

7052 ✓



VOLUME IV NUMBER 1 — SEPTEMBER, 1967

Published by the Academic Registrar as occasion requires

Registered at the G.P.O., Melbourne, for transmission through the post as a periodical

# MONASH UNIVERSITY GAZETTE

## CONTENTS

FACULTY OF ECONOMICS AND POLITICS	1	THREE HONORARY DEGREES CONFERRED	16
UNIVERSITY'S FIRST MEDICAL GRADUATES	3	RELIGIOUS CENTRE	18
THE WESTERNPORT BAY RESEARCH PROJECT	4	OVERSEAS STUDENTS AT MONASH	19
VIETNAM 1967	5	IMMUNORADIOACTIVE ATTACK ON CANCER AND OTHER TISSUES	21
HEAVENLY BODIES	7	THE ROLE COUNSELLING CAN PLAY IN A UNIVERSITY	23
PROGRAMMED LEARNING IN PROFESSIONAL EDUCATION	10	THE CHEMICAL ENGINEER AND THE FOOD INDUSTRY	26
OPENING OF ALEXANDER THEATRE	13	OBITUARY	29
BIOLOGY AND ENGINEERING	14	UNIVERSITY STAFF	30

## FACULTY OF ECONOMICS AND POLITICS

*By D. Cochrane, Dean of the Faculty*

In March, 1961, Monash University opened its doors and admitted 347 undergraduates. Out of this first intake 57 enrolled with the faculty of Economics and Politics. In March, 1967, the number of undergraduates enrolled in the first year of the economics degree numbered 520 while total undergraduate enrolments exceeded 1,200. The staff of the faculty has clearly had to run at a fast rate in the years between 1961 and 1967 in order to keep up with the expansion required in undergraduate teaching.

In its early years the faculty was accommodated in the first year physics building and after a further temporary spell in the west wing of the Robert Menzies School of Humanities, the faculty moved into its permanent home in the east wing of this building in 1965. At present the faculty occupies the first six floors of the east wing plus additional rooms on the eighth floor. As might be guessed from the expansion of student numbers just indicated, this accommodation is rapidly proving to be inadequate for the requirements of the growing staff.

Within the faculty there are two departments — Economics and Politics. The department of Economics is a large multi-professorial department which is capable of being sub-divided into at least five departments — accounting, administration, economics, economic history, and economic statistics. However, because the contents of these areas tend to overlap the staff has so far been against any fission. In addition to teaching students enrolled in the faculty of Economics and Politics, the department of Politics teaches a large number of

students who take degrees in the faculty of Arts. However, in the following survey the discussion will be limited to an outline of the courses of study available to students enrolling in the faculty of Economics and Politics.

The first degree of the faculty is the Bachelor of Economics. Although economics degrees have long been granted by other Australian universities and by overseas universities this degree was new to Victoria. A question commonly asked in the early years was why should we select B.Ec. as the title of the degree rather than the better known Victorian title of B.Com. Perhaps the best way of explaining this is to give a brief description of the course which comprises the degree of Bachelor of Economics at Monash.

The course for the Bachelor of Economics extends over three years of full-time study for the pass degree and over four years for the honours degree. The core requirement of the pass degree is that a student should take a sequence over three years of what may be described as the fundamentals of economics, including an elementary knowledge of quantitative analysis or economic statistics. This absorbs four subjects out of a total of ten, and ensures that the student pursues at least one discipline in depth while at the same time laying the foundations for much of the applied work which is taught in the associated subjects. The students have a great deal of freedom of choice over the remaining six subjects of the degree.

While some elect to concentrate on economics by taking further subjects on theoretical and applied

economics, others combine their study of economics to varying degrees with study in such fields as accounting, administration, economic history, mathematics, politics, quantitative economics, law, and the other social sciences such as anthropology and sociology, geography, history, and psychology. The increasing extent to which the other social sciences are being studied to a second and third year level along with the study of economics is becoming a feature of the economics degree.

While there are large areas of economics which do not require the use of mathematics it should be observed that it is becoming increasingly necessary for a student to have some knowledge of mathematics if he wishes to make a career in economics or business. In this connection it should be added that while most economics textbooks are littered with geometrical diagrams the standard of mathematics that is required for most of the work is still quite elementary. It may come as a surprise to say that economics teachers would be very happy indeed if all their students *understood* mathematics to the intermediate level. A knowledge of leaving mathematics would leave the staff in a state bordering on ecstasy. I should, of course, add that in the higher reaches of economic theory, where honours students are likely to tread, a knowledge of university mathematics is becoming essential.

While students are encouraged to take up any of the associated subjects which interest them, the strong interest of students in the field of quantitative economics — economic statistics, econometrics, and operations research — has led to the development of a wide range of subjects in this area. The number of students taking these subjects in the later years of the degree is surprisingly high and increasing from year to year. This is very heartening for the staff who have been attracted to Monash whose main interests are in these areas. This interest in quantitative economics also extends to graduate school work which is discussed later.

Associated with the study of quantitative economics is the need to understand and use high speed digital computers. At the same time accounting is spreading into the field of data processing. As a consequence an attempt has been made to acquaint all B.Ec. students with the mysteries of computers and programming while at the same time providing special course work for those students who wish to pursue the topic in depth.

But why, it may be asked, are so many students taking an economics degree and what sort of standards are required for acceptance to the faculty?

The Universities of Melbourne and Sydney have always had large and strong faculties of economics. It should be added that they are also larger in comparison to other faculties in their respective universities than has tended to be the case in the other state universities. In general, this is because of the occupational opportunities that have been available to the graduates of the Universities of Melbourne and Sydney. The cities in which these universities are situated have dominated, and still dominate, the manufacturing, commercial and other business activities of Australia. The many corporations — both large and small — in these cities absorb a steadily expanding number of economics graduates. However, not only are there many opportunities in the business sector of the economy, but the public service and the teaching profession are constantly looking for graduates in economics.

Honours graduates are, of course, in even greater

demand by business and the public service; while the rapid rate of expansion of universities adds still another large avenue of employment.

In this rapidly growing post-war Australian economy a degree in economics has become a strongly sought after qualification. This then provides the main reason why the demand for places in the faculty of Economics and Politics has been so great. In an endeavour to satisfy this demand the faculty has continued to increase its intake of students, but it has now reached a stage where any further expansion would produce a faculty which would tend to become administratively unmanageable. In this connection it might be mentioned that the faculty admits annually a larger number of new undergraduates than does the London School of Economics despite all the resources and staff at the disposal of that institution.

At a rough guess it would seem that the faculty is unable to take almost as many students as it admits, so that the standard required at the matriculation examination for entry is very high and increasing. It is to be hoped, however, that now La Trobe University is functioning it can rapidly come to the assistance of the Monash and Melbourne faculties. With a stable intake of approximately 500 first year students enrolling for a degree in economics it is expected that the total undergraduate student numbers in the faculty of Economics and Politics will settle down at around 1,600.

Since the faculty also teaches economics, economic statistics, accounting, and politics to students of other faculties, particularly to those from Arts and Law, the first year classes tend to be very large and range from 400 in the case of accounting to nearly 800 in the case of politics. In order to help students in their first year at the University and prevent them from feeling lost if lectured to in excessively large numbers, each first year subject is divided into four groups for lecture purposes and then further subdivided into small tutorials.

Students are allocated to a particular group and attend the same set of lectures for each of the subjects taught in the faculty. In this way the size of the lecture group is kept below 200 and the tutorials around 12. Each lecturer has a good chance of getting to know some of his students, especially if he also takes tutorials. Different lecturers are in charge of the lecture groups so that the disadvantages of "repeat" lectures are avoided. With a small group of tutors assigned to each lecture group the problems of co-ordinating the activities of students and tutors are eased. It should be added that there is a common syllabus for each subject and the lecturers need to co-ordinate their activities very carefully. Problems which may not have been seen by a single lecturer are raised and sorted out, and in particular the question of ensuring that first year students are not expected to do too much receives thorough consideration. A common examination paper is set for each subject.

During the planning and development of the course for the degree of bachelor it became increasingly obvious that with the rapid advances being made in economics and the increasing complexity of techniques being used in these advances, it was not possible in a first degree to cover to a sufficient depth the economics required for the practitioner, the specialist teacher, and the researcher.

The faculty accordingly decided to extend the area of course work into the degree of Master of Economics,



while at the same time retaining the right of the student to embark on a major piece of research if he prefers to do so. Thus in 1967 the faculty offered two routes to the degree of Master of Economics — one via course work plus a minor thesis and the other via a major thesis. There are already 15 students embarked on the degree by course work; some of these will continue on to a Ph.D.

The degree of Doctor of Philosophy will always occupy its traditional place as a research degree. However, to ensure that students are fully competent to pursue their research and so minimize the time that graduate students often spend equipping themselves it is felt that Ph.D. students should also undertake the course work prescribed for the degree of master before embarking on their thesis.

Another area of graduate study in which the faculty has taken an interest lies in the field of administration. The efficient administrator needs to possess competence in a variety of skills which will enable him to understand and cut through the many complex problems which face him in the modern developing society. These skills include:

An understanding of administrative theory and practice in both business and government.

A knowledge of, and skill in the use of, quantitative methods of analysis.

An understanding of economic principles and an

appreciation of significant government economic policy decisions and policies.

An understanding of the accounting function.

A realization of the relationships of traditional functions such as finance, labour relations, and marketing, to business and administrative policy.

It was felt that it would be more convenient to group together the subjects relating to these skills, and design a special graduate programme leading to the degree of Master of Administration, which would be available to those interested in both business and public administration. It is expected that students will be accepted for this degree in 1968.

Applicants for such a degree need only possess a first degree of any faculty in a university. In certain circumstances they may need to undertake some preparatory work but for the most part especially designed subjects are being prepared in fields in which these more mature students may not have received previous training. As in the case of the M.Ec. degree by course work, the students must present a minor thesis in addition to their course work.

In addition to providing a comprehensive first degree the faculty has now embarked on a major programme of graduate studies which will enable graduates of other faculties as well as of the faculty of Economics and Politics to engage in studies and research to the level of master and doctor.

---

## UNIVERSITY'S FIRST MEDICAL GRADUATES

The first conferring of M.B., B.S. degrees and the first conferring of an honorary degree of Doctor of Medicine at Monash took place on Wednesday, December 14, 1966, in the Union Hall.

Twenty-nine medical students received their degrees.

The University's first Doctor of Medicine *honoris causa* was awarded to Professor F. J. Fenner, head of the department of Microbiology in the Institute of Advanced Studies, A.N.U.



Front row: Henry Lipson, Christine Crane, Chan Soh Ha, Margaret Chen, John Murtagh, Linda Brightford, Choi Ho-Yin, Judith Lumley, Ewald Einoder; Second row: Norman Pointer, Harry Preston, Avni Sali, Jonathan Mulligan, Roger Watts, David Meyers, Barry White; Third row: John McMichean, William Rehfsch, Norman James, Richard Dargaville, Donald McKenzie, Gordon Youatt, Geoffrey Parkin; Back row: Keith Bottomley, David Fairweather, Russell Corlett, Murray Johns, Peter Longney, Robert Hudson

## THE WESTERNPORT BAY RESEARCH PROJECT

*By J. B. Hinwood, Lecturer, Department of Mechanical Engineering*

Last April the Victorian State Parliament approved a proposal to develop an industrial centre near Hastings on Westernport Bay, utilizing the naturally deep channels of the bay for the future harbour. News of this proposal had already led many to wonder what would happen if sewage and industrial wastes were discharged into the bay.

We put this question to a class of twelve fourth-year engineering students, and in lieu of attending eighteen hours of formal lectures and laboratory experiments, the students have conducted a research project to answer this question. The class met each week for informal discussions, and between meetings collected information on the area, studied theories of turbulence and waste disposal, and planned and carried out a full-scale experiment on turbulent diffusion.

The full-scale experiment was planned to discover how waste discharged into the north channel of Westernport Bay would spread, and to see if this would reach either shore. The class decided — after a forceful presentation by one member — to adopt the most direct procedure, that of utilising a tracer. The tracer would directly simulate the drift and spreading of waste water under the action of the currents and turbulence. Shortage of time necessitated that the staff assist with the design and construction of the instrumentation, but otherwise the students did the work.

At the appointed time, one party of students dumped 40 lbs. of fluorescein into the bay, and the spreading of the brilliant green patch of dye was photographed by another party in a chartered aeroplane. Colour film was used to enable the fluorescein to be distinguished from cloud shadows and underwater mud banks. At fifteen minute intervals a high altitude photograph was taken to allow the position of the patch to be determined, then the plane plummeted to 500 feet to take large scale photographs of the patch to determine its size. A radio link allowed co-ordination between ship and plane.

The boat party took water samples, measured wave heights, wind speed and direction, and the turbulence of the tidal currents. The turbulence was measured using a conventional rotating-cup meter which was modified to produce six pulses each revolution. These pulses were recorded on a tape recorder, and were later played back, and analysed using the University's CDC 3200 digital computer and a programme previously developed by Dr. Deane Blackman for analysing atmospheric turbulence data obtained from his towers in the University grounds.

The water samples were visually compared with standard samples prepared on board. The dye fluoresced strongly, and most observers could readily detect dilutions of one part in twenty million (or as one student calculated for the benefit of a news reporter, one drop in 200 gallons), subsequent laboratory measurements using ultraviolet light enhanced the fluorescence and were even more sensitive. Sampling difficulties reduced the usefulness of these data, but they did show that the dye took about fifteen minutes to mix over the whole fifty foot depth of the channel.

Wave frequencies were determined by timing and

wave heights were measured using a graduated rod. The heights were so small in all cases that the effect of waves on the turbulence, and hence on the movement of the dye, was almost certainly negligible. The wind also exerted little influence on either the currents or the dye.

The data obtained by the boat party not only defined the conditions of the bay during the experiment, but also allowed independent computation of the diffusion parameters. On two other days parties of students measured wind, waves and turbulence, again from the Fisheries and Wildlife Department's boat "Caprella", to allow the diffusion of a pollutant under other weather and tidal conditions to be estimated.

In general terms the final report of the class concluded that the high turbulence intensities present will lead to rapid mixing and dilution of a pollutant, but will rapidly carry it on to the shores. Another conclusion was that field data collection on the bay is great fun on a sunny afternoon, but is a very troublesome business.

Our conclusion was that the students had not only learned much more about turbulence in theory and practice than could have been covered in formal lectures but also that they had enjoyed themselves much more. The challenge of carrying out a real engineering job by themselves stimulated even the most lethargic of the class. About half of them put in many hours each week beyond their usual effort, as was evident from their two excellent preliminary reports "Some Basic Information on Westernport Bay" and "The Diffusion and Propagation of Waste in Westernport Bay".

We hope to continue this project next year, since we have a continuing interest in fluid turbulence, and in addition many other engineering questions are raised by the development plans, such as possible long term effects on siltation and sediment transport. However, we are at the mercy of the new class, who must decide for themselves whether to accept the risks and work of a research project or the security of a lecture room.

---

### MISS ALICE HOY

At the A.N.Z.A.A.S. Congress, Miss Alice Hoy, a member of the University Council, was awarded the Mackie Medal for distinguished service to science. She is the first woman to be awarded this medal.

Miss Hoy was a member of the Interim Council in 1958 and has been a member of the University Council since 1961.

---

### ADDRESSES OF GRADUATES

For the purpose of the distribution of this Gazette and also for notification of Council elections, the University should be notified of any changes of name and address. Notification of these should be sent to the Academic Registrar.

## VIETNAM 1967

By H. A. F. Dudley, Professor of Surgery, who spent three months with the Alfred Hospital Surgical Team in Bien Hoa

If you drive for thirty hot and dusty kilometres north-east from Saigon sandwiched between petrol tankers, armed personnel carriers and the battered overloaded Citroens which, since the railways were dynamited into activity, constitute the only form of inter-city transport in South Vietnam, you come by way of a scabrous mass of military installations to the outskirts of Bien Hoa.

Once just a sleepy market town and province centre pleasantly situated beside a half-mile wide river, it is now a dirty, noisy boom city parasitic on the combined U.S.A.F. - Vietnamese air base at its edge. The formerly tree-lined streets and the few elegant houses — relics of a vanished era of French colonialism — have become submerged under a garish mess of bars and prostitutes' hovels alternatively booming or bankrupt depending on the whim of the local commanders who from time to time put their troops on a leash, usually, it would seem, in the wake of a particularly juicy series of crimes in which rape, murder, and the wholesale ingestion of drugs seem to figure frequently.

Along the streets of this approximation to a modern Gomorrah thunder ten-ton trucks, tanks, timber trailers, and a cloud of lambretta taxis and motor-cycles acting much as an old-fashioned army would do in the production of casualties. The lambrettas are the light troops — tirailleurs — breaking a limb here, tearing away skin or scalp there; the big trucks are the heavy infantry with damage power to kill, to crush and to destroy.

If one looks carefully amongst these black battalions of the war gods, one may see at certain times of the day threading through the thundering hoards a variety of vehicles which look a little out of place; perhaps a dusty grey jeep, its red crosses almost obscured, its laconic driver clad only in tattered shorts and open-necked shirt, one thong-clad foot on the running board to catch the available breeze and beside him a starched and gleaming nursing sister; a Volkswagen minibus, its windshield missing from an encounter with a flying stone, weighed down with crates of baby food and intravenous fluids; a somewhat crumpled Holden sedan full of men and women still clad in their sloppy operating theatre dress.

Common to all the occupants of this motley collection would be two things — their destination at the province hospital in the town and a green badge which describes them as "uc dai loi" — Australians. For here under an umbrella of noise from the constant overpassage of helicopter, fighter-bomber, and transport and against an obligato of nocturnal artillery fire an Australian surgical team has worked for the past fifteen months. To this hospital and to others where teams from many countries confidently called in South Vietnam, "the free world", comes the detritus of the mean and brutal war being fought to a finish in every province of the country.

Here is the sharp end of Australian aid — whatever one's political views, whatever the energetic debates in university or parliament, whatever one's fears for one's own children shortly to be conscripted to serve in the unknown of South Vietnam — here as elsewhere are a group of people drawn by their own free will into

total involvement with the day-to-day tribulations of the Vietnamese. What this means in terms of human values may best be understood by selecting at random a typical day.

The morning had been fairly uneventful: two major operations in one theatre, a lot of minor tidying up of old wounds and a few small emergencies in the other. There had been time not only to make rounds of the sixteen critically-ill patients in the six-bed recovery ward but also to emerge into the heat and blinding sunshine, traverse the rubbish-bordered path to the surgical wards and cast a hasty — perhaps too hasty — glance at the convalescent patients.

There had been time *mirabile dictu* for a long cool drink and a contemplative sandwich at lunch-time instead of a hastily-gulped gin and tonic and back to work. Now it was planned that one surgeon should continue operating for the afternoon while the other foraged at a nearby American base for surgical goodies — oxygen, sutures, drugs, all those things so essential to the easy prosecution of modern surgery but so difficult to find in a war zone. Two o'clock found a little group of surgeon, theatre sister, and anaesthetist once more at work moving between theatre and theatre to open an abdomen, graft skin on to the shattered leg of a victim of the swathe thrown out by a Claymore mine the previous week, and to complete the tidying up of a Montegnard tribeswoman who had survived a 200 km. helicopter trip after having been buried in a rice paddy by artillery fire and whose spleen had been removed in a dramatic twenty minute operation at 2 a.m. four nights before.

The inconsequential talk across the operating table which, much to the horror of laymen always accompanies relaxed surgery, had begun to turn to the idea of a swim as the heat dwindled from the day. But this was not to be, for in the battle-scarred country around Bien Hoa the casual arm of war had delivered a side swipe to a hamlet called Tay Binh and the surgical team was about to gather in the result.

Tay Binh is a typical Vietnamese village on the edge of jungle about 30 km. from Bien Hoa. In the forest are said to lurk Viet Cong guerrillas, and a main force North Vietnamese battalion was also not far away. The village chief was regarded as loyal, and the sympathies of the villagers if consciously directed anywhere were for the central government — at least up to that afternoon. It was late afternoon when suddenly a mortar shell descended on the house next to that of the village chief. Its origin, as with so many of the incidents in this muddled engagement, was quite obscure. Perhaps it was a Viet Cong attempt to destroy the village government — if so it was typical of their policy of intimidation which has been all too successful in the past but in this case failed; perhaps a short round from American H and D (harassment and interdiction) fire — a euphemism for plastering an area of jungle trail or clearing in the hope that V-C will be on it at the time of the firing. Whatever the source — and we shall never know — the flimsy building came tumbling down and then caught fire. Eleven of the occupants were killed outright and ten casualties were dispatched by

any available transport to Bien Hoa and the surgical team.

The first to arrive was a man whose right arm had remained buried in the building and whose leg was partially pulped above the knee. The surgeon could get no coherent story across the language barrier and assumed optimistically and wrongly that this was an isolated casualty. Within ten minutes and with blood — good G.I. blood flown in along with 17,000 more pints every month from Toyko and the western seaboard of the United States — flowing rapidly into his veins he was asleep on the operating table and the process of tidying up his wounds was rapidly accomplished. Ignorant of what was to come the team now slightly wearily turned its mind to a man who had just descended on them with acute intestinal obstruction, and performed the fifth major abdominal procedure since 9 a.m. that day. By now it was close to 6.30 p.m. and after quickly sewing up a small gash on the back of a girl's neck they felt that, deprived although they had been of that swim, at least there was the possibility of a shower and a drink before dinner. But the rest of the Tay Binh casualties of which the first was but an outrider now appeared in a bunch. Nine injured were soon lying on stretchers in the reception area designed for two or at the most three. As usual they were accompanied by a cloud of relatives — perhaps an average of two each — and by the stench of blood, wet clothes, and vomit.

There is an ugly but effective word for what happened next. Triage — the act of sorting according to quality, so the dictionary says — was applied to separate the severely injured from the superficially damaged, and to decide if among the former there were any upon whom it would be a possible waste of time to expend the limited resources at the team's disposal. Within a few minutes an order of priority was established, blood was running in where necessary and, most important, the rest of the surgical team, gathered for its evening meal, was alerted. The little group who had worked through the afternoon stood down for twenty minutes of fried chicken liberally flavoured with garlic by the Vietnamese cook, a flavour that was to stay with them through the hours that followed.

Thus it was that 8.30 p.m. found two operating rooms going full blast. In such a situation there is no place for hidebound specialism, and much as with the Romans hewing down the bridge behind Horatius, the individual seized the most appropriate role which could benefit the patient. So we find the senior-general surgeon assisted by a plastic surgeon sewing up multiple perforations in the upper small bowel of an eight-year-old boy, an orthopaedic surgeon having fixed the shattered bones in one leg helping the junior surgeon at the start of a ticklish repair of torn major vessel in the other leg but giving way to the senior surgeon so as to slip with the alacrity of a ballet dancer back into the other theatre to combine with plastic surgeon to amputate an arm and repair a disorganized face. The paediatrician led a schizophrenic existence — administering an anaesthetic one moment, supervising a transfusion the next and finally with his left hand, as it were, dealing with a quite unrelated emergency in a child with an acute blood disorder. Throughout he still found time to keep his eye on yet another boy with a head injury.

Gradually the chaos subsided into something like order and it was possible to close the operating lifts

with some of the minor work that had been given a low order of priority — lacerations and burns. In the meantime the recovery room staff had caught and fielded each unconscious patient emerging from the operating theatre, bedded him down, miraculously found room in the overcrowded ward for yet another body, and shepherded anxious relatives out of the way. They had done this against a background of having some of the minor injuries lying in the recovery area; in particular one large-eyed solemn girl of about eight years had been repeatedly told to go to the ward but inexplicably remained hanging about the other casualties. Understandably, but not excusably, the senior surgeon who had now been continually in action for twenty hours and who had a background of two months of the same sort of thing, irritably shooed the child away only to have her re-appear ten minutes later. Ultimately he accepted the inevitable and the child curled up on a stretcher and fell into a fitful slumber. Next morning to his chagrin and the amusing glares of his nursing colleagues he discovered that the child's parents were among the eleven fatalities: the little girl had nowhere to go, no one with whom to identify. She had joined the heap of human wreckage that any war seems to produce.

But back to the team. By midnight the nine casualties — five major — had been successfully treated and stillness had descended on the surgical suite. A quick round to see that their other seriously ill patients were comfortable, and home with their fingers crossed that no more stray shells would descend on the unsuspecting to precipitate another period of intense but purposeful activity. By this time the original group who had operated through the day had lost the ability to sleep and sat talking until 2.30 a.m. — a syndrome that afflicts tired professionals as they unwind from the hours of work. There was only one thing certain, the following day would start at 7 a.m. and there would be plenty more of the same.

This is the face of Australian surgical aid in South Vietnam. Others must judge if it is politically right or morally acceptable, for fighting in a platoon one does not see the grand design of war. Similarly face to face with Tay Binh one cannot take a detached view. The surgical teams are there and there to stay. Their mission is the relief of suffering in friend and foe; whether it is successful is for the reader to judge.

---

#### ACADEMIC PUBLISHING

Two books have appeared this year under the University's academic publishing programme. Professor R. Duncan's *The Northern Territory Pastoral Industry 1863-1910* was published jointly with Melbourne University Press and appeared on June 22. On the previous day a ceremony was held in the bookshop and Professor Duncan came from Wollongong for the occasion. Speakers were Mr. I. Free, bookshop manager, Mr. J. Byth, assistant director M.U.P., the chairman of the Publications Committee, Professor A. G. L. Shaw, and Professor D. H. Monro. The author responded.

A monograph on language data processing by Bruce Pratt and Georgette Silva appeared in August and was published independently by the University which was also responsible for production and distribution.

# HEAVENLY BODIES

By K. C. Westfold, Dean, Faculty of Science

## APPARENT MOTIONS

Because movement and change attract attention it is probably true to say that our awareness of the various heavenly bodies is enhanced by their apparent motions over the sky. We are aware of the sun bringing with it the day, as it rises from the eastern horizon, follows a circular path to its highest point in the north at noon, and descends to the western horizon, bringing the night. Likewise the moon, sometimes during the daytime, sometimes in the night, rises in the east and sets in the west.

At night it appears that all the stars in the firmament partake of a similar motion, but in concert. The farther south we look at stars rising and setting the greater is the portion of their paths above the horizon, until at due south a star on the horizon is at the lowest point of its path, which is entirely visible as a complete circle



Figure 1. Star trails. The photograph has been taken in the direction of the south celestial pole with an exposure of about  $1\frac{1}{2}$  hours. The silhouette is that of an early-type radio telescope

centred on the south celestial pole. As we raise our eyes in altitude above the southern horizon the stars can be seen to execute smaller and smaller circles about the pole (Figure 1).

The apparent motions that I have been describing are most readily understood in terms of the diurnal rotation of the earth about an axis through its poles once in about twenty-four hours relative to the stars, which are, for the most part, fixed in their positions on the celestial sphere. The first exceptions are the sun, which over the course of a year appears to move round a great circle called the ecliptic on the diurnally rotating sphere of fixed stars, and the moon, which traverses an almost circular path inclined at about five degrees to the

ecliptic in about  $27\frac{1}{3}$  days. In addition, an observer will notice over the course of a few months that some of the brighter objects in the neighbourhood of the ecliptic move in quite irregular paths relative to the fixed stars. These wanderers, the planets, are confined to a belt called the zodiac about eighteen degrees wide, centred on the ecliptic.

Again, all of these motions become intelligible in terms of the Copernican system of Kepler, in which all the planets, including the earth, move in elliptic paths about the sun with periods ranging from eighty-eight days for the innermost planet Mercury to 248 years for the outermost Pluto; the moon likewise describes an elliptic path about the earth in  $27\frac{1}{3}$  days. Besides the planets, whose paths are nearly circular, there are members of our solar system that have very elongated paths. These are the comets which have periods of up to several hundred years, and the meteor streams, remnants of comets, which produce displays of shooting stars whenever the stream meets the earth's atmosphere.

## PROPER MOTIONS

The planets and satellites are not the only members of the firmament that move relatively to the main pattern of stars. A careful comparison of photographs of an area of the sky, taken at intervals of years, often reveals a slight change in position of one or more stars in the field. Such motions across the line of sight are called proper motions and are measured in terms of their angular motion on the celestial sphere, in seconds of arc per year. Given the distance of the star from the solar system (whose dimensions are minute by comparison) its transverse velocity is determined. If for the same star its line-of-sight velocity can also be determined, its motion is completely specified.

## SPECTRA

The spectrum of a star is the pattern of the distribution over all wavelengths of the light it emits, from red to blue. Different types of stars are characterized by different spectral "signatures", patterns in brightness and distribution of various emission lines, which correspond to different chemical compositions and physical states. In particular they indicate intrinsic brightness, or absolute luminosity. When the spectrum of a star is compared with a laboratory spectrum it is sometimes found that the stellar spectrum is displaced, towards either the red or the blue end. Such displacements are normally attributed to the effects of motion having a component along the line of sight, the Doppler effect. In terrestrial circumstances, when a periodic source is moving relatively towards an observer its apparent wavelength is reduced, and when its relative motion is away from the observer its apparent wavelength is increased. The pitch of a whistle blast from a passing train exhibits the effect in the case of sound waves. The direction and magnitude of these Doppler shifts determine the relative velocity in the line-of-sight between source and observer.

Thus, the Doppler effect provides a method for determining the line-of-sight velocities of individual stars whose spectra can be measured.

## THE GALACTIC SYSTEM

The Milky Way appears as a bright band of stars, luminous gas, and dark clouds, lying within about ten degrees of a great circle on the celestial sphere. We infer that the sun and solar system lie in the plane of the Milky Way within a flattened disk-shaped system. Both the bright and dark clouds are so dense to optical radiation that we cannot see to anywhere near to the limits of the system in directions towards the centre. The situation away from this galactic plane is more favourable for long-distance viewing, since there are no obscuring clouds of gas and dust in the way. In these directions we find the globular clusters, each containing hundreds of thousands of stars, among them the cepheid variables characterized by regular fluctuations in their brightness.

In the early decades of this century it was observed that, of the stars in the neighbourhood of the sun, there was one group that moved with high velocities, of the order of 200 kilometres per second relatively to the

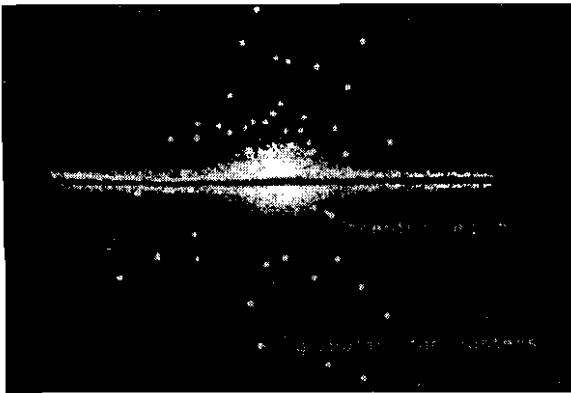


Figure 2. A schematic view of our galaxy seen edge on. Note the dark clouds in the disk and the position of the sun

sun, whereas another group moved with relative velocities of no more than about 30 kilometres per second. This phenomenon finds its explanation in terms of a picture of our galaxy (Figure 2) as a disk of stars, dust, and gas, in a state of differential rotation about a centre distance some 30,000 light years<sup>1</sup> from the sun, surrounded by a halo of stars which do not partake of the galactic rotation. The sun and its neighbouring members of the disk population have circular velocities of about 200 kilometres per second past the halo stars, the residual differences being within about 30 kilometres per second. The corresponding period of rotation is about 200 million years.

In differential rotation the time to complete a circuit is different at different distances from the centre, and in these circumstances we might expect to find spiral arms such as are observed in external galaxies (Figure 3). In fact these features were not directly observed in our galaxy until the advent of radio astronomy and the development of techniques to observe the 21-centimetre hydrogen-line radiation. By this time

<sup>1</sup> One light year is the distance travelled in one year by light at a velocity of 300,000 kilometres per second.

radio astronomers had found that the gas and dust in the disk was transparent to radio-frequency radiation, and had already discerned the main features of radiation originating throughout the disk and halo regions.

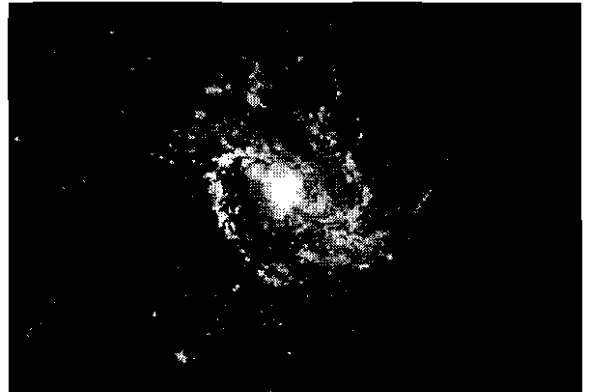


Figure 3. A typical spiral galaxy

## DISTANCE MEASURE

The picture we have provided of our galactic system has been derived from the angular measurements of proper motions, the spectroscopic measurements of radial velocities, and measurements of distance. So far we have not indicated how astronomers estimate the distances of the heavenly bodies. Two principles are involved. The first is that light travels in straight lines and the second that the apparent luminosity of a star is diminished inversely as the square of the distance from the observer. The first principle is used by terrestrial surveyors, who use trigonometry to determine the distance of an object from a measurement of the angle subtended by a measured baseline. Using the earth's orbital diameter of about 300 million kilometres as a base line, astronomers can determine distances by this method out to about 100 light years. Beyond this the second principle is invoked. We have already remarked that each of the various types of star, recognized by their spectral signatures, has associated with it a definite absolute luminosity. Application of the inverse-square law to measurements of the apparent luminosity of a star of given type immediately provides a value for its distance. Another kind of signature, applicable to variable stars, is the period of their light fluctuations. In 1912 Miss Leavitt of Harvard Observatory discovered a relation between the periods and luminosities of the cepheid variables in our nearest extra-galactic neighbours, the Magellanic Clouds. When this period-luminosity relation was applied by Shapley to the cepheids in the globular clusters of our galaxy, he was able to determine their distances and the location of their centre, a fundamental step in building up our picture. Clearly, wherever cepheids can be recognized and their periods and apparent luminosities measured, their distances can be estimated.

## THE EXPANDING UNIVERSE

The first large optical reflecting telescope was built by Lord Rosse in 1845. With its mirror of diameter six feet it was able to collect enough light to discern for the first time the characteristic spiral shape of fourteen of the nebulae visible in directions away from



the galactic plane. With the advent of larger telescopes and photographic techniques permitting long time exposures, many millions of these nebulae can be seen. It was originally supposed that these nebulae belonged to our own galactic system, despite their multiplicity and their curious shape. But opinion changed when in 1924 Hubble, using the 100-inch Mount Wilson reflector, was able to identify cepheid variables in the nearer spiral nebulae. Using the period-luminosity relation, he found that they lay at distances of the order of millions of light years, far beyond the limits of our galaxy. Hubble devoted the rest of his life to a study of the extra-galactic nebulae, the other galaxies of the universe. Unfortunately, cepheids can be identified in only a small number of them, but in 1929 he established that their brightest members were all of about the same absolute luminosity. Using these he was able to extend his measurements of distance to about 150 more galaxies in which individual stars could be detected, out to about 100 million light years. For distances beyond he had to find a third criterion. This was based on the small scatter of absolute luminosities of galaxies about an average figure. With this figure, a measurement of the apparent luminosity of a galaxy will provide a crude estimate of its distance. Since 1948, when the 200-inch reflector was installed at Mount Palomar, the techniques of surveying the external galaxies have been refined. It now appears that the galaxies are not distributed uniformly in space, as Hubble had supposed, but in clusters of hundreds or thousands, allowing far more reliable statistics to be applied in obtaining estimates of their distances. At the same time as he was estimating their distances, Hubble was taking spectra of the distant galaxies. He found that all their spectra were shifted towards the red end of the spectrum, by amounts that were proportional to their distances. This remarkable relation, known as Hubble's law, has only been confirmed by the continuation of these studies using the 200-inch Palomar telescope. It is generally held that the red shifts are Doppler effects, indicating velocities of recession of about 10,000 kilometres per second for every 100 light years of distance. Rather than indicating that our own galaxy is at the centre of the universe, this feature of recession is one that would be observed from any member of an expanding universe. The analogy sometimes given is of currants in a large pudding, expanding uniformly in all directions. From the point of view of any currant within it, all the others appear to be moving away from it in all directions.

The interpretation of Hubble's law brings us to the realms of cosmology, the theory of the universe, how it began — if indeed it did begin — and how it will continue to behave. At last, with the construction of the large radio telescopes, a stage has been reached where it seems possible that the theories proposed can be subjected, as in other sciences, to observational testing. But that is another story.

---

#### MICROFILM PRINTING

The main library has acquired a "Filmac 400" microfilm reader printer for use by any reader wishing to print from microfilm. A choice of lenses is available, and others will be bought as particular requirements develop. Both 16mm. and 35mm. film can be accommodated.

#### VISITING PROFESSOR OF RUSSIAN

Dr. Rudolf Zimek has been appointed to a visiting professorship in the Russian section of the department of Modern Languages. The appointment is for a period of fifteen months.

Dr. Zimek is a graduate of the universities of Prague and Olomouc in Czechoslovakia, majoring in English and Russian. He is at present head of the department of Slavonic Studies and vice-dean of the faculty of Arts at Olomouc.

He has had considerable teaching experience and has made valuable contributions to recent developments in the fields of general and Slavonic linguistics. He will be especially welcome as a contributor to the rapidly developing linguistics research programme in which his colleagues from various sections of the department of Modern Languages are now engaged.

---

#### OPEN DAY

Monash held its first Open Day on Saturday, June 17, 1967, in an attempt (one of many) to strengthen the ties between the universities and the community.

Departments with displays and exhibits ranged from the technical to the humanist, with material from the remote past to the present and even the possible future.

The department of Mechanical Engineering, for example, demonstrated a steam engine with origins in the ancient Greek world as well as equipment used to measure the expected wind forces on the passengers' lounge at the airport being built at Tullamarine.

Visitors saw devices about which there is much publicity but not many opportunities for inspection. The department of Physics demonstrated Laser techniques and an electron microscope; Botany showed earth-coring equipment; the Computer Centre was in operation and explained by tape recordings.

Machinery was found, however, even in humanities departments. The department of English had microfilm readers, record and tape-playing equipment, and slide projectors. The foreign language laboratories, and sophisticated electronic machines used in the study of linguistics, were also on show.

Although the Alexander Theatre was formally opened in March and has been used for productions, Open Day provided many people with their first chance to see it, "backstage" as well as front, in conducted tours.

Estimates of the number of visitors ranged from 15,000 to 20,000. The day was generally felt to have been a great success.

---

#### QUEEN'S BIRTHDAY HONOURS

Two members of the University Council were honoured in the Queen's birthday list.

Mr. J. A. Forrest was created a Knight Bachelor for services to the community, and Dr. T. E. Lowe a Commander of the order of the British Empire for services to medicine. Sir James Forrest has been a member of the Council since 1965 and Dr. Lowe since 1963.

## PROGRAMMED LEARNING IN PROFESSIONAL EDUCATION

By M. Balson, Senior Lecturer, Faculty of Education

The training for the professions is currently facing instructional problems of crisis proportions largely as a result of two factors:

(a) The need to prepare a greater number of professional workers to cope with the demands of an expanding economy.

(b) The information or knowledge explosion which is producing a rapid accumulation in the amount to be learned in both initial and continuing education.

A unique phenomena of our age is the information overload. Professor Purcell of Harvard recently pointed out that 90% of all scientists who have ever existed since the beginning of time are alive today and producing a huge output of scientific information. For the student entering professional school, there is an overwhelming problem with which to cope. It has been estimated, for instance, that a good medical student may learn as many as 60,000 new words in his first year — and words are only a small part of what he learns.

The net result of these influences is a continuing pressure to reorganize various courses, to add new courses, to eliminate others, and to extend the period of professional education. In addition, we are forced to recognize that professional training is not a one-time thing but rather a lifelong part of a professional career. Faced with these problems, together with a search for more efficient ways of collecting, organizing, disseminating, and assimilating information, a sense of urgency characterizes the endeavours of those responsible for training in the professions.

Over the past few years, the role of programmed learning has become more significant. More programmes have become available, the prescription of programmed texts has become more common, and the field of programmed learning has generated more research studies over the past few years than any other single topic in the field of education. The level of activity prompted Schramm to write: "No method of instruction has ever come into use surrounded by so much research activity." Enthusiasm is great and the atmosphere is buoyant. While many could not accept Komoski's prophesy that "programmed instruction will work miracles in solving the world's educational problems", those who have used this instructional medium would generally confirm Roucek's assessment that "this new field is destined to revolutionize all levels of education."

Because many lecturers are unfamiliar with the basic tenets of programmed instruction, it may be useful to indicate the major characteristics of the most common

programming model, the linear format. Features of this technique are:

- (1) A statement of the goals of instruction expressed in performance terms.
- (2) An ordered sequence of items through which each student works.
- (3) The learning process is divided into a large number of very small steps.
- (4) At each step the learner is required to construct a response.
- (5) Each response made by the learner receives an immediate reinforcement or feedback.
- (6) Because the steps are small, the learner will make few errors and those which are made, are immediately identified.
- (7) Each student proceeds at his own rate.
- (8) Programmes are validated against the behavioral objectives by thorough and frequent field testing.

An example of how these features are incorporated into written materials may be seen by comparing the traditional text-book approach to learning with a programmed learning segment. Read the following statement:

In order for fertilization to occur the ovary must first release an egg into the fallopian tube. This is called ovulation. For ovulation to occur, the hormones FSH and LH must both be present in the bloodstream. These hormones are produced by the pituitary. Two hormones which inhibit the pituitary from producing FSH and LH are estrogen and progesterone. When these are present in the bloodstream in sufficient quantities FSH and LH production is inhibited. Oral contraceptives act like estrogen and progesterone in that respect. When oral contraceptives are present in the blood FSH and LH production is inhibited, with consequent inhibition of ovulation and therefore fertilization.

Without looking back try to describe how oral contraceptives work. Did the statement teach or merely present information? Did you have a way of knowing which aspect of the content you might be responsible for. Was your attention focused on the relevant points or did you scan until you reached a point where some specific response was demanded and then you went back to relevant points? If you had known at the outset that you would later be called upon to describe how oral contraceptives work, would you have been able to proceed more effectively?

Programmed instruction attacks these problems by focusing the student's attention on the significant points while he learns. After the student answers an item correctly he receives immediate confirmation that he has mastered the relevant information and proceeds with confidence.

The following segment (on the opposite page) takes the same concept of oral contraceptives and teaches it via a linear form. Conceal the answers which are presented on the right-hand side of the page. Write down your answer to each frame and then confirm its correctness by checking with the programme answer.

---

#### NAMING OF CHAIRS OF EDUCATION

The second chair of Education held by Professor S. S. Dunn has been named "The K. S. Cunningham Chair of Education". Dr. K. S. Cunningham was the first director of the Australian Council of Educational Research. The third chair, held by Professor P. J. Fenham, has been named "The Ian Clunies Ross Chair of Education". Sir Ian Clunies Ross was first chairman of the C.S.I.R.O.



In view of the problems of professional education mentioned earlier, it is suggested that programmed learning may be most fruitfully employed in the following areas:

*Normal Course Work.* A well-prepared professional person must have a large amount of knowledge thoroughly mastered. There is considerable evidence that the use of programmed learning makes it possible for a student to master a given amount of information in less time than with traditional methods.

It is envisaged that programmes could be used as part of a course in any of the following ways:

- (a) To allow students to acquire basic terminology and concepts before they meet with their instructors.
- (b) To be used as a supplement in paralleling a course of instruction.
- (c) To be used as revision for a unit in a course of instruction or for additional practice in a unit.
- (d) To be used either as enrichment or remedial material for selected areas.
- (e) To be used instead of normal instruction.

The use made of programmed learning will depend largely on the availability of material and on the attitude of the lecturer towards programmes. Seen as either-or development, programming will fail. Seen as an extremely valuable teaching aid, programming will contribute significantly to the improvement of the total instructional programme.

*Remedial Education.* Frequently a course may require prior skills or knowledge which some students may lack. For example, students with minimal background in mathematics may have difficulty with modern biochemistry. A programme on the relevant mathematical area, taken during the months of February or March, would ensure that the students would have the necessary mathematical skills to profit from the subsequent course of instruction.

*Supplementary or Enrichment Work.* There are many special topics which are important to the various professions that cannot be satisfactorily handled in normal courses at present. For example, a special topic such as advanced X-ray diagnosis in medical education, may be presented much more efficiently through programmes used as a supplement to normal courses. One of the most useful roles of programmed instruction is in explaining discrete topics of particular difficulty which are not generally taught well or enthusiastically. Often student preparation for such topics has been highly variable. For example, acid base balance is seldom adequately or efficiently taught; one finds it appearing over and over again, in small doses, in biochemistry, physiology, medicine, paediatrics, and surgery. Another such topic is enzyme kinetics. The advantages of programming small selected areas are:

- (a) The student can assume the responsibility for reviewing topics to the level of proficiency he needs.
- (b) Areas falling between courses and between departments or faculties, can be strengthened.
- (c) Serious log-jams in comprehension in a given scientific field may be broken.
- (d) Very short programmes in dynamic areas where obsolescence will occur very rapidly presents the only opportunity of bringing our finest scholars in the sciences into occasional programme writing.

*Continuing Education.* With the accelerating expansion of knowledge, one of the most difficult problems facing

the professional worker is to keep abreast of many significant developments. Much of the information can be obtained by reading journals and by attending conferences. It is highly probable, however, that programmes can be used effectively to communicate new material of critical importance in a minimum length of time. In addition, programmes may be studied by individuals working at their own pace, at times and places most convenient to them.

The experience of practising physicians with a programme on *Allergy and Hypersensitivity* is interesting. In 1962, the journal *Spectrum* carried an article on programmed learning together with a programmed sequence on how to read an electrocardiogram in myocardial infarction. The issue went to 225,000 physicians in the United States of whom 50,000 replied with a blanket endorsement of medical programmed instruction. As a result, a longer programme was written on *Allergy and Hypersensitivity* which was available to physicians on request. The first run of 100,000 copies was soon exhausted and a second edition run of 100,000 is now almost gone. Though it was designed only as graduate review material for practising physicians, the programme is being used as supplementary teaching material in 74 of the 91 American medical schools.

Programmed learning represents an advance of such significance that no professional can afford to ignore the advantages it offers. Monash University has already made a significant contribution to the field. Many departments have conducted seminars on the application of programming to subject areas; workshops have been conducted for institutions such as A.C.I., College of Nursing, and the Institute of Management; research studies have been reported at conferences; programmes which have been written or purchased have been prescribed in psychology, anthropology and sociology, education, mathematics, chemistry, music, and economics.

It is evident that education has come upon a new day in which solid theory is being translated into new instructional concepts and methods. It is to be hoped that all departments will vigorously explain what is sound in this new science.

---

#### LORD CASEY PATRON OF MONASH GRADUATES ASSOCIATION

The Monash Graduates Association advises that their most distinguished member, the Rt. Hon. Lord Casey, has consented to become patron of the Association.

Lord Casey received the University's first honorary degree, that of Doctor of Laws, in April, 1966.

This is a personal patronage and the Association feels particularly honoured by Lord Casey's gesture.

---

#### THE GREAT HALL

The total sum received and anticipated for the Great Hall Appeal when this issue went to press was \$730,000. The total amount necessary is \$900,000.



## OPENING OF ALEXANDER THEATRE

The University's Alexander Theatre was officially opened by Senator Gorton, Minister for Education and Science, on Saturday, March 11, 1967. The opening was followed by a performance of "Much Ado About Nothing" presented by the Monash Players.

The Alexander Theatre provides the University with one of the most flexible auditoria in Australia. It stands close to the entrance of the University on a podium adjoining the main car-park, where its dramatic external appearance and seventy-five foot high fly-tower make

it a conspicuous addition to the University's buildings.

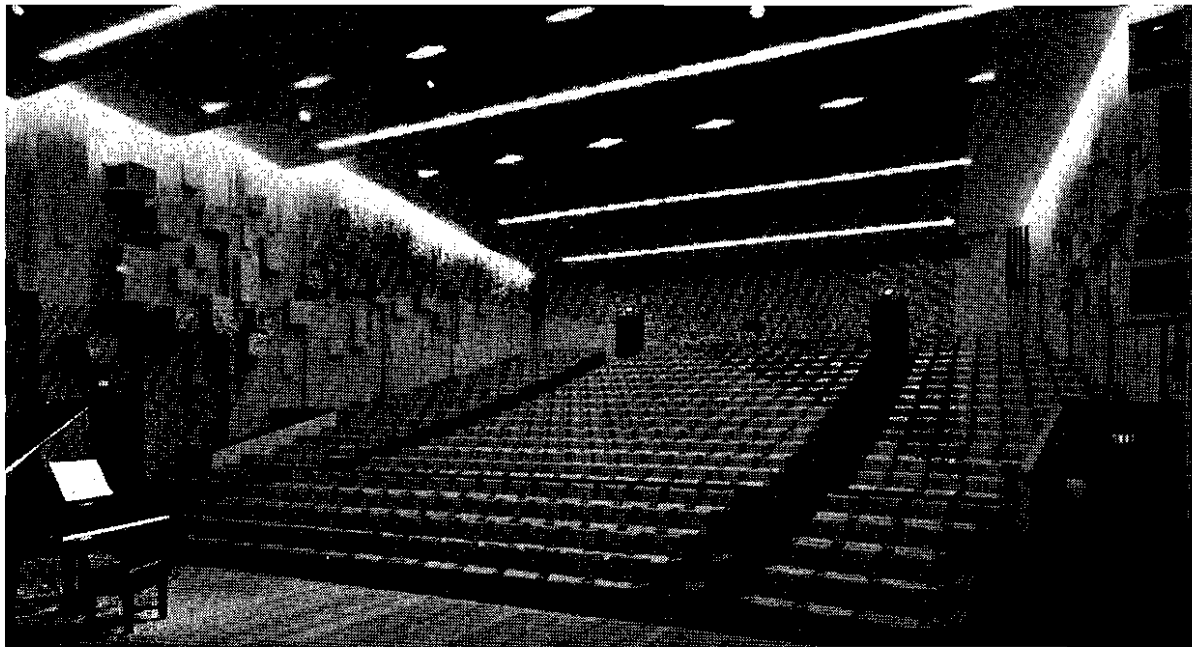
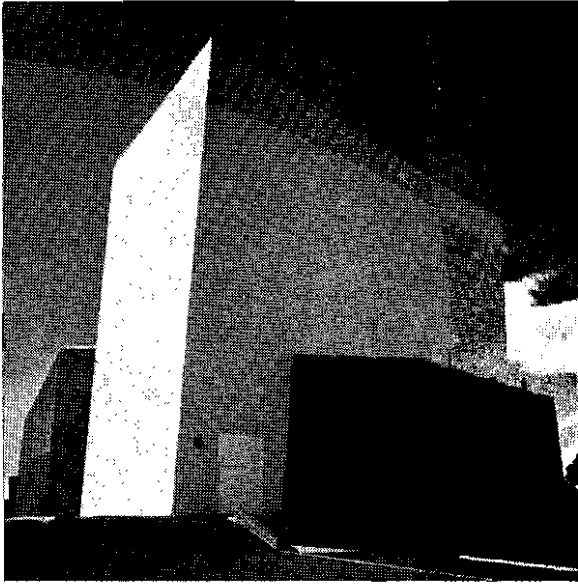
The interior has been designed so as to allow it to be used for as many different purposes as possible. It can easily be set up as a conference hall, and there are facilities for the installation of deaf-aid transmission and simultaneous translation services. It is as suitable for the presentation of classical drama as for modern experimental plays; it will also make a comfortable cinema.

The theatre is named after Emeritus Professor Samuel Alexander, O.M., F.B.A., the great Australian philosopher, whose bust by Epstein dominates the foyer.

In speaking of Samuel Alexander, the Vice-Chancellor, Dr. Matheson said:

"Manchester, when Alexander first went there, was part of the Federal Victoria University, which comprised Owens College in Manchester and colleges in Leeds and Liverpool. I hope you will not think it tactless of me, Mr. Minister, to draw attention in your presence to Alexander's strong advocacy of the abandonment of the federal system and the setting up of independent universities because of the 'organic connection of a university with its city and district.' 'The sentiment of organic connection,' he wrote, 'is the feeling that a university meets the desires of the people for it, and that it is strong according as they take interest and pride in the extension of its influence and in the distinction of its members. From another point of view it is the sense that academic work, the life of the teacher, and the learner, and the investigator, is not something remote from daily interests but is a form of citizenship.'

"These words of Alexander's express much better than I could, our hope that this theatre, named after him, will form a real link between Monash and the people of this district."



## BIOLOGY AND ENGINEERING

By A. K. McIntyre, Professor of Physiology

It is a long time since serious attempts have been made to question the validity of current general belief that biological phenomena depend basically upon the same chemical and physical processes which govern the properties and behaviour of inanimate matter, and do not require in addition some vital essence, a Maxwell's demon or other ghost in the machine, for their operation.

It is easy to see why such supernatural agencies were formerly invoked to explain, for example, such apparent violations of natural law as the failure of a warm-blooded animal to cool down when placed in cold surroundings; nowadays a child of six brought up in a house with thermostatically controlled heating has no difficulty in grasping the general nature of the automatic control systems involved in each case. The staggering development of technology during the last fifty years has brought with it such a profusion of mechanisms, ranging from household appliances to computers and space craft, that modern man no longer looks for supernatural factors in even the most obscure and complex phenomena such as are manifest in living organisms.

Thus what can be called the engineering approach to biology has for long been accepted as a natural and proper way to go about investigating living things; the converse is not yet true, but may well develop before long. In the borderland between these two traditional disciplines lies a rich and as yet scarcely-worked field of study which is likely to yield increasing intellectual and practical rewards. At the present time, bio-engineering activities at Monash are restricted to graduate level, and take the form of formal or informal collaboration between departments in the faculty of Engineering and biological departments such as the departments of Biochemistry and Physiology. Other departments in the faculty of Medicine also maintain contacts with Engineering, and the likelihood of more extensive collaboration in the future is indicated by the representation of Engineering on the Joint Planning Committee for the Monash Medical Centre.

What sort of topics are of current interest from the bio-engineering point of view? Many of the more obvious are now common knowledge, thanks to mass media of communication, although popular exposition rarely presents a balanced or accurate picture. The applications of complex engineering technology to medical and surgical problems are amongst the more widely known bio-engineering topics: to mention just a few examples, artificial blood-circulation and oxygenation systems for temporary use during surgery, so-called artificial kidneys, replacement spare parts such as plastic blood vessels, artificial heart valves, or even complete artificial hearts, the use of computers as diagnostic aids — these and similar matters receive almost daily mention in the press or other news media. The exceedingly complex "life-support" devices necessary for survival in abnormal situations such as the implacably hostile environment of outer space provide further and maximally publicised examples of highly sophisticated and dramatic — though not always successful — applications of engineering in the service of biology.

However, these well-known technological endeavours

and achievements give a very limited picture of actual or potential activities in the whole field of bio-engineering. Prominent amongst its less well-known aspects is the analysis of biological function in terms of engineering control systems; how, for example, the actions of the heart, blood vessels, and respiratory organs are regulated and co-ordinated by nervous and other mechanisms in such a way as to remain stable under constant conditions, while responding promptly and appropriately to changes in bodily activity or posture. Such an engineering approach is being increasingly employed in the analysis of many organs and systems in the living body, including the complex and little understood control systems within individual cells which regulate the array of interlocking chemical synthetic and energy-yielding processes upon which depend the cells' survival and activity.

In many cases, engineering models are set up in the attempt to unravel vital processes — necessarily much simplified initially — the operation of which may help to reject untenable hypotheses and select others consistent with known data, and so lead to further and more crucial experiments. These models may be actual physical entities, such as mechanical or hydraulic systems devised to help, for example, in the analysis of muscle function, of blood circulation, or of the processes which maintain the body's water content so remarkably constant in health; or the models may take purely symbolic form, and may be set up and studied by appropriately programming a computer. The application of computer-modelling is becoming increasingly valuable in the biological field, and the day is not far off when adequate knowledge of computer technique will be as essential to students of biology as it is now for so many workers in the physical sciences.

Brief mention is appropriate of two problems with biological and engineering aspects which are currently under study at Monash. One of these concerns the nature of animal connective tissue and the exploration at the molecular level of what gives the various forms of connective tissue their characteristic and remarkable properties. The problem is being studied jointly by members of the department of Biochemistry and of the Engineering faculty. Connective tissue is the stuff which knits together the various parts of the body; it forms an essential part of the skin's fabric, giving it strength and pliability; it encases the muscles and knits them to the bones which they must move or hold steady; it forms a vital part of the walls of blood vessels, amongst other things providing the elasticity which allows the arteries to store much of the heart's energy between beats, thereby greatly reducing the load on the heart; and it also forms the tenuous but tough flaps of tissue which form the vitally important valves in heart and veins. Cartilage and bone are also examples of highly specialized connective tissue. Basically, this tissue is composed of vast numbers of filaments of the fibrous protein collagen, spun, as it were, by special cells, and these fibres interpenetrate a meshwork of mucopolysaccharide molecules which form a gel-like matrix. Studies of the tensile and elastic properties of different

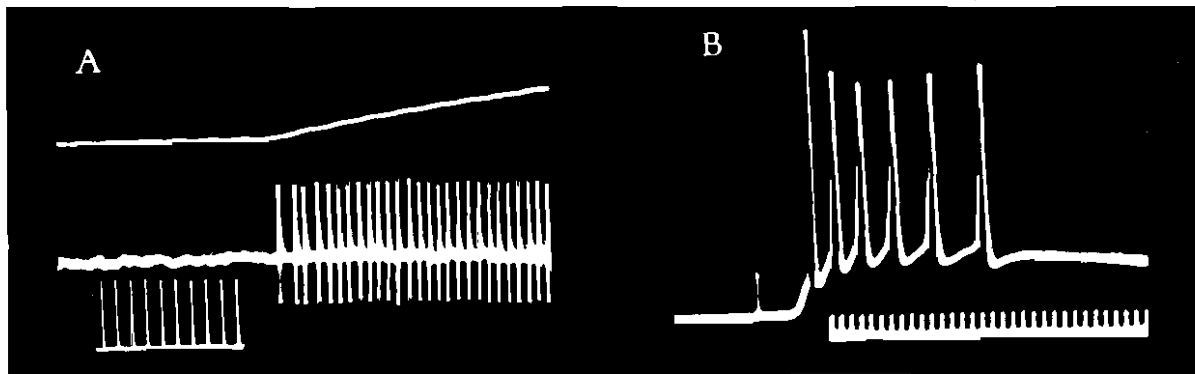
kinds of connective tissue, and of "synthetic" assemblies of collagen and mucopolysaccharide are being carried out, and it has been shown that striking alterations in physical properties can be produced by relatively minor and reversible changes in configuration of the mucopolysaccharide molecules, findings of relevance to many practical problems of medicine and surgery such as disorders of joints, tendons, blood vessels, and skin.

The other problem — or rather, series of problems — being studied at Monash by engineers and biologists concerns nerve and brain function. It has been known for many years that the brain's short-term, moment-to-moment transactions depend upon information received from sense-organs in coded form, the code being based on stereotyped dot-like electrical pulses — nerve impulses — varying in frequency according to the intensity of sense-organ stimulation. These travel at speeds of 2 to 250 miles per hour in myriads of sensory nerve fibres, constantly bombarding the central nervous system with information about the body and its surroundings, immediate and distant; in the brain and spinal cord, this information is processed and analysed in an enormously complex three-dimensional array of thousands of millions of interconnected nerve cells, each of which can affect others by way of intimate contacts or synapses. The coded information — still in the form of nerve-impulse patterns — may reach higher brain levels and evoke conscious sensations, and it may after suitable transformation impinge on the output, motor nerve cells, causing them in their turn to discharge impulse-patterns which then bring about appropriate adjustments of muscle activity. Some examples of signals recorded from single nerve cells are illustrated in the figure.

Despite this general understanding of the basic code system, very little is yet known about details of the analysis and transformations of the input-signal streams which take place at the synaptic junctions between nerve cells. In the department of Electrical Engineering, a group is studying aspects of the responses of motor nerve cells to randomly-timed input volleys in nerve fibres with direct connexions to the cells. Much of the analysis of results is performed on tape-stored data by the appropriately programmed 3200 computer. In the depart-

ment of Physiology, studies are being carried out on the operation of sense-organs and the transmission and modulation of the coded sensory signals as they negotiate synaptic junctions on their way to the brain. These studies, and related ones on the functions of intermediate nerve cells in controlling motor nerve cell discharge, are also greatly facilitated by the use of computer technique, both for revealing very small electrical responses of nerve cells and cell populations which would otherwise be masked by other, larger signals, and for analysing the discharge-patterns of single cells. Work is also being initiated on one of the most baffling and vitally important aspects of brain function — the nature of the mechanisms responsible for storage of experience and the long-term modification of behaviour. This study also involves the tape-recording of nerve-cell firing patterns, and their subsequent analysis by computer.

So much for the engineering approach to biology. What about a biological approach to engineering? There are, of course, outstanding examples of biological contributions to industry — for example as everyone knows the yeast cell is an essential part of the engineering equipment of bakeries and breweries, and other lowly organisms with special synthetic skills have been pressed into service by chemical engineers for the manufacture of antibiotics. It is not too far a cry to entertain the ultimate prospect of a food or fuel technology based on direct use of solar energy for the manufacture of complex energy-rich molecules, given a sufficient understanding of the whole array of intricate physico-chemical processes which enable the green plant cell to perform this difficult and fundamental task. Similarly, fuller understanding of the computer-like operation of the brain may ultimately help in the design of computers far more sophisticated than any which have yet been conceived. One should not forget that devices such as aerial and aquatic sonar used by bats and marine mammals were developed, tested and perfected over long ages through the pressure of biological adaptive selection; there may well be many other biological mechanisms waiting to be re-discovered and exploited in hardware versions — it must be hoped for purposes beneficial rather than destructive to mankind.



Some examples of nerve signalling. "A" shows the series of electrical impulses recorded by external electrodes from a single nerve fibre of a muscle sense-organ as it signals extension of the muscle, indicated by upward movement of the top trace. "B" is the repetitive firing of a brain cell, recorded by an intracellular electrode, in response to a brief input of impulses in a sensory pathway. Time scales indicated by vertical lines in lowermost traces, those in "A" showing one-hundredth of a second, and in "B" one-thousandth of a second intervals

## THREE HONORARY DEGREES CONFERRED

At a special graduation ceremony in May three honorary degrees were conferred by the University. In addition 445 degrees were conferred in the faculties of Arts, Economics and Politics, Education, Engineering, Law, and Science. The Occasional Address was delivered by the Chief Justice of Victoria, Sir Henry Winneke.

The following citations were read to the three honorary graduates by the Vice-Chancellor:

*Presentation of Willis Henry Connolly for admission to the degree of Doctor of Engineering, honoris causa*

When Sir John Monash returned to Australia after the Great War it was not long before he became chairman of the newly-formed State Electricity Commission and, until his death in 1931, he laboured to establish the electricity supply system on which we now rely.

The decision to name Victoria's second university after Monash, and the special responsibility which it was to discharge in the area of technical education, made it of particular interest to the present electricity commissioners and their chairman and, among the many individuals and groups who have helped us, they occupy a rather special place.

The present chairman, who stands before you, was educated at Benalla High School; following the custom of the time, he then went up to the University of Melbourne, and, after the usual interval, emerged as a Bachelor of Electrical Engineering; from then on his career lay with the Commission. On his way up through what has become a very large and complex organization he participated in the work, both technical and administrative, of many departments and he became engineer and manager of the Electricity Supply Department at the age of thirty-six. A dozen years later, when he was appointed assistant to the general manager, the then commissioners were sure that the qualities of intellect and character that he had already displayed would take him to the top and, indeed, he was appointed chairman in 1956.

The head of a large public utility has to exercise judgment and give leadership in many different but related areas of activity, but his success is judged by the public according to the simple criterion of whether he supplies the goods — in this case electricity — at a reasonable price and in excess of demand. In order to satisfy this criterion many difficult decisions of a technical-cum-economic nature have to be made and the Government's confidence in and support of these decisions has to be won.

The tremendous developments in Victoria's electricity supply system which have taken place under Willis Connolly's chairmanship are an indication that the decisions in which he has participated have been sound and that he is indeed a worthy successor to his great predecessor, our namesake. His professional reputation was signally endorsed five years ago when he was elected president of the World Power Conference.

He has long had an active interest in technical education and, since 1961, has been chairman of the committee which the Minister of Education set up to advise on the work and development of the technical colleges. He was thus an obvious choice for the presidency of the recently established Victoria Institute of Colleges,

a development of great interest and promise but, it should be added, one of some complexity and difficulty where precedents have to be made for none exist; we shall watch his work with confidence.

*Presentation of Mabel Balcombe Brookes for admission to the degree of Doctor of Laws, honoris causa*

The most difficult and complicated faculty in any university is undoubtedly Medicine for, in addition to the teaching and research carried out in the university proper, the clinical training of the medical students has necessarily to be conducted in hospitals. This brings the university into contact — sometimes even into conflict — with an esoteric world of honoraries, medical staff, nurses, clinical professors, hospital managers, boards of management; there are also some patients.

When the Monash medical school was established it was necessary to make arrangements for clinical teaching at several hospitals pending the establishment of our own hospital at Clayton; this became possible when the University of Melbourne, with great generosity, agreed to withdraw gradually from some of its affiliated hospitals and to allow Monash to take over.

The necessity to provide training in obstetrics and gynaecology brought us into partnership with the Queen Victoria Memorial Hospital and with the remarkable and talented woman who has presided over its Committee of Management since 1924. It is not necessary, Mr. Chancellor, to pursue the history of the institution back to that time except to say that, until the advent of the Monash era, the "Queen Vic" was essentially a hospital run by women for women. Nor can anyone now imagine a time when Dame Mabel was not in command — and I use the noun advisedly.

Running a hospital in this State seems to me to require the same sort of talents as are required by, say, the Secretary General of the United Nations. Premiers and Ministers of Health have to be persuaded, charmed or out-manoeuvred; doctors have to be humoured and battled for — alternatively; universities have to be hypnotised into co-operation on reasonable terms; patients have to be cherished.

Under Dame Mabel's generalship the Queen Victoria has made steady and sure progress from the time when its terms of reference were exclusive and limited until the present when it is moving rapidly into the full status of a teaching hospital. Over these long years it has built up a loyalty and devotion among its patients that must on no account be lost, whatever changes the future may bring.

Mr. Premier, you know far better than I that politics is the art of the possible and that although progress cannot be made on all fronts simultaneously there come opportunities, from time to time which, if recognized and seized boldly, lead much further than might have been anticipated. Dame Mabel is a master of this kind of strategical thinking; in a different world — the one that she perhaps had in mind when she stood as a candidate in the Women for Canberra movement — she might have reached the top of the political tree. In the world that she has actually known her talents have been deployed over a more restricted range but to the



immense advantage of the thousands of patients who have passed through her hospital.

When the time comes for her to hand on to her successor she will be able to look back with satisfaction over long years of devotion to her hospital, secure in the knowledge that that devotion is reciprocated by her colleagues, her staff, her patients and, now, by her university.

*Presentation of Henry Edward Bolte for admission to the degree of Doctor of Laws, honoris causa*

Just over six years ago Mr. Henry Bolte, as he then was, opened Monash University and in the course of his speech said two things that should be recalled today.

The first was to the effect that his Cabinet had agreed to legislation to create a second university before the Commonwealth Government set up the Murray Committee to examine and report on university needs for the whole of Australia.

University people are a little apt to regard the arrival on these shores of Sir Keith Murray as heralding the renaissance of learning, the end of the Dark Ages in which education had been languishing. Murray's achievement in securing agreement to the participation of the Commonwealth Government in university finance was very great but let us not forget that the Government of this State was already active and so was fully ready to take advantage of Murray's work.

Not only did the Victorian Government fall in with the general propositions that Murray advanced; it sought his particular advice on the form that Victoria's second university should take, and our history has been not a little affected by what then transpired.

The six years that have passed since our opening have seen much progress and, with the award today of our first degrees in law and in education, it can be said that we have reached the end of the beginning, as students have now graduated from all our faculties. This is therefore a peculiarly apt moment at which to confer a degree upon the man who, more than any other, can be called our founder.

There are many who believe that honorary degrees should not be offered to politicians in office, especially if their portfolio is one which involves them in university legislation or finance. And there are some who suppose that such an offer necessarily implies the identification of the university with the general policy or particular decisions of the government of the day.

There is obviously much to be said for these views, but there are special reasons why they should not prevail in the case of this particular premier, with whom, as has been said, we have a special relationship.

He has held office, as is well known, for a record term and it may well be that historians, looking back, will judge it a term of outstanding development and prosperity. Certainly in our own world of higher education his record of establishing two universities and the Institute of Colleges will be hard to beat.

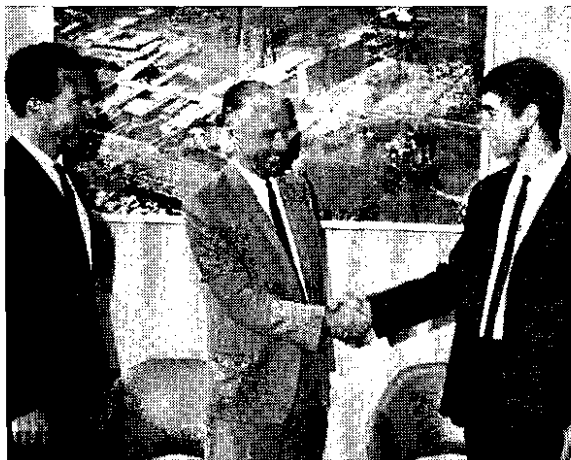
Those who know Sir Henry well speak of his intelligence, his political skill, his grasp of financial details, his determination. For my part I value particularly the trust he puts in those who carry responsibility. As a university we recognize his great capacity and achievement and especially what he has done for tertiary education. In his speech at our opening ceremony, to which I have

already referred, he described the steps that had been taken to bring Monash into being and his hopes for its future. He has perhaps forgotten but we remember the words he used: he said 'I can assure you that what I'm telling you comes from the heart.'

APPLIED CHEMICALS PTY. LTD. GRADUATE SCHOLARSHIP

The George Hicks Foundation of Hawthorn, Melbourne, has established a graduate scholarship at Monash for research in chemistry and chemical engineering. It will be known as the Applied Chemicals Pty. Ltd. Scholarship and will be available to students wishing to proceed to the Master's and Doctor of Philosophy degree at Monash.

By awarding a scholarship of this kind the Foundation hopes to provide greater opportunities for contact



*Mr. Ross Spence (right) is congratulated by Mr. George Hicks. At left Professor J. M. Swan*

between people engaged in university research and those concerned in industry with the application of chemistry.

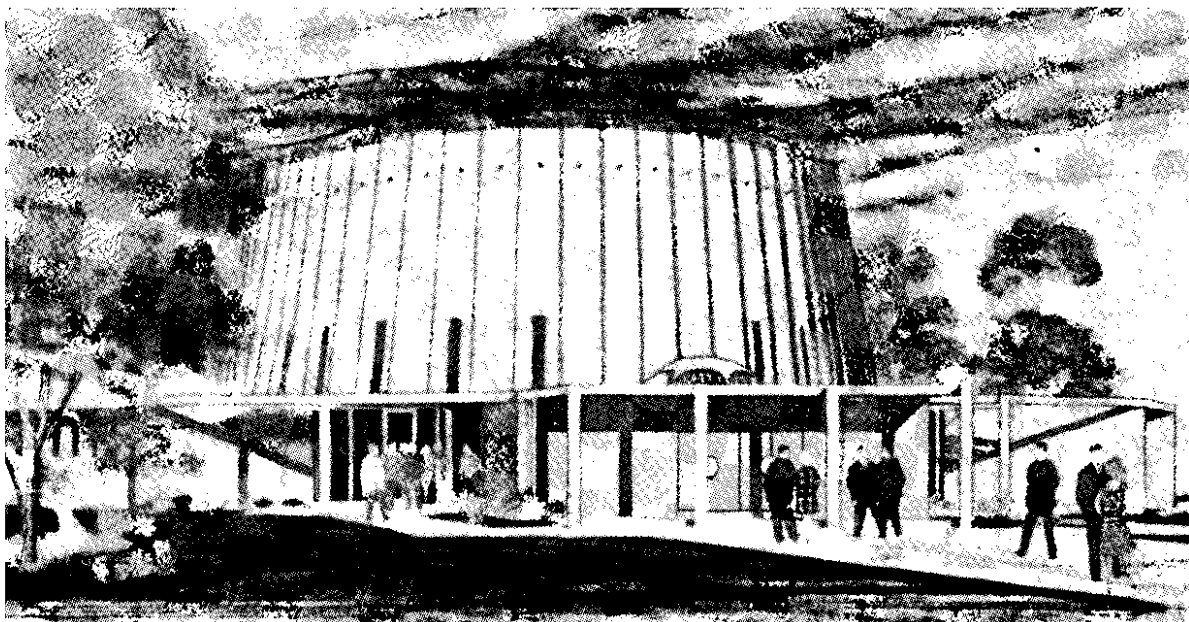
The first of these scholarships has been awarded to Mr. R. A. Spence, an honours graduate in chemistry of the Wollongong University College. Mr. Spence was awarded the Masson Memorial Scholarship for 1966 of the Royal Australian Chemical Institute. At Monash he will work under the direction of Professor J. M. Swan and will investigate the synthesis of radioactive organophosphorus compounds for application in anti-cancer research.

The George Hicks Foundation has been established by Mr. George F. Hicks, the founder, chairman and managing director of Applied Chemicals Pty. Ltd. This company was the pioneer in Australia of modern and highly technical cleaning methods for industry, of technical lubricants, of water treatment chemicals, and of petroleum industry chemicals.

DRAMA JOURNAL

The first two issues of "Komos", a new quarterly journal of drama and fine arts of the theatre produced by the department of English, have now been published.

## RELIGIOUS CENTRE AT MONASH



*An architect's sketch of the Religious Centre*

The Religious Centre had its beginnings as early as January, 1959, in the thought of a group of representatives of the Anglican, Baptist, Catholic, Methodist, and Presbyterian Churches who proposed the establishment of a united Christian Centre in the University.

A public appeal for funds was launched in September, 1966, and the required \$500,000 has now been raised. In March the Churches Appeal Committee arranged an informal ceremony at which the Premier, Sir Henry Bolte, placed the central survey peg. In announcing a contribution to the project by the Government, Sir Henry said:

"It gives me great honour to do this and may I say that I am thrilled to have the honour because I believe this is one of the greatest concepts of all time. The principle behind it is so wonderful and the need is so urgent that it would be intolerable almost if we did not raise sufficient money to go ahead with this project. The Government thinks so greatly of it that we are prepared to put in \$20,000."

The foundation stone was laid on Sunday, April 9, 1967, by His Excellency, the Governor of Victoria, Sir Rohan Delacombe.

The unity of thought which lies behind the whole conception of the Religious Centre is emphasized by the circular plan for the project with its radial vestries and meeting places.

The Centre will consist of a main chapel, circular in design, with a capacity of 475, which will be used for either denominational or combined services; a secondary chapel, behind the main chapel, which will be capable of accommodating 50; five vestries, around the perimeter of the main chapel, which can be used either as meeting rooms or for small religious services, and a

large meeting room in the narthex. The site is between the University Union and the main administration block. Construction has already begun.

When completed at the beginning of the 1968 academic year, the building will be given by the churches to the University.

---

#### FIRST AWARD OF MONASH FELLOWSHIPS

The University has awarded its first three senior research fellowships.

Dr. A. H. Spry, reader in Geology, University of Tasmania, and Associate Professor F. R. Routley, Associate Professor in Philosophy, University of New England, have been awarded senior research fellowships. Dr. I. D. Rae, postdoctoral research associate, department of Chemistry, University of Toronto, has been awarded a research fellowship.

Dr. Spry, who has already taken up his position in the department of Physics, is carrying out research into the interpretation of rocks in terms of solid-state processes.

Associate Professor Routley is currently carrying out research into logic and mathematics. Associate Professor Routley will take up his post in the department of Philosophy in December this year.

The research to be undertaken by Dr. Rae will involve the synthesis of nitrogenous plant products of Australian origin, and further structural studies of aromatic compounds. Dr. Rae will take up his position in the department of Chemistry in November this year.

## OVERSEAS STUDENTS AT THE UNIVERSITY

*By Tharam Dillon, former President, S.R.C.*

Since the very outset the University has included in its ranks students from overseas countries. As the University grew, the number of overseas students increased until in 1966 the total number was 335. They came from countries as diverse and widely separated as Malaysia, Iran, U.S.A., India, New Zealand, Hong Kong, Sierra Leone, and Britain.

The majority of these students are enrolled in the faculties of Arts, Economics and Politics, Science, Engineering, and Medicine. They consist of both undergraduate and graduate students.

The atmosphere of a university by its very nature creates a series of problems for all students, whether they come from as far as Macao or as near as Clayton. They include problems of adjustment to a university situation after the comparatively sheltered and disciplined life of a school. Among them is the feeling of isolation which may be a feature of communities where a large number of individuals are thrown together. This feeling is best described as the kind of isolation one experiences in a crowd. The isolation is more acute because of an awareness of the unknown persons standing next to you.

The stress of examinations and the pressures to be successful constitute a second such problem. There is also the dilemma, particularly in first year, as to what proportion of time should be devoted to the various facets of university life in order to derive the fullest benefit from one's stay within the university.

Besides these problems which are universal there are special problems which are unique to students, whether from the country or from overseas, living away from home. Suitable accommodation and study conditions have to be found. If the student is living with a family there is the question of compatibility. The other more serious matter is the awareness that his family is not

there to fall back on in a moment of crisis or uncertainty.

The overseas student also experiences a sudden change in cultural background, social habits, and local customs. An Asian student, for instance, would find a complete change in the values which are accepted within the society. The emphasis from the spiritual and moral values at home shifts to the more material here. This is best typified by the exaggerated need for material success that is required of an individual within this society. Apart from this change in perspective, he meets with a few lesser examples of what he considers peculiar. This is perhaps illustrated by the case of the Asian student who was surprised to learn that his landlady only did the washing once a week. He remarked that this was thoroughly unhygienic as he felt that the clothes were virtually left to rot for a week. The customs of the people, he finds, are different, the habits are different, the manners are different. What was considered good manners at home might be considered offensive, and vice versa.

Fortunately within Australia the overseas student does not encounter any overt discrimination. He does, however, meet with a more insidious form of discrimination manifested in the form of a patronising attitude by people who might well be his intellectual, social, and cultural inferiors. This attitude is not as apparent within the university as in the community at large. This demands a certain degree of forbearance on the part of the overseas student.

Difficulties in communication are suffered by students from countries where English is not widely spoken. This has a two-fold aspect. There is the problem of comprehending the lectures in a strange language and there may be the frustration, because of the language difficulty, of not fully participating in any conversation.



*Asian students in the anatomy museum*

Thus the overseas student not only faces the problem of adjustment to a university situation but also that of settlement within a community that is foreign to him.

Under these circumstances how, therefore, does the overseas student fare in the various facets of university life? The answer to this question is not a simple one.

In the first instance, it is a question that can only be applied to one student at a time. This is because the capacity of the overseas student, like that of any other, to make a success of his stay within the university depends greatly on his personal attributes. These vary greatly from individual to individual and hence the measure of success must vary accordingly.

Perhaps the criterion that can be used to judge the performance of the overseas students at the university is an assessment of activities and achievements. On examining the records we find that on the whole the percentage of overseas students who are successful in their examinations is no less than that of others, and if anything is a little higher. In particular we find that students who are under the auspices of the Colombo Plan for the most part have outstanding academic records.

The field of endeavour of overseas students is not

restricted to good academic records. We find a large proportion of them taking part in the extra-curricular activities of the university. These extend from the various sporting activities such as hockey, soccer, karate, judo, and fencing, to the cultural, social, and communal. At Monash as in a number of the other universities some overseas students interest themselves in the management and organization of student affairs by taking an active role in such bodies as the Students' Representative Council and the Union Board.

The benefits that accrue to an overseas student at Monash are greater than those accruing to the Australian student, for he not only acquires the basic skills of his profession and all that is involved in a university education, but also experiences a different kind of society. This will undoubtedly be of great value when he returns home as it will add another dimension to his insight. He will also be in a position to give more sympathetic consideration to public opinion in the society he has visited than he would otherwise have been able to do. This might well be considered an argument for sending larger numbers of Australian students to complete their studies overseas, particularly in countries in the Asian region.

---

## MONASH UNIVERSITY ASSOCIATION

The aims of this Association, which was formed in the latter half of 1966, are to —

(a) provide an opportunity for parents and others interested in Monash to identify themselves more closely with the University;

(b) encourage contact between representatives of the University, parents, staff, and members of the community generally for their mutual benefit;

(c) assist with projects associated with the University and help raise funds for specific University purposes;

(d) help students and parents cope better with problems arising from transition from school to university, and from university to employment.

In brief, this means that the Association is intended to act as a general support group for the University.

Activities organized to date have included a Parent Orientation day, held on the Sunday following Orientation week, which was attended by more than 1,600 parents of new students. In view of its success, it has been agreed that this function should be an annual event and the "Parents' Day" eliminated from student Orientation week.

The Association has also initiated a programme of visits to country regions, aimed at keeping parents, school heads, graduates, and parliamentary and civic leaders in these regions in touch with developments at Monash, and to answer any queries or correct any misconceptions which they may have. These visits have earned much goodwill and support for Monash. Regions visited during 1967 were Gippsland, the Mallee, and the North-East. A visit to the Western District is planned in October.

Generally speaking, the Association welcomes any

opportunity to be of service. It does not want to restrict itself to purely academic matters, nor does it wish to enter fields in which sufficient work is already being done by present members of University staff. It is happy to support or augment any activity or to explore topics about which there is a need for some background information. Comments or suggestions should be directed to the executive officer, Mr. John Wilson, on extension 2049.

---

### 1967 VICTORIAN INDUSTRIAL SAFETY CONVENTION

The 1967 Safety Convention was held at Monash in May. It was conducted by the Department of Labour and Industry to encourage development in industrial safety. Thirty-four exhibitors had displays in the Union foyers depicting safety equipment as well as methods for the prevention of industrial accidents. Over 1,100 people attended lectures held during the three-day convention.

---

### FORUM ON PAPUA AND NEW GUINEA

The S.R.C. held a successful forum on Papua and New Guinea in the Union dining room on July 24. Guest speakers included Professor Peter Lawrence, Brisbane, Mr. Kim Beasley, Perth, Dr. John Gunther, Mr. O. Oala-Rarua, New Guinea, Mr. J. Hawke, Melbourne, Professor D. Derham, and Mr. Barnes, the Minister for Territories. The S.R.C. will be publishing the speeches.



# IMMUNORADIOACTIVE ATTACK ON CANCER AND OTHER TISSUES

By R. C. Nairn, *Professor of Pathology*

It is common knowledge that some infectious diseases such as measles or whooping cough very rarely occur a second time. This is because infected animals manufacture antibodies which circulate in the blood for defence against invading germs, and such antibodies or their immediate sources may persist many years after recovery. Immunization by vaccination against such diseases is based on this. For example, killed poliomyelitis virus in the Salk vaccine when injected into human subjects stimulates antibody production which prevents infection on subsequent contact with live virus. This kind of immune reaction to the introduction of foreign material into the body is not always helpful. It is in fact responsible for much of the difficulty in obtaining successful transplantation of organs and tissues from one individual to another because the donated organ is regarded as a foreign invader. Moreover it has recently been discovered that not only will the body reject foreign tissues, but in certain diseases, spoken of as "autoimmune", the immune system goes wrong leading to self-attack on one's own organs and tissues. Since immunological attack can be mounted against parts of the body as well as against germs, by analogy with vaccination against infectious diseases, it will not be unexpected that we are able actively to provoke antibody formation to a tissue by injecting an animal with a suitable preparation of the tissue.

In order to prepare such a tissue vaccine the procedure is to procure a fresh sample of the tissue which might be a whole organ such as a kidney or a cancer, obtained at operation, and prepare it in a form suitable for injection. For this purpose its cells are broken up by physical methods and the resulting subcellular particles believed to be richest in materials unique to the tissue are then concentrated by high speed centrifuging and discarding unwanted contaminants. The purified particles form the active principle of a vaccine which is injected into an experimental animal, or in rare instances into a human subject, to provoke antibody formation. The vaccinating particles are, despite the initial purification procedures, never a single homogeneous biochemical, and the antibodies produced against them will therefore include some with activity versus any other tissue component contaminating the vaccine. Such unwanted antibodies can usually be removed by special absorption procedures to yield a product with the specific activity required.

Antibodies are nowadays recoverable from the blood of the animal in which they are produced, in fairly pure chemical state. One of their remarkable features is an exquisite specificity of action, which is limited almost exclusively to the agent which stimulated their production. Poliomyelitis antibodies protect only against poliomyelitis, and, similarly, antibodies to tissues will bind only to those tissues against which they were provoked. This can be tested by labelling the antibodies with fluorescent dyes or radioisotopes and examining their adhesion to the corresponding provoking agent, whether this be germ or tissue. For the latter purpose various preparations of tissue are available in the laboratory, or the labelled antibody may be injected into a

living animal and its "homing" followed to the target tissue.

Binding of antibody to tissues, although an indication of the homing effect, is not itself necessarily harmful to them; additional biological mechanisms are required for destruction of an antibody's target whether this be a tissue or indeed an invading germ. Thus although we have prepared potent antibody preparations active against organs such as stomach, intestine, kidney, and even cancer, which can home selectively on these tissues, their effect ends there as far as we can judge. We do not seem to be able to invoke artificially the additional immunobiological mechanisms needed to induce tissue destruction. An anti-cancer serum, therefore, for all its intrinsic interest probably would not of itself provide a therapeutic weapon against cancer. Some years ago, in collaboration with my colleague Dr. Ghose, now a senior member of our departmental cancer research team at Monash, we succeeded in provoking an antibody to cancer in a patient suffering from the disease. Unhappily it proved ineffective in arresting the progress of the cancer, but it occurred to us that if we had been able to couple such a serum to some potent conventional anti-cancer agent, we might then have a means of cancer treatment of truly remarkable specificity.

The activity of conventional anti-cancer drugs is unfortunately hardly ever limited exclusively to the cancer. When administered to patients in sufficient dosage to guarantee destruction of cancer, many normal tissues of the body may also be harmfully affected, though naturally every means possible is employed to obtain the best selective action. For example, some drugs are administered directly into the artery supplying the cancerous part ensuring that the body elsewhere gets only diluted drug, or X-ray treatment is focused on the lesion from many directions so that intervening tissue receives only a fractional dose. There is one instance of highly selective anti-cancer activity provided by a simple chemical: radioactive iodine is concentrated from the body fluids by the thyroid gland, and if it is administered to a patient with a thyroid cancer which has retained this property of concentrating it, selective destruction of the cancer and any surviving normal thyroid tissue will be achieved with little or no damage to other parts of the body. Such preferential uptake of a chemical by a cancer at present seems limited to the rather rare thyroid lesions and the principle is not applicable to other cancers.

Lack of a homing mechanism in simple cancer-destructive chemicals should be overcome by carrying them to their target, on the backs, so to speak, of specific antibodies. Their superb localizing properties combined with the destructive effects of potent cell-killing chemicals should provide a unique homing device selectively lethal for cancer — an "anti-cancer guided missile". Recently we have had the opportunity of testing this hypothesis with an experimental cancer in mice. It was found that this cancer could be destroyed by specific antibody that had been coupled with radioactive iodine. The iodinated antibody was bound by the cancer cells, and only the cancer cells, which were then

destroyed by the radioiodine perfectly positioned for the task. Iodinated serum from which antibody was absent was ineffective as was the antibody without radioiodine. This seems a very promising beginning to the exploration of possible immunoradiotherapy of cancer in human patients.

Our present efforts in this experimental cancer field are directed towards defining optimal dosage of antibody and radioactivity, and studying the time relationships between treatment and onset of cancer to obtain the most favourable response. Attempts to develop new sera against various human cancers is our major preoccupation. Unfortunately cancers are so similar in composition to normal tissues of the body that specific antibodies to cancer without any activity against normal tissues will not be easily obtainable, but we feel that for some cancers at least the goal is not an impossible one.

Meanwhile we already possess antibodies with specific binding activity for some normal animal and human organs and tissues. However, we do not normally wish to destroy normal organs and it might well be asked: What value would a homing missile against, say, kidney be to us? In fact a specific destructive agent for a particular part of the body would have great potential for experimental physiology and pathology. It would complement surgical excision to permit investigation of the effects of deprivation of certain tissues. More particularly it would permit the extirpation of diffuse components of organs and organisms, which could not be accomplished surgically. For example, radioactive anti-kidney sera should permit selective experimental destruction of functional zones of the kidney and enable us to confirm our ideas about the sites of particular

functions. In another area, radioactive antibody to, say, a blood constituent such as one of the white cells would permit selective extirpation of these widely dispersed cells in a way impossible by any mechanical means and permit studies of the effects of such experimental deprivation of a particular body cell.

Quite apart from the value of such a weapon as an experimental tool, antibodies to certain normal tissues and organs might have value one day in clinical therapeutics. A promising example of this is an antiserum we have available directed against the acid-secreting cells of the stomach. This antiserum binds quite specifically to these stomach cells in standard experimental models and we are studying its homing properties in the living animal. If such selective homing of the serum coupled to a radioactive agent can be successfully accomplished we might conceivably have here a medical, as distinct from surgical, means of curing excessive gastric acidity and thus a useful addition to our armament against the not uncommon disease, peptic ulceration.

Choice of radioactive agent for coupling to our antiserum has so far been restricted to radioiodine as the chemistry and immunological effects of the coupling have already been extensively studied in many laboratories and are now well understood. However, iodine is not ideal for our purpose as its radiation effect cannot be localized in the body quite as rigidly as we should like. We have therefore embarked on a combined research project with Professor Swan of Organic Chemistry in this University for the preparation of organic radio-phosphorus compounds and their coupling to the antiserum, in place of the radioiodine. If this proves feasible several advantages should accrue: the experimental



Then



Now



When?

animal work will be simplified because radiophosphorus is easier to handle and we may expect better localization of the radiation from the immunoradioactive agent bound to the animal tissues. The ideal would be to adjust the dose of radiation and antibody activity so that a single treatment by injection would suffice to coat the cells of the target tissue and destroy them. The natural radioactive decay of radiophosphorus, which has a half-life of fourteen days, is fairly rapid and should avoid problems of persistent irradiation of the body after the target is destroyed. We already know that antibody remains attached to target tissue for some weeks and shall ensure that the bonds with the radioactive chemical will be sufficiently secure to keep it in place for the same length of time.

However, it cannot be maintained that immunoradio-

active treatment would always be without harmful side effects. It will not be possible to avoid some irradiation of cells adjacent to the real target and there is a risk that such minimally irradiated cells might develop harmful mutation, which could itself be a cause of a new cancer. The risk of cancer is well known to be greater in individuals who have been irradiated, but the chance must be calculated and balanced against the advantages of any therapeutic procedure. Fortunately it is least in the elderly for whom the therapy is most often likely to be required because they have the highest incidence of spontaneous cancer. In any case desperate diseases justify desperate remedies so that the mere increased likelihood of another cancer developing in a patient to be treated for an existing lesion would hardly justify the withholding of an effective remedy.

---

## THE ROLE COUNSELLING CAN PLAY IN A UNIVERSITY

*By G. A. Cally, Student Counsellor*

Counselling services in Australian universities are of relatively recent origin. Although, both prior to and in the immediate post-war years, some universities had non-academic services of an advisory kind, it was not until the early 1950's that specialist counselling services made their appearance in tertiary institutions. Until then they had tended to make use of the vocational guidance and psychiatric services established in the community a quarter of a century earlier.

A decade ago, only thirty per cent of our universities had full-time professional counsellors but at the time of writing seventy-five per cent have or are about to establish such services.

Some insight into this movement may be gained by a consideration of the sociological forces which may have contributed to its birth and development.

In the two decades since the war, Australia, like many of the developed countries of the world, has undergone significant socio-economic changes: migration, the post-war population explosion, great technological advances, and unprecedented affluence have had tremendous impact.

The impact has been felt most dramatically in the educational sphere. Between 1945 and 1965 the number of students enrolled at Australian universities increased more than five-fold and that of staff more than six-fold. As a result the older-established universities have had to expand to a degree far beyond the physical capacity for which they were intended. Another consequence has been the emergence of the "new universities", characterized by a meteoric rate of development. This is clearly illustrated by our own University, Monash, where the annual rate of increase in the student population over the past six years has been about seventy per cent.

Another important change has been the considerable increase in the general body of knowledge. Whether in the old or new universities, these rapid changes have placed tremendous strains on the adaptive powers of the educational structure as well as on the individuals within it. Ever-increasing specialization of function and an accompanying degree of de-humanization have been the main reactions to these stresses.

The justification for this philosophy of action or reaction is a naive belief that in spite of segmenting the whole of experience into increasingly smaller compartments so that more and more can be learned about less and less, some sort of integration between the parts will somehow occur.

Although the emergence of counselling psychology is linked with, if not the direct result of, this specialization of function, counsellors have been assigned the paradoxical task of helping to heal not so much the condition itself as the effects of the condition — the individual breakdowns.

Whether or not counselling succeeds in its task largely depends on its conception of the magnitude of the task and the modes of tackling it. In what follows I should like to present my own views on how counselling should proceed.

Firstly, we must try to resolve the logical paradox facing it. If there is any validity in this analysis of the genesis of counselling it must follow that if it restricts itself solely to the attempt to heal the *effects* of the conditions which gave it birth (segmentations, etc.), it is doomed to become further engulfed in segmentation, which will lead it by an infinite regress to failure. If, on the other hand, it devotes all of its energies to dealing with the condition itself it can only do so effectively if it considers both the effects and itself as part of that condition.

Put another way, if one of the reasons for the emergence of counselling services is the actual or threatened breakdown in the relationship between staff and staff, staff and students, and students and students, then at least one of the counsellor's functions should be to examine what those relationships should be. Furthermore, if the pressures of the environment, whether physical or social, are unduly stressful and precipitate unresolvable conflicts, then it is important not only to understand the student's strengths and weaknesses, but also the environmental conditions which precipitate the difficulties.

As part of the disease it is attempting to heal, counselling should view itself as a necessary evil, constantly

working towards its own demise. To do this it must resist the temptation to enhance its own importance by developing too specialized a language or technique which would set it apart and thus create a sense of distance and mystery.

The special function of counselling should be to facilitate the flow of communication within and between individuals and within the university community at large. Since there cannot be unambiguous communication of experience of reality ("what is") without some degree of *awareness*, counselling is vitally concerned with enhancing awareness of both inner and outer reality. The specific means of achieving this depend on numerous factors, the most important of which may be the counsellor's conception of human nature or the human situation.

As I conceive it, counselling is an infinitely varied process, the aims of which are to create, expand and sustain opportunities for growth within a person (individual counselling), a small group (group counselling), and the University at large (staff, students, etc.). By growth I mean the propensity of any living organism to expand, to become more self-governing, more autonomous and less dependent on internal or external forces outside its control.

It might be relevant at this point to discuss what I consider to be some popular misconceptions about counselling.

The term itself is a misleading one as it is often linked with the giving of advice and information. Another widely-held and more serious misconception is that it is nothing more than a conglomeration of technical skills which allows the counsellor to diagnose a complaint, problem or disease through the use of tests and other measuring devices. Having made the diagnosis, he is then expected to produce various ready-made solutions. Both these notions stem from an outdated nineteenth-century view of the person as a static object, no different from a physical object.

In my conception the person is held responsible for his own actions. What the counsellor aims to do is to help the person become the best possible version of himself as defined essentially by his own values, ambitions and limitations. The counsellor's function is neither to predict nor control behaviour but to help the individual assume the responsibility for his own decisions. This alone can give him a sense of personal identity — a sense of "I". In this conception, disturbance is equivalent to lack of personal identity, or identity diffusion, which is related to an avoidance of decision and personal responsibility. The difference between the highly disturbed and the so-called "normal" person lies in the degree of consistency of experience and subjectively-felt freedom of choice and in the person's tolerance of the anxiety that usually accompanies such a feeling.

But why, one might ask, do people experience so much difficulty in making responsible decisions or choices? Common experience suggests that normally we are held responsible for what we choose to do and not responsible for what we are forced to do. Responsibility can be a frightening experience if it has not been acquired gradually. The young person who has had all his major decisions made for him by his parents and teachers will experience great difficulty when they suddenly throw

<sup>1</sup> "Existence" edited by Rollo May, Ernest Angel, Henri F. Ellenberger, P. 52 (Basic Books Inc., 1959).

him in at the deep end of the pool of life and expect him to swim like a veteran.

According to whether a person's decisions have been associated with encouragement and a personal feeling of success, or with humiliation and a personal feeling of failure, his natural propensity to make further growth-promoting choices will be facilitated or emotionally blocked.

Observations seem to indicate that too great a rate of change in external conditions places tremendous pressures on the organism, be it a person or institution. The changes must be recognized and assessed quickly enough to allow commensurate internal change. The greater the gap between the external and internal realities, the greater the anxiety and the graver the risks of disintegration and breakdown. Anxiety in this context is not to be interpreted as an affect or by-product but as a state of being. Rollo May describes it thus, "Anxiety occurs at the point where some emerging potentiality or possibility faces the individual, some possibility of fulfilling his existence; but this very possibility involves the destroying of present security which thereupon gives rise to the tendency to *deny* the new potentiality."<sup>1</sup>

In one sense life consists of a continuous series of transitions, the magnitude and importance of which vary according to the demands for change they impose on the person, institution or community. Most of these changes are usually changes in detail and do not seem to affect the person in any significant way.

It is when change is of such magnitude that it affects the congruence between the person's picture of himself and his picture of what others in the situation expect him to do, or when he suspects something ought to be done but does not know exactly what, that is, when his identity is at stake, that it can become highly anxiety-provoking.

Adolescents in our culture have to go through a period of development, which is characterized by such incongruence. This period of transition has been described as a "no-man's land between childhood and adulthood" — an apprenticeship period at the end of which he is expected to have chosen a socially acceptable and personally satisfying adult identity. During this stage he is supposed to search for and discover suitable vocational goals, an appropriate sex role, and a satisfying system of personal values and attitudes. He is also expected to achieve a successful emotional emancipation from parental and adult authority and to become economically independent of them. He also tries to establish satisfying relationships with other people.

What distinguishes the University student from his non-academic counterpart is his relatively higher intellectual capacity and an artificial prolongation of his adolescent status, that is, longer financial dependence on parents, aggravated by exposure to an environment richer in choice than he is ever likely to encounter again.

Faced with this unusually contradictory situation it is not surprising that some break down, and of those who survive, many may do so at tremendous cost to their ultimate development.

Individual counselling can and does help many, but it would be naive to think that it helps all who need help.

The impression I have tried to convey is that for a multitude of reasons the pressures operating on the various human elements of the University culture are



considerable. The problems with which administrators, academics, and students have to contend are highly complex. Under such circumstances there is a tendency for each of these sub-cultures to concentrate on resolving its own immediate problems and to partially neglect the fact that pressures in one sub-culture affect all others.

This incomplete awareness of what goes on in other meaningful aspects of the environment leads to prejudicial attitudes which, instead of relieving the accompanying pressures and anxiety, add to them and enhance the chance of further breakdown.

For the past two and a half years at Monash we have been experimenting with various ways of implementing the philosophy of counselling discussed here.

As well as dealing with the day-to-day casualties that come our way, we have, with the generous help of our Vice-Chancellor and the active co-operation of members of staff, been developing a sort of mental health scheme, the broad aims of which are to encourage better understanding between and within the various sub-cultures in the University.

Space will permit me only to delineate some of the salient features. Our first task was to discover a suitable theme which would have personal relevance and a strong appeal to a sizeable proportion of students and staff. The process of transition between school and university and the associated problems seemed to be eminently suitable for the purpose. No theme, it was felt, could illustrate more dramatically the effect of rapid transition, incongruence, anxiety, etc. Another important consideration which led to this choice was the difficulty we experienced in handling this cluster of problems effectively in a one-to-one counselling situation.

It was felt that since the main source of a student's anxiety was that he lacked adequate standards by which he could assess his thinking and behaviour in his new environment, the most logical way for him to acquire such standards was in as realistic a context as it was possible to contrive.

Since a large portion of the student's time at the University entails complex dealings with the staff, other students, and the subject matter of his course, it was thought that in order to provide opportunities for effective learning these three elements should be incorporated in the experience.

#### STAFF

Since teaching staff are to a large extent the vehicles through which modes of thinking are communicated to students, their inclusion in this experiment was seen as imperative. As the transmitters of culture they could either facilitate or retard adjustment to a new set of cultural values according to whether they were —

- (a) familiar with the various aspects of the culture they were supposed to communicate;
- (b) aware of their own set of expectancies regarding the student;
- (c) able to communicate these expectancies as unambiguously as possible;
- (d) aware of the implications of "transition", not only in the limited sense described here, but in the broader sense used earlier, that is the transition between childhood and adulthood.

We felt it would have been unreasonable to expect any staff member to satisfy all the above criteria. For

this reason we thought it necessary to provide a situation which would give staff an opportunity to clarify and expand on their necessarily limited personal experience. This we did by arranging seven to ten two-hour weekly discussions in small groups of about ten people. Within the general area of student life, University activities, student-staff relationship and their effects on teaching and learning, the content of the discussions was largely dictated by the individuals within each group.

#### OTHER STUDENTS

As I pointed out earlier, one of the shortcomings of the one-to-one counselling situation in dealing with "transition problems" is that it lacks a realistic set of standards against which the student can gauge the validity of his own feelings and attitudes. In late adolescence and early adulthood people are often oversensitive to their difficulties and not sensitive enough in their assessment of other people's problems. This often leads to an over dramatization of their own situation and a psychological isolation which, if uncorrected, would at best significantly affect their capacity to learn effectively and at worst could develop into a pathological state. What we felt the student needed most was a situation removed from the day-to-day competitive atmosphere of the campus, which provided sufficient safety for him to explore and share his reactions, particularly his fears and self-doubts, with other students and members of the academic staff.

To this end we organized a three-day residential conference for students and staff (those who had already attended the preliminary staff discussions). Students from all faculties were randomly assigned to a small group of about eight students which was led by two members of staff.

The discussions followed similar lines to those for staff members. There was no agenda or syllabus — subjects dealt with were largely dictated by student needs. Various other devices to encourage communication were also used, for example, talks on study, lecturing, tutoring, and University life and what it could mean.

#### SUBJECT MATTER IN COURSES

Since our main concern was not so much in helping the student learn specific behaviour such as how he should set about tackling his essay or mathematics problems, but rather to help him develop new attitudes towards his work (how to think for himself, the resources available in his new environment and their uses and limitations in terms of his aims), the main emphasis was placed on those factors which were thought relevant to attitude change.

Nevertheless, some procedures were adopted which it was thought might incidentally facilitate content learning. On the whole the results of these experiments which have been reported elsewhere have been highly encouraging. Teaching staff, students, and counsellors alike seem to have benefited by the experience. Students felt much more positively about staff members and students in other faculties. They were able to admit that they had problems but expressed greater confidence in their ability to solve them. Staff on the other hand felt they had gained more insight into and respect for the student as an individual human being. Many said that as a result of this experience they had questioned some of their previous assumptions in teaching, and

## THE CHEMICAL ENGINEER AND THE FOOD INDUSTRY

By P. J. Meddings, Research Student, Department of Chemical Engineering

Food is a basic necessity of life and we tend to accept its availability in many and varied forms without giving thought to the enormous effort involved in processing primary food products to suit the public palate. The following table indicates the relative importance of the food manufacturing industry in the national situation. Although tobacco has been included with food and drink, its contribution is relatively stable at only a few per cent of the other two.

AUSTRALIAN MANUFACTURING SITUATION 1963-1964		
Industry	Value of Output \$ millions	%
Metals, Plant/Machinery	5,046	39.9
Food/Drink/Tobacco	2,302	18.2
Chemicals and Paints	1,221	9.5
Textiles and Clothing	1,169	9.3
Paper and Printing	759	6.1
Timber	470	3.7
Heat, Light, and Power	356	2.8
Other	1,311	10.5
Total	12,637	100.0

Source: Commonwealth Statistician

### THE ROLE OF COUNSELLING — *continued*

others have already started experimenting with various teaching methods including a wider use of small group discussions.

Despite the success of these conferences there are indications that their influence will be limited to the small proportion of students they can accommodate; nine per cent of first year students attended in 1966 and it was felt that this number was already unmanageable. Furthermore, it seems that the main effect on the student is essentially to create the necessary precondition for the solution of his problems (diminishing anxiety, increasing feeling of belonging and confidence).

There is a danger that unless favourable conditions for the actual solution of the student's problems prevail in the University environment at large, not only might these newly-acquired insights be lost to him but, more importantly, he may run the risk of finding himself saddled with problems the solution to which lie outside his control.

For these reasons it may seem more profitable and safer in the long run gradually to shift our emphasis and attention on to the staff discussions since staff have continuous contact with the student. Ideally the best help will be provided in the natural setting in which the student spends most of his time, that is the classroom.

### NEW STATE LIBRARIAN

Mr. K. A. R. Horn, former chief accessions officer in the University library, was appointed State Librarian of Victoria early this year.

Mr. Horn had been at Monash since January, 1961, and was president of the Staff Association 1964-65. He was interested in the early work of the Choral Society at Monash, and was an active member of the hockey club.

In value of output, food manufacture ranks second only to metals, plant, and machinery, of which, incidentally, a proportion would be consumed by the food industry. Employment figures show that approximately 11% of all Australians employed in the manufacturing industries are engaged in food manufacturing.

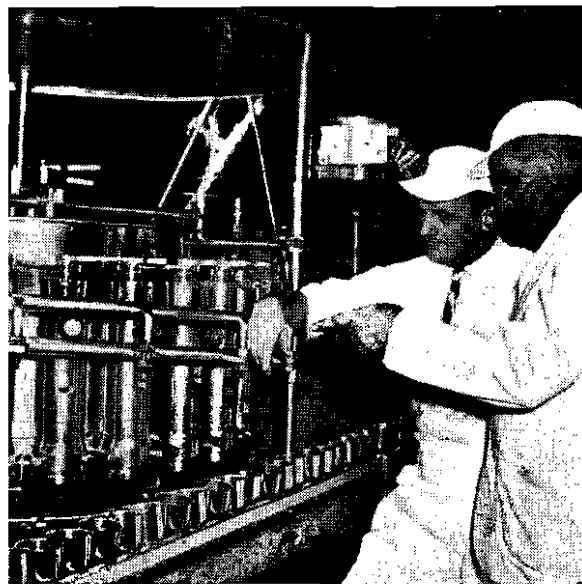
The gross value of rural production in Australia is approximately \$3,356 million (information from the Bureau of Agricultural Economics, 1964-65). Of this nearly 75% represents the contribution from foodstuffs such as meat, dairy products, cereals, fruit, potatoes, eggs, sugar, etc.

With regard to export, statistics compiled from the Overseas Export Bulletin indicate that \$1,057.8 million worth of processed foods were exported during 1965, compared with only \$97.5 million imported.

This information is sufficient for us to realize that food manufacturing in Australia represents a very significant proportion of our total activity, and it is of great importance to our national economy.

An interesting aspect of recent developments in the food processing industry is the trend to concentration of operations into large factories, caused mainly by the presence of competition that has followed the increase in overseas ownership. (It is believed that approximately 50% of the Australian secondary food industry is controlled by overseas interests.) It could be useful to understand why such concentration is necessary, and this will be mentioned again later.

Man's diet now is basically the same as it has always been, primarily meat, seeds, berries, nuts, roots, fish, and so on. Probably long before the threshold of recorded history, man learnt that drying or cooking his meat enabled him to store it longer, that the cultivation and storage of seeds allowed him to forego his nomadic



Bean/soup filler — 400 cans a minute

existence and to settle in one place, that the grinding of seeds into flour gave him the opportunity to improve the palatability of his basic foods. Being able to settle in one place encouraged more permanent dwellings and their grouping into small villages, and eventually into towns. This made even more essential the need to preserve foods and to manage their production.

Through experience and communication with others, methods of treating raw foods to preserve them and to make them more attractive developed over the centuries. The stories and legends surrounding these methods are legion. The first cheese is said to have been made by a goat herdsman who carried his supply of milk in a pouch made of a goat's stomach. The chemicals indigenously present in the pouch, together with movement and heat, produced curds and whey, or cheese.

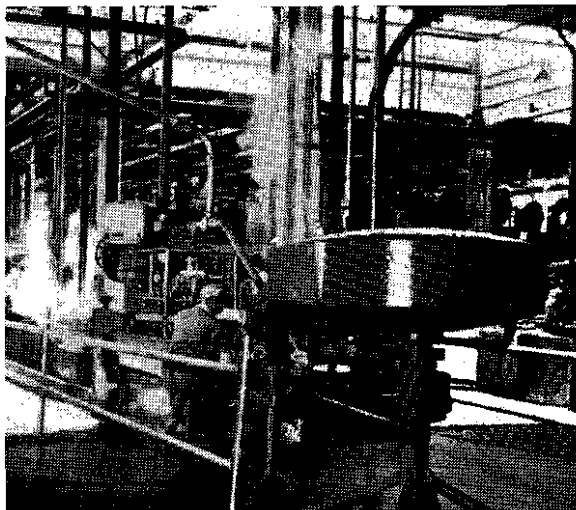
#### NEEDS OF AN ARMY

By the time of the Middle Ages, many processing and preserving methods were in common use, though very often on individual premises rather than in anything resembling factories. Methods included meat curing, drying and smoking, salting of fish, the baking of bread, butter churning, the drying or pickling of vegetables and fruits, spicing, and so on.

Strangely, though in common with many other advances, modern food processing began with the needs of an army. To feed his armies during long campaigns, Napoleon offered a prize of 12,000 francs to anyone who could develop a method for preserving foods in a palatable and nutritious condition over a long period. In 1810, Nicholas Appert, a French cook, showed that if certain foods were heated sufficiently and stored in jars, they would keep for long periods. He won the prize. Although it was decades later before the reasons for the success of this type of preservation were known, other people used Appert's method. Durand patented the "tin can," and the canning industry commenced. Since then, as we all know, canning, whether it be in tins or glass jars, has blossomed into a huge industry employing highly sophisticated methods. It is not at all unusual for a single canning line in a modern factory to produce 600 cans per minute.

The growth of canning is typical of the development that has occurred in all aspects of food processing and is still occurring. The processor has many aims. In particular, he desires his products to be of high quality — to have good storage stability, to have the desired texture, flavour, and palatability, and to be nutritious. To ensure these aims, many scientific disciplines represented in this University have directed their attention to their specific interest in food processing. Bacteriologists work to reduce microbial spoilage. Chemists and biochemists are studying enzymic and other non-microbial aspects of food preservation. Rheological and other physical properties governing texture, etc., are the interest of physicists. These are only a few of the fields concerned with food processing, for which there is now a vast literature including many journals covering food science and technology.

Just as vigorous has been the development in food processing equipment. Engineers have utilized equipment from other industrial operations and applied them to the task of converting laboratory developments, or sometimes even kitchen recipes, into industrial processes. At the same time, a completely new technology has arisen in the food industry, equipment designed specifi-



*Baby food filling line — 600 cans a minute*

cally for food processing of all kinds — washing, peeling, blending, evaporating, centrifuging, cooling and chilling, heating and sterilizing, filtering, and so on. Some aspects of this equipment are peculiar to the food industry, particularly the emphasis on sanitation and the degree of microbial contamination in the finished product.

Another aim of the food processor is of course to be economically efficient, and here we return to the earlier comment on the present trend to concentrate food operations into large factories. In terms of return on capital invested machines in any industry are more effective when operated at maximum capacity, because of reduced overheads. At the same time, greater production allows the use of more sophisticated machinery, which can be designed if it is not readily available. It is in this area that the chemical engineer plays his part.

#### OTHER SCIENTIFIC DISCIPLINES

The chemical engineer has the task of using fundamental knowledge and data from other scientific disciplines in designing and operating processes and equipment to produce large quantities of processed goods. Very often the data or knowledge available is not sufficient, and the chemical engineer must determine his own design information or develop suitable theory in whichever field it is deficient. In this busy, important, and competitive processing industry outlined above, much of the design of plant and processes has been based empirically on past experience, or conservatively on the first method that worked. There is plenty of scope for the chemical engineer.

The type of information that is often sought and used by the chemical engineer is a quantitative description of the movement of mass or heat in a particular system. For example, in the sterilizing of full cans it is necessary to know the lowest maximum temperature reached in the can, and how long that temperature is maintained. From such information, the microbial "kill" can be determined. Yet the food in the can may consist of solid lumps heated by conduction only, or of liquid

heated mainly by convection, or of both solids and liquids. Therefore, to design the correct times of heating and cooling for the cans, the chemical engineer must have data from which to calculate the rate of heat transfer through the can, through the solid lumps, and throughout the liquid.

In the dehydration of foodstuffs, e.g. the drying of peas, water must be driven from inside the material to the surrounding atmosphere. This is known as a *mass transfer process*, and the chemical engineer must know at what rate water is transferred from the pea under various conditions to be able to design efficient drying equipment.

Other physical operations than the transfer of mass and heat are studied by the chemical engineer, but he is not limited only to physical processes. Many advances are now being made through the study of reaction kinetics, i.e. the rate of progress of a chemical reaction. A typical example of this is one of the current projects in the chemical engineering department of Monash concerning the rate of enzymic reactions.

Enzymes are organic catalysts, i.e. they cause reactions to occur but they are not consumed by the reactions. They are necessary to and are present in all forms of life, both animal and plant. They are also present in many industrial processes, either indigenously as in industrial fermentations such as brewing, distilling, baking, antibiotic manufacture, yeast manufacture, etc., or they can be added for a specific purpose. Examples are the use of amylases to break down starch in producing glucose syrup, removing starch in desizing textiles, and the coating of paper. Proteases are used to tenderize meat, prevent haze in beer, modify dough in baking, and to "unhair" leather. Pectinases help in the clarification and standardization of fruit juices.

Biochemists have elucidated the mechanism of reaction of most of the enzymes, but naturally they are less concerned with their behaviour in factories. Chemical engineers must know this to design equipment, and the present study is aimed at quantitatively describing the extent of the reaction and the product composition at any time during the hydrolysis of starch by amylases.

Many new food processes have been developed in recent years. Freeze drying enables food to be dried at low temperature, thus retaining natural flavours and texture. Irradiation is being used successfully to sterilize food for preservation. Microwave heating is a new method that produces a volume heating effect because the microwaves pass through material uniformly. Along with continual improvements in conventional techniques, these provide a challenge in new areas for the chemical engineer. Undoubtedly other developments will follow.

The managing director of a large food retail organization predicted recently that the housewife of the future might telephone a computer which would receive her order, sort and package the items, and have them either delivered or ready to be collected. Some food processing plants are already reaching this stage of complete automation from receipt of raw materials to the packing of finished goods.

The universities have their part to play in training scientists and engineers who will accept the challenge of the food industry, enable it to compete efficiently in both home and export markets, and continue to contribute importantly to the national economy.

## MT. BULLER ALPINE LODGE

The latest extension to the Monash Union has just been completed. Unlike most other extensions however, this one is separated from the main Union building by some 140 miles and three to four hours driving. The extension referred to is the Alpine Lodge, situated on Stirling Track, Mt. Buller. The lodge, which was designed by Mr. A. Scott, one of the University architects, is a two storey structure planned for the maximum of ease of operation and a minimum of maintenance.

A particular effort has been made to construct a building capable of being used, winter or summer, by either individuals or large groups, and it is hoped many of the University clubs and societies will avail themselves of this facility.

Most of the thirty-two bunk accommodation is provided on the ground floor, together with the toilet and shower facilities. Each bunk room has four bunks complete with a mattress and pillow, but users must provide their own sleeping bags or blankets.

The kitchen and lounge/dining room are upstairs and are heated by a 65,000 B.T.U. oil fired unit. Guests must bring their own food but all crockery and cutlery is provided. The kitchen is divided into three units, each with its own electric cooker, sink, and cupboards. There is also a refrigerator.

The lodge is for the benefit of all members of the Union and, with the exception of weekends during the snow season, should give ample opportunity for those members of the University who wish to relax up in the mountains.

---

## AGREEMENT WITH LENINGRAD UNIVERSITY

Monash University and Leningrad University entered into an agreement in June, 1966, to exchange scholars under the following conditions:

Each university annually sends one senior member of staff to give lectures and one graduate student for research work.

The senior member of staff goes for one to two months; the graduate student for an academic year of ten months.

The sending university pays fares and travel expenses for its scholars and the receiving university provides accommodation and stipends appropriate to their status.

Under this scheme, Monash University this year has nominated Dr. George Ettershank, department of Zoology and Comparative Physiology, as the visiting senior member of staff, who will leave in November, and Miss Ann Livingston as a graduate student. Miss Livingston is a candidate for a Master's degree in Russian and she will continue her work on Russian authors using material available only in Russia. Dr. Ettershank, whose special field of interest is the ecology and taxonomy of ants and the ecology of other insect groups, will lecture on the techniques for the study of energy flow through communities of ground-living invertebrates.

## OBITUARY



*Professor A. J. Marshall*

It must be exceptional for a new university to have amongst its first small group of senior appointments a man not only of high scholastic attainment and outstanding personality, but also distinguished for leadership and achievement in fields beyond the usual confines of an academic discipline. Monash can count itself as fortunate in having attracted such a man in the person of Jock Marshall, the second foundation professor to be appointed to the embryo University. An outstanding and colourful figure, Jock Marshall was well known at the time of his appointment as an explorer, journalist, and author in addition to his international renown in the field of biology, especially for his extensive original work on the physiology and ecology of birds.

Tragically short though his term of office proved to be, his strongly held and often picturesquely expressed views have had a profound influence on the development of Monash in its critical formative years, an influence which it must be hoped will be lasting. The adoption of his notion to plant only native trees and shrubs, and the hard-won success of his unique proposal to establish the "snake gully" reserve (now appropriately named "The Jock Marshall Zoology Reserve") will continue to bear witness to his foresight and imagination for generations to come. In less tangible aspects of University growth and development, his dedication to high academic ideals, and vigorous and outspoken opposition to bureaucracy in University affairs both on and off the campus have also been of inestimable value, and will be sadly missed by his colleagues.

Like most other aspects of the man, Jock Marshall's entry into academic life was unusual. Undeterred by the loss of an arm in a shotgun accident at the age of sixteen, he set about the business of overcoming this severe physical setback with courage and resourcefulness, and embarked on a career of intellectual and physical vigour and variety of interest and achievement which would be matched by few men not thus handicapped.

### WRITER AND OBSERVER

Prevented by the accident from matriculating at the customary age, he became a journalist with a Sydney newspaper, thereby helping to develop his very considerable potential as a writer and observer. He was able to combine writing with his love of adventure and exploration and a growing interest in zoology by actively participating in expeditions to the Great Barrier Reef, and Central and Northern Australia on behalf of the Australian Museum, from which stemmed a series of papers concerned with the animals observed and collected. His unusual talent as a field observer and naturalist may be judged by the fact that the Australian Museum appointed him at the age of twenty-two to its honorary scientific staff; a year later he was invited to join the Oxford University Expedition to the New Hebrides, and subsequently he took an active part in working out the expedition results at Oxford. After returning to Australia, he undertook further research and exploration in New Guinea before joining another expedition, this time to Spitzbergen; appropriately, he became a member of the Oxford Explorers Club and the Arctic Club.

### VITALITY AND STRENGTH OF CHARACTER

Not until he was twenty-seven did he embark on a formal academic career, entering the University of Sydney as a non-matriculated student under a little-used provision in the by-laws. This required him to attend the full B.Sc. undergraduate courses, in which he majored in zoology and physiology, and then to submit a dissertation based on two further years of advanced study and research in order to become eligible for the degree of Bachelor. As a student, Jock's maturity, exuberant vitality and strength of character soon established him as a leader in student affairs; for example, his experience as journalist and author made him an obvious choice for the editorship of *Hermes* (he had already written "The Black Musketeers" and "The Men and Birds of Paradise"). In other aspects of his student activities some of his exploits have become legendary — as, of course, did those later carried out by the "Jockforce" in New Guinea, the commando group which he organized and led as the only one-armed Australian infantryman admitted to active combat service during World War II. Perhaps the best known of his student pranks was the "kidnapping" of the founder of the English Speaking Union. This humourless British visitor was considered by many to have insulted the University and its Vice-Chancellor by refusing to speak at a pre-arranged but scantily attended meeting. Those who were there at the time still remember with amusement the audacity of the hoax, in which the victim was politely deposited outside the Botany Municipal Incinerator in lieu of the broadcasting studio which he thought was his destination.

After the war, Jock returned to Oxford for post-

graduate study, holding a Beit Memorial Fellowship and the post of demonstrator in Physiology from 1947-1949, his research earning for him first the degree of D.Phil., and not long afterwards his higher doctorate. During this time he undertook further exploration as organizer and leader of the Oxford University Expedition to Jan Mayen. In 1949 he was appointed reader in Zoology and Comparative Anatomy at "Barts" Medical School, University of London. Despite the long period spent abroad, he remained deeply Australian in outlook, and welcomed the opportunity to return in 1960 as foundation professor of Zoology and Comparative Physiology at Monash. Here he saw a unique opportunity to create a department not only broadly based on the various subdivisions of zoological science but also with a special bias towards studying by a variety of approaches the Australian fauna which he knew and loved so well. This aim he was certainly able to achieve, and the unique flavour of his department is symbolized by the existence on the campus of the native fauna reserve which now bears his name.

Until the final stages of the illness which he fought so courageously, Jock played a dynamic part at all levels in the complex business of the new and rapidly growing university, from gatherings at the Notting Hill Hotel (re-christened "The Vicarage") to the formal deliberations of Professorial Board and other University committees. In addition, he launched a vigorous and sustained public campaign for action to preserve Australia's unique wild-life assets from destruction by commercial exploitation or by neglect, culminating in his last book "The Great Extermination". He also ventilated this and many other matters in his widely-read articles in "The Australian", renowned for their outspokenness, vigour and biting wit.

Not all of Jock's colleagues on University committees were in sympathy with the blunt and colourful outspokenness of some of his attacks in matters on which he felt strongly. Nevertheless, it can be refreshing, if sometimes uncomfortable, to have honestly felt criticisms expressed directly and emphatically; and Jock's occasional infusion into academic deliberations of the tang of pub and outback campfire was an invigorating and healthy element which will be sadly missed.

#### WARM HUMANITY

Those of us who were present at the last committee meeting which he attended only a few weeks before his death were deeply moved by his courage in attending with the fires of his once blazing vitality burning so low. Nevertheless, they still glowed, and he spoke at length, making a trenchantly objective and invaluable contribution to the matter under consideration. Though Jock's devotion to the arts, especially the visual arts, was widely known, perhaps the sometimes aggressive bluntness of his external manner may have obscured from some the warm humanity of the man within. However, the passionate intensity of his advocacy of causes and the poetic insight revealed in some of his writing testify to his inner sensitivity and essential idealism of outlook. The sources of creative drive for the artist and the scientist are basically similar, and even the methods of the two differ less than is superficially apparent. In Jock Marshall, the artist and the scientist both found expression to an unusual degree.

—A. K. McIntyre.

## UNIVERSITY STAFF

### CHAIR OF PHYSIOLOGY

Dr. Robert Porter, a former lecturer in physiology at Oxford University and official fellow and medical tutor at St. Catherine's College, Oxford, has been appointed to a chair of Physiology.

Professor Porter has pursued a distinguished career since his entry as an undergraduate to the faculty of Medicine in the University of Adelaide. Graduating in 1953 as Bachelor of Medical Science, he was awarded a Rhodes Scholarship in 1954, and continued his studies



Professor R. Porter



Professor A. C. Jackson

at Oxford University and Lincoln College, gaining his B.A. with first class honours in animal physiology in 1956, and a clinical medical scholarship of the Radcliffe Infirmary. Upon completion of the medical course, he returned to the study of physiology first as demonstrator and then university lecturer in physiology, and fellow of St. Catherine's College, Oxford University.

Professor Porter's research interests and activities are concerned with problems of nerve and brain function, especially the mechanisms involved in the control and co-ordination of movement, and he has published widely in physiological and neurological journals. In 1962 he was appointed Radcliffe Travelling Fellow in Medical Science, and spent the following year as Visiting Scientist at the Brain Research Institute, U.C.L.A., Los Angeles, working with a group investigating patients suffering from disorders of movement.

He is married with three children.

### CHAIR OF PHILOSOPHY

Dr. A. C. Jackson accepted the invitation of the University Council to occupy a chair in Philosophy. This is the second chair of Philosophy in the University, the first is held by Professor D. H. Monro.

Professor Jackson obtained the degree of Master of Arts with first class honours from the University of Melbourne in 1942. In 1946 and 1947 he attended Professor Wittgenstein's classes in Cambridge and was supervised by Professor Wisdom. He was awarded the degree of Doctor of Philosophy in the University of Cambridge in 1953.

In 1958 the University of Oxford invited him to be the John Locke Lecturer and more recently he has taught general philosophy and moral philosophy at University



College, Oxford.

Professor Jackson's particular interest is in the philosophy of mind, and a good deal of his time in the University of Melbourne has been spent in teaching graduate students at the Master of Arts and Doctor of Philosophy levels.

Professor Jackson is married with four children.

#### NEW CHAIR OF EDUCATION

Dr. Peter Fensham has been appointed to a chair of Education. He will be specially concerned with the methods of teaching science in schools and universities, the education of science teachers, and the improvement of the curriculum in the science subjects taught in schools.

Dr. Fensham, who is at present reader in physical chemistry in the University of Melbourne, has had



*Professor P. Fensham*



*Professor E. Campbell*

experience in both the physical and the social sciences. He holds a Ph.D. of Bristol University in physical chemistry and a Ph.D. of Cambridge University in social psychology. Dr. Fensham has had a distinguished career in chemistry, graduating Bachelor of Science in 1948 and Master of Science with first class honours and the Dixon Research Scholarship in chemistry from the University of Melbourne in 1950. In 1953 he was admitted to the degree of Doctor of Philosophy in Bristol University for his work on "magnetochemical studies of oxides" and later carried out some post-doctoral research at Princeton University.

From 1953 to 1956 Dr. Fensham was Nuffield Sociological Scholar at King's College, University of Cambridge. This imaginative award by the Nuffield Foundation enabled him to obtain training and do research in social psychology. In 1956 he was admitted to the degree of Doctor of Philosophy in the University of Cambridge for his work on the psychological and sociological consequences for all levels of management and labour of technological change in two Essex weaving companies which were switching to more automatic methods of production.

For the past ten years Dr. Fensham has been on the staff of the department of Chemistry at Melbourne University and has had a wide variety of experience in teaching at tertiary level. In 1963 and 1964 he visited a number of overseas universities.

He has been involved in several special tutorial experiments and has published work on these and the objectives of teaching and examining.

His interest in the social sciences has been maintained by co-supervising a field study of leisure attitudes and behaviour in a Melbourne suburb (1957-61) and by investigating the distribution of Commonwealth Scholarships in Victoria between different types of schools (1965).

Dr. Fensham is married with four children.

His appointment marks a further stage in the development of a multi-professorial faculty of Education at Monash in which individual professors are leaders of the teaching and research in their own special fields.

Dr. Fensham's appointment complements that of Professor S. S. Dunn, who took up duty last year, and whose special interests lie in the fields of measurement and experimental education.

#### FIRST WOMAN PROFESSOR OF LAW

Dr. Enid Campbell has been appointed to the Sir Isaac Isaacs Chair of Law.

Dr. Campbell who is Associate Professor of Law at the University of Sydney, will be the first woman to hold a chair of Law in an Australasian university.

She will be the second woman to hold a chair at Monash as Professor Maureen Brunt occupies a chair of Economics. She was recently at the law school of the University of Wisconsin as a visiting fellow. A graduate of the University of Tasmania in law and economics, in 1959 she obtained her Ph.D. from Duke University, U.S.A. The topic of her thesis was "John Austin and Jurisprudence in Nineteenth Century England".

Her main interest is public law and her work in this area has been focused on constitutional history, parliamentary law and practice, legislation, judicial administration, civil liberties, criminal law and procedure, and public land law.

In addition to many contributions to legal literature Professor Campbell has recently published two books: "Parliamentary Privilege in Australia", Melbourne University Press 1966, and "Freedom in Australia" (with Harry Whitmore), Sydney University Press 1966.

Professor Campbell took up her appointment in August.

#### CHAIR OF MATERIALS SCIENCE

Dr. I. J. Polmear has been appointed to the chair of Materials Science in the faculty of Engineering.

Dr. Polmear is at present a principal research scientist with the Aeronautical Research Laboratories in Melbourne. He is a graduate of the University of Melbourne taking his Bachelor of Metallurgical Engineering in 1949, Master of Science in 1956 (thesis entitled "A Study of Ageing in Aluminium-Copper and Aluminium-Copper-Tin-Alloys") and Doctor of Engineering in 1965 (thesis entitled "Investigations of Aluminium Alloys with Special Reference to Aircraft Applications").

Dr. Polmear's main research activities and interests are age hardening phenomena in aluminium alloys; development of improved aluminium alloys; fatigue in metals and alloys; problems in aluminium alloy technology; thermodynamics of alloy systems; and supersaturated alloys. He is a fellow of the Institution of Metallurgists, London, and a member of the Institute of Defence

Science, Australia. He has travelled extensively overseas and has published widely.



*Professor I. J. Polmear*



*Professor J. D. C. Crisp*

Dr. Polmear represented Australia in athletics at the British Empire and Commonwealth Games in New Zealand in 1950.

He is married with three children.

#### CHAIR OF ENGINEERING DYNAMICS

Mr. J. D. C. Crisp has been appointed to the chair of Engineering Dynamics. Professor Crisp was formerly Associate Professor in the department of Mechanical Engineering at Monash.

Professor Crisp is a graduate of the University of Adelaide. His research and teaching interests lie in the dynamics of mechanical systems.

Before his appointment to the staff at Monash in 1961,

Professor Crisp was research Associate Professor of Applied Mechanics in the department of Aeronautical Engineering and Applied Mechanics at the Polytechnic Institute of Brooklyn, New York, where his research interest centred on the dynamic problems associated with the re-entry of space vehicles. He has also worked at the Aeroelastic and Structures Research Laboratory, department of Aeronautics at the Massachusetts Institute of Technology, Boston, the Aeronautical Research Laboratories, Melbourne, Vickers-Armstrong Limited, Weybridge, and the Royal Aircraft Establishment at Farnborough, U.K., where he carried out research into the structural dynamic problem of missiles and high speed aircraft.

Professor Crisp is married with three children.

#### CHAIR OF FRENCH

Dr. Ivan Barko has been appointed to one of the two available chairs in French. Dr. Barko, who is at present reader in French at the University of Melbourne, is expected to take up his new appointment in December this year.

He obtained a "Licence en Philologie romane, avec distinction" from the University of Brussels in 1954 and gained a "Doctorat de l'Université de Strasbourg, mention très honorable, à l'unanimité du jury, avec éloges" from the University of Strasbourg in 1956. Dr. Barko is chairman of the French Standing Committee of the Victorian Universities and Schools Examinations Board.

He has carried out research into late nineteenth and early twentieth century French literature and thought and is currently engaged in work on seventeenth century French literature with special reference to symbolism, structural patterns and bibliographical problems in Racine's drama.

Dr. Barko is married with three children.