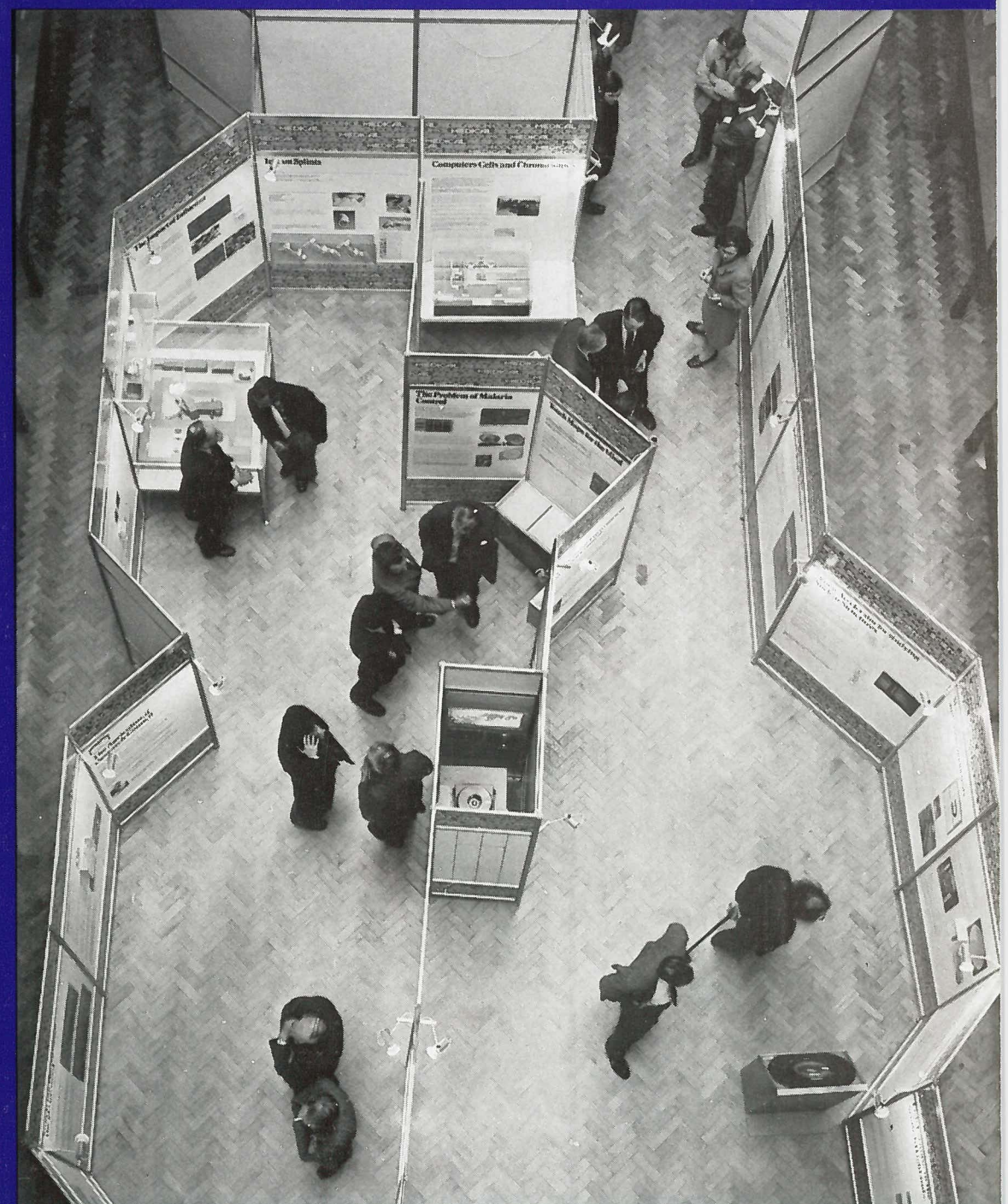
QUEST

Vol 9 No 1



QUEST

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Cover

Cover picture shows an unusual view, taken at a press preview last November, of the Research Councils' Exhibition, at the Royal Scottish Museum, Edinburgh. The exhibition, which has now transferred to the National Museum of Wales, is on view in Cardiff until 28 March.

Photo by courtesy of 'The Scotsman'

Contents

The car of the future?

One of two test vehicles used to study energy requirements and fuel utilisation in conventional automobile drive systems

Work at the University of Warwick, where Dr Mike Hughes and his team have a six-year, £39,000 Council grant, for the study of the feasibility of a hybrid car, has reached an interesting stage. The method of approach is to fit specially designed instruments to a standard car such as a Ford Cortina or a Chrysler 'Hunter' series, to measure and record continuously the vehicle speed, and the torque transmitted via the propeller shaft, whilst the vehicle is being driven 'normally' over selected representative routes. On return to the University after the test, the recorded data is processed, using an XDS Sigma 5 computer provided by the Council, to yield hitherto unknown details of the second-to-second demands on energy from the engine, made by the driver in the course of extracting 'normal' performance from the vehicle.

Further analysis of the data can show how this energy could be supplied, as demanded above to a *hybrid* power train, from *two* or more energy sources, such as a reasonably conventional engine, a bank of batteries, or even a rotating fly-wheel. A popular concept of a hybrid car consists of a vehicle fitted with a smaller than normal conventional engine, petrol or diesel, operating over a carefully chosen, restricted range of power and speed, thus permitting finger tuning for efficiency, and lower levels of exhaust pollutants and noise. This engine would supply the *average* power during a journey, but, to provide for acceleration demands, would be supplemented by energy drawn from electric batteries carried on the vehicle. The *hybrid* characteristic of the scheme is the combination of the mechanical and electrical systems, for which a

SRC supported staff, working on the project. From left to right, back row: Mr D Hurtley (Research Fellow) and Dr M T G Hughes (Principal Investigator). Front row: Mr T M Winter (Assistant Research Officer), Mr J N Devlnpia (Research Officer) and Mr G S Gill (Research Student)

carefully devised control strategy will be required.

It will be an important part of the research project to ascertain whether energy losses due to the additional energy transfer processes required by the hybrid configuration will be more than offset by the extra efficient use of the engine.

Signal conditioning equipment and instrumentation power supplies are carried in the luggage compartment of the test vehicle

Warwick have not re-invented the hybrid car, which has already received attention, notably in the USA. Their 'invention' is their original approach, whereby the analysis of requirements is matched to standard family cars of mass consumer appeal, with the object of examining *real* journeys, complete with full range of known and unknown variables, as opposed to the use of rather arbitrary 'standard' duty cycles, in which particular aspects of vehicle performance have been lumped together in the interests of ease of application. The latter approach is not seen by Warwick as a fair test of a hybrid vehicle, since it fails to examine the effects of actual transient demands on engine and batteries, and it is on the satisfactory handling of these transient demands that the success of the hybrid vehicle will depend.

The Teaching Company

A scheme to provide manufacturing engineers with the industrial equipment of a teaching hospital has been proposed by the Council and the Department of Industry in a recent consultative document called "The Teaching Company". Through the scheme, selected well-managed and successful manufacturing firms would, in partnership with university and polytechnic departments, become "teaching companies" in which young engineers under the supervision of industrial and academic staff would receive training at postgraduate level in the advancement of manufacturing. At the same time, they would help to introduce advances in production and management methods in the collaborating firm. Their practical work would be complemented by instruction at their university or polytechnic.

The scheme, which is intended to improve postgraduate training in manufacturing industry would be financed through the Council, the DOI and the co-operating firms and educational institutions.

The document suggests that programmes at the individual firms and educational institutions would be co-ordinated and cross fertilised by a central administrative group which would provide a sense of unity to all the trainees and staff taking part in the programmes at the "teaching companies". The group would ensure that the results of the research carried out were made known and help to convince schoolchildren and others that manufacturing engineering is an exciting and rewarding profession.

The Council and the DOI intend to decide this year whether to adopt the proposed scheme and are inviting comments on the proposals. In the meantime, limited programmes have started at four prospective companies. In consultation with the Social Science Research Council, SRC and the DOI have appointed a working party under the chairmanship of Professor L Maunder of Newcastle-upon-Tyne University to consider the comments made on the proposals, ensure that the first programmes proceed satisfactorily and recommend how the scheme should be developed.

Council Commentary

October to December 1975

Membership

In October, the Council welcomed Professor Jinks (Birmingham University) the new Chairman of the Science Board, and Professor Polkinghorne (Cambridge University) as new members.

The Council formally agreed a resolution seeking Privy Council approval to an amendment of the Council's Charter. The proposal is that the maximum size of the Council be increased from a Chairman and fifteen members to a Chairman and eighteen members, of whom not more than four should be Departmental members. The proposed increase will allow the balance of academic members to be improved while maintaining membership from industry and government.

(Note: Formal approval of the proposed amendments to the Council's Charter has now been obtained.)

Finance

(*i*) *Estimates 1976/77*

As part of the government's counter-inflation policy, the basis of updating Estimates allocations for inflation has been altered by the new "cash-limits" procedure. Although the Government has still to announce its Public Expenditure plans, the Council expects to receive a 1976/77 Estimates allocation about £6M lower than would have been expected under the previous system. In November, the Council, following a meeting of Board Chairmen, agreed a 1976/77 Estimates submission of £113M.

(*ii*) *Guidelines for the Forward Look 1977/78–1981/82*

In November, the Council approved the financial guidelines to be used by Boards in preparing the 1977/78–1981/82 Forward Look. The Council's Forward Look will be submitted to the Advisory Board for the Research Councils in April 1976. Provisional DES guidance suggests that the Council's resources after 1976/77 will be reduced by about 2% per year in real terms until 1980/81. This provisional planning assumption will be reviewed in the 1976 Forward Look exercise.

December Review Meeting

In December, the Council held a special review meeting with Board representatives at Reading University. The main issues discussed were the SRC methods of supporting research in universities and polytechnics and the related SRC policy on extramural research manpower. Proposals arising out of the meeting will be considered at later Council meetings.

Postgraduate Training

(*i*) *Postgraduate Awards*

The take-up of studentship awards in 1975 is expected to be about 3550 compared to the 3620 awards available, of which Co-operative Awards in Science and Engineering (CASE) are expected to number over 300 compared to the target of 240. There were nearly 200 unsuccessful appellants in Science (including NP and ASR). However, the Council was particularly pleased with the increased take-up of CASE awards.

For 1976 Council has decided to make 3300 awards available. The reduction in awards compared to 1975 reflects the reduced numbers expected to graduate in science and engineering in 1976 (3% and 8% respectively) and also the pressure on the Council's funds. Council agreed that the allowance for CASE studentships in 1976 should be 310 although extra awards will be made available as necessary.

(*ii*) *SRC Postgraduate Training Reports*

SRC has recently published two reports* on postgraduate training, namely the Report of the Working Group on Postgraduate Training under the Chairman and the Second Report of the Joint SRC/SSRC Committee Report. The reports have been widely circulated for comment to all interested parties and Council in October agreed that it should hold a series of regional meetings to allow the academic community to discuss the Council's future policy on postgraduate training in the light of the two postgraduate reports. The meetings will also discuss the Council's new methods of supporting research following the Reading Review Meeting (see above). Universities and polytechnics will be invited to nominate academic representatives to attend the meetings. It is hoped that some postgraduate student representatives and industrial members of the Confederation of British Industries, the Council of Engineering Institutions and the Council of Scientific and Technical Institutions will also attend.

* For details see Council Commentary in Quest Vol 8 No 3.

Data Compilation
SRC took over responsibility for the compilation of critical data in April 1974 and the Council subsequently set up a Data Compilation Committee to advise it on the organisation and extent of SRC support required in this field. Council in accepting the recommendations of the first interim report from the Committee, at its November meeting, endorsed the Committee's highly selective approach to the establishment of new data bases and agreed that Boards and Committees should be invited to consider whether there are any areas within their remit on which the compilation of data should be encouraged by SRC. Council also agreed that the remit of the Committee should be broadened to advise generally on scientific and technical information matters.

Astronomy Space and Radio
(*i*) *Termination of the Skylark Programme*
Council in November endorsed the decision of the ASR Board to terminate the standing Skylark Rocket programme. There will be a controlled run-down of the programme and by 1978 a saving of £4M per annum will result. The Board took this decision in order to ensure that some new projects can be started before the end of the decade. Council expressed its appreciation of the willing co-operation provided for this successful programme by RAE Farnborough, BAC Ltd and the Australian authorities over some 20 years.

(*ii*) *EISCAT*
In May 1975, Council gave conditional approval to UK participation in the proposed collaborative European Incoherent Scatter Facility (EISCAT)* by provision of a VHF transmitter. It had since become clear that a combined VHF/UHF transmitter would provide significant savings. The Council reaffirmed its approval of UK participation in the proposed VHF/UHF EISCAT project and agreed to contribute £2·4M towards its capital cost subject to DES approval. [N.B. This scheme has now been approved and the six-country EISCAT Association has come into being.]

(*iii*) *IRAS*
In November, Council agreed in principle, subject to DES approval, that SRC should participate in the Dutch/NASA Infra-red Astronomy Satellite (IRAS), the spacecraft for which will cost about £22M. This project will carry out the first infra-red satellite sky survey and its results are expected to have a major impact on the future of the fast developing subject of infra-red astronomy. Council has agreed that the UK should provide a fixed price contribution of £2M to the project, together with an offer of observing time on SRC facilities for Dutch astronomers. In return UK scientists would have immediate access to the survey results and the bulk of the UK contribution will be spent on contracts with British industry.

(*iv*) *Northern Hemisphere Observatory* (*NHO*)
The Council in November received a progress report for 1974/75 on the NHO project and proposals for its next phase. The main development was that La Palma was now the preferred site for the proposed Observatory. It was hoped that, under an international convention, an institute for astrophysical research would be established, which would allow a number of European countries (including the UK) to use this observing site. The Council reaffirmed its full support for the project and approved the proposed scheme which included the modification and transfer of the Isaac Newton Telescope (INT) to La Palma from RGO. Formal DES approval will be sought for the various phases of the scheme at appropriate times.

(*v*) *Revised Costs of UK-6 Satellite Project*
The Council approved increases in cost of the UK-6 project of nearly £1·4M arising from increased NASA launch costs and slippage of the project. The approved cost estimate for the project up to launch, now planned for January 1978, is £7·557M.

(*vi*) *Replacement of the Appleton Laboratory's Argus Computer at Chilbolton*
The Council in October approved the proposed replacement of the Chilbolton Argus computer by a 2 processor system at a cost of up to £110K.

(*vii*) *Research Grants and Contracts*
The Council approved:
(a) additional costs of £304K for the Multi-Telescope Radio-Linked Interferometer project of Professor J G Davies (University of Manchester);
(b) an SRC contribution of £164K towards the costs of the Mullard Radio Astronomy Observatory (University College, London) for the calender year 1976;
(c) the placing of a contract with Imperial College London for the continued operation of the 1·5m flux collector at Tenerife until 31 December 1977 at a cost of £111K.

Nuclear Physics
(*i*) *EPIC*
Council learnt at its November meeting of the decision of the German government to proceed with the PETRA project. They welcomed this far-sighted decision but noted that it meant the end of the imaginative EPIC project.

(*ii*) *NP Board Committee Structure*
Council approved the revision of the NP Board Committee structure. The four main committees,

* See Quest Vol 8 No 2.

Picture shows backrow (from left to right): Dr E Dunford, Miss J Donohue, Mr P Seager, Mr P Casey, Mr W M Bray, Mr J T Reader, Mr R St J Walker, Professor V C Reddish, Mr M W Message, Dr J M Valentine, Mr A H Spurway, Professor A Ashmore, Mr R Edmonds, Mr A J Egginton; front row (from left): Mr R F Childs, Mr G Scott, Miss C J E Penny, Mr J D Clenaghan, Miss A C Hilton, Mr F Farrimond, Mr R W H Morgan, Mr V Foley, Mr J H Aram (Vice Chairman), Professor Sir Sam Edwards (Chairman), Mr B E Broughton, Mr J B Visser, Mr M O Robins, Dr J A Saxton, and Dr A Hunter

SRC Whitley Council

Inaugurated in December 1965, its constitution provides the machinery for consultation between the SRC's administration, in its capacity as employer, and its non-industrial staff, as represented by members appointed by staff Associations having members employed by SRC, with a view to securing the greater measure of co-operation to increase efficiency in the SRC combined with the well being of those employed. While the full Whitley Council meets only once a year, consultations and negotiations between the Official Side and the Staff Side are conducted both by informal contacts and through discussions in sub-committees of the General Purposes Committee which is the main negotiating body of the Whitley Council. Apart from the Staff Side Chairman and Secretary, who are given secondment full time from their official duties, all time devoted to Staff Side activities by other members is purely of a voluntary nature.

Council Commentary (*continued*)
Film Analysis Grants, Nuclear Structure Grants, General Grants and the Laboratories Committee, will be wound up and replaced by two main committees, Particle Physics and Nuclear Structure, with a Nuclear Physics Theory Sub-Committee to advise each Committee on theoretical studies. The Film Analysis Grants Committee will become a subcommittee of the Particle Physics Committee. The NP Board will also establish a Standing Committee on all matters relating to CERN.

(*iii*) *Nuclear Structure Facility*
Council approved an increase in the capital cost of the NSF project of about £1·9M bringing the approved revised cost £9·856M (at June 1975 prices). The increase was due to inflation rather than design changes but, in view of the financial climate, some rephasing of the project might be required.

(*iv*) *Enhancement of the Rutherford 370/195*
Council approved enhancement of the Rutherford IBM 370/195 computer at a total cost of £240K. This would allow upgrading of the magnetic tape system and purchase of a second block multiplexor and eight Menorex disk drives.

(*v*) *Research Grants*
Council has approved consolidated grants for the five major Film Analysis Centres (namely Birmingham, Glasgow, Liverpool and Oxford Universities and Imperial College London) totalling £981K for the year ending 31/1/77 subject to some reductions by the NP Board.

Approval has also been given to two grants to allow nuclear structure research groups at Birmingham and Oxford Universities to utilise Harwell accelerators. The grants total £240K for the year ending March 1977. The Council has also approved an annual consolidated grant of £109K to Birmingham University for nuclear structure research for the year ending January 1977.

Science
(*i*) *Purchase of a Nuclear Magnetic Resonance Spectrometer*
The Council approved the purchase of a WH 180 WB nuclear magnetic resonance spectrometer at a cost not exceeding £150K to provide a general service. The location of the spectrometer is still to be decided. This instrument uses a super-conducting magnet with a very large bore, enabling high-resolution NMR spectra to be obtained from samples as large as 25 ml.

(*ii*) *Research Grants*
The Council approved a grant of £109K over three years to Professor M M W Thompson et al Sussex University for the study of particle-solid interactions.

SRC and noise control

More than half a million people, in the manufacturing industry alone, work in an environment which may cause permanent deafness unless precautions are taken. These facts came from a survey carried out by the Factory Inspectorate for the Industrial Health Advisory Committee. In 1972 a code of practice was issued, which recommended maximum acceptable noise levels for the protection of industrial personnel and it is likely that legislation will follow.

The present state of noise control is such that reduction of noise levels to acceptable limits (at present 90 decibels—roughly equivalent to the noise of a motor-bike revving up), is sometimes extremely difficult. Many industrial users are already pressing manufacturers to provide machinery with noise levels substantially lower, to meet any possible further lowering of acceptable limits, or to improve the working environment in their factories and the cumulative noise levels of machinery within a localised area.

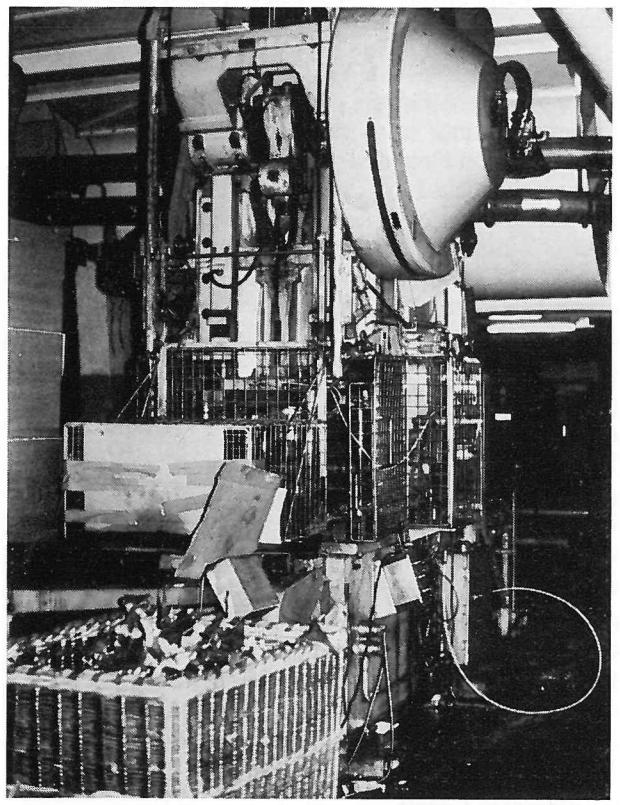
An appropriate grant in this field of study, is one which the Council made last summer, when the Institute of Sound and Vibration Research at Southampton University was awarded a three year £121,000 grant to study industrial machinery noise and to find ways of reducing it.

The grant will establish an Industrial Noise Research Unit under the direction of Professor E J Richards. He founded the Institute, which has a world reputation in matters of acoustics, some eleven years ago and has given up the Vice-Chancellorship of Loughborough University to lead the Unit.

The Unit's work will be related to deafness in places of work such as factories, lorry cabs and construction sites. Its first objective is to collect information on the fundamental nature of the most serious noise problems in factories or offices. This survey of industry will be carried out with the help of both the Health and Safety Executive and, of course, relevant industrial firms. Then research will be undertaken to develop quieter but still practical techniques of production for industry.

Fundamental work on reduction of noise from individual sources within machines will be complemented by studies of the combined effects of the many different sources in entire installations: for instance noise from manipulative machines and mechanical noise in hand-held tools and woodworking machinery.

The Unit will establish close links with industry, and research into modifications of entire machines will take place both at industrial sites and at the Institute using machinery loaned by industrial companies. The Unit ultimately aims to help industrial users and manufacturers of machinery to reduce levels of noise by the production of design guides, the dissemination of advice through the advisory service of the existing Wolfson Unit for Noise and Vibration Control at the University, and by offering short courses on noise control.



Picture shows a typical press used in an industrial process. It is used to press out small containers (such as freezer containers) from aluminium foil sheet

Preserving our resources

Recent speakers at the Rutherford Laboratory's monthly general lectures have highlighted the problems of the world's limited energy resources. Gordon Fraser, the lab's new resident technical editor took time off from editing to report for Quest on these topical issues. In the first lecture Dr John Davoll, Director of the Conservation Society, took a pessimistic view, saying that the whole motivation of industrialised society is 'mad'.

"The whole drive of industrialised society, judged on anything but a short-term basis, is mad," alleges Director of the Conservation Society Dr John Davoll, comparing the situation to the philosophy of Captain Ahab, who said "All my means are sane: my motives and object mad".

"The outcome of an exponential growth of technological skill inspires fear rather than admiration," Dr Davoll says. "A minimum of eight billion people living in a highly industrialised world would be supported by a huge technological equivalent of the biosphere, with wastes being recycled by energy from thousands of breeder reactors, fusion reactors and orbiting arrays of solar cells."

"With a population and level of economic activity far beyond the capacity of the battered remnants of the biosphere to support, it will be necessary for our only partially sane species to manage the mechanism for ever, phasing in new resources exactly as needed."

"Consider the life this would offer," Dr Davoll continues, "Human behaviour would need to be wholly predictable and controlled in a highly optimised physical and organisational structure which itself could be highly unstable—a prospect which makes the effects of today's malaises seem like momentary unease."

Dr Davoll basically questions the need of industrialised society to continually increase its flow of goods. Only a minor fraction of the world's energy output goes into providing warmth, food and shelter while the remainder goes into increasing the flow of consumer goods demanded by the developed nations.

Turning to possible solutions to resolve the world's energy problems, Dr Davoll proposes that it is quite possible that a more labour-intensive system, using maximum recycling of wastes, could supply an adequate, if largely vegetarian, diet indefinitely for the whole population of the world.

He declares that in future our economy will need to be based on stock in which durability, ease of maintenance and design for reuse and recovery are especially important. Overall a change of emphasis is required away from progress as an increase in material possessions by the individual towards progress which strives for a more broadly satisfactory society and for pride in common achievement.

"The acceptance of the idea of an economically steady-state society is essential if an adequate environmental policy can be set up before the present one begins to break down," he asserts, warning that the present growth patterns in both population and consumption have considerable inertia and cannot therefore be modified within the space of a few years. Once the rot sets in and shortages of essentials become severely felt, there might be little chance of peaceful change.

Another problem he declared is that the majority of people have no wish to exchange the high standard of living which they enjoy today for nebulous promises of a better environment and they are therefore reluctant to advocate any changes which might make their position perilous.

"I do not believe that my assessment of the situation should lead to despair, or to any abandonment of action," concludes Dr Davoll. "Continuous growth can only be a limited phase, insignificant in terms of length to the span of human history, and eventually we will be forced back to a lower level of population and economic activity. This will involve crossing unknown but perilous social terrain, and the further we continue to grow economically, the longer this journey will be. But understanding that growth could never have solved our problems anyway, may make this journey a little easier."

A few weeks later, Ian Glendenning of the Energy Studies Group at the Central Electricity Generating Board's Marchwood Engineering Laboratories proposed that natural sources of energy, particularly wave power, could provide important new sources of energy to satisfy the needs of an energy-hungry society.

With the increasing awareness of the limited resources of fossil fuels and even nuclear fuel available to mankind, some people have begun to look to the possibilities of apparently limitless power available from the sun, the earth, the atmosphere and the oceans. Scientists from the CEGB's Research Department have been looking at the prospects which these natural power resources offer.

"Despite the fact that Britain is one of the windiest places on earth, a barrier of windmills around the entire coastline of the British Isles would provide only a small fraction of the country's power requirements—less than ten per cent of the present installed capacity in the UK" says Ian Glendenning, head of the long-term studies group at Marchwood.

Apparently the economic generation of electricity by wind power only becomes feasible when the average wind speed exceeds about nine metres per second, and a survey conducted some years ago by the Electrical Research Association found only thirty nine sites in the UK which were suitable.

"Wind power," says Mr Glendenning, "is therefore not likely to make a major contribution to the country's overall power requirement, but individual small stations, say of about 1MW capacity, might be useful. Moreover the Dutch, with a deep-rooted tradition of windmills, are apparently considering a national windmill research programme."

Another potential source of energy with which Britain is particularly well-endowed is ocean tides. The waters around Britain have a wide range of tidal patterns, and a French pilot scheme has been in operation for many years, in the Rance Estuary, off the coast of Brittany, but has encountered problems with silting, Mr Glendenning points out.

Electricity is produced from tidal energy by trapping a high tide behind a barrage and making it drive water turbines as it returns to the sea at low tide, explains Mr Glendenning. Because the available energy is proportional to the square of the tidal amplitude, about two-thirds of the available tidal energy around Britain is concentrated in the Severn Estuary, he continues. This source alone could provide up to 10 per cent of the country's present power consumption.

But the energy available from just two high tides a day means that a single barrier is not sufficient if a constant supply of energy is to be made available. One way to do this, Mr Glendenning suggests, is to construct multiple barriers so that water can flow from one to another at various times of the day, so ensuring a more or less constant output of energy from a limited number of high tides.

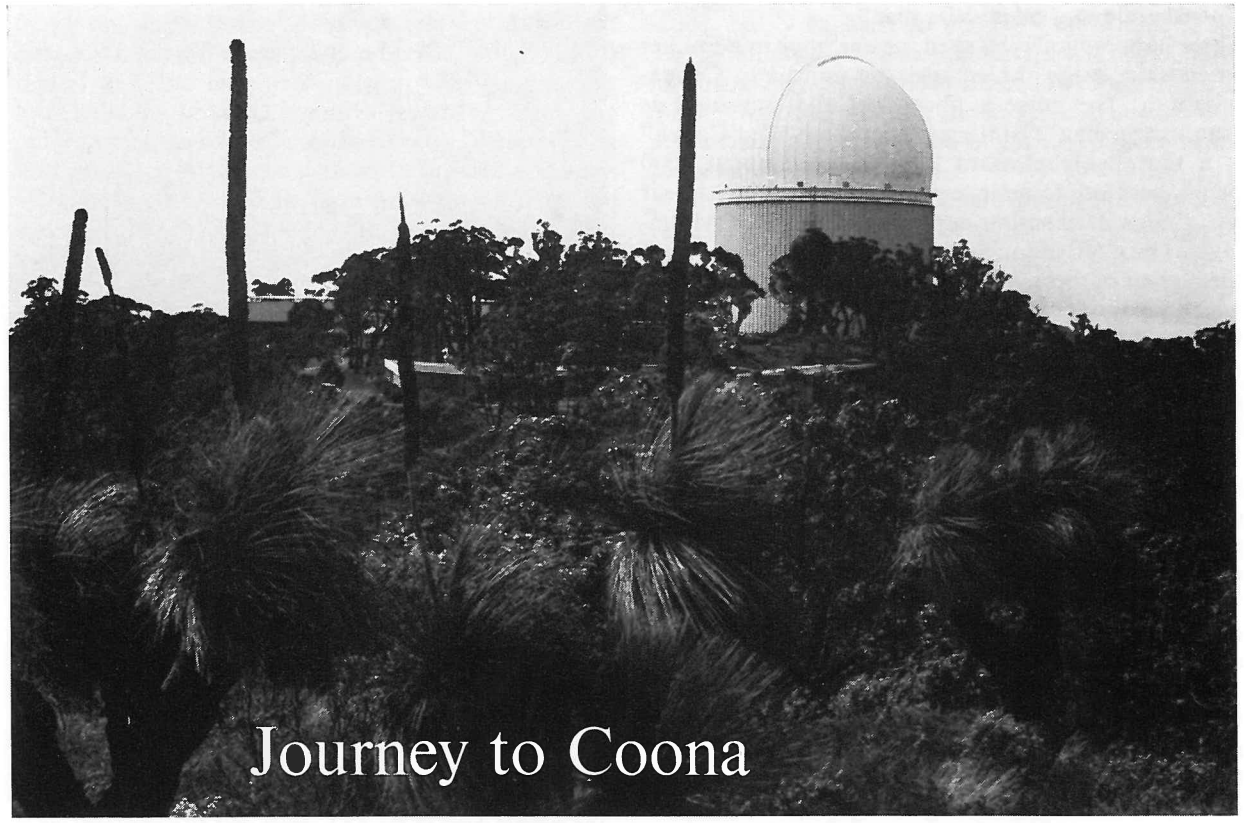
Another problem is that tidal energy cannot be exploited piecemeal. Unlike a windmill solution where more and more windmills can be constructed as time and available resources allow, generation of electricity from tidal energy demands the construction of some vast installation, with all the difficulties and uncertainties which such a large project entails.

As well as the tides, the water waves themselves can be considered as new sources of electrical energy. Again Britain has an ample supply of wave power, and, as Mr Glendenning points out, it has a seasonal peak in the winter which closely matches the demand for electrical power. On the debit side, the available power is not predictable and adequate storage or standby units would be required to provide the necessary output during calm weather.

Mr Glendenning tells of a floating 'duck' which has been developed to extract power from waves and is thought to achieve conversion efficiencies of up to 90 per cent, many times that of other mechanisms which have been proposed.

Before wave power can be exploited on a large scale, there are technical difficulties to be overcome, for instance the provision of adequate cables to bring the current to dry land where it is needed. Alternatively large power-consuming units could be based on floating platforms.

Initial work in the laboratory had produced schemes for converting wave power to electricity which are highly efficient and look promising, and that only a relatively small investment would be required to produce a working prototype wave power plant, concludes Mr Glendenning. If this were successful, a concerted wave power programme could make a significant contribution to the country's energy resources within a relatively short time and within the existing technological framework.



Journey to Coona

Picture shows the AAT dome seen from grass trees standing just below the summit of Siding Spring Mountain

D ALLEN

The seasoned astronomer must be congenitally nomadic: globetrotting is his way of life. If not at a conference in an Austrian ski resort he may find himself lazing on Waikiki Beach as a prolegomenon to tackling the rigours of cold nights on the bare mountain of Mauna Kea. In his stride he takes day-long flights to South Africa or the States. So when the roulette wheel of research fellowships stopped with "Anglo-Australian Telescope" displayed, shoulders were shrugged, visas acquired and suitcases packed.

Flight delays

All travellers have tales to tell, spicy morsels to toss in at the dinner table. If the Sydney radio announcements of international flight delays are acceptable evidence, Qantas passengers get more than their fair share. We were no exceptions: scarcely had we left behind the bustle of Amsterdam airport than two explosions jolted the starboard wing. A voice from the flight deck calmly announced that we were returning to London on three engines. We eventually limped into Sydney on Good Friday morning, twenty six hours late, to find a Marie Celeste city basking in what to us was an oppressive heat wave. (The radio stations continually insisted it was mild).

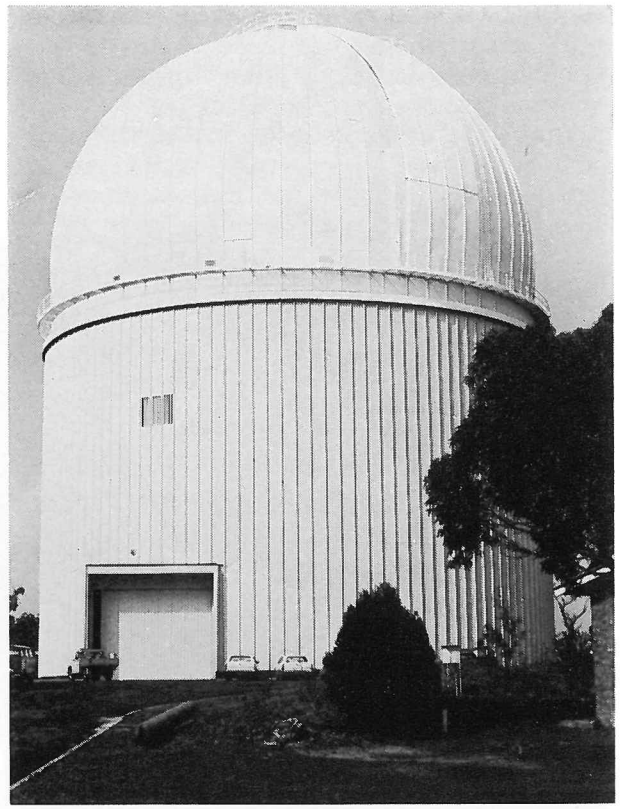
Observatory headquarters

The headquarters of the Anglo-Australian Observatory is in Epping and presently occupies three cramped portable huts in the grounds of the CSIRO Division of Radiophysics, the abode of most of Australia's radio astronomers. More spacious accommodation is under construction. It seems a far cry from the castle at Herstmonceux, but the mocking calls of mallards on the moat have been freely translated into the comic cackling of Kookaburras in the gum trees (memo: only toffee-nosed Poms call these trees eucalyptus). Epping is a pleasant enough suburb sporting much of the forests that must once have reminded settlers of the Motherland. It lies about ten miles from the cosmopolis, in the nor'west quadrant, and is spread thinly across an undulating counterpane of rounded hills and shady streams. Our first impressions of Sydney were of its similarity to California. The spacious streets, wooden bungalows, rows of used car lots and garages and the hint of photochemical smog in the air all stirred dormant memories of the Los Angeles basin. But on closer acquaintance we found Sydney to have a character of its own—unique Australiana glazed with only a thin Anglo-American veneer. Sydney is, in fact, quite a nice city.

Coonabarabran—"inquisitive man"

Three hundred miles by road, or one hour in a Fokker Friendship, takes the enthusiastic nomad to Coonabarabran. The name is aboriginal and translates as "inquisitive man": a fitting site for the AAT. "Coona" is a thoroughly pleasant little town of about 3000 people set close to a range of volcanic peaks that bear the almost Dickensian name Warrumbungle Mountains. The AAT sits on Siding Spring Mountain, one of the highest of these, at an altitude close to 1200 metres, which for the benefit of non-metric readers is about as high as the Cairngorms. It is remarkable how many major observatories are sited on volcanoes; in case persons of nervous disposition read this I should hasten to add that the last eruption of Siding Spring Mountain occurred about 13 million years BC. From the catwalk around the dome there is an extensive view over the bluffs and pinnacles of the Warrumbungles to the inland plateau which stretches from their feet towards the sunset and the edge of the world. The same view is shared by the bedroom windows of the observers' lodge and is the most beautiful from any observatory I have visited.

I used to believe that the 200-inch Palomar reflector was the finest telescope in the world. I have had to revise my judgement. The new generation of 4 metre telescopes marks a pronounced step forward in astronomical technology. Three giant eyes have been completed in the past few years: one at Kitt Peak, the sacred mountain of the Papago Indians of southern Arizona; one on the foothills of the Andes just inland from the southernmost tip of the Atacama Desert; one on Siding Spring Mountain. From the meagre comparisons I can make, the AAT is the best of these: it surely deserves to be, it cost the most.



The massive dome of the AAT stands over 50 metres high, its top is the highest point for over 50 miles

The tourist's view

To the average tourist who stops off on his way through Coona and makes the pilgrimage to the visitors' gallery it is no more than a gigantic piece of machinery that, like the ark, has run aground on a mountain top. This average tourist may be impressed by its sheer size, by the soaring grace of its horseshoe mounting, or the confident way it sweeps across the dome at the controller's merest fiat. More likely he will be impressed by its sleek pastel paintwork or by the rich wooden floor of the dome.

The computer's role

The observer, however, sees a whole new dimension to the telescope when he enters the control room. The buzzing of line printers, the hiss of tape decks and the random flashing of lights tell him that he has entered the den of a pack of computers, and indeed almost all the functions of the telescope are controlled by these beasts. The setting to any desired star, the tracking of that star across the sky, the rotation of the dome: all are computer controlled. For many purposes the taking of data is also automated. Gone are the long nights of discomfort when numbed fingers manipulate ice-cold knobs and levers, when red-rimmed eyes strain to focus a star barely bright enough to stir the rhodopsin into action. Much of the observing is performed in the fleshpots of the computers' den, a television screen replacing the eyepiece, a teletype instead of a spectrograph at the fingertips.

When the observing gets to be a little boring, a video disc can bring back one of the prettier objects observed last night or last month. I shouldn't be surprised if they soon start to intersperse the starfields with adverts. Nor is this all mere showmanship. Under computer control the telescope sets, guides and manipulates far better than in the hands of all but the most experienced observers. This giant hulk can be aimed at any chosen star with an accuracy of 2″ arc, which means that it is theoretically capable of selecting the left or right eye of a man three miles away across the Warrumbungles. Alas we are precluded from attempting this experiment: the telescope cannot be pointed close enough to the horizon.

The AAT is a humbling instrument, and not just because of its size. A great deal of money and effort has been put into making this telescope the best available to the astronomical community; the observations that come off it should repay this confidence, which in turn means that the astronomers who use it are under some pressure to select the most rewarding observing programmes. In addition to the director, therefore, six staff positions have been created to provide a nucleus of observers who will be familiar with the telescope and will be able to use it to the full. Two UK fellowships tenable at the AAT were also created by SRC to further swell this nucleus. Aside from the directorship, all staff positions and fellowships are for terms of 1–5 years, so there will be a continuous infusion of new blood and hence new ideas.

Siding Spring Mountain

The massive dome of the AAT does not stand alone on Siding Spring Mountain. There are three smaller telescopes operated by the Mount Stromlo Observatory, Australia's long established astronomical centre in Canberra. Here too is the UK 48-inch Schmidt telescope, busily engaged in mapping the southern sky. The proximity of the Schmidt and the AAT is valuable, for interesting discoveries made on the former can be quickly followed up with the larger instrument. With just a smidgeon of luck we might make some of our better discoveries this way.

The astronomers do not rule Siding Spring Mountain, however. In the dead of night most people opt out of driving round the summit area. This is not in deference to the observers' distaste of headlamps. Rather it is to avoid antagonising the true owners of the mountain top. From sunset to dawn, when astronomers are safely tucked up in their domes, Siding Spring resumes its time-honoured role: playground of the grey kangaroo. What right have we to displace them?

David Allen holds an SRC Fellowship tenable at the AAT. Prior to going to Australia in March 1975, he worked in the Astrophysics Division at the Royal Greenwich Observatory.

Select Committee Reports on Scientific Research

Scientific research in British universities, including the activities of the Science Research Council, is the subject of a new report from the Science Sub-Committee of the House of Commons Select Committee on Science and Technology which was widely reported in the national press.

While noting the 'high regard' in which many British scientific institutions are held by their counterparts overseas, the Sub-Committee does not think that all is well with the British system of research funding, saying 'we are deeply disturbed about the effectiveness of the universities' present contribution to the national scientific effort and believe that considerable changes in attitudes and practice may be required. This question will be the subject of further study, but the principle of enabling the universities to provide their staff with independent facilities for research is one we support."

The Select Committee employed a consultant to study SRC grant-giving who reported on the statistics he had gleaned from SRC's published data. He concluded that "there is room for further study of the extent to which the existence of a handful of highly favoured university scientists may influence the formulation of SRC policy." However, as an editorial in 'Nature' has noted, and as will be obvious to any member of SRC staff who follows the way grant-giving goes on, the consultant has completely misread the statistics and made elementary blunders in interpretation (SRC was not asked to verify any of the work).

Although the Sub-Committee acknowledged that there were difficulties in dealing with large numbers of grant applications and that dissatisfaction among disappointed applicants is inevitable, it nevertheless recommended that "the element of uncertainty, particularly when applications are made for the renewal of grants" could be reduced to a minimum, citing the example of an overseas research council which provides additional grants to cover the period after the termination of research grants to help staff readjust to a new situation.

The Sub-Committee agrees with the SRC's view that improved methods of support for 'engineering research' are needed and that the requirements in this direction of the natural sciences and the engineering

sciences are different, but rejects the idea of the creation of a separate 'Engineering Research and Development Council', saying that this would represent unnecessary bureaucracy."

Instead, the Sub-Committee says that there would be 'merit' in renaming the Council as the 'Science and Engineering Research Council', as this would emphasise the SRC's national role for funding research in both science and engineering.

The Sub-Committee also endorses the SRC's own recommendations that "a substantial improvement is needed in the training of future research workers and particularly for those many scientists and technologists whose careers should be outside the confines of research." It agrees with the views of the Council's own specially-appointed working party which recommends that broader, less specialised postgraduate education is called for, and that a number of research studentships should be awarded competitively to students who would then be free to choose the subject of research at any university with any supervisor. Some students could be selected by the SRC to work on particular topics of national importance.

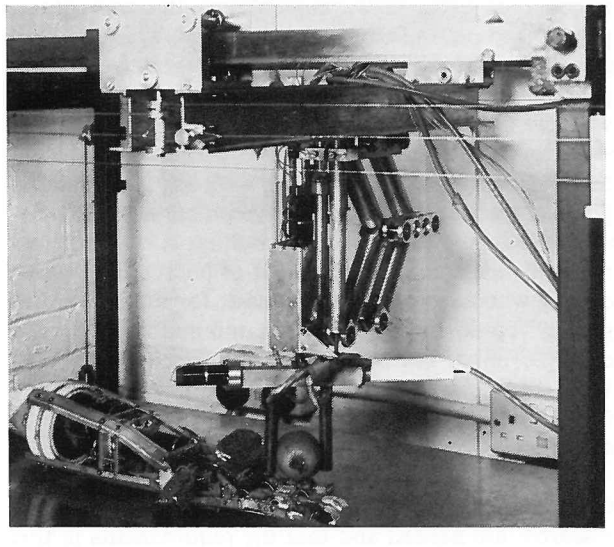
First Report from the Select Committee on Science and Technology—Second Report on Scientific Research in British Universities. HMSO, 75p.

The mechanical manipulator

Professor J M Nightingale of the Department of Electrical Engineering, University of Southampton has a £14,000 grant from the Council to investigate the automatic control of prehension and manipulation and here he explains the purpose of the investigation.

"Over the years the design of manipulating machines incorporating and extending the skills of the human beings has been of great interest. While outlets for this effort have existed in diverse fields of application there has also been a basic fascination for hand-like devices.

This project is concerned with the tactile properties of a mechanical manipulator and in particular with control systems which may be employed to achieve flexibility and reliability of operation. The work is being undertaken with a view to application in automatic assembly, inspection, testing etc. However the principles underlying the systems being developed have been conceived and tried in a different field, namely, powered artificial hands for amputees. While the overall aims are quite different here, many of the control concepts are equally applicable and we are drawing heavily on an earlier work on an adaptive multi-degree-of-freedom prosthetic hand. This earlier work, which has been sponsored by MRC and DHSS as well as SRC, has reached the advanced stage of clinical assessment.



Picture shows the mechanical manipulator in action

Our approach to control of prehension has involved a multi-level control system. The key to this is a sensory system which measures contact points, operating forces, joint angles etc. These sensors are incorporated in fast reflex loops which achieve particular actions. Intermediate levels in the control hierarchy adapt the shape of the manipulator to the object contours and also vary the forces to correspond to a number of basic commands such as hold, squeeze, manoeuvre, release etc. These systems receive many feedback signals from the lower system but they are activated by a few inputs from a high level logic system which interprets simple decision signals as appropriate commands. In this way the manipulator is able to operate on a very low level of "conscious command" from the input, just as does the neural system which controls our own limbs. This greatly simplifies the task of controlling such devices in terms of the communication rate required."

Royal Observatory Dinner

In their heyday dinners given for the Board of Visitors of the Royal Greenwich Observatory were gargantuan and it is impossible to resist the temptation to give the menu submitted by the manager of the nearby Ship hotel in 1889.

Royal Observatory Dinner

Sherry	Thick or clear soup
Hockheimer	Flounders Souchée
Bordeaux	Lobster Rissoles, Fried Slips
	Whiting Pudding à la Crémiere
	Stewed Eels à la Bordelaise
	Grilled Trout. Tartare Sauce
	Crab Omelettes
	Salmon Cutlets à l'Orientale
	Whitebait, Plain, Black and Red devil'd
Champagnes	Timbales Foie Gras Périgord
Irroys	Fore quarter Lamb. French Beans and Potatoes
Delbeck	Ducklings and Green Peas
	Asparagus
	Devilled Ham and Tomato Salad
Liqueurs	Jellies, Creams, Pastrys
	Ice Puddings
Port	Dessert
Margaux	Claret Coffee

20 Courses and Dessert Wine, inclusive attendance, 25s. per head

(*P S Laurie The Board of Visitors of the Royal Observatory. Q J Royal Astronom. Soc., 8, No 4 1967*)