COPY

Manuscripts (original plus one copy) should deal with topics of interest to physicists in Australia, such as developments in the teaching or practice of physics and reports on lectures, conferences, Australian facilities, Institute Affairs, etc. They should be double-space typed on one side of the paper only, with margins 40 mm wide, and should follow the style used in this journal. The recommended length is up to 4 pages for articles (as printed with figures), up to 500 words for letters, and up to 250 words for Notes and News.

Deadline—15th of month prior to month of issue.

Figures—High contrast originals suitable for reduction to 80 mm width or, if essential, to 108 mm width. Half-tone illustrations should only be included if essential; they should be on white glossy paper and show a full range of tones with good contrast. Authors are asked to pay for block costs with the purchase of reprints.

References—are to be cited in the text thus:

[Brossel, 1947] or Brown [1971]

They should be arranged alphabetically at the end of the article and be presented thus:


Standards—Concise Oxford Dictionary; Metric Units (SI); Symbols, Units and Nomenclature in Physics, IUPAP Document UIP II (SUN 65-3) 1965; World List of Scientific Periodicals.

Reprints—Three kinds of copies of items published are available to authors. In order of increasing cost these are: Extracts—the relevant pages as they are printed in the journal; Clean Extracts—printed as in the journal but with extraneous material removed; Reprints—printed separately, with any extra requirements by authors such as covers, special headings, etc.
This issue completes volume 10 of the Australian Physicist as well as a year of struggle by the Editorial Committee with costs and methods. The introduction of new methods of printing raised many problems and these have been compounded by industrial disputes which have hindered both production and distribution. Readers will have noticed some errors in recent issues and we apologize for these. Our resolution for 1974 is to reestablish accuracy and a regular schedule coupled with improved coverage of physics activities in Australia and neighbouring areas.

The compensation for the difficulties of 1973 lies in a reduction in costs which should help prevent frequent fee rises - but only temporarily. Costs and incomes continue their interlocking spiral. One dramatic factor looming ahead is the change in postal rates from 3½ cents per copy in September 1973 to 11 cents per copy in March 1974.

We are not alone in these problems. Both the Institute of Physics and the German Physical Society have decided not to print and distribute Europhysics News for their members. In order to avoid a deficit budget, the German Physical Society is considering either a reduction in activities or a 10 per cent increase in subscriptions (for the highest grade these stand at DM80).

Members of the American Physical Society will be able to recommend support for the programs of their choice (Placement and Manpower Services, Professional Concerns, Physics Education, Public Awareness of Physics, Optional Membership Services) by making voluntary contributions when paying their dues for 1974.

The RACI is considering increased subscription rates from July 1974 - with a Fellowship subscription at $30. In the RACI, subscription rates can only be altered after the appropriate amending resolutions have been passed at two general meetings of members. To overcome this cumbersome and expensive procedure, amendments are being considered which would provide for regular increases of $1 per annum in Fellowship fees and larger increases for Associates until fees for these two grades become the same.

Which way should the Institute of Physics go? Don't forget that we need readers' continuing comments, criticisms and contributions to ensure that the Australian Physicist can serve its proper function in this area. Why not include in your vacation plans the resolve to put in writing those news and views which, by communication, will help the physics profession to find direction and to be collectively greater than the sum of its component parts?

Offers of informative summaries of physics activities in Australia are also needed. Call your Associate-Editor now and arrange a timescale for a contribution on a topic that interests you. To quote the IOP Bulletin: "the value one gets from the Institute is the result of making the slight extra effort to take part in its activities; it is a well, not a drip-feed."

Greetings and best wishes for 1974 - The Editor

ERRATUM

The title of the article by T. F. Smith commencing on page 163 of the October issue should have read: THE SEARCH FOR NEW AND BETTER SUPERCONDUCTORS.

The telephone number of our advertising Manager was given incorrectly for two months. It is (02) 389-9698.

ADVERTISEMENTS

Readers may have small advertisements placed in the Australian Physicist at a cost of 50 cents per line (maximum - 8 lines). Copy should reach the Editor before the 8th day of the month of issue.

NATIONAL PHYSICS CONGRESS

Inquiries and offers of papers should be addressed to Physics Congress, W.S. Boundy, School of Physics, SAIT, Adelaide, SA, 5000. Further information can be found elsewhere in this issue.

Teenco Electronics (Marrickville, NSW, 2204 or Northcote, VIC, 3070) have available free of charge a limited supply of a 10 page article "The Renaissance of Polarographic and Voltammetric Analysis".

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All enquiries and correspondence concerning subscriptions to Australian Institute of Physics, PO Box 52, Parkville, VIC. 3052.

Advertising space instructions—forward to the Advertising Manager, J. T. O'Mara, PO Box 39, Bondi Junction, NSW 2022; Telephone (02)389-9698. (Deadline—6th of month of issue).


Copy deadline—15th of month prior to the month of issue.
For those who practice physics in the field of biology or medicine, whether it be in the ivory towers of academic life or within the ivory painted walls of a busy hospital, the conferences on Physics in Medicine and Biology have become an annual event - a part of the way of life. Beginning with a few radiation-oriented enthusiasts in Adelaide in 1961 these meetings have grown from strength to strength. The thirteenth of the series, again in Adelaide in May of this year, proved no exception to the high standards of its predecessors. The papers ranged over an ever-widening field which in itself, sets a problem of finding common ground, even within this sub-speciality of science.

The conference was opened with a review by Dr Colin Field, Head of the School of Life Sciences, NSW Institute of Technology on the somewhat esoteric and fascinating subject "The Biophysics of Plant Glands". A whole new world was introduced to those of us who did not really appreciate that a plant might have glands.

The symposia were highlights of the programme. One on "Biological Feedback Systems" indicated the wide variety of physiological problems which are amenable to investigation by the consideration of models of feedback relationships. Quite complex systems models may be proposed which make use of computer simulation techniques for their complete analysis. The strength of this systems approach is its ability to direct experimental investigations in an optimum manner. Another symposium on the use of computers in medicine and biology not only told us of new and significant computer applications in the field but also generated much interesting discussion. If not a little heat, on the how and why of computers in a hospital environment, particularly for scientific and research applications rather than administrative and patient record uses. The relative merits of large centralized or small dedicated computers, off-line or on-line, time sharing or batch processing were explored. Everyone, every application and every institution has its own needs and own problems. We heard a lot and indeed learnt more than a little.

A symposium has been defined (Concise Oxford Dictionary, 1965) somewhat baldly as an after-dinner drinking party. A third symposium was held in some valley some kilometres North of Adelaide but this appeared to be more of an intensive workshop session rather than a presentation of prepared papers. The exact title is somewhat obscure but may have been Physicist(s) Research into Oncology. One dimly recalls a feeling of satisfaction with the outcome of this symposium.

An interesting group of papers and an open discussion on Radiation Dosimetry showed that this evergreen topic is still far from 'sewn up' both in fundamental concepts and in practical applications. Much more interesting work remains to be done.

The final two days of the conference were held in conjunction with the Australian and New Zealand Society of Nuclear Medicine where the leisurely pace of well considered and discussed papers gave way to the urgency of presenting thirty-four diffuse offerings in limited time. It is hard to see that this American style force feeding is in the best interests of all.

Despite the final rush our Adelaide organisations have once again done us proud and are to be congratulated. Selected papers from the Conference are being published in the Australasian Bulletin of Medical Physics and Biophysics. Copies are available from the Editor, Mr K.H. Clarke, Physics Department, 273 William Street, Melbourne, Victoria, 3000. The Fourteenth Conference is to be held in Sydney in May 1974.

RADIOISOTOPES TECHNIQUES

The ninth course will be held at Lucas Heights from 22 April to 9 August 1974. (Contact the Principal, ASNT, Private Mailbag, Sutherland, NSW, 2232.)

NATIONAL PHYSICS CONGRESS

This is to be held at Flinders University on 21-24 May 1974. Inquiries and offers of papers should be sent to: Physics Congress, W.S. Boundy, School of Physics, SAIT, Adelaide, SA, 5000. Further information can be found elsewhere in this issue.

THE DICTIONARY REVISED

New Definition of Vacuum Physics: Physics in Vacuum, viz. submitting proposals to Government re physics or science developments and policies.
The stock of physicists in 1971 was estimated at 2500. This figure was based on a projection from surveys in 1950 and 1968.

Between 6500 and 7000 newly-qualified physicists are expected to enter the labour force during the nineteen seventies (excluding migration). This figure is based on estimated university graduations.

Three quarters of Australia's physicists were located in New South Wales and Victoria.

Half of Australia's physicists were under 30, and more than half had an honours bachelor degree or a higher degree.

The average length of work experience of Australia's physicists was eleven years.

Over 60 per cent of all employee physicists worked for Government—either Commonwealth or State—while another third worked for academic institutions.

Over half of Australia's physicists worked for educational bodies, and less than a third were employed in research organisations.

One in four were secondary teachers and one in five were tertiary teachers.

More than a third of physicists in Australia were employed on scientific research. A quarter worked full time and two fifths spent more than half their working time in this area.

One in every four employee physicists spent less than two years with his present employer, and more than half spent less than five years.

Apart from education, the specialist areas where the largest number of physicists worked were 'general physics' (22%), earth/ space physics (16%), physics of the structure of matter (9%), biophysics and other physics (9%).

The most common field of former experience (apart from education) was general physics (10%) and earth/ space physics (13%).

About a third of Australian-born physicists have gained overseas experience.

Six out of ten physicists with overseas experience named the United Kingdom as the country in which they had worked longest overseas.

While the demand for physics teachers remained high, opportunities in the other main area of employment (professional scientific work) were scarce. Other opportunities were very limited. This situation applies in every State.

With at least a doubling of the current stock of physicists expected over the next decade, demand would need to be very high to employ physicists in job areas where they are presently engaged. Apart from teaching (which appears acceptable to only one in four physics graduates) there is no backlog of demand. Replacement demand is not likely to be high over this period, because 90 per cent are under 50 years of age. New demand is very unpredictable, but does not appear significant. However, new research opportunities and the movement of physicists into new areas of work could overcome any potential over-supply of physicists.

Due to the cut-back in US government research spending and a levelling off in the growth of research staff in Australian universities and government organisations, opportunities for professional research work at the present time are scarce.

There is a good demand for science graduates in physics to enter secondary teaching. Secondary teaching is the biggest single field of employment for graduates in science and there is a serious shortage of graduates to teach mathematics and science. However, the growth in the recruitment of graduates in physics for tertiary level teaching has now slowed.

There is a continuing shortage of 'numerate' graduates (i.e. graduates whose courses contain a substantial mathematical or statistical content), and physics graduates with these qualifications can find employment outside their profession in occupations requiring mathematical and statistical ability.

The formerly high level of demand for graduates for electronic data processing has now fallen, and supply exceeds demand for graduates not trained in computer science.
A limited number of positions are offered to physics graduates in manufacturing, administration, and sales and technical services in commerce and industry.

For higher degree science graduates, jobs appropriate to their degrees usually mean teaching and/or research in universities or other research organisations. The employment outlook for them is not bright at present.

In New South Wales the supply of physicists generally exceeds the demand, even for physicists with higher degrees. Employers report that they find it easy to recruit most categories of science graduates, in spite of lower numbers graduating in 1970 due to the 'Wyndham gap'.

There is also a good demand for science graduates in physics to enter secondary teaching and it would appear that many majoring in physics go on to do a Diploma of Education. There have been a number of predictions that increasing numbers of higher degree graduates will in the future enter secondary school teaching.

In Victoria, for all levels of science graduates in physics, supply greatly exceeds demand. There is also a very limited demand for geophysicists in the private sector, as these are mainly employed by the Bureau of Mineral Resources.

Of 100 male BSc graduates in physics from the University of Melbourne in 1970, 50 entered post-graduate studies, nine commenced teacher training, seven entered secondary teaching, two took positions in research, development and investigation, 25 found other employment and for seven the occupational status was not known.

Of the 25 who entered other employment, twelve became armed service officers or cadets, three found employment in data processing, three entered graduate training schemes and four entered non-professional positions.

In Queensland, science graduates are experiencing some problems in finding employment, particularly PhDs in physics. In secondary teaching there is a high demand for pass or honours BSc graduates.

Recently in South Australia a small number of graduates in physics was unemployed for about 4 to 6 months before deciding to enter the teaching profession. It is also found that higher degree graduates experience some difficulty in finding suitable employment immediately after graduation.

In Western Australia, employment opportunities for graduates in physics are poor, and for graduates in geophysics employment is becoming difficult. In a graduate employment survey in 1969, 14 per cent of science graduates reported difficulty in finding employment and 31 per cent of PhDs in science reported employment difficulties.

In Tasmania, graduates in physics find professional scientific work difficult to obtain. There are opportunities in secondary teaching, although it is reported that it is not easy to place PhDs in teaching positions. There are some opportunities for science graduates in data processing. Employment opportunities are generally very poor for PhDs in physics at the present time.

It is not possible to give a precise quantitative forecast of future supply and demand for physicists in different fields of specialisation as there are so many arbitrary assumptions which would have to be used as a basis of projection. What is outlined here are the major factors influencing demand and how these factors are likely to move in the near future.

It is estimated that over the past twenty years approximately 5000 science degrees with physics majors have been conferred by Australian universities. This figure is calculated on the estimate that 20 per cent of science graduates have taken a major in physics. Australia has also shown a net gain from the migration of physicists over this period, although the size of this gain is difficult to estimate. After allowing for wastage due to deaths and retirements, there would probably still be more than 5000 physicists added to the labour force over this period.

From estimates of future science graduates made by the Australian Universities Commission it can be calculated that another 8500-7000 science degrees with a major in physics will be awarded in Australia over the next decade. Even after allowing for wastage due to deaths and retirements, this means that the number of physicists in the labour force will probably be at least doubled by 1980, if current trends continue.

The factors on the demand side which have made possible the absorption of 9000 physicists into the labour force in the last twenty years were:

(i) normal replacement needs, resulting from deaths and retirements;
(ii) the backlog of unsatisfied demand which existed at the start of the period;
(iii) new requirements resulting from general economic expansion, technological change, the establishment of new industries, the growth in school and university requirements, and the development of research programmes.

Whether the Australian labour force is able to
absorb over the next ten years a number of new physicists 40 per cent higher than the number absorbed over the past twenty years will depend on the strength of the three factors outlined above.

There is not much to be said on the question of replacement demand because we do not have sufficiently precise data on age distribution and retirement habits. From the available age distribution data, it seems that this type of demand will remain a relatively small component of total demand and will be roughly of the same order of magnitude in the seventies as it was in the sixties.

Turning to the second source of demand it has already been pointed out that there is no evidence of any backlog of unsatisfied demand for physicists today (apart from secondary teachers). This means that an appreciable source of total employment growth in the sixties will almost certainly be absent in the seventies.

If, therefore, employment opportunities for physicists are to keep up with available supplies in the seventies, the third component of total demand—viz. new demand—may need to be many times larger in the seventies than in the sixties. There are no strong indications at the present time that this is likely to occur.

Physics teachers in secondary schools must be looked at separately as they represent a special case.

The demand for graduates with physics majors as physics teachers would mainly be in teaching senior forms in secondary schools. Projections of numbers of school enrolments in this age group (16 and over) over the coming decade show that a rapid growth is expected. For this reason new demand for physics school teachers is likely to expand quite strongly. Moreover, this is one area where fairly substantial arrears already exist, in the sense that sizes of physics classes could certainly be reduced and teachers more highly qualified in physics could be used if they were more readily available.

However, on past experience only about one quarter of physics graduates would wish to take up teaching. What of employment prospects for the remaining three quarters of physics graduates, who will probably not want to enter teaching?

Consider first the tertiary institutions, which absorb about one third of all new graduates. In this area, new demand may fall a little, compared with the past decade. The reason is that post-graduate and under-graduate enrolments in science faculties are not expected to show the same spectacular growth in the seventies as they showed in the sixties. In the first place, demographic factors are less favourable and will affect all enrolments. The 'bulge' in the university student population during the sixties will not recur in the seventies. In the second place, the recent trend towards a falling proportion of science to total enrolments will probably continue due to the increasing proliferation of non-science courses offered by universities.

In other words, university enrolments in physics may be expected to increase at a much slower rate between 1971 and 1981 than they did in the previous decade and hence university staff expansion in physics teaching and research personnel should be correspondingly smaller.

It is true that physics teachers will be needed in increasing numbers by colleges of advanced education and teachers' colleges. And it is possible that greater efforts will be made to reduce student-staff ratios. But when reasonable assumptions are made on both these counts, it remains extremely probable that new demand for physics tertiary teachers and associated personnel will be no larger in the seventies than in the sixties.

Commonwealth government bodies employ almost one third of all physicists in the labour force. The major employers (in order of magnitude) are the CSIRO, the Department of Supply, the Australian Atomic Energy Commission, the Department of National Development, and the Department of the Interior.

The Department of Labour sought from these organisations some indication about their future requirements for physicists. Generally they were unable to forecast their requirements beyond the immediate future. The overall assessment at the end of 1971 was that growth in employment in the near future would be curtailed. Studentships and cadetships normally offered by these bodies were virtually unobtainable. Any staff needed to replace wastage could be recruited easily from available qualified applicants. Overseas applicants were being told that no employment was available at the moment, although some positions were being held unfilled due to financial pressures. However one Commonwealth body, the CSIRO, had set up a new mineral physics section for which a small number of geophysicists would be recruited.

This situation should improve as economic expansion gathers strength but no great leap in demand seems likely.

Future demand for physicists in private industry will depend basically on the extent of industrial research and development. Social attitudes of employers and graduates will also be important.

With regard to opportunities for physicists in Australian industry two generalisations can be made on the basis of overseas (especially US) experience: firstly, the development of industrial research is an important precondition for any major increase in the employment of physicists in private industry in Australia, and secondly, large-scale enterprise is an important prerequisite for research.
Although there is a steadily increasing awareness by industry of the 'spin-off' which can result from basic research projects, the relatively small size of most Australian-owned companies and the subsidiary nature of local research by overseas-controlled enterprises makes it unlikely that there will be any 'take-off' in research expenditures in the near future.

Now are changes in the pattern of industrial development likely to produce major increases in demand for physicists. In the USA about three quarters of all physicists are employed in five industries: chemicals, electrical equipment, transportation equipment (particularly aircraft), scientific instruments and related products, and services (e.g., commercial laboratories). It is difficult to predict how these types of industries will grow in Australia, and in particular how government policies will affect electronic, nuclear and aero-space developments, but it must be remembered that industrial employment of physicists is such a minor proportion of the total that even a doubling over the next decade would make a relatively small impression on total demand.

A further factor to remember is that technicians and sub-professional personnel may increasingly carry out more routine functions at present performed, in many instances, by qualified physicists. State technical education authorities have, in recent years, been giving more attention to the training of technicians, and more courses designed to meet their needs have been instituted. It is widely felt that not enough use has been made of ancillary personnel in scientific and technical fields in Australia. If, as expected, the number of such sub-professional personnel does increase more rapidly in the future, this might tend to restrict somewhat the size of any future expansion in the demand for physicists.

In conclusion, whilst there are many unpredictable technical and economic factors affecting demand, it is difficult to foresee any major acceleration in the rate of growth of new job opportunities for physicists in the future. Of course, in all projections of demand the present tends to weigh heavily in the assessment of the future and new developments cannot be foreseen. This tends to give such projections a conservative downward bias. Whilst acknowledging this, it should also be accepted that, on present indications, the near-trebling in new demand which the conditions of supply seem to require over the next decade is unlikely to eventuate.

It follows that a tendency towards a surplus of some types of physicists could well emerge. This does not mean that there is any prospect of Australia being faced with a large number of unemployed physicists. If the above analysis of demand in the seventies proves correct, all that will happen is that more new graduate physicists will work in areas where their training will not be directly used (e.g., in computer work, or actuarial fields), the proportion of students undertaking physics courses will decline rather more than projected, and there will be a much smaller net intake of physicists from abroad than in the past.

It is also possible that supply will create its own demand, by way of three developments. Firstly, faced with a more plentiful supply of physicists and prospects of a brain drain, the community may grasp the opportunity for more research spending. There are some signs that this may already be happening. For example, grants made by the Commonwealth to encourage additional expenditure by Australian manufacturing and mining companies on research and development reached $13 million in 1971/72, and are expected to reach $14 million in 1972/73.

Secondly, employers may recognise the high degree of interchangeability between physics and other professions and employ more physicists in jobs now reserved for other professional groups, such as engineers; the extent of substitution will depend, in part, on the degree of flexibility in salary structures.

Finally, it is possible that the more technologically oriented industries will seize their chance and employ an increasing number of physicists in the actual planning, production and marketing process.

Assuming these developments, the scope for the employment of physicists in Australia could be greatly increased.
PHYSICS IN THE SOUTH SEAS

R. Lawrance


School of Natural Resources, University of South Pacific, Suva, Fiji.

I have often been asked what made me accept the position as head of a Physics Department in a new university in the South Seas, forsaking what might appear to be the greater comforts and opportunities of a metropolitan university in Australia. I must admit that, in looking back on it, I sailed forth in pretty much a state of blissful ignorance. I suppose I pictured the community comprising the University region as being somewhat like our own in requirements and aspirations and that a sort of transplant of metropolitan ideas as to the place of physics in a community was what was required.

It was clear enough that initially the main aim would be to meld physics into the broad aims of the School of Natural Resources which comprised Biological Science as the mainspring of our efforts, with chemistry considered of lesser importance while physics and mathematics were to be taught as a platform for other sciences.

John Steinbeck sums up the one-ness of sciences in the overall ecological picture when he says, in his famous book "The Log from the Sea of Cortez". "And it is a strange thing that most of the feeling we call religious, most of the mystical outcrying which is one of the most prized and used and desired reactions of our species, is really the understanding and the attempt to say that man is related to the whole thing, related inextricably to all reality, known and unknowable. This is a simple thing to say, but the profound feeling of it made a Jesus, a St. Augustine, a St. Francis, a Roger Bacon, a Charles Darwin, and an Einstein. Each of them in his own tempo and with his own voice discovered and reaffirmed with astonishment the knowledge that all things are one thing and that one thing is all things - plankton, a shimmering phosphorescence on the sea and the spinning planets and the expanding universe, all bound together by the elastic string of time. It is advisable to look from the tide pool to the stars and then back to the tide pool again".

And so, I came with the initial intent of showing the students the relationship between the tide pool and the stars, and the two years of physics course now available reflect that philosophy in such titles as 'the Physics of the Environment' - a quarks-to-quasars summary of our present world picture; 'Liquids, Surfaces, Interfaces and Related Phenomena' and 'Physics of the Biosphere'.

However, my ignorance was of the real place of physics in the community in general; in the natures and diversities of the students we were to enrol and in the frustrations and difficulties involved in putting plants into practice in a situation where reality is primitive but is clouded by a veneer of apparent Western civilisation and by the largely fanciful glories of the South Pacific.

At the University of the South Pacific, about half of our students are Fiji Indians and half Pacific Islanders from the Melanesian, Micronesian and Polynesian islands which one might loosely term 'under British influence'. Thus, we have students from the Solomon Islands, New Hebrides, Fiji, Gilbert and Ellice Islands, Tonga, Samoa, Niue, the Cooks and several lesser islands. In addition, there are a few Europeans - both Island citizens and staff relatives.

To say that Indians and Pacific Islanders are different is an understatement, but to say that Pacific Islanders are all the same is an equal understatement. The wide variety of attitudes towards the gaining of knowledge makes teaching and assessing very difficult and a challenge to say the least. Indians tend towards rote learning with the pass as the main raison d'etre of the exercise; some Islanders will only put their minds to the study of a subject if the real connection with their future is obvious, the question of passing being of lesser importance and being left to what we call 'Fiji time' which effectively means 'manina'. Again, Islanders are often poor at analysis and good at synthesis which is just the opposite to the general ability of Indians. Thus, a course which is designed to suit one group may not suit the other and an examination question designed to test a certain ability may be meat to one group and poison to the other.

In bringing aspects of an advanced community to a developing community, there is always the danger of overlooking the existing indigenous approach to the subject. Thus, for instance, in New Guinea, biologists have found, I believe, that the scientific classification of animals has to compete with existing classifications which may appear to the people involved to be much more pragmatic. For instance, classifications which involve the edibility of the animal or, perhaps, it habits which enable it to be trapped using a certain kind of hunting practice. The question of whether it has a backbone, or suckles its young or walks on one foot must seem rather puerile when filling bellies is the main preoccupation.

In the same way, we have to be careful not to overlook the importance of indigenous physics. A beautiful example of primitive physics is the Solomon
Islands drill, used to bore the holes in shell money. Let us consider the many physical principles which go to make this beautiful tool, firstly, the drilling tip. This is made from a piece of flint which is sharpened to a cutting tip using a shell. The sharp edge of the shell is pressed against the flint producing a strain until a small chip flies off along a conoidal fracture. This is the same method as that used by American Indians who make obsidian arrow heads using a bone awl — the physics of solids in action. Then, we need to rotate the tool while applying vertical pressure. This is achieved using the principle of the screw through a string coiled round the shaft. Due to inertia as the rotation reverses at each stroke, the angular acceleration has to be matched with a uniform downward pull which is achieved by judicious tapering of the upper end of the shaft, while the angular momentum required to unwind the string is achieved through a bone flywheel placed very carefully also to achieve vertical stability of this top-like tool. Another example of perfection of physical principles in tools can be found in that ubiquitous device the adze — what a beautiful tool it is to use and what a wide variety of uses has it in woodworking!

At USP we have often been criticised for including under the title of 'Physics of the Environment' an introduction to astrophysics and cosmology. But these two subjects are old friends to the Pacific peoples in their skill in navigation and their mythology of the creation.

In pre-contact days, navigation by the stars was well advanced. Tongan houses (Fales) were built with astronomical charts woven into the under-side of the roof so that they were impressed upon the mind from the earliest recollections of children lying in their cradles. Navigation is a very interesting subject in the South Seas.

Its principles have been lost in many places, but in the far-flung islands of the Gilbert and Ellice groups the locals are still as intrepid as ever. In addition to using the sun and the stars, they use the state and direction of waves utilising the principles of refraction and diffraction caused by islands not visible over the horizon. Thus, aided only by this kind of knowledge, they navigate between their many islands which are scattered hundreds of miles apart.

An author who has written about his experiences in leaning Gilbertese navigational methods has related how, after failing to see most of the phenomena being pointed out to him, he asked his Gilbertese tutors whether it was true that they used the light from blue lagoons reflected in the clouds to indicate the presence of islands over the horizon. Their reply was that it was indeed true but they hadn't mentioned it because "any fool can see it!"

You might ask at this stage where the wealth of classical and modern physics fits into our courses and that surely some of it is a must in a University, even in the South Seas. The answer is that we have to keep a very close eye on the requirements of our students in their future callings. Few, if any, will be attending other universities for advanced physics degrees and therefore we do not pursue the ideas of quantum mechanics and nuclear physics beyond the brief introduction in the first year. Our students come to us from a preliminary year taught at the USP and of a standard and nature equivalent to Matriculation level in Australia or New Zealand. Thus, we can introduce the Schrodinger equation and discuss its relevance to chemistry and physics but the level of pure mathematics achieved by the science student does not permit us to advance further, nor does there seem to be any value in doing so. In first semester of second year we do have, however, a compulsory physics course in which we catch up and fill in on electricity and magnetism, waves, A.C. theory, the interaction of electromagnetic waves and matter and an introduction to electronics — all related topics and of a 'need to know' nature.

Some of our students go on to do Master's degrees in topics which may be quite diverse. They have some third year soil physics disguised under an interdisciplinary title of Soil Science, and this enables them to bring much knowledge to bear in topics like 'Productivity of Sugar Cane Under Water Stress'. Others pursue postgraduate work in biology under such titles as 'The Toxicity of Paraquat and Other Weedicides to Fresh-water Fish'. You can see that this sort of work is well suited to students who have had an interdisciplinary background of biology, chemistry, physics and particularly statistical mathematics.

While talking of research, I should mention that the extreme lack of equipment and money to carry out is only one of our bothers. Petty theft is a continual curse and limits what we can do. As an example, last year I took some undergraduates out to a small sand islet to survey it carefully. We wanted to see whether it was changing in size and shape or not. We used a laboratory telescope supplied with a bubble level on the tube as a dumpy level and made a surveyor's staff out of a length of wood. Then we drove a 1½ in length of 5 cm water pipe into the highest point of the islet and carefully surveyed its contours to the nearest centimetre. We returned later to measure some other features and found that our waterpipe bench-mark had been pulled up and stolen in spite of it having been covered by several inches of sand! So bang went the survey and now that hurricane Bebe had completely changed the islet's shape and size the past survey is of little use to us.

Again, recently the Department of works carried out some current surveys near the site of a new sewage treatment works. Several fishermen were seen from the helicopter to be towing away the dye-makers with long fishing lines and a buoy which was placed at a surveyed spot representing the end of the outfall pipe was stolen within 12 hours, negating about eight hours of survey work.

The interference with the markers only ceased when the local chief was taken for a flight in the helicopter and instructed on the necessity of the survey if their
fishing grounds were to be protected. Thus, all projects which affect the local population must begin with an approach to the local chief (Ratu), the presentation of gifts and the sealing of the agreement with yaqona, the local and symbolic drink.

Other difficulties one faces are tied up with the still strongly held belief in spirits, ghosts and tabu. A few years in the islands and one does not lightly brush aside those beliefs as I shall relate.

The same sewage works had reached a deadlock in one of the construction sites. Men were having accidents, machines were breaking down or getting badly bogged, one man went mad and had to be transferred elsewhere. All this until it was discovered by the engineer that there were rocks on the site traditionally housed a devil. Yaqona ceremonies were carried out, gifts exchanged and miraculously the tabu lifted and work proceeded without further delay or mishap. This is one of many similar incidents which I could relate about the confrontation of advanced technology and primitive belief.

We have branched out into the field of satellite communication over the last two years. I am pleased to relate that the Physics staff fostered the idea of combining with the University of Hawaii to utilise the old ATS 1 stationary satellite in an experiment in educational communication. NASA gave us time on a channel and, using simple equipment designed and built by the University of Hawaii (who were the project originators), we set up our 100 watt ground station. This includes both voice inter-communication and facsimile.

The finance for our project came from Carnegie Corporation and the success of the proposal was largely due to members of the Physics staff. The money was so effectively used by the station manager (again, a Physics staff member) that we were able to erect a ground station at our University Centre in Tonga and increase our own station power to 1 kw.

There has been a constant flow of seminar and other information since then between the several stations now on the link and between the main campus and our external students in Tonga. NASA and Carnegie have been so impressed by our (USP) handling of our stations and our report on future operations that they are considering granting a channel and finance so that USP can become a major centre with its own programmes to the region.

Returning to indigenous knowledge of physics, there is a story which I really must relate about a naval architect who works for a Suva boat builder and who was recently commissioned to have built a Gilbertese sailing canoe in traditional style.

These canoes are amongst the sweetest sailing craft ever devised. They are about 10 m in length — a single hull and outrigger joined by planked deck. The hull is the shape of a catamaran hull about 40 cm wide and perhaps 1 m high. It is made from 1 cm planks and completely sewn together with coconut fibre or sinnet.

The seams are caulked with cocoanut fibre from the leaf stems wrapped round saw-saw or the leaf spines. This stuff is called “bunga-bunga” by the Gilbertese. The canoes have a large lateen sail and can sail in either direction in excess of 32 km per hour.

My friend approached a toothless old Banaban from Rabi Island, who said his village could make such a boat. The Banabans come originally from Ocean Island in the Gilberts but were resettled in the Fijian Island of Rabi after their island became uninhabitable due to phosphate mining.

The suggestion was that the keel should be made in the workshop in Suva where mechanical saws were available, but the Banaban did not like the idea, preferring his adze and eye to the mechanical monster. However, with persistence on my friend’s part he decided he would consider it.

The 10 m keel is made in one part but has to have a rebate on each side to house the bottom planks. A large sheet of paper was brought and the Islander asked to draw the shape of the cross-section of the keel. He produced a sketch about the size of a pea — an illustration of that peculiarity often encountered in children and in those not used to transferring ideas to paper.

My friend then stepped in and drew some curves representing the cross section of the boat. O.K.? A pause for reflection and then “O.K.!” Then to fit these curves my friend drew the keel cross-section with the rebates matching the curve. O.K.? A long pause. No, not O.K.

“The rebates must be at a different angle to the curve” said the old man “because…” and here followed a long lecture on the indigenous physics of water flow over the hull and keel — all thoroughly understood by the old man and the kind of stuff taught in more mathematical terms in advanced texts on hydrodynamics.

Next came the shape of the keel length. “Let’s rip it out now on the saw” said my friend. The old man was most perturbed. “No good” he said, “it has to be curved to one side”. Then followed another lecture on how the shape of the hull must not be symmetrical but be bellied out slightly on one side so that the asymmetric flow of water produced a torque which would just balance the torque over to the outrigger. Again, the principles and reasons were thoroughly understood by the old man but the very devil to calculate. (The actual curve is about 2 cm from the centre line and is made by eye and faith).

Then came the height of the hull. “Mm” mused the old man standing with his hands clapping undecidedly at his hips “about this — yes,” now firmly decided, “this high”. My friend mused as to what shape the boat would have been if the old man had been a foot taller!

Finally, when the question of the sails was broached, he knew not only the correct plan and why, but the correct contour — where to have it flat, where belled and so on. Here is an example of real education — the thorough understanding of principles and practice to yield real advantages to man.
A couple of weeks ago I heard the end of the story.
The whole boat is to be built in Rabi, complete from keel to sail. The old scientist artian refused to
compromise the accuracy of the adze for the speed of the circular saw. “And anyway,” he said, “it has to be in
Rabi because we have no women here”. “Women?” asked my friend with surprise (and a little conjecture
too) “What on earth for?” “Make bunge-bunge” he said, “only Banaban woman can make bunge-bunge”.

So the thing will be made in Rabi where the
knowledge is and I suspect to the accompaniment of
various incantations and ceremonies without which any
fool knows that no reliable canoe could ever be made.

I referred earlier to the prevalence of superstition in the
form of devils and tabu’s. These things have only two
real consequences. In Fiji and elsewhere in the Islands,
witchcraft is still widely practised both by Indians and
often its success in the medical field has caused serious
investigations to be made.

Here is a witchcraft ‘cure’ for the accuracy of which
I can vouch. Whether it cures I do not know, but a very
close European friend of mine (an industrial chemist)
tried it out in desperation. If you can give me the
physical explanation of how it works, I would be very
interested to hear it.

The cure is for back ache. The Hindu priest takes a
giant bamboo about 8 cm in diameter and 2 m long and
splits it almost in two lengthwise. This giant forceps is
then clipped onto the patient’s waist just above the hips
and supported there by his hands while the other end is
supported on a chair. The priest then begins various
prayers and incantations and slowly the forceps being to
tighten. The force is so great that the split closes up and
the ends take on a considerable curve. At this stage,
the hands can be removed from supporting the ends
and the forceps will remain clamped tight in position.
Gradually, then, the pressure eases and eventually the
bamboos release their hold. The extent to which the
split closes tells the priest how bad the back is and how
many more ‘cures’ are needed. This ‘cure’ is said to have
had great success but was only effective for a few
months on my friend who has an asymmetrical pelvis.

No stories of the South Seas would be complete
without ghosts. They are taken for granted by the
local population and seem to differ in number from
type to type. An Australian headmaster, Methodist
minister and resident of Tonga for ten years was
reluctant to relate to me his countless real
experiences over that time. Tonga is a real haunt for
ghosts and those interested in investigations of the
supernatural might well go there. Although it has
nothing to do with physics, I will relate briefly two
such stories from Europeans in responsible positions —
stories which can be vouched for by the people
themselves.

One large European house is haunted by a white horse. It has caused several people to vacate the place.
Typically, a horse is heard in the yard at night. The
householder see it out the window and goes downstairs
and locks the fence gate with a view to finding the owner
next morning. Of course, next morning the horse has
gone. Sometimes, it appears in the front landing and
clatters up the stairs to the next floor.

Another animal one — a long-dead pet dog which
continues to haunt its former owner’s house. Since it
died, the owners have raised the floor about 15 cm and
now the ghostly dog walks across the floor with only
three quarters of its body showing above the concrete —
probably an animal of habit since it keeps to the old
floor.

There are so many of these stories — my
aforementioned headmaster friend volunteered that a
boy was most upset about how he was going to pay his
fees as his father had died some few days before. “But
” said the headmaster, “your father came in to me this
morning and paid your fees”. He had the hard cash to
prove it. Did I say it had nothing to do with Physics?
Perhaps it does. Perhaps we have a lot to learn about the
things we call reality.

...
materials which are available but not necessarily satisfactory.

I shall be terminating my appointment at this end of the year to return to Perth and some personal responsibilities. It looks as though someone else will have to take up the challenge of fostering physics in the South Seas.

LIQUID SCINTILLATION COUNTING

An International Symposium on Liquid Scintillation Counting was held in Sydney from 20–22 August 1973. Altogether, 97 delegates attended to hear 33 papers (14 by Australian authors). In the first plenary lecture J.B. Birks reviewed a quarter century of progress in organic scintillation counting, and the complex sequence of events by which the energy of an ionizing particle is converted in a few nanoseconds into solute fluorescence.

The importance of quenching was emphasized in many papers. A stochastic multidimensional model for colour and chemical quenching was illustrated with an interesting film. The purity of synthesized benzene is one of the significant factors influencing the reproducibility of $^{14}$C age determinations. Naturally, sample preparation is a vital step in all uses can be developed which take advantage of the presence of quenching. For example, colour quenching can provide an alternative to the spectrophotometric method for measuring colour density.

A wool sample, which has been labelled with a $\beta$ - emitting nuclide affects the efficiency of counting when immersed in a liquid scintillator solution. The amount of self-absorption of the $\beta$ - radiation within the fibres determines the number of counts and this can be used as a measure of mean fibre diameter.

Quenching occurs if the wool is yellow, so that a channels ratio taken at the same time serves as an index of yellowness.

New instruments for low background counting of $^{14}$C and $^3$H were described (E/2/B of 1800 or more) and for increased throughput by the use of three phototubes to count three samples simultaneously. Most scintillation counters measure the pulse height of the summed output of two photomultipliers when a coincidence occurs: however the measurement of the lesser pulse height can lead to reduced errors in disintegrations per minute calculated from external standard ratio quench curves.

A simple, rapid and reliable method for counting $^{14}$C in soil, soil extracts or plant material is to grind 25–100 mg of material to a particle size of 50 µm or smaller and dispersing this in a thixotropic gel. $^{14}$C or $^3$H in tissues can also be counted directly by using liquid scintillators to extract active components.

Liquid scintillation counting equipment can be used with little modification for Cerenkov counting and for bioluminescence measurements – techniques which were discussed at the conference along with radioimmunoassay and other rapidly growing techniques.

BOOK REVIEW


Reviewed by G.C. Fletcher, Monash University, Clayton, Victoria.

The author of this book has contributed in no small way in the past few years to the subject matter concerned and in it he has expanded and extended his writings to give a very complete description of the predictions of current solid state theory for thermodynamic properties of perfect crystals subject only to an external homogeneous stress. Specifically magnetic and electric effects, surface effects and imperfect crystals are not considered. Three-quarters of the book is essentially theoretical and includes, apart from normal phonon theory, a concentrated review of thermodynamics and thermoelasticity and very welcome chapters on band structure and pseudopotential theory. The whole section is extremely painstaking with little left to the imagination of the reader while care is taken to consider and clarify misunderstandings which have arisen in the past. The remainder of the book is largely taken up by an analysis of experimental data and model calculations, to which the author has contributed so much and the numerous tables here are a good and very useful summary of the validity of models of simpler types of solids at the present time. Two brief appendices of computational methods and tables of experimental data complete the book.

The fact that there are 2134 mathematical equations in the theoretical section does indicate that this is not a book to be read quickly as an introduction to the subject but, as the author suggests, is mainly a reference book which most workers in the field will wish to have on their shelves.

The Australian Physicist, December 1973 199
NOTES AND NEWS

The prospect of depletion of energy reserves is receiving considerable public attention. The problems of helium supply are of less immediate interest to the public but of considerable importance to the scientist. The US administration is trying to terminate the program for extraction and storage of helium from natural gas fields which may be depleted by 1990. The reduced demand for helium for the space program and the high price of government helium compared to that from private industry threaten this long term policy for saving helium which will otherwise be wasted as the natural gas is burned.

The July 1973 issue of Atomic Energy in Australia contains articles on Positronium Chemistry, Some Problems of Fusion Reactors, Safety and Reliability of Nuclear Power Plants, as well as details of ASNT courses, AINSE grants and fellowships.

The primary mirror for the Anglo-Australian telescope was scheduled to arrive in Sydney on November 26. The mirror is composed of Cer-Vit, a relatively new glass ceramic material which will have lower thermal distortion than the silica glass previously used.

Grubb Parsons, Newcastle on Tyne, have been grinding the mirror since 1970 and have achieved better accuracy than expected so that the primary mirror alone should be capable of resolving one-tenth of a second of arc.

A computer controlled tracking system which will automatically correct for any inaccuracies in gear manufacture has been devised by the National Engineering Laboratory at East Kilbride, Glasgow.

Professor Geoffrey I. Opat was appointed as Professor of Physics in the University of Melbourne, in October 1973. He entered Melbourne University in 1954 and undertook studies with the aim in life of becoming a theoretical physicist working on fundamental problems in elementary particles and field theory. Following submission of a PhD thesis on electromagnetic interactions of nuclei he took up a position as Research Associate at the University of Pennsylvania, working on elementary particles, in particular the theory of weak interactions. Studies 'on the side' included solid state physics (superconductors and ferromagnets), statistical mechanics (stochastic theory) and experimental high energy physics.

Returning to a Senior Lectureship in Melbourne in 1964, he started a small research group in high energy theory, but by 1966 plans were being developed for a high energy physics experiment in collaboration with ANU and using a bubble chamber at BNL, USA. Since 1967, four experimental runs have been carried out at Brookhaven studying antiproton interactions in deuterium. Professor Opat spent the year 1970-1971 at the Rutherford High Energy Laboratory.

As a member of the VUSEB Standing Committee on Physics since 1965, he has been involved in Secondary School Physics curricula and examinations.

Dr Robert L. Segall will take up the position as Foundation Professor in Physics in the School of Science at Griffith University in January 1974. After BSc and MSc degrees at Melbourne he went to Cambridge for PhD and postdoctoral research. His research interests have been mainly on the borderline between physics and metallurgy including the nature of imperfections in crystals and the role of these imperfections in determining macroscopic properties. Part of this work has involved an attempt to explain the very different behaviour of lattice vacancies in similar metals such as gold and silver.

Another interest has been in the behaviour of dislocations in metals under conditions where they can assume a configuration of minimum energy by interaction with vacancies. Segall has been particularly interested in explaining differences in the X-ray and calorimetric observations on metals hardened an equal amount under unidirectional or reversed stress - studies which bear on the problem of metal fatigue.

After a period at CSIRO Tribophysics, and at the University of Warwick during its first year of operation, Segall is at present Senior Research Fellow in the Department of Metallurgy at the University of Melbourne.

Professor Bruce Mainshridge will take up an appointment to the Foundation Chair of Physics at Murdoch University, Perth, early in 1974. After studying for a BSc at the University of Tasmania, Mainshridge obtained a PhD at the Research School of Physical Sciences, ANU. He also has had experience as a secondary school teacher in Tasmania and in the United Kingdom and has had appointments at Rice.
University, USA and Wollongong University College.

Since 1967 he has held the positions of Associate Professor and Professor at the University of Papua New Guinea, where he has developed new approaches to the teaching of physical sciences at undergraduate level. He has also carried out interdisciplinary research into bioelectric potentials in plants and micrometeorology. These have involved the application of physical methods to the solution of biological and environmental problems.

Professor Alan E. Beck has recently taken up the position of H.C. Webster Visiting Fellow in the Physics Department at the University of Queensland. He will be in Brisbane until mid-1974 and will be involved in establishing a heat flow laboratory and the initiation of an associated field programme in terrestrial heat flow.

Dr John E. Rose has taken up a position as lecturer in theoretical physics at the University of Queensland. His research interests are in various aspects of solar and stellar physics.

Professor E.H. Curnow has been appointed to the Chair of Physics at the University of Dar es Salaam in Tanzania, East Africa.

Professor R. Street (Monash), who is already chairman of the National Standards Commission, has been appointed chairman of the Interim Commission on Consumer Standards.

The 14th Conference is to be held at UNSW on 20-24 May 1974, and papers are invited for presentation at this conference. It is intended to widen the scope of the meeting compared with previous years and to change its format to allow some parallel sessions. It is hoped that these changes will help to maintain interest at a high level throughout the meeting for the specialized and diverse fields represented. The Conference Secretary is D.E. Robinson, C/- Commonwealth Acoustic Laboratories, 5 Hickson Road, Miller's Point, NSW, 2000.

**X-RAY FLUORESCENCE**

The 1973 Prince Philip Prize for Australian Design was presented in October to Philips Scientific and Industrial Equipment for their design of a radio-isotope on-stream analysis system for use in the mineral processing industry. This event marked the culmination of many years of collaboration between various Australian organizations.

High voltage systems for X-ray fluorescence analysis have various drawbacks, not least of which is the high initial cost ($150,000 to $200,000). The use of radioisotopes and a modular analysis system enables the minimum initial cost to be kept down to $35,000—a cost that may be recovered from increased profitability in the first year of operation. This was Philips' achievement which received the top design award of the Industrial Design Council of Australia.

For 12 years or more J.S. Watt and the Radio-isotope Applications Research Section at the AAEC Research Establishment have been developing radio-isotope X-ray techniques. These have included methods for determining medium weight elements such as iron, nickel, copper and zinc in mineral processing plant streams. A preferential absorption measurement can be added for determining heavy elements such as lead or bismuth.

The precision of determination of the wanted element can be as low as one per cent, for five per cent, or more by weight present, and several elements can be determined simultaneously by using several sensing heads. An on-line computer for data collection processes the results and can also be used in plant control. A description of methods and results are given by Watt and Howarth (Atomic Energy of Australia (1973) 16:8).

Zinc Corporation Ltd. developed the concept of analysis probes that could be immersed in a slurry stream while AMIRA and AMDEL cooperated in demonstrating the usefulness of these techniques to the mineral industry. Feasibility studies have been carried out for at least 16 mineral concentrators and production version equipment has been installed in six plants. Because the Australian system is the only one of its type commercially available in the world, export orders are also expected.
INSTITUTE AFFAIRS

About 150 people gathered in the Hobart Town Hall on September 28, 1973 to hear the eighth Pawsey Memorial Lecture, delivered by Professor W.N. Christiansen. By Tasmanian standards this is a very good attendance, and both the speaker and the organisers were delighted to receive such support. A dinner was held before the lecture and was attended by a number of guests and AIP members.

Professor Christiansen’s lecture, entitled "Australia's Giant Radio Telescope", provided an extremely interesting, intriguing and fascinating account of the growth of radio astronomy within Australia. He pointed out the fact that this growth was due very largely to Dr Pawsey and described how the growth progressed, from its birth in the 1940s until the present day. Professor Christiansen also described future requirements for radio-telescopes and emphasised the need for higher resolution.

A delightful programme was arranged by the NSW Branch on 9 October 1973 to celebrate their one hundredth scientific meeting (since formation of the Australian Institute of Physics). The meeting was beset with many difficulties. Some members received no notice of meeting because of a postal dispute and an air transport stoppage forced the speaker to travel by road from Canberra. The usual dinner at the Sydney University Staff Club was converted by a power blackout into a candlelit dinner, and part of the lecture was illuminated from a bank of batteries.

A fascinating talk was given by Professor D.J. Mulvaney of the ANU's Department of Prehistory and Anthropology on "Australian Aboriginal Prehistory - Contribution of Carbon 14". Australian archaeology has been a Cinderella until rather recently but now efforts in the fossil lakes and fossil sandhills of Western NSW and on the Nullarbor have revealed that some artefacts, developments in cave art, and burial sites date back well over 20,000 years. The earliest human remains so far found go back 32,000 years. The great cave at Koonalda, which is hundreds of feet below the Nullarbor plain shows wall markings and associated spinifex torches which are 20,000 years old, predating the Lascaux art in the dordogne region of Southern France. Ground-edge axes from the North of Australia are nearly as old. Finds of burnt and powdered bones suggest that aboriginals attached ritual significance to burial as long ago as 20,000 years.

Comparatively little work has yet been done on our prehistory and there is a dearth of information about the North where the first arrivals must have come across the then narrower water passage from SE Asia. Where more is known the 'frontier' may be pushed back well beyond 32,000 years. Old ideas of the Middle East as the fountainhead of all culture are already being modified by discoveries of early pottery in Japan from 12,000 years ago.

I haven't stayed awake so easily through an AIP lecture for years. Then to cap it all, we enjoyed coffee and well-chosen liqueurs with a rich birthday cake (in the shape of the AIP Symbol). The Secretary reminded me that a little over 10 years ago, on 14 February 1963, our first Branch Scientific Meeting was addressed by Dr J.R. Macdonald of Texas Instruments on "Aspects of Semiconductor Research". I hope that I stayed as successfully awake then, since on that occasion I was Chairman. - C.K. White

Professor A.E. Beck, Head of the Department of Geophysics at the University of Western Ontario and presently H.C. Webster Visiting Fellow at the University of Queensland, recently made brief visits to James Cook University (October 8) and Capricornia College of Advanced Education (October 9) under the auspices of the Queensland branch of the AIP. Meetings have been held annually in Townsville for the past several years, but the Rockhampton visit was the first of its kind; in view of the very encouraging response, it seems probable that a tour of this nature may become an annual event.

On the evening of 3rd October the SA Branch held a joint symposium with the Astronomical Society of SA on the subject of Astrophysics. Dr Robertson, Mr Legg and Dr Gubbay outlined advances in the technique of long baseline radio interferometry, with particular reference to their own work in the field. This was followed by Professor Prescott describing what can be deduced from observations on cosmic rays, and Mr Ward doing the same for interplanetary scintillation. All the speakers gave the large audience of over a hundred a good idea of the fascinating advances being made in the various fields, and the meeting, which had been preceded by a dinner, was followed by a lively discussion over coffee and biscuits. - K.H. Lloyd

The first meeting of the Victorian Section was held at Swinburne College of Technology on October 12, when Dr Jack McDonell spoke on "The Open University" to an audience of about 80 people.

Dr McDonell described the setting up of the OU and talked about its aims and objectives. He pointed out that there are no prerequisites for any course - except one of the higher level Quantum mechanics units - and such the OU material may not be completely suitable for any standard course in any standard
university or college. However the techniques used to prepare courses could well be adopted.

At the OU a course development team (typically 6 to 10 academics, 2 or 3 BBC production staff recruited from the academic market place, an editor, a member of the Institute of Educational Technology, a staff tutor, course and research assistants and one or two external consultants) is responsible for the production of course units.

Provided the units can be used without serious change for three years the cost per student is considerably less than the cost of the equivalent lectures given in the conventional way at a conventional tertiary institution. Jack produced estimated costs that showed how a course development team of a more limited nature could be economically justified even in the conventional system.

The questions which followed the talk covered all areas including the problems associated with laboratory work for students at the OU and the standard of the OU students. At about 9.45 p.m. the meeting was referred to coffee and biscuits and to the display of OU material (books, cassettes and films) commercially available in Australia. — Paul Clark

THE REGISTER


New Election
Cowen, L. R. - Australian National University, ACT.
Lo, S. Y - University of Melbourne, Vic.

Transfers
Dalton, A. W. - Australian Atomic Energy Commission Research Establishment, NSW.
Mansfield, W. W. - CSIRO Division of Applied Chemistry, Vic.

New Election
Barton, M. J. - Department of Navy, ACT.
Ellis, H. D. - Queensland Institute of Technology.
Gottlieb, H. P. W. - University of Adelaide, SA.
Hennessy, J. - Swinburne College of Technology, Vic.
Hirst, R. A. - State College of Victoria.
Owen, J. M. - State College of Victoria.
Rogers, P. J. - State College of Victoria.
Watson, R. B. - Central Studies Establishment, ACT.

Transfers
Farmer, A. J. D. - CSIRO Division of Physics, NSW.
Gowdie, D. R. R. - University of Papua and New Guinea.
Grinton, G. R. - State Electricity Commission of Victoria.
Prager, P. R. - University of New England, NSW.
Rigby, B. J. - Queensland Institute of Technology.
Rosman, K. J. R. - Western Australian Institute of Technology.
Stening, R. J. - The University of New South Wales.

Deceased
Raju, B. B. V. - (Vic.)

New Elections
Doughty, C. J. - South Australian Institute of Technology.
Haig, F. D. - Plastic Protection Pty Ltd, Vic.
Trainor, R. L. - Dataline Systems Pty Ltd, Vic.
Watts, D. L. - State College of Victoria.
Wilding, W. J. - St Virgil's College, Tas.
Wilson, R. L. - Education Department, WA.

Transfers
Le Page, E. L. - University of Western Australia.
Newing, D. R. - Department of Education, NSW.
Payling, R. - University of Newcastle, NSW.
Payne, L. C. -
Peck, D. J. - Department of Education, Vic.

Resignations
Fuell, J. K. - (SA)
McNutt, G. W. -

Removal from Register, Address Unknown
Molde, T. A. - (SA)
Severin, D. F. - (Vic)
Shortis, W. G. - (Q/S)

New Elections
Ball, S. M. (Qld) Grey, S. J. (NSW)
Brookes, D. S. (Vic) Kennedy, P. A. (NSW)
Chandler, G. K. (Qld) La Robina, M. (NSW)
Chapman, J. W. (Vic) Nicola, A. (Vic)
Cook, S. M. (Qld) Savage, L. (NSW)
de Veer, J. W. (Vic) Soutter, J. E. (Qld)
Dillon, M. D. (Qld) Withers, G. S. (Vic)
Fink, D. (Vic)

Resignations
Clynes, E. (NSW) Cooper, R. J. (Vic)

Resignation
Webb, J. E. (SA)

Resignation
North Broken Hill Limited (NSW)

The Australian Physicist, December 1973 203
SIR — Dr Macfarlane's report ("Why a cricket ball swerves"—Australian Physicist, August 1973) of the June meeting of the NSW Branch omits to mention a major point of controversy.

The title and that of the discussion also were incorrect and should have read "Why a cricket ball swings". Since a good deal of my contribution to the discussion dealt specifically with the distinction between 'swing' and 'swerve' in terms of the physical causes of each, it is rather disheartening to find no mention of this in the report.

The confusion of terms appears in Lyttleton's article ("The swing of a cricket ball—Discovery, 1957") where the terms 'swing' and 'swerve' are used indiscriminately, and where, moreover, spin is excluded as a specific cause of the lateral deviation of a cricket ball in the air. This exclusion is incorrect, since spin is, in fact, the prime requisite for what, in Australian cricketing parlance, is usually called 'swerve'.

Briefly, lateral 'swerve' in the air occurs, when assuming the ball is projected horizontally, a component of spin exists about the vertical axis. In this case the seam acts as a rotating roughness element and is most effective if it lies in the horizontal plane. Incidentally, the usual explanation given in elementary physics texts of baseball swerve is incorrect. It is there usually assumed that the boundary layer is swept completely around the ball due to the spin. This is only correct if the rotational speed of the ball is large compared to the translational speed.

On the other hand, lateral 'swing' occurs when the ball is projected horizontally, so that the plane of the seam lies in the vertical, but inclined to the velocity direction (seam angle). The spin, if any, acts in this case merely to maintain the seam orientation during flight. If a surface roughness asymmetry exists between the two hemispheres produced by dividing the ball along the seam plane, it is not necessary to incline the seam at all to produce 'swing'.

Thus, while 'swerve' and 'swing' are both due to an asymmetry in the position of the separation points of the boundary layer, in the former case, it is spin which produces the asymmetry, while in the latter, it is the geometrical asymmetry of the ball, due to the inclined seam, or the surface asymmetry of roughness which are the basic causes.

If a component of spin exists about the velocity axis, 'break' when the ball strikes the pitch can occur with either type of delivery. However, the 'break' in 'swerve' is far more pronounced due to the magnitude of spin, whereas in 'swing' it is negligible. If 'swing' is produced by roughness asymmetry, alone, i.e. with zero seam-angle, then no 'break' from the pitch can occur. 'Swerve' commences immediately the ball is delivered, whereas 'swing' is usually delayed unless a large seam-angle is used. Many bowlers produce unknowingly, a combination of both 'swing' and 'swerve'.

NSWIT,
Broadway,

L. O. BOWEN

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Inquiries and Offers of Papers to: Physics Congress,
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- Cosmic Rays (Professor J. R. Prescott, University
  of Adelaide).
- Geophysics (Dr F. H. Chamalaun, Flinders
  University).
- Nuclear and Particle Physics (Professor I. E.
  McCarthy, Flinders University).
- Plasma and Discharge Physics (Professor M. H.
  Brennan, Flinders University).
- Solid State Physics and Optics (Dr S. G. Tomlin,
  University of Adelaide).
- Upper Atmosphere and Magnetosphere (Dr B. H.
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