analyse the influence of differential rates of technological progress in advanced and developing countries on the export performance of the developing countries. Science policy in China is also being studied, despite difficulties in getting reliable information, and a start has been made on an analysis of the growth of the scientific instruments industry in India which should help to pick out some of the factors affecting the transfer of technology both within India and from abroad.

The unit also hopes that techniques of cost-benefit analysis can be applied to social studies of science and will contribute to the solution of problems of environmental pollution and other by-products of industrialized society. One scheme aims to compare the costs of safety precautions in operation and design of machinery and the costs of industrial accidents.

The staff of the unit now numbers thirty and is involved in postgraduate teaching and direct work for outside bodies. The director, Mr Christopher Freeman, has worked with the OECD and Unesco on problems connected with the measurement of scientific and technical activities. Other staff members have worked with the Canadian International Development Agency, the Economic Commission for Europe and various United Nations agencies.

OPTICAL TELESCOPES

Polishing a Blank

from our Astronomy Correspondent

WORK started this week, at the Newcastle upon Tyne works of Grubb Parsons, Ltd, on the eighteen-month task of turning the largest piece of glass ever imported into Britain into the primary mirror for the Anglo-Australian telescope (see *Nature*, 224, 935; 1969). Strictly speaking, the twenty-ton millstone-shaped block is a glass-ceramic, made out of a material called Cer-Vit developed by Owens-Illinois, Inc., of Toledo, Ohio. Because of its nearly negligible coefficient of thermal expansion, Cer-Vit is superior to the Pyrex and fused silica which was formerly used in telescopes, the 200-inch on Palomar Mountain included. Owens-Illinois has lately done a roaring trade in Cer-Vit—this year, blanks are being cast at Toledo for the 158-inch mirror of the Cerro Tololo Inter-American Observatory in Chile, for a 144-inch telescope to be installed in southern France and for the 150-inch Anglo-Australian telescope. Happily, Cer-Vit is also more easily prepared than conventional materials. The melt for the Cerro Tololo blank took only ten days to prepare, compared with a month for the Pyrex material of the Palomar 200-inch, for example.

The blank now in Newcastle was cast on April 9 this year and then transferred to a kiln where the physical properties of the material were adjusted by firing. The Pyrex of the 200-inch, on the other hand, had to be annealed for eleven months before shaping could begin. But the low-expansion properties of Cer-Vit yield only slight advantages in the grinding and polishing process, Mr D. S. Brown of Grubb Parsons said this week. Although at first sight it might appear that a Cer-Vit blank would deform less markedly than glass under the heat of grinding and

polishing, so that it should be possible to test the surface soon after each process instead of waiting for the blank to cool, what actually happens is that the heat causes air currents which spoil the optical measurements.

The blank will go through three stages at Newcastle to improve the accuracy of the surface from the one or two hundredths of an inch left by preliminary finishing at Toledo to a few millionths of an inch. First, two or three months of diamond milling will remove some three hundred pounds of material and

Uncrating the mirror blank.

leave all surfaces accurate to a few thousandths of an inch. Then about fifty pounds will be ground away from the surface, using successively finer abrasives, and the mirror will be given its hyperboloidal shape. Finally, polishing and figuring with cerium oxide will be interspersed with frequent optical tests at a test tower.

Grubb Parsons will also be shaping three secondary Cer-Vit mirrors for the Anglo-Australian telescope, the largest of them 58 inches in diameter, together with five flat mirrors for the Coudé optics. They are also making the telescope tube, and will be tendering for the telescope mounting next year. Naturally, Grubb Parsons is hoping that the experience gained on large mirrors, like the facilities which they have installed, will pay off in more contracts of this kind. The AAT blank, for example, is being prepared on the machine that shaped the 98-inch primary of the Isaac Newton telescope in a temperature-controlled workshop. The problem is of course that big telescopes are to astronomy as GeV accelerators to physics, and equally hard to come by.

STEEL INDUSTRY

Computer on the March

THE mobile computer ordered by the British Steel Corporation's BISRA laboratories for studying process control in the steel industry went through its first trials last week on a miniature rolling mill in London. In January the computer unit will move to the Spencer steelworks in South Wales for field trials on a steel making plant.

The mobile unit comprises a CON-PAC 4020 computer supplied by AEI-Elliott Automation at a cost of £100,000. The computer has a central processor with a 16K word store and a one million word disk backing store. There are 112 analogue input channels to take signals from the plant sensors to the computer and sixteen analogue output channels. Dr J. G. Wistreich, assistant director of BISRA, pointed out last week that it was part of BSC policy to buy the best computer for the task, irrespective of origin, and there had been no pressure to buy from a British company.

The mobility of the new unit will allow the computer to be used on a variety of processes. At the Spencer works, for example, the computer will be linked to monitoring sensors in the furnace and will compare performance with a prescribed model. The object is then to refine the model so as to work towards automatic control of the furnace. At the beginning, the computer will not be used for controlling the plant.

The steel process to be monitored at Newport is an ideal candidate for automation. Accurate control of oxygen flow during the half-hour blow is critical for maintaining the temperature of the furnace at its optimum value, and control of the charge towards the end of the blow is also important for obtaining steel of the required composition. The computer will be used to evaluate models for controlling the temperature and also for regulating the carbon content of the final steel. The first trials should be completed by the middle of 1970. The sintering of iron ore and the operation of rolling mills seem to be two processes next in line for the mobile computer.

One objective is that plant managers should have some incentive to experiment with computerized control before committing large sums of money to this end, and BISRA is confident that there will be plenty of clients for the unit.

RADIO TELESCOPE

Progress at Effelsberger

THERE seems nothing to prevent the large radio telescope in West Germany from being the largest fully steerable paraboloid in the world when it is finished in spring 1971. Construction is smoothly on schedule. The minor crisis this time last year, when an overspend of some DM4 million over the funded amount of DM30 million threatened to bring work to a standstill (see *Nature*, 220, 634; 1968), was resolved early this year. The two principal contributors, the Volkswagen Fund and the Federal Ministry of Research, agreed to guarantee a further sum.

Almost all the support structure for the dish is now in place (see photograph). The overall design is similar to the Jodrell Bank Mark I telescope, but will be