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DIRECTOR's REPORT TO COUNCIL
ON RESEARCH SCHOOL OF BIOLOGICAL SCIENCES

INTRODUCTION

The Annual Report of the Research School of Biological Sciences for 1969 (41/1970 to 46/1970) is for the second year in which the School was operating pretty fully. The material of the Report has already been printed and copies distributed to members of Council.

In this report, I am also referring to some of the developments which have occurred in 1970, three quarters of which has elapsed, and which may be of special interest to Council.

Last year it was pointed out that the School, with its headquarters, a major department and central services (such as workshop, photographic facility and electron microscopy) in Block M, had required other accommodation to provide for three of its departments and a unit. One department, Environmental Biology, is in the Research School of Chemistry which will require the space as soon as we can vacate it. Likewise, the John Curtin School of Medical Research, which continues to house the Department of Genetics and the Unit of Molecular Biology, will be anxious to obtain the space for the interesting new developments it is planning. Our fourth department, Behavioural Biology, is in Block C and has grown rapidly to absorb all of the space in that building. It can be seen that the School, while flourishing, will be severely restricted by limited space until the permanent building becomes available, hopefully in the early part of 1972. While the present accommodation is less in amount and less convenient than we would like, I do not believe that its shortcomings really interfere with good work being done.

Work on stage 1 of the permanent building has begun and appears to be progressing satisfactorily despite some labour troubles. Most of the work so far does not show much. The site required extensive piling owing to the nature of the ground conditions. Unfortunately, as Council will know, when tenders were received these were found to exceed by a considerable amount the finance which had been made available. The reasons for the excessive cost are diverse, including the unexpectedly high cost of piling and the greater increase in building costs in Canberra than had been anticipated. The School was asked to make substantial savings and did so in various ways, including leaving a part of the building as a shell. Unfortunately such deletions did not result in savings which are commensurate with the difficulties which will be brought about by the loss of space. No doubt too, the cost of restoration will be greater than the saving made at the time. The effect is that the School will be left without spare space in which to develop new activities which are planned to begin in 1972, apart from any new developments which may be approved for the 1973-75 triennium.

The School began the year with 25 academic staff appointed, including 22 in post, added 6 and lost 1 during 1969, to reach 30, 29 being in post at the end of 1969. So far in 1970, 5 more staff have been appointed and with 2 resignations we now have a total of 33, all in post. Two members of staff, Mr K.P. Tognetti and Dr C.K. Pallaghy, resigned during the year. Mr Tognetti left to take up the post of Senior Lecturer in Mathematics at University College, Wollongong, while Dr Pallaghy went to a Fellowship at Michigan State University.

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The greatest growth has of course been in the Department of Behavioural Biology since Professor Horridge arrived in August 1969. He has been extremely successful in recruiting young and active men and now has five staff apart from himself. The Department has also attracted five scholars and there seems to be no shortage of good people anxious to come and work with him. This same feature is shown by the keenness with which visitors seek facilities in Professor Horridge's department.

The most important new appointment in the School is that of Professor J. Langridge to a Chair in the Department of Genetics and to the Headship of that department. This has relieved me of immediate responsibility for the Department of Genetics, a point to which I will return later. Professor Langridge's appointment is significant in several ways. He has retained his position in the Division of Plant Industry, CSIRO, where he is continuing to direct research, particularly in the section of Genetics. This joint appointment is the first such close association of ANU with CSIRO. It will in my opinion very greatly strengthen genetics in Canberra since it will draw together the complementary staffs of Plant Industry and RSBS. The arrangement appears to be working extremely well, the staff of the Department of Genetics responding well to the change in leadership and to the change in emphasis which Professor Langridge is proposing. The Department had become rather more biochemical and less genetical in its outlook than is desirable and the genetical emphasis appears likely to be restored gradually in the future.

The lines of work which Professor Langridge is developing are all concerned with the biochemical aspects of adaptation and evolution. Evolution provides a theme in which genetical considerations predominate, but it is one which should be ready now to take account of the data of chemical genetics. The means whereby organisms adapt to their environment are of especial interest at present when environments are changing rapidly, often in ways unfavourable to many forms of life. In particular, we would like to know more about the processes involved in the development of resistance to poisons and antibiotics and in the possibilities of genetic adaptation of microorganisms to degrade detergents, plastics and so on. Specifically the central study will be how a new function is evolved. The choice will be made of systems which can be manipulated in the laboratory.

Not only has the direction of research in the Department of Genetics been reviewed, but other sections of the School have also given serious consideration to these matters. In particular the Department of Environmental Biology proposes to emphasise more strongly research directed towards comprehension of ecosystems as self-regulating entities. A full understanding of the factors associated with stability and instability is fundamental to the long term conservation and management of ecosystems, especially of the Earth as a whole. At first work will be concentrated on the study of the flow of energy and materials in various ecosystems. The interactions represented by plant and herbivore and by consumer and decomposer will be emphasised, since these are strongly influenced by human activity. There will be some redirection of the activities of existing staff, as well as recruitment of suitable persons as vacancies occur.

In the case of Developmental Biology, where the range of research has become rather too diffuse, consideration is being given to how particularly desirable projects can be more strongly promoted in the future than others which are more marginal in interest. The opportunity to effect these changes in balance will be taken as temporary staff reach the end of their appointments and as vacancies occur.

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The work being developed in the Department of Behavioural Biology is concerned with the precise mechanism by which a stimulus is perceived, how it is transmitted through the nerve paths and integrated in the ganglia to produce responses on the part of the animal. A favourable example for experiment is the reception of light by, and the anatomy and the electrophysiology of, the compound eye of insects. Behind each of the many facets of these eyes lies a group of nerve cells specialised as light receptors. Each receptor has a nerve fibre which runs back to an integrating ganglion behind the eye. There is a succession of such ganglia and the information received by the numerous receptors in parallel is processed in such a way that only relevant aspects of it are important in the resulting visual responses of the insect. Data processing of this kind is a necessary part of perception. In the compound eye of favourable large insects it is possible to analyse the process of light capture by single cells, the integration in successive ganglia, the over all perception by the whole insect and the growth process by which the complex patterns arise.

The number of research students was 23 in 1969, including 9 supported by funds other than ANU scholarships. 3 scholars completed their courses during the year and gained Ph.D. degrees. While the School has a substantial number of students, it must be noted that some members of staff consider that there are too few. However, some of us believe that much greater care needs to be taken in the recruitment of students, This is not only because we should take those who will fit well into the special lines of research which are being conducted in the School. Various difficulties which have occurred, such as withdrawal or transfer to other departments or to a Master's degree may be a consequence, in part, of unsuitability which appeared only after the student had begun work. Various other questions relating to students, such as the provision of extra time for the submission of theses and problems of later employment, are matters for continuing concern. So too is the question of whether research students might not better be trained in research, together with advanced courses of lectures, without necessarily taking a degree by thesis. This would be virtually a return to the situation in British Universities existing 50 years or more ago. Unfortunately the possession of a higher degree has become regarded as a necessary qualification for an academic or a research career, perhaps to the exclusion of other desirable qualities. Essentially, the problem lies in retaining breadth, while achieving great depth in a small field of knowledge. This problem may be more serious in science than in arts and most serious in biological sciences which require very specialised techniques.

During the year 12 visitors were in the School for periods ranging from one to twelve months.

In my previous report I drew attention to the fact that when the School was conceived and started, it was intended that it should not be organised into separate departments, a notion which was at first accepted without comment or criticism. It was expected that there would be a very loose organisation principally directed to the solution of problems chosen in a few selected areas. Experience has shown that due to the desire of the foundation Professors to be given assurances of supporting staff, both academic and non-academic, as well as defined shares of funds and facilities, they acquired groups whose nature, function and relations are those of separate departments. Together with the need to share out scarce commodities, such as funds for equipment and scholarships, and the desire of academic and indeed non-academic staff to be associated with a group smaller than the School, these considerations led the School towards the establishment of a departmental structure. This was approved in 1969 by Council on

the recommendation of the Board of the Institute. This new structure, which existed effectively from the start, has not changed the work of the School nor its objectives and we believe that there is no lessening of interaction between the different parts of the School. If anything the present separation into four different buildings scattered across the campus is much more injurious to interaction.

I have referred to the assumption by Professor Langridge of the Headship of the Department of Genetics. I should like to take this opportunity of saying that my experience has proved to me that the Head of the School cannot combine this post with that of Head of Department, or any equivalent group, without some detriment to both functions. It is my view that the future good of the School requires the retention of a Director without responsibility for a large department, although he should have a small unit to assist him with the personal research he may wish to pursue. The means to do this, with the provision of a laboratory adjacent to the Director's office, is provided for in the design of the new building and in the School's budgetary proposals. The Director may of course be dependent for some facilities on the good will of another department in the School, but it is hard to believe that such would not be forthcoming.

To turn to a brief review of research in the School, an indication of the growth in activity is provided by the fact that 69 papers based on work done in the School were published during the year, compared with 35 in 1968. Of course, mere number of publications is no indication of outstanding quality. A few of the more significant pieces of research may be indicated briefly and are more fully described in the research reports of the departments.

Dr Pickett-Heaps, who has recently left for a post in the University of Colorado, Denver, U.S.A., has been responsible for a remarkable body of work on the process of cell division in algae, using electron microscopy as a principal tool. This work is unmatched in the world and is an excellent example of the power of comparative descriptive anatomy, at an ultramicroscopic level, in analysing fundamental biological properties.

Another body of work, being developed by Professor Horridge and his colleagues, uses similar methods. They are tracing the precise pattern of connections in the nerve nets from the receptive cells of the compound eyes of insects to the ganglia by patient study of very large numbers of successive thin sections. It turns out that there is an incredible degree of precise and repeated geometrical order in these systems.

Professor Slatyer, Dr Osmond and their colleagues are concerned with a recently discovered pathway of photosynthesis involving compounds with four carbon atoms instead of the usual three as in most plants. Many highly productive species from tropical and arid environments possess this special and efficient method of utilising light energy in the primary synthesis of carbohydrates and related compounds.

Considerable progress is being made in understanding the mechanism of genetic recombination and its control. This is the complex process by which exchanges occur between genetic materials in the chromosomes in which the material of heredity is deoxyribonucleic acid (DNA). My work over the past 7-8 years has disclosed two new classes of gene, one of which appears to be the specific region of the chromosome in which recombination begins, while the other determines a regulator of the enzyme which initiates recombination by causing a nick in the specific region. This work is almost unique to this School and we are certainly well in the lead.

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Dr Naora is studying details of the mechanism of protein synthesis. Individual proteins are formed by a special process of copying, or rather translation, from individual ribonucleic acids, so called "messengers". The process occurs on special minute structures, the ribosomes, of which there are many in each cell. The ribosome is roughly the shape of a cottage loaf and the translation is done in the groove, the protein coming out like a thread. Naora has shown that there are ribosomes of different specificity and he is concerned to discover what factors confer the different properties.

The provision of equipment for research in the School continues steadily. One major acquisition in 1969 was a glasshouse which has proved to be indispensible and is constantly fully occupied with plants being grown for several sections of the School. This is operated as a central facility useable by anyone in the School. In 1969 also, the School argued for the acquisition, as soon as possible in the 1970-72 triennium, of a second electron microscope which would be capable of work impossible with the existing low voltage machine. Following careful investigation by Professor Horridge and our laboratory manager, Mr Hardman, it was decided to acquire a medium high voltage electron microscope and this has now been installed and is operating. Its advantages are that the structure of relatively thick sections of biological material can be explored and also, using a tilting device, pairs of stereo pictures can be obtained allowing the demonstration of surfaces in three dimensions. Both of these properties are essential to the work which Professor Horridge and his colleagues are doing on the detailed structure of nerve nets referred to above and the co-ordination of their action.

Reference should be made to the participation of members of the School in the organisation and conduct of important international symposia and conferences, normally sponsored by the Academy of Science, bringing together people in Australia with visitors from abroad. In 1969 there was an important conference upon those organelles, in cells, which appear to have their own independent genetic determination. These are the chloroplasts, which carry the green pigments essential for the process of photosynthesis, and mitochondria, which are the seat of enzyme systems concerned in the production of energy for the activities of cells. Work on these matters is of concern to several sections of the School, especially the Department of Developmental Biology. It may be noted that two other conferences of significance to the School are being organised for December of this year. One, sponsored under the joint agreement of the governments of Australia and the United States of America, concerns the special pathway of photosynthesis discovered within recent years and which is a matter of intensive research by our Department of Environmental Biology and the Division of Plant Industry of CSIRO. The other international conference "Plant Growth Substances", sponsored by the Australian Academy of Science and organised by a Committee under the Chairmanship of Professor Carr, is concerned with the variety of hormones now known to be concerned in the regulation of growth and development of plants.