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RESEARCH SCHOOL OF BIOLOGICAL SCIENCES

Text of the Director's presentation of the Report to Council

Thank you, Chancellor, for this opportunity to report on research and other activities in the Research School of Biological Sciences in 1993. You have before you our Annual Report, a turgid document designed to report to our peers, and the most recent issue of Biologic, our attempt to communicate some of our front line research to the public at large, especially to teachers and senior students of biology in high schools. Although our Annual Report looks much as it did last year, it comprehensively updates and abstracts research output. On the other hand Biologic has been completely revamped and, as you can see from the selection of responses received from its target audience, it clearly hits the mark.

Biologic costs us about $12,000 an issue, about the equivalent of a junior technical appointment in the course of a year, but I believe that after a year's trial, it is well worth it. Biologic is part of a cascade of communication of our research, which begins when a particularly creative discovery is accepted for publication in a high profile journal like Nature. Preparation of popular communication for Biologic serves many purposes, including this report to Council. The part-time science writer we retain for this purpose also coordinates press releases, and preparation of video clips for TV exposure as soon as the turgid science appears in print. We have been well pleased with the greatly increased exposure of the Research School's highest quality research that this enterprise has facilitated. We hope to sustain the enterprise with a successful bid for quality assurance funds recently awarded to the University.

Could I draw your attention to just two research projects described in the Annual Report which have been represented in Biologic after publication in Nature? Both have to do with increasing atmospheric CO_2 concentration and global climatic change, a field in which RSBS was awarded an Institute strategic planning grant in 1991. First, Professor Farquhar's team attracted attention for their study of how gas and water vapour exchange in leaves leads to swapping of oxygen isotopic signatures between ground water and CO_2 in the atmosphere. The process integrates the important events of plant growth and water use, and has established a whole new agenda for measuring and modelling the activity of the global biosphere on land. As a result future predictions of changing climate will accommodate this hitherto neglected component, now recognised to be very significant. Second, Dr. Stange's interest in the olfactory system of moths has given unexpected insight into a historic event, the biological control of prickly pear cactus in the 1930's. Stange has found the CO_2 sensors of the *Cactoblastis* moth in flight match those of the most sensitive physical instrumentation known. The moths use these sensors to detect the cactus plants which are most active in CO_2 uptake at night. The cacti are almost unique in this property among Australian plants. Not only can Stange now explain how the moth finds its host; he has found that increasing atmospheric CO_2 and increasing temperature desensitise the moth, potentially decoupling the biological control process as global warming progresses.

These are but two examples of the ways RSBS continues to fashion the agenda in biological research nationally and internationally. The hard evidence for this is abundantly clear in the bibliometric analyses undertaken by Professor Bourke, RSSS, in preparation for the review of RSBS next year. In my introduction to the Annual Report I point out that, over the last decade about 31% of Australian high impact research papers in biology have come from RSBS, in return for expenditure of about 5% of the national research budget in this field. The School's particular forte, for integrative research in biology, is seen increasingly as a model for research programs elsewhere.

The distinction of our researchers was recognised in many ways; by the election of Dr. Gibbs to the Australian Academy of Sciences and by the award of the gold medal of the Australian Ecological Society to Emeritus Professor Slatyer, now a distinguished scholar in residence. Dr. Gibbs enthusiasm for the creative retrieval and interpretation of biological information has given RSBS the edge, nationally and internationally. The Bioinformatics Facility established by him in 1993 will have a major role in the development of information technology for research in IAS. I chose this example of our research for inclusion in the University's report to Parliament for last year.

We have been very active in recruitment following our reviews of all sectors of the School, and have revamped the Visual Sciences group following the retirement of Professor Horridge in 1992. The Cooperative Research Centre in Plant Sciences is now at full strength and a major research force in the School. As the budget summary shows, the School now funds 26% of its research from external sources, about half of this via the CRC. Other significant trends indicated in the budget are that to keep our research output up we have more than doubled expenditure on scholarships since 1991, for example, but have been forced in the process to halve expenditure on equipment. This is a disturbing trend and we hope it can be rectified in 1994 with help from the University's major equipment fund.

A significant effort was mounted by senior staff of RSBS in 1993 to draw attention to the need for sustained funding of basic research, both in the IAS and via the ARC. Submissions were made to the Senate enquiry into the organisation and funding of research in higher education, and to the Industry Commission enquiry into R&D. After the demeaning years of Dawkins' levelling there is some evidence that academic values and priorities may be returning to research in the University sector. The School is conscious of its role, and that of the Institute, as the flag carrier in this enterprise. We look forward to the support of the Council of the University in this quest for excellence and achievement.

Half way through 1993 the School began its preparation for the ANU/ARC review in 1995. We have progressed well, and our preliminary thoughts on the ways the School's vision can help underpin the Institute's agenda for the next decade have been well received. Central to this agenda are collaborations between Schools within the Institute, and collaborations with other Australian universities. We have benefited enormously from cross-campus initiatives such as the Centres for Visual Science, and for Molecular Structure and Function. We have had a marvellous reception for our Collaborative Research Scholars program in other universities. We have a vision which embraces both of these successful ventures, and which could focus national research agendas for biomolecular structure and function in the IAS over the next decade. You can expect to hear more of this during 1994, and I expect you will see the vision detailed in next year's Annual Report.

C.B. Osmond, 8 April, 1994

The Research School of Earth Sciences at ANU is recognized internationally as one of the world's premier research institutions in the study of earth sciences, with particular emphasis on basic research in geophysics and geochemistry applied to understanding of the structure, composition and evolution of the deep Earth.

The 1993 Annual Report provides a summary of the basis for this international standing and I refer Council particularly to the publications, the Honours and Awards and the Visitors' details as providing a record of this aspect of the School's work.

I believe it is also useful for Council to place RSES in its national context.

Research and research training in the solid earth sciences represent the primary science and technology infrastructure for Australia's major export industries, i.e. the mineral and energy resources industries. These industries had a total value of $29.7 billion in exports in 1992/3 and represent 48% of merchandise exports and 40% of total exports. Sustainability of these industries in a very competitive global market is a key element in the Australian economy and the industries must be underpinned by a strong science and technology infrastructure. The science and technology infrastructure must, for a developed nation, cover the spectrum from basic research to applied research and to development. There is no dispute that, in Australia, the higher education sector is particularly responsible for basic research, for research training and for maintaining effective and rapid communication of basic research information into Australia from international sources.

It is instructive to place RSES in the context of R&D funding of solid earth science, and particularly of basic research. From the 1991/92 survey of universities, the DEET estimate of research expenditure in earth sciences in the higher education sector is $41.6 m or 4.3% of total research expenditure. [These figures include estimates of fractional research component of academic staff together with research grants, etc.] In 1993, RSES expenditure was $10.1 million of which $8.0 million was recurrent funding from the Commonwealth Government and $2.1 million was external funding earnings, by contractual agreements or competitive grant awards. The recurrent funding of $8 million for RSES may be compared with $11.9 million allocated by ARC in 1992 for the solid earth sciences, including Large and Small Grant Schemes, Major Equipment Funds, Fellowships Program and Key Centres and Special Research Centres Program.

Placed in this context, RSES must be seen as the major focus of national investment in basic research in the solid earth sciences. For comparison, the total R&D expenditure in solid earth sciences by governments in 1991/92 is estimated as $163 million. This includes $53.9 million in BMR/AGSO and $31.9 million in CSIRO. The introduction of the Cooperative Research Centre (CRC) program is estimated as having allocated $2.9 million to solid earth science R&D in 1992/3.

Another view of the relative importance of RSES in the Australian context is to compare staffing numbers in earth science departments. In 1993, with approximately 60 staff holding PhDs or equivalent, including 50 academic staff of Postdoctoral Fellow and above, RSES has 2-1/2 to 3 times the academic strength of any other Earth Science Department. On the other hand, RSES does not train a proportionate number of graduate students. Enrolments in 1993 (30 students) represent <10% of the total research degree enrolments in solid earth sciences in Australian universities. This issue was addressed through 1993 with active recruitment of PhD students and particularly by the continuation of the Summer School. Recognizing the growing strengths of the National Key Centres and the Cooperative Research Centres and that ~ 90% of PhD students in the discipline will continue to be based in the State universities, the School is increasingly using the 'research session' approach to bring appropriate PhD students into the School for 3-6 month sessions. These collaborations will be focussed on particular aspects of their research for which RSES facilities are necessary or desirable.

I have spent some time placing RSES in its national context because this is one context in which the performance and characteristics of RSES are being assessed. I now want to highlight some of the achievements of 1993. Firstly, among Honours to RSES staff, Professor Lambeck has been honoured by election as a Fellow of the Royal Society of London, a Fellow of the Netherlands Academy of Science and as a Fellow of the Norwegian Academy of Sciences. In addition, he was awarded the Charles A. Whitten Medal of the American Geophysical Union. These are in recognition of his contributions to geodesy and global geodynamics and Council may note that these scientific achievements testify to his considerable skill, dedication and determination in continuing his scientific output while Director of RSES from 1983-1992. Professor Ringwood was awarded the Hess Medal of the American Geophysical Union, the Clarke Medal of the Royal Society of New South Wales and the Jaeger Medal of the Australian Academy of Science. These continued Ted Ringwood's outstanding record and his national and international recognition in research leadership. His premature death from cancer in November is thus an enormous loss to RSES and we are currently filling positions which are aimed at maintaining the international leadership in at least some of the fields to which he contributed so brilliantly.

I draw Council's attention to the information in pages 155 to 173 which details the Visit Outside Studies Program and invited lecture visits, national and international collaboratio these are essential elements to maintaining an effective role for RSES as a National focus basic research and for information flow into and out of the Australian research communit also draw attention to the role of this aspect of the School in ensuring that basic research applied research feed off and interact with each other. RSES illustrates outstanding examp of pure basic research and market-oriented applied research co-existing in the same laborato the high pressure laboratories, environmental geochemistry laboratories and the SHRI (Sensitive High Resolution Ion Micro-Probe) laboratories are outstanding examples. In financial summary, the $919k earned from services and materials supplied and the $1,1 earned by contractual and competitive grants, testify to the strategic and applied rese activities of RSES.

In terms of major and unique facilities at RSES, 1993 saw the commissioning of the ICPM Inductively Coupled Plasma - Mass Spectrometer - facility. This maintains and extends School's capacities in trace-element analyses at extremely low abundances and for a w range of elements. This technique supersedes the Spark Source Mass Spectrometer which be decommissioned this year and complements the X-ray fluorescence analysis facilities major element (available in the Geology Department, The Faculties, and AGSO). The versions of SHRIMP (I and II) continued very effective operation and 1993 saw the f commercial sale (to Curtin University, Western Australia) and delivery of SHRIMP, placem of a second order (through ANUTECH) by the Canadian Geological Survey. Most recen RSES has committed itself to development and construction of a new, modified instrum which will be built ahead of, and in tandem with, an instrument for Stanford University/ Geological Survey in consortium. The considerable outlays and investment of manpower resources are an affirmation of the unique results being achieved by this instrument and recognition that there are many more applications to be developed and exploited.

Finally, I draw Council's attention to the body of our Annual Report by highlighting a research themes that illustrate the diversity and impacts of the School's work. The f overhead illustrates the progress of the major seismology project which uses the nat earthquakes occurring around Australia to obtain multiple ray paths to a grid of mobile seis stations. The experiment is yielding detailed information on the deep crustal and upper ma inhomogeneity beneath Australia. This is a survey-style project with a large field-work c and it is complementary to the seismic reflection and refraction studies undertaken by AG and minerals and petroleum exploration surveys.

The second overhead is an example of the increasingly important work on Global Chan a geological record, i.e. recorded in rock or mineral materials, but happens to be a reco 1978 to 1988, i.e. before you and I reached our prime. It illustrates our ability to s geochemical sensor for water temperature, the Sr/Ca ratio in coral skeleton, on a 2- basis. Oxygen isotope measurements, also sensing both salinity and water temperature obtained on the same scale. The groups in RSES are calibrating, demonstrating and app technique that will enable us to obtain an extremely detailed picture of sea temperature, (i.e. rainfall and run-off inputs) on a regional basis over the past 1,000 years, and usin coral-reefs back into the last glacial and interglacial periods. This is the sort of detail we must extract from the very recent geological record if we are to be able to test and e the global and regional models of climate change and thus develop any confidence in ou to predict the future - global warming? or global cooling?; sealevel rise?, etc. Th essential ingredient in this work is the development of measurement of absolute time c past 1 million years. I refer Council to the effective inter-School (RSPAS and collaboration represented by the Quaternary Dating Centre in its Radiocarbon work a other inter-School collaboration (RSPhysSE and RSES) in Accelerator Mass Spectro These facilities and new developments are uniquely possible in the ANU environme exploit the possibilities of both the ANU concentrations of expertise and equipment Research Schools, and their diversity.

My fourth overhead illustrates analyses of noble gases - neon and argon and their isot work of Dr Honda and Professor McDougall. This is a 'pure science' - developin techniques to obtain new information about the Earth's earliest formation and its evo through time. Although not the first institution into this new field in the global sense, has very quickly established that it is a front performer in the quality of its data and its abi obtain analyses from 'difficult' samples.

Finally, I would like to illustrate a PhD project, an application of SHRIMP and a collabo with the mineral exploration industry. Mr David Compston has worked to unravel the history of the host rocks to the Tennant Creek ore deposits. The overhead illustrates the event defining the observed geology of rock units at Tennant Creek as 1860-1820 million old. The populations of zircons reveal much earlier events back to 3 billion years g insights into the precursor rocks and minerals that were reconstructed in the 1860 m events.

These examples are indicators of the School's activity over the past year. In looking to the present and immediate future, the priority tasks include rebuilding the Petrochemistry and Experimental Petrology group to maintain the excellence and creativity that characterized Ted Ringwood's work. Secondly, the interactions with industry and other 'users' of the School's basic research expertise can be, and are being, developed. Thirdly, graduate student recruitment is being pursued, particularly seeking collaborative linkages with other, complementary expertise within other universities around Australia. Fourth, the leadership in instrumentation and facilities as illustrated by SHRIMP, by developments in analytical techniques at the microscale and by the development of new materials, will be maintained and commercial opportunities arising from these will be pursued appropriately. I believe that Council can look forward to a continuation of RSES as a leading international research institution in Earth Sciences and as a flagship, closely linked to an Australian fleet, in terms of its role in an Australian National University.