CONTENTS
President's Column..................................................57
Editorial......................................................................57
Research Performance of Physics Departments...........58
Branch News...............................................................61
ARGS Funding for the Physical Sciences....................63
Performance in Undergraduate Physics.......................64
Letter.........................................................................66
AIP Nuclear Arms Symposium....................................67
Seminar on Nuclear Radiation Applications................68
Pakatoa 84.................................................................69
People.........................................................................70
Higher Degrees in Physics..........................................74
Book Reviews............................................................75
Physics Roundabout....................................................78
The Australian Institute of Physics

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of the Australian Institute of Physics, its Council or
Committees.
President's Column

In November 1983 issue, the Editor suggested that it might be a good idea to somewhat increase the physics content of the journal and to reduce the emphasis on policy matters. Now President's columns might usually emphasise policies and this is natural. In my case, while it might be reasonable for me to write on NMR or low temperatures, this column would not really be an appropriate forum — unless I was pressing for new Government initiatives to declare such endeavours to be part of the national goal.

Now much of the NMR is based on the strange (to the uninitiated) properties of angular momentum so that some of the best demonstrations of the principles of NMR are done with such common objects as bicycle wheels. As a fit young physicist, I do sometimes cycle the 16 km between my home and office. The route includes several long hills and the wind is usually head-on (both ways) so that I have much time to ponder on important topics such as the dynamics of bicycle wheels and remain too exhausted to concentrate on my next contribution to science policy.

On one of my first such cycling ventures, I was slowly pedalling up a long hill; a price of age is that I prefer to stay in relatively high gear and push harder rather than strain the cardio system by pedalling quickly in low gear. A fit young cyclist stopped, explained to me that it would be less work in a lower gear, and then pedalling furiously, disappeared up the hill. I slowly continued up the hill wishing that I could have kept up with my adviser to explain the physics to him. Of course, neglecting friction, the same work is involved in climbing the hill at any speed and in any gear. One would even expect that, at the same cycle speed, more work would be expended by the cyclist moving his legs rapidly in the lower gear. Expert cyclo-physicists assure me that physiology and psychology are important and that in fact, there is an optimum pedalling speed linked to phenomena such as time-dependent hysteresis in the legs!

We have probably all, as students, poured over vector diagrams to see how yachts can move against the wind by tacking. The problem for this month is to consider if it is possible to design a bicycle which would use wind energy to move directly (i.e. no tacking) against the wind. Solutions may be published in a later issue.

One of the best examples of the vector relationship between torque and angular momentum changes is that of riding no-hands. In demonstrating the principle of NMR, I have longed to ride a bicycle no-hands across the theatre. What one really needs is a special cycle with a counter-rotating front wheel which does not touch the ground. By adjusting the moment of inertia of this wheel to be large enough, one could make a bicycle which turned left when one leaned to the right; by matching the moments of inertia one could have a bicycle on which all fools who ride no-hands would quickly come to grief. Experience gained this way would never be forgotten by those wishing to understand the intricacies of nuclear precision.

In the next issue, I will concentrate on the most exciting highlights of the Annual General Meeting.

Jeff Wilson

Editorial

The current controversy between the medical specialists and the Minister for Health illustrates a major pitfall in politics and in industrial relations. Neither side is taking the trouble to find out what the other is saying. Each assumes (wrongly, I hope) that the points at issue are clear to the other side, and that each is opposing the other out of pig-headedness, or greed, or ambition.

In the same way, I believe that Barry Jones has in mind a stereotype of a scientist that is at best a caricature. In these days of exploding knowledge, science is a full-time occupation, and except for extraordinary gifted people, it is not possible to combine politics or entrepreneurial activity with a successful career as a working scientist. It is however, possible and mandatory for a scientist to communicate his results. If he does not do this his support base soon dries up.

Granted, some scientists do not communicate well with outsiders, but there are many reasons for this apart from Mr Jones' "Avoidance syndrome" and his "slow, even retarded, social response".

These phrases come from a recent address to graduates of Sydney University in which the Minister pointed out that "only" eight of 129 Federal Members with tertiary qualifications have science degrees. It would surprise me if any of these eight people were considering politics as a career when they chose their courses, whereas arts, law, business administration etc. are all seen to be aids to such a career. If there is a fault, it is therefore that those aiming for a business or political career do not choose to take science degrees. Some years ago (Aust. Phys. 16, 155), I wrote of the virtues of science as a general education. I believe it is more than ever essential for science to be included in everyone's education, so that the understanding of the two cultures can be bridged from both directions. I know very few scientists who are not interested in cultural and sociological areas outside of science, but I also know of very few non-scientists who spend their leisure hours browsing in the scientific area.

Most scientists like talking about their work provided that their audience is interested, and scientific literacy on the hearers' part always helps. But how far should we press people who should be interested and are not?

Some of us even have difficulty in encouraging people to use results that they themselves have paid for. Wouldn't it be nice if we felt that they really understood what we were talking about?

Jim Graham

The Australian Physicist, Vol. 21, April 1984 — Page 57
Comparative Evaluation of the Research Performance of the Australian University Physics Departments

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Griffith University, Nathan, Queensland 4111

INTRODUCTION
Numerous studies of the research performance of university departments have been completed overseas, particularly in the United States and the United Kingdom (Bernier, 1975; Endler, 1978; Johnson, 1975; Liu, 1978; Rushion, 1981) but few have been published in Australia (Brown, 1982; Campbell, 1982).

An obvious difficulty in assessing research performance is to find reliable measures to quantify performance. Most of the published studies have tended to focus on the publishing activity associated with the research. The number of publications resulting from the research have been counted and their impact upon the scientific community has been assessed by counting the number of times each publication has been cited in the literature. Publication productivity is considered an indicator of "quantity" and citation level an indicator of "quality".

Another popular method has been to analyse the level of funding which a department attracts from external grand-recommending bodies such as the Australian Research Grants Committee, in support of research. These organisations generally base their recommendation upon peer review evaluations of both the calibre of the applicant and the merits of the research project, and hence should be a reliable indicator of the level and quality of research.

In the present study, publication, citation and research funding data were used to compare the research output of seventeen Australian university physics departments.

STUDY POPULATION
The study population was comprised of all staff of lecturer status and above (as listed in the Commonwealth Universities Yearbook 1982) working in the physics departments of seventeen Australian Universities.* The Research School of Physical Sciences, ANU and the University of New South Wales, Military College, because of their unique nature, were excluded from the study. Deakin and Murdoch University were also excluded as the former, established in 1977, was not in existence for the whole of the study period 1975-1982, and the latter had only three faculty staff officially designated as physicists in 1982 and it was considered that a staff complement of three did not constitute a "department". The size of the departments vary considerably, ranging from a staff complement of 7 at James Cook to 40 at the University of Sydney. A total of 282 physicists were included in the study.

EVALUATION CRITERIA
Three parameters were used to evaluate the research performance of the departments: publication productivity, the significance of the research publications as measured by their rate of citation and the degree of success in attracting grants from external research-funding bodies.

* Griffith University (School of Science) and Macquarie University (School of Mathematics and Physics) do not have separate departments of physics. For these universities the study population comprised of staff with teaching and research interests in a physics related field.

PUBLICATION PRODUCTIVITY
Details of the publications produced by each individual physicist were obtained from the university annual and research reports, 'Physics Abstracts', 'Electrical and Electronics Abstracts' and 'Science Citation Index'. Publications were restricted to primary documents which included accounts of original experimentation and investigation. Secondary publications such as books and literature reviews which are based on collective rather than authors' research, were excluded. Similarly conference papers were excluded as research outlined in conference papers is also generally reported in the Journal literature.

SIGNIFICANCE OF RESEARCH PUBLICATIONS
The significance of the research undertaken by the individual researchers was assessed on the basis of the number of times the publications resulting from the research were cited in the scientific literature. Many previous studies (Cole, 1973; Gaston, 1978) have shown that a strong positive relationship exists between the significance of scientific publications assessed in a variety of different ways, e.g. peer review, and the number of citations the publications received. The theory of citation analysis assumes that the impact of a research paper on the scientific community is indicated by the number of times it is cited in the literature. Similarly the significance of the research work of an individual researcher or university department can be assessed on the basis of the number of times the publications of that researcher or department are cited.

In the present study the 1662 publications produced during the period 1975-79 were used as the source documents for citation analysis. Citation data for these publications were compiled from 'Science Citation Index' for the period of 1977-1982 inclusive. Studies of the citation patterns of scientific literature have revealed that the majority of publications achieve their citation peaks within three years of publication (Martino, 1971). The three-year differential in the publication dates of the source and citing documents allowed the majority of the source documents analysed to reach their citation peaks. A total of 10455 citations were counted relating to the 1662 publications; an average citation rate of 6.3 per paper.

RESEARCH GRANTS
The research grants awarded by the Australian Institute of Nuclear Science and Engineering (AINSIE), the Australian Atomic Energy Commission (AAEC), the Australian Research Grants Committee (ARGC), the National Energy Research, Development and Demonstration Program (NERDDP), the Radio and Electrical Research Boards, were used to assess the relative success achieved by the individual departments in attracting external research funds. The data relating to the Radio and Electrical Research Boards are restricted to the number of grants as value of the research grants awarded is regarded as confidential information. Grants which were awarded to several physicists in the same university department were counted once only.
SUMMARY DATA

The summary data are shown in Tables 1 and 2. To compensate for the variable staff complement of the departments, the publication productivity and research grant data are expressed in both global and per capita terms. The grant data clearly emphasize the significant role which ARGC plays in the funding of university-based research with 67% (by number) and 76% (by value) of the grants awarded in the physical sciences originating from ARGC.

The citation data are expressed as a citation rate per staff member i.e., total number of citations to the source publications of the staff divided by the number of staff, and as a citation rate per paper, i.e. the total number of citations to the source publications divided by the number of publications. The relative ranking of the departments for each parameter is shown in parenthesis and is illustrated graphically in Figures 1-3.

In order to rank the universities on the basis of all three evaluative criteria, the total of the relative rankings of a university for publication productivity per capita

Table 1: Comparative data for publication productivity and citation rates
The relative rankings are shown in parenthesis

<table>
<thead>
<tr>
<th>UNIVERSITY</th>
<th>NO. OF STAFF</th>
<th>NO. STAFF</th>
<th>NO. STAFF</th>
<th>NO. STAFF</th>
<th>NO. STAFF</th>
<th>NO. STAFF</th>
<th>NO. STAFF</th>
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<td>37</td>
<td>1.9(15)</td>
<td>103</td>
<td>5.2(15)</td>
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<tr>
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<td>35</td>
<td>3.2(10)</td>
<td>93</td>
<td>8.5(9)</td>
</tr>
<tr>
<td>FLINDERS</td>
<td>12</td>
<td>86</td>
<td>7.2(5)</td>
<td>66</td>
<td>5.5(6)</td>
<td>152</td>
<td>12.7(4)</td>
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<td>GRIFFITH</td>
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<td>52</td>
<td>6.5(1)</td>
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<td>14.8(2)</td>
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<tr>
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<td>81</td>
<td>11.6(5)</td>
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<tr>
<td>LA TROBE</td>
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<td>49</td>
<td>3.8(7)</td>
<td>148</td>
<td>11.4(6)</td>
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<td>1.6(17)</td>
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<td>11.1(8)</td>
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<td>3.2(10)</td>
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<td>466</td>
<td>15.3(1)</td>
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<td>1.7(16)</td>
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<td>4.7(17)</td>
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<td>137</td>
<td>3.4(9)</td>
<td>320</td>
<td>8.0(12)</td>
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<tr>
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<td>13</td>
<td>59</td>
<td>4.5(14)</td>
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<td>3.2(10)</td>
<td>101</td>
<td>7.8(13)</td>
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<tr>
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<td>34</td>
<td>2.3(14)</td>
<td>128</td>
<td>8.5(9)</td>
</tr>
<tr>
<td>WOLLONGONG</td>
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<td>4.7(12)</td>
<td>20</td>
<td>2.9(13)</td>
<td>50</td>
<td>7.1(14)</td>
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</table>

Table 2: AINSIE, AAEC, ARGC, NERDDP, RADIO AND ELECTRICAL RESEARCH BOARDS
RESEARCH GRANT AWARDS 1977/78-1982/83
The relative rankings are shown in parenthesis

<table>
<thead>
<tr>
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<tbody>
<tr>
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<td>111</td>
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<td>22</td>
<td>121</td>
<td>12</td>
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<td>121</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>JAMES COOK</td>
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<td>121</td>
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<td></td>
</tr>
<tr>
<td>LA TROBE</td>
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<td>22</td>
<td>121</td>
<td>12</td>
<td></td>
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<tr>
<td>MACQUARIE</td>
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<td>121</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>MELBOURNE</td>
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<td>22</td>
<td>121</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>MONASH</td>
<td>24</td>
<td>22</td>
<td>121</td>
<td>12</td>
<td></td>
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<tr>
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<td>NEW ENGLAND</td>
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<td>22</td>
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<td>QUEENSLAND</td>
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<td>SYDNEY</td>
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<tr>
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<td>WOLLONGONG</td>
<td>7</td>
<td>22</td>
<td>121</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

1975-1982, citation rate per paper and the total number of research grants awarded per capita, was calculated (Table 3).

<table>
<thead>
<tr>
<th>Rank</th>
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<tbody>
<tr>
<td>1</td>
<td>Flinders</td>
</tr>
<tr>
<td>2</td>
<td>Griffith</td>
</tr>
<tr>
<td>3</td>
<td>James Cook</td>
</tr>
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<td>Tasmania</td>
</tr>
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<td>New England</td>
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<td>16</td>
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<td>17</td>
<td>Macquarie</td>
</tr>
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</table>

The rankings in Table 3 represent a rather crude assessment of the relative research performance and activity of the Australian university physics departments based on a global spectrum of the research undertaken by the staff of the departments. The interesting feature of the rankings is the large number of small university departments in the top half of the table. Western Australia (15 staff), New South Wales (30) and Monash (24) are the only representatives of the larger departments to appear in the top nine places.

REFERENCES

AUTHORS
Malcolm Campbell is a graduate of the University College of Wales (Ph.D. - Chemistry) and the University of Sheffield (M.Sc. - Information Science). He has held several posts in academic libraries in the U.K. and Australia and is currently the Science Librarian at Griffith University, in Brisbane. His interests are in bibliometrics, particularly in its application to the evaluation of research.

Cathy Campbell recently completed a thesis entitled "A bibliometric analysis of the Australian Research Grants Committee grant allocation procedures 1969-1974" as partial fulfillment of the requirement of an M.Sc. in Science, Technology and Society at Griffith University. She is currently Circulation Librarian at the Mt. Gravatt campus of the Brisbane College of Advanced Education.

BRANCH NEWS
South Australia

At the beginning of each year, before school recommences, the University of Adelaide Physics Department holds a summer school for students who are about to commence Matriculation Physics. Usually a guest speaker of note is invited, and to take advantage of the visit, the first SA branch meeting of the year is held during this time. The 1984 guest speaker was Professor Peter Mason from the Physics Department of Macquarie University. The topic was 'The Brain — the Ultimate Problem' with the sub-title 'Brain Control of Body Temperature'. In his abstract Professor Mason said 'Thinking about Thinking' sounds like one of those self-referential problems that delight philosophers and readers of Scientific American's puzzle corner. "The language of the brain" wrote von Neumann, "is not the language of mathematics". So how can physicists get into the act? One way is to investigate a simple, low level problem such as: How does the brain control the temperature of the body?

For most of the time the brain does manage to control body temperature to 0.1°C. So where is the thermostat? This tantalizing question was discussed during the lecture and some quite novel ideas for possible solutions proposed. One theory Prof Mason and his group are working on is the "collagen theory". Collagens are constituents of skin, bone, teeth, blood vessels, tendons, cartilage and connective tissue. In fact they are the most abundant of all proteins in the body, making up almost 30% of total body protein mass. The distinctive physical property of collagen is that it forms long insoluble fibres of very high tensile strength — equivalent to that of steel — but when heated in water they become gelatinous and elastic. This was most dramatically demonstrated by Professor Mason with a long strand of collagen from a kangaroo tail which when dipped in the hot water became shorter, soft and elastic. The structure of collagen is a three stranded conformation called the collagen triple helix which contains a high percentage of glycine, proline and hydroxyproline amino acids. When put in hot water the triple helix collapses into random coils. Since the conversion process from inelastic to elastic state occurs at a definite temperature and could, in line with other proteins that are temperature sensitive, be made reversible, the questions posed were; could there possibly be a collagen-operated thermostat in the brain, with the site of this thermostat being in the hypothalamus? Could such a thermostat have some control over the flow of blood in veins close to the skin's surface, since this is known to help regulate body temperature? If collagen is not the sensitive element in the body temperature control system, then temperature control may turn out to be essential for collagen in say the growth of new skin tissues around a wound. Such growth is thought to occur at a slightly elevated temperature, ie an annealing process could be taking place.

Judging by the lengthy discussion session following the lecture the subject matter and questions posed by Professor Mason's talk are quite provocative and thought-provoking.

Monica Oliphant

The Australian Physicist, Vol. 21, April 1984 — Page 61
Australian Research Grants Scheme Funding for the Physical Sciences 1984

Report from Australian Institute of Physics Science Policy Committee

1. Total ARGs Funding

1.1 Although announced as a 16.5% increase in funding, the total grant of $224.24M for 1984 represents closer to a 5.5% increase when indexed to a constant dollar base. Thus, the increase falls short of the Government's pre-election commitment to an increase in ARGs funding in real terms of 10% per year over three years and does little more than compensate for the decline in funding which occurred in 1983 (Fig. 1). For the purpose of comparison, unless stated otherwise, all following dollar values have been converted to a 1982 base assuming a conversion index from 1984 values of 0.814. This figure has been derived from a combination of the 1983 index (0.904) employed by the Department of Science and Technology and an estimate of the 1983 index based on a figure of 11% for inflation.

1.2 The total number of applications dropped from 2000 in 1983 to 1984. However, there was an encouraging increase in the number of grants awarded, with 1313 successful applications compared with 1193 in 1983, an improvement in success rate from 59.7% to 66.2% (Fig. 2). The number of successful initial applications rose from 382 (1983) to 551, whereas the number of renewals fell from 811 (1983) to 762. Earth Sciences is the only discipline to suffer a reduction in the total number of grants awarded, in spite of a substantial (75%) increase in the number of initial applications being funded.

1.3 With the increase in the number of applications received, the number of 'good quality' ('Gold Stamp' letter) projects that could not be funded was reduced from its 1983 value of 514 to 361, reversing the alarming growth that has occurred since 1980. ARGs estimates the shortfall on the funding required to support these worthy projects exceeds $7M.

1.4 Although higher in dollar value the 1984 average grant of $17,088 represents a drop of 4.8% in constant 1982 value from $14,593 (1983) to $13,910, reversing the steady increase that had occurred since 1980 (Fig. 2). Thus, in 1984 there appears to be a move away from the trend towards the higher funding of a decreasing number of projects which has been evident over the past three years.

1.5 Little change has occurred in the distribution of funds between the disciplines (Fig. 3).

1.6 Overall, the ARGs have been able to award 42% of the total amount requested for 1984 compared with 41% in 1983. In terms of the total amount awarded relative to the total amount requested, the Physical Sciences had the greatest success receiving 47% of the amount requested with the Chemical Sciences receiving the lowest level of award at 37%. However, when the value of the average grant awarded is considered, the Biological Sciences and Earth Sciences continue to have the greatest success, receiving approximately 72% of the average grant requested. By this measure of success, the Chemical Sciences were again the lowest with a 55% success rate, compared with an average value of 64%.

1.7 It should be realised that the above success rates are based upon the total amounts of grants requested and awarded and the corresponding number of grants involved. A more meaningful comparison would be the average amount received as a percentage of the average amount requested for successful applicants. Unfortunately this information is not available.

2. ARGs Funding of the Physical Sciences.

2.1 The situation in the Physical Sciences generally reflects the changes in the overall funding situation. There has been no change in the number of applications, but the number of grants awarded increased from 142 (1983) to 161.

2.2 In spite of having the highest overall success rate in terms of the percentage of total funds requested, the average grant awarded was still only 61% of the average grant requested (63% in 1983).

2.3 The most disturbing statistic emerges when the average funding for the individual areas of Personnel, Equipment and Maintenance are compared for the laboratory disciplines (i.e. excluding Humanities and Economics and Social Sciences). The average values of the grants awarded (at 1983 levels) for these categories are $12,796, $2,874 and $2,356 respectively. The corresponding amounts for the Physical Sciences are $9,167, $5,989 and $2,792. Thus, it would appear that while the Physical Sciences receive somewhat better support for equipment, this is at the expense of support for personnel. Clearly, this raises serious questions concerning the standards and priorities that have been exercised in regard to requests for personnel by the Physical Sciences Subcommittee relative to those adopted in other disciplines. There is little point in having well equipped laboratories if the manpower required to staff them is not available.

3. The Future of the ARGs

3.1 Towards the end of last year the ARGC issued a policy statement entitled 'The Case for the Australian Research Grants Scheme for 1985' highlighting the need for increased funding in order to properly support its projects and to provide additional funds to implement new developments. The section of this document relating to these new developments has been reprinted in the January/February issue of the Australian Physicist.

3.2 Had the pre-election commitment of the Government to increase ARGs funding by 10% per year in real terms over the next 3 years been kept we would have expected a figure of $23.5M for 1984. Even this amount falls short of the $36.03M that the ARGC considers is required to adequately fund the 1313 projects.
that the Scheme will be supporting in 1984 and the 261 'good quality' projects that it was unable to support.

3.3 The ARGC estimates the additional support required to maintain the Scheme properly in 1985, including support for new initiatives, is $19.11M, without correction for inflation.

![Figure 1](image1.png)

**Figure 1.** Total ARG3 grant and average grants from 1972 to 1984 (1983 dollars)

![Figure 2](image2.png)

**Figure 2.** Total applications and applications in the Physical Sciences made and approved from 1972 to 1984.

![Figure 3](image3.png)

**Figure 3.** Distribution of ARG3 funds by discipline expressed as a percentage of total amount from 1972 to 1984.

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**Australian Journal of Physics**

Contents Volume 37 Number 2 1984

**Particles and Fields**

- Trivial solution to the domain wall problem G.A. Christos 119

**Nuclear Physics**

- Coulomb excitation of the 2.615 MeV (3^+) and 4.086 MeV (2^+) states of 209Pb. W.J. Veerman, M.T. Esat, J.A. Kuehner, R.H. Spear, A.M. Baxter and S. Hinds 123

**Fluid Dynamics and Plasma Physics**


- Modelling reactive gas flows within shock tunnels. I.M. Varadavas 157

- The influence of vertical vorticity on thermal convection. J.O. Murphy and J.M. Lopez 179

**Condensed Matter**

- Rotational motion of the NH3 ion in ammonium chloride. Sadhana Pandey and S.K. Trikha 197

**Electromagnetism and Optics**

- Two procedures for phase estimation from visibility magnitudes. R.J. Sault 209

**Ionospheric Physics**

- Nocturnal sporadic-E activity at two Southern Hemisphere stations over three solar cycles. W.J. Baggaley 231

- Corrigendum to: Electric quadrupole excitation of the first excited state of 18O M.P. Fewell, R.H. Spear, T.H. Zabel and A.M. Baxter 239

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**Meteorological Buoys Deployed**

A total of six Bureau of Meteorology drifting buoys is being deployed in Antarctic waters south of Australia this summer. The buoys, which measure sea surface temperature and pressure, provide important information in areas where very few meteorological observations are normally available. Their data is transmitted via polar orbiting weather satellites into the Global Telecommunications System.

Two buoys were deployed from “Nella Dan” in December and January, and a further two are to be released from that ship this month. Another two buoys have been released from the new Japanese icebreaker “Shirase” on her way from Freemantle to Showa station.

This year's deployment is the start of a planned ten-year program by the Bureau to maintain buoys in waters south of Australia. The buoys released this year were ones that were originally manufactured for the First GARP (Global Atmospheric Research Project) Global Experiment (FGGE) into the world's weather processes in 1978-79. The six had been deployed during FGGE but were washed ashore at various locations, retrieved, and rebuilt for use again.

Currently the Bureau has tenders out for United States or Canadian buoys. These would be released next season, however the Bureau hopes that after that the Australian made buoys can be utilised for the program.

*The Australian Physicist, Vol. 21, April 1984 — Page 63*
Intellectual Development and Performance in Undergraduate Physics

P.J. Jennings and M.G. Zadnik*
School of Mathematical and Physical Sciences, Murdoch University, Murdoch, W.A. 6150.

In this article we examine the intellectual development of a class of first year physics students at Murdoch University at the beginning of their course and attempt to relate their cognitive level to their performance in this physics course. We also assess the relationship between cognitive level and the difficulty students had in assimilating the course material.

Background

There has been considerable interest in the application of educational theories of Jean Piaget to the learning of physics (Renner and Lawson, 1973; Fuller, 1982). According to Piaget and Inhelder (1958) children pass through four stages of intellectual development — "sensory-motor", "pre-operational", "concrete-operational" and "formal-operational". By the time they leave high school many should have entered the final, "formal-operational" stage (Karpus, 1977). At this stage they are supposed to be capable of formal, abstract scientific thinking while in the previous "concrete-operational" stage they are incapable of using abstract logic. Students at a concrete-operational stage of development are capable of understanding and using science but this is only via analogy from concrete examples or demonstrations or experiments which they have witnessed. At the formal-operational stage students are able to manipulate abstract concepts with no need to resort to concrete objects in the process. Many students exhibit characteristics of both of these stages during their first years of tertiary study. Such students are described as transitional.

Many science educators have drawn on these theories and developed courses which provide both concrete and formal elements to cater to students at various stages of their intellectual development. Their aim is to provide the basic concrete experience in science upon which students may build formal abstractions and thus foster intellectual development (Fuller, 1982). Many of these ideas are familiar to physics educators who have long used lecture demonstrations and laboratory sessions to provide direct concrete experience of physical phenomena to students. The most significant of these developments is the Karpus Learning Cycle (Lawson and Renner, 1975) in which concrete learning experiences become a central part of the teaching method. Karpus (1977) recommends that a course should be broken down into a large number of modules and that each module should be studied via a three-stage learning cycle based on the theories of Piaget. The first stage is called exploration and is devoted to practical activities and demonstrations through which the students can progress at their own pace. The second stage is called concept introduction in which formal reasoning methods are introduced by means of lectures, tapes or notes drawing upon the exploration activities in the previous stage. The final stage is concept application in which the students apply the new concepts or reasoning patterns to unfamiliar examples or to experiments. Thus the students progress from one module to the next in this manner, building up formal reasoning patterns on a basis of concrete experience.

Piaget's ideas and Karpus' application of them to learning in the sciences have many supporters and some critics. The University of Nebraska has developed a physics programme based on these principles (Fuller, 1982) and many other courses have been modified to include elements of the Karpus Learning Cycle. We have had considerable success with an introductory computer programming course based on a book by Peckham (1981) which uses the Karpus Learning Cycle (Jennings and Atkinson, 1982).

Cognitive testing programmes in the USA (Renner and Lawson, 1973; Liberman and Hudson, 1979) indicate that many university entrants have not fully reached the formal-operational stage of intellectual development. This does not mean that they are still concrete-operational thinkers. Most are at a transitional stage where they still have difficulty with abstract thought processes when they first enter university. Consequently the supporters of Piaget's theories advocate the use of practical experience as an aid to the development of abstract thought processes for all university entrants (Prago, 1977). They emphasize that self-regulation is essential in the learning cycle and that learning is most effective when a sound basis for it has been established through practical experience and discussion of concepts and their application.

The critics of this approach (Orear, 1980; Goodwin, 1978) point out that Piaget's theories have been oversimplified in these applications. Further they claim that there is no clear distinction between the different stages of development which Piaget has identified. It could also be argued that concrete models and thinking by analogy are important even at advanced levels in physics and that formal-operational thinking is not essential for success in physics. Some authors point to a lack of correlation between intellectual development and success in physics (Cohen et al., 1978; Liberman and Hudson, 1979) to support their views that Piaget's ideas have very little real relevance for physics education.

In this article we attempt to assess the validity of some of these claims in the context of our first year mechanics course at Murdoch University.

Cognitive Testing

Piaget's original experiments were carried out by analysing individual children's attempts to solve practical problems. This case-studies approach is however quite unsuitable for application to large classes of students and many subsequent researchers in this field have developed written diagnostic tests which may be used to determine intellectual development (e.g. Liberman and Hudson, 1979; et al, 1978). Most of these tests contain problems related to the specific tasks which Piaget identified as being useful indicators of cognitive level. These include simple proportion, combinations of variables, isolation of variables, verbal analogies, correlations, verbal and numerical abstractions, probability estimates. Generally the student is asked to solve a problem and display his or her reasoning. The marker assesses both the correctness of the answer and the method by which it was attained in order to determine the student's cognitive level. Concrete

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thinkers tend to work via concrete analogies, explicitly examining all particular cases while formal thinkers are able to work in abstract, general terms. Usually one finds in marking these tests that most students of physics use a combination of formal and concrete reasoning and many are able to switch easily from one mode to the other to find the most effective method of solving the problem. Indeed by its practical nature, physics is a field in which both forms of reasoning are encouraged and developed.

After several years of experimentation and interviews and analysis of student responses we have developed our own version of the cognitive test which we find simple to administer and relatively straightforward to mark. It contains five of the Piagetian tasks: simple proportion, verbal analogies, combinations of variables, isolation of variables, and verbal and numerical abstractions. Three of the questions require written answers and explanations and the other two require only multiple choice selections. Copies of the test and marking scheme are available from the authors.

The written answers were marked independently by two markers using a marking scheme based on a Piagetian analysis. Differences were resolved by discussion between the markers.

We administered this test to a group of 48 students at the start of their first year mechanics course at Murdoch University. These students were predominantly science majors who had had some exposure to physics and calculus during their high school studies. This course is run on a modified version of the Keller scheme (Keller, 1968) which allows students to study at their own pace (Cornish and Jennings, 1977). It also integrates both theory and experiment and thus provides some concrete experience during the formation of abstract concepts. However it is not explicitly based on the Karplus Learning Cycle and thus we might expect that students at a concrete-operational level of development would be disadvantaged relative to formal-operational thinkers.

Results

The results of testing are shown in the Table. An A grade indicates that the student had completed four advanced modules, while a B grade required two advanced modules in addition to the ten modules required for a C pass.

<table>
<thead>
<tr>
<th>Cognitive Level</th>
<th>Grade Obtained</th>
<th>Fail or withdrawn</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Transitional</td>
<td>0</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Concrete</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

These results indicate that only 23, or 48%, of the class had reached the formal-operational stage of their intellectual development at the start of this course. However most of the class had developed some skills of formal, abstract reasoning and only 6, or 12%, were still at a purely concrete-operational stage. A chi-squared analysis of this data shows that there is no significant correlation between cognitive level and performance in the course. Although 83% of the formal thinkers and a similar proportion of the concrete thinkers were successful, only 68% of the transitional group passed. There is a higher proportion of As and Bs amongst the formal and transitional thinkers than amongst the concrete thinkers.

Discussion

Our results confirm the pattern established by cognitive testing in the USA (Cohen et al., 1978; Liberman and Hudson, 1979). This is:

(a) less than half of the first year class had clearly reached the formal stage of their intellectual development,

(b) there is little correlation between cognitive level and performance in the physics course.

The reasons advanced for this lack of correlation are that other factors, including motivation, diligence, personal circumstances, mathematical and physical preparation, are also significant determinants of student performance. Other research has confirmed the importance of these factors (Hudson and McIntire, 1977) yet it does appear to us that cognitive level is still an important factor in physics education. By carefully analysing the experiences of the concrete-operational students in this course, through interviews with these students and their tutors, we established that all of them had great difficulty in understanding and using the material. Those who passed the course did so because of intense effort produced by strong motivation which was facilitated by some aspects of the course design (e.g. self-pacing). However few of them achieved anything other than a basic C pass. These students tended to work more diligently than those at higher levels of intellectual development because they were aware from the start that they would find the course difficult.

Analysis of the class records indicated that many of the students at the formal stage of development underestimated the difficulty of the course and tended to procrastinate. Students in the transitional group were particularly at risk because they found the early modules easy but were not able to cope as readily with the more advanced modules later in the course because of their less developed skills of formal reasoning.

Conclusions

The following conclusions have emerged from this study:

(a) We believe that we can explain the lack of strong correlation between cognitive level and performance in terms of a complex interaction between preparation, motivation, diligence, course design and intellectual development.

(b) Our results support the use of cognitive tests as diagnostic tools to identify students who will experience difficulty with the course. Once such students are identified by cognitive testing they may be given additional assistance or counselling directed towards their specific needs.

(c) The results also indicate that the transitional group of students may be at risk unless they are encouraged to work steadily through the course.

Finally, it is worth noting that previous findings (Jennings and Atkinson, 1982) support the use of the Karplus Learning Cycle in first year courses as an aid to concept development for students who have not reached the formal-operational stage of their intellectual development at the start of their university studies.

ACKNOWLEDGEMENTS

The authors wish to thank Rod McDonald, Jill Barrett and Roger Atkinson of Murdoch University for many helpful discussions of this work and its interpretation.

REFERENCES


Cornish, J.C. and Jennings, P.J. (1977) "Self-paced

The Australian Physicist, Vol. 21, April 1984 — Page 65
Forthcoming Conference

The Third Applied Physics Conference of the Australian Institute of Physics will be held between 3-7th December 1984 inclusive, in Melbourne.

The host will be the Department of Applied Physics, Royal Melbourne Institute of Technology. Members will recall that this Department was the host for the second A.P. Conference.

The Conference theme will be ‘Physics and Australia’s Resources’. The first announcement and Call for Papers will appear in the next issue.

K.R. Cook
Honorary Secretary
3rd A.P. Conference.

Operation of National Research Granting Schemes

A Report to the Prime Minister by the Australian Science and Technology Council (ASTEC), Australian Government Publishing Service, Canberra 1983, 76 pp. Reviewed by S.P. Burrey, School of Economics, La Trobe University, for the Science Policy Committee.

This report presents a compendium of the operations of the major national research granting schemes, and makes a number of very general suggestions as to how they might achieve a more effective promotion of research given their allocations of funds. These suggestions arise from a comparison of the workings of the different schemes, which comparison also indicates the desirability of each scheme to relate to the others. The report further suggests the provision of greater “administrative support” for some of the schemes by the Government, to enable “proper evaluations of progress achieved and the forward commitment of funds”.

Nine specific recommendations are made, concerned with: annual reports of areas of strength and deficiency in the various areas, peer reviews, coordination, assessment of progress, stronger secretariats, more flexible uses of funds and forward commitment of funds. A perceivable overall suggestion appears advocating greater bureaucratisation of what has been largely a management by hard working committees of volunteer experts. This suggestion is not without foundation, but older hands will no doubt be alert for the first signs of any needless emergence of more administrators and controls.

For physicists however the most pertinent section of the report will probably be the last one, headed “between logical abilities and success in physics”. Am. J. Phys. 47, 784-786.


“Provision of major equipment”. This is a major and growing concern. The question is complicated by the normal division of equipment into “large”, “major” and “small” with the middle group, $0.2 to $1.0 million proving the most difficult to handle. It seems to be too big for individual universities to handle comfortably and too small to warrant national involvement. The Committee draws attention to the possibilities of coordination but makes no formal recommendations concerning this whole problem in the present report. However it indicates that an “integrated solution” will be considered in its forthcoming report on research funding.

LETTER

Dear Sir,

I notice that for the AIP National Congress of Physics in Brisbane, all oral presentations will be invited papers of a review nature and contributed papers will only be presented in poster sessions. I am writing to suggest that such an organization of the timetable for a week long conference represents a lack of balance. Surely half of the time for oral presentation could be devoted to local research contributions. We don’t only want to hear general talks on ‘appropriate technology’ and ‘nuclear warefare issues’.

I realize that in the past Australian research in physics has been weak, and that it has been usual in Physics Congresses to go along and either meekly listen to invited talks from overseas experts who have been flown in, or else listen to review lectures, again largely of overseas developments, as perceived by respected local professors, who frequently spend most of their time in administration.

I believe that there is now local research work done by individual scientists in Australia which is world class. There should be an opportunity for such work to be presented orally. There can be considerable stimulus in an oral presentation to publicize work, and gain from the general reactions and questioning from an audience. Presentation time for each paper can be quite short. At some conferences of the American Physical Society it is only 7 minutes.

I know that it is said that poster presentations have just as much status as oral presentations. Yet the high status professors don’t seem to rush to contribute to poster sessions, whereas they often feel very honoured to be asked to give an oral presentation.

John J Lowke
Division of Applied Physics,
CSIRO

The Australian Physicist, Vol. 21, April 1984 — Page 66
The Institute’s Working Group on Nuclear Armament and Warfare, convened by Professor W.A. Runciman, has released the final program outline for the ANZAAS Symposium on nuclear arms, sponsored by the Institute.

The Program is outlined below:

**Major Symposium:** NUCLEAR ARMS: THE RACE TO OBLIVION OR JUST TESTING?

**Sponsor:** Australian Institute of Physics

**Convenor:** Professor Alan Runciman, Department of Solid State Physics, Research School of Physical Sciences, Australian National University, Canberra.

**Brief Description:** The nuclear arms race poses the greatest threat to our civilization. Regional and global issues will be outlined. A special feature will be a discussion session with an emphasis on what we can do and are doing about the nuclear arms race.

**Wednesday, 16 May, 2.00-5.30**

**Chair:** Professor Geoff Wilson, President, Australian Institute of Physics

2.00-2.10 **Chairman’s remarks**

2.10-3.00 **Keynote Address:** The Nuclear Arms Race

Professor George Rathjens, Co-director, Program in Science and Technology for International Security, M.I.T., Cambridge, Massachusetts

3.00-3.30 **Accuracy, Survivability and Outer Space Weapons**

Dr Julie Dahlitz, Barrister and Solicitor of the Supreme Court of Victoria

4.00-4.35 **Atmospheric Effects of a Major Nuclear War**

Mr Ian Galbally, Principal Research Scientist, Division of Atmospheric Research, CSIRO, Aspendale, Victoria

4.35-5.00 **Health of Australian Atomic Personnel**

Dr John Donovan, Senior Medical Adviser in Epidemiology, Department of Health, Canberra

5.00-5.30 **A Nuclear Free Zone for the South Pacific**

Mr Greg Fry, Postdoctoral Fellow, Strategic and Defence Studies Centre, Research School of Pacific Studies, Australian National University, Canberra.

**Friday, May 18, 9.00-12.30**

**Chair:** Professor Alan Runciman, Department of Solid State Physics, Research School of Physical Sciences, Australian National University, Canberra.

9.00-9.10 **Chairman’s remarks**

9.10-9.30 **Australia and the Nuclear Arms Race:** Can We Break the Links?

Dr Jim Falk, Senior Lecturer, Department of History and Philosophy of Science, University of Wollongong

9.30-10.30 **Discussion (with an emphasis on regional issues)**

11.00-11.30 **Introductory remarks**

Ms Petra Kelly and General Gert Bastian, Parliamentary Members of the Green Party, Federal Republic of Germany

11.30-12.30 **Discussion (with emphasis on global issues)**

Participants wishing to make short contributions up to five minutes are invited to let the Chairman know in advance giving keywords for the topic to allow the discussion to be somewhat structured. It is hoped that both a slide projector and a viewgraph will be available.

Further information on the Institute’s involvement can be obtained from Professor Runciman, telephone (062) 49 4244.

For a copy of the preliminary ANZAAS program (Circular No. 2) or other information, contact Dulcie Stretton Associates, 70 Glenmore Rd., Paddington, NSW 2021, (02) 357 6862 or 331 5258.

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**Errata**

"Women in CSIRO"

Two significant errors occurred in Rachel Makinson’s paper on Women in CSIRO in the first issue this year. In column 1, p14, line 20 should read “The first drawback (i.e. low number of staff in certain occupational groups) was often overcome by the discovery of similar patterns of differences running through most of the occupational groups.”

In column 2, p14, line 19 should read “The proportion of staff perceiving these differences was higher among men than among women, among staff aged 35 or over than among staff under 35, and among administrative and office staff than among scientific and technical staff.

Our apologies to Dr Makinson.

Further unfortunate errors occurred in the last issue. Our printing arrangements are being altered slightly to try to improve the error rate. We hope it will not result in much delay in delivery.
SEMINAR ON NUCLEAR RADIATION APPLICATIONS

This one-day seminar was sponsored by the School of Nuclear Engineering, University of New South Wales, and was held in the grounds of that University on the 22nd February 1984. It was arranged to demonstrate contributions made by the applied nuclear sciences over a wide area of activities. Although the accent was on engineering applications and there was no specific reference to physics research, several physicists offered papers and the event may be of interest to members of the Institute for reasons which will appear. Since the present writer was the organizer of the seminar, it could be considered as incorrect that he is also the reporter, but this was by far the simplest way of getting a report written. Readers are free to allow for bias if they are so inclined.

There were eleven talks, dealing with:
- the management of water resources
- land erosion and sedimentation
- the treatment of waste water and other industrial problems
- nuclear techniques in the mineral industries
- nuclear techniques in the forensic sciences
- radiopharmaceutical substances and their application to diagnostic medicine, especially to cases of cancer and heart disease.

The seminar was opened by the Chairman of the Australian Atomic Energy Commission, Professor M.H. Brennan, FAIP, and it was the AAEC which, next to the School of Nuclear Engineering (Professor J.J. Thompson), made the largest contribution to the running of this function. But there was also valued support from the CSIRO, from the Australian School of Nuclear Technology, from the Nuclear Medicine Departments of Royal Prince Alfred and the Prince of Wales Hospitals, from the Neutron Activation Analysis Section of the Australian Federal Police, and last but not least, from a distinguished radiopharmacist hailing from the University of Alberta, Canada.

Many of the techniques which were described were pioneered in this country. Their employment has, to quote the opening speaker, made industry more efficient, agriculture more productive and medicine more pertceptive. There remain numerous potential applications for new procedures, many of them suggested by the successes of work at present in progress. All this work is uncontroversial (in terms of contributions to nuclear proliferation) and of demonstrated economic, scientific and social benefit. For example, in the mineral and processing industries the use of applied nuclear science-engineering has been a responsible for annual savings of hundreds of thousands, if not millions of dollars.

Results of monitoring the nature and origin of water resources, and of measures to assist in the preservation and restoration of agricultural lands were not readily expressed in monetary terms, but contributions by the applied nuclear sciences to the effectiveness of these essential activities were nevertheless convincingly demonstrated, as were the contributions to the preservation of the integrity of agricultural products.

A notable case was made in radiopharmaceutical research and its clinical applications. During the 1960's Australia was among the world's leaders in these medically and socially important fields. It lost its leading position when successive governments failed to support the setting up of cyclotrons and associated physical and clinical facilities. Nuclear medicine physicians are now unable to use diagnostic procedures available in many Third World countries.

Most of the recent advances achieved by overseas laboratories occurred through applications of cyclotron produced radionuclide tracers too short-lived to be imported into Australia, whilst there are no facilities to make them here. Not only does this hold back the practice of nuclear medicine, more fundamentally, it inhibits research and consequent development. While much good work with reactor-produced radio tracers continues at Lucas Heights, contributions from university and hospital departments are small to nonexistent; a highly unfavourable environment for work at the frontiers of knowledge.

There was no intention to use the seminar for unravelling new science and engineering developments for the attention of specialists. It was intended to be an exercise in communicating well-established and successfully-working achievements in applied science and engineering to those quasi-mystical beings, the interested laymen; industrialists, engineering consultants, financiers and similar groups. The extensive pre-seminar publicity, largely unnoticed as it turned out later, had taken pains to present the event as such. It even dwelt on the good prospects for profitable ventures, but all to small avail; there was a roll-up of about 60 people, but the groups it was hoped would be present were a small minority of this not over-impressive number.

The seminar revealed two facts, neither of which is new. First there is the fact that Australian achievements in applied nuclear science-engineering are impressive by any criterion used to judge them. Secondly, the enlightenment of industry in reward to potentially profitable prospects within the area of nuclear science will require many more attempts before it can be hoped that the beginnings of an impact will register. High technology does very nicely as a trendy subject over cocktails or as a mirage conjured up by politicians. For entrepreneurs to go out and study these techniques, and to consider to what extent they could be useful in their own spheres of interest, would appear to be an aberrant response rather than a normal reflux. Besides, should one want to apply nuclear radiations, one also has to contend with the provisions of the relevant radioactive substances act, and there is all the sensation-loaded publicity about dreaded consequences of invisible radiations. In actual fact, those who did come to the seminar to be informed by the experience of practitioners rather than by innuendo, learned that the conditions of the act are not unduly restrictive and if adhered to the dangers from ionising radiations are very much smaller than from any other agents in common use.

A condensed version of the proceedings of the seminar, together with an introductory note on the nuclear sciences and a glossary of terms (total 60 pages) has been publicised and is available from the Cooperative Bookshop in the Electrical Engineering Building at the University of New South Wales, Kensington (price $8 postage paid).

G.C. Lowenthal
School of Nuclear Engineering
University of New South Wales
This annual meeting of Australian and New Zealand condensed matter physicists was different. It was not just the mild 23°C warmth and calm seas of the delightful island setting off Auckland contrasting sharply with the harsh 40 + C heat and dry inland landscape of the 1983 meeting in Wagga. The physics was different. Bulk crystalline properties of solids, so long the backbone of “Wagga meetings”, took second place to amorphous solids, glasses, liquids, polymers and surface physics. One reason is undoubtedly the decision taken at Wagga 83 to widen the scope of the conference from “solid state” to “condensed matter” physics. Another reason is undoubtedly the interests and research emphases of the New Zealand physicists and physical chemists who organized the program of invited speakers for the meeting. But, perhaps we are also seeing a real swing in our subject.

Firstly, some bare statistics: the two and one half day meeting attracted 99 participants over 50 of whom were from Australia. They variously presented and/or digested nearly 100 papers, 72 in poster form. This rather formidable fare was sampled in three daily sessions: 9:00-12:20, 18.00-6:00 and 8:00-9:00, plus continuous informal intake around the posters.

The lunchtime siesta period was a welcome break that gave attendees the chance to sample the pleasures of this resort island: swimming, golf (trying putting over parasol some times), running or clambering around the rocks. The Committee, led by Prof David Beaglehole (Victoria University) and Dr Jeff Tallon (DSIR, Wellington), arranged for perfect weather albeit with a slightly uncertain, overcast start on the first morning.

The Committee successfully tapped funds from the New Zealand/ France Science Agreement and from a consortium of universities and the DSIR to bring out three keynote speakers from France. Dr Marie-Luce Theye (Universite P et M Curie) opened the conference with a very clear and comprehensive review of optical/spectroscopic experiments aimed at studying disordered semiconductors, semiconductors incorporating hydrogen, and amorphous alloys between semiconductors and noble metals. Prof P de Gennes (College de France) in a special evening lecture on polymer dynamics gave a lucid account of the motion of flexible, entangled chains ala “spaghetti soup”. This came over to the audience as a beautiful example of a complex problem in fundamental topology and statistical physics with immediate and important application to the formulation of polymers with specified properties and to the means of extruding, moulding and shaping them. In another invited paper Prof de Gennes gave an enthusiastic talk on the dynamics of wetting: what are the forces on a fluid droplet spreading over a solid surface? Again he described a difficult and fundamental problem with application to paints, sprays, oil recovery, aquaplaning of tyres, etc. Dr Francoise Brochard (College de France) spoke on phase separation in a binary gel and the similarities with random field effects.

Dr Jacob Israelachvili (ANU) described the elegant experiments his group have carried out with deceptively simple-looking apparatus to measure the forces between molecularly smooth liquid surfaces separated by 5-10 molecular diameters. He explained why these forces oscillate with distance with a periodicity equal to the mean molecular diameter of the intervening fluid.

The elastic properties of sea-ice and its dependence on brine concentration was described by Dr Bill Robinson (DSIR, Wellington). This information, gained in situ at McMurdo Sound, has a highly practical application in assessing the elastic response of sea-ice to the movement of vehicles and aircraft.

Prof Dan Haneman (UNSW) reviewed the present state of our knowledge of the properties and economics of thin film photovoltaics, giving enthusiastic support to the admirable properties of amorphous hydrogenated silicon and sadly rejecting CulnSe: Cds heterojunctions as beautiful material with no staying power.

Several other speakers concentrated on the more traditional aspects of the solid state. Dr Stuart Dryden (CSIRO, Applied Physics) talked of the resurgence of interest in work he and Wadsley did 25 years ago using dielectric relaxation to study the movement of ions through hollandite. This material is now highly “relevant” because of its potential as a solid electrolyte and as a constituent of Synroc, a possible storage medium for nuclear waste. Dr Stuart Campbell (ANU) summarized the applications and stressed the versatility of Mössbauer spectroscopy as a diagnostic tool; Dr Alan Kaiser (Victoria University) gave a short and snappy account of his theory of the resistance minimum in metallic glasses, which he attributes to interplay between the temperature dependence of phonon resistivity and material fluctuations and not the Kondo mechanism favoured by the rest of the world. Prof Fred Smith (Monash) described how his group, in collaboration with CSIRO Chemical Physics, had rediscovered the “K-patterns” of divergent-beam X-ray and electron diffraction — but this time in gamma-ray and Mössbauer spectroscopy. They are also looking for the effect in neutron diffraction experiment resistivity and spin fluctuations and not the Kondo mechanism favoured by the rest of the world.

The standard of poster presentation continues to improve and is now very high. Unfortunately, contributors were let down a little by overcrowding and insufficient illumination in the display area. Following the Wagga 83 precedent, the Committee awarded prizes for the best posters each day. The Duntrium team of Baek, Chaplin, Foster, Stewart and Wilson showed that their 1983 win was no fluke by taking out a 1984 award for a very clear description of ever more subtle NMR experiments to study quadrupole interactions and spin—spin relaxation of CoFe alloys.

The posters contained much of the traditional solid state work from the major centres: magnetic spectroscopy is alive and well at ANU and the Kensington and Duntrium campuses of UNSW; CSIRO Applied Physics presented work on thermal and magnetic properties of crystalline and glassy systems; solitons remain an elegant solution for looking for more problems; ion implantation flourishes at Lucas Heights (CSIRO Chemical Physics); optical spectroscopy is widespread (ANU, Wollongong, Victoria and Canterbury Universities); and Monash is having a breather from A15 compounds.

The New Zealand Committee reminded us that the kiwi, though flightless, is a bird with a long memory. The “Underarm Delivery Awards for the most intelligible Australian poster” went to the Melbourne consortium of Norman, Finlayson, Goodman, Olsen and Wilkins (variously from Chisholm Institute, CSIRO...
Chemical Physics and Monash), and to Collocott (CSIRO Applied Physics). Amid mutterings about a 1985 "Wide Blade Award for the wooliest New Zealand poster", the winners collected their roll-on deodorant prizes. The spirit of ANZAC lives on.

An evening symposium discussed "What should condensed matter physicists down under be doing?" After introductory remarks by invited panellists Profs Fred Smith (Monash) and Dan Haneman (UNSW) and Drs Bill Robinson (DSIR Wellington) and Stuart Smedley (Canterbury), comment was invited from the floor. Not unexpectedly, no decisions were reached and the points made tended to apply to physics as a whole rather than to be specific to "condensed matter". What emerged was a worry at the lack of industrial physics research in both countries and a lack of industrial interest in both countries in what we have to offer ("Would any physicist from industry who is present please stand up?"). There was an obvious awareness among all present that we are funded by the community and have an obligation to try to return some of our research effort directly to the community. There was an endorsement of the actions of the AIP and NZIP in establishing and maintaining close contacts with the Government and Minister for Science of the day to keep them aware of physics and its importance to the community. And, there was agreement that attitudes to the importance of applying physics — rather than just studying it — were set in university teaching laboratories, where much more emphasis might be placed on application of the discipline rather than formal background.

The conference ended with the traditional conference "awards" for achievement — the most notable being to Dr Catherine McCammon (ANU) for the first recorded circum-nutation of Pakatok Island (1.5h) by a physicist — and a hearty vote of thanks to the Organizing Committee. Particular mention was made to Drs Buckley and Staines of DSIR, Wellington, who carried out, respectively, the onerous tasks of Secretary and Treasurer.

The next meeting is scheduled for 6-8 February 1985 in Wagga Wagga and will be organized by a committee of the CSIRO Division of Applied Physics in Sydney under the chairmanship of Dr GK White.

— JG Collins

PEOPLE

Two long-serving members of the staff of the Division of Applied Physics in Sydney recently retired, sharing between them almost 60 years' service to CSIRO.

Alan Driver joined the Division in 1956 and carried out a variety of duties, including audio visual, patents and licensing.

Jack MCAe joined the CSIRO as a sheet metal worker temporarily in 1949 and stayed for 34 years. Over that period, he has assisted with a wide range of research programs including most recently the quantified hall measurement program with Dr Brian Ricketts. Jack has been an enthusiastic supporter of the Benevolent Fund and Community Aid Abroad, and was a member of the Safety Committee and a first aid officer.

This invitation was in recognition of his long involvement in various space programs, particularly in earth resource applications.

The Space Association is an Australian public space-interest organization that promotes the advancement and expansion of space exploration, technology and applications.

Ken has a new scientific assistant, Ms Christine Astley-Boden, Information Officer at the Minerals Research Laboratory.

Keith Chapman, a marketing executive from John Lysaghts (Australia) Ltd, has also been appointed to the Division of Mineral Physics as commercial manager.

Dr Ted Radoslovich of the Division of Soils in South Australia has been elected Deputy Mayor of the City of Mitcham, a suburban council covering the south-east area of Adelaide, and including the Flinders University, the Waite Institute and three CSIRO Divisions, including his own.

Ted has served for the past two years as an alderman prior to his election as Deputy Mayor at the start of the new council.

At their annual council meeting in Canberra in September, the Australian Council for Overseas Aid (ACFOA) elected as its Chairman for the next two years John Birch, Scientific assistant to the Chief at the Division of Applied Physics.

ACFOA is the coordinating body for over 50 non-government Australian based organizations working in the field of overseas aid and development. As well as representing the views of the voluntary overseas aid sector to the Australian Government on issues relating to Australia's relationship with developing countries, ACFOA also conducts an active research and community education program.

John Birch was also elected as one of the three non-government organization (NGO) members on the ADAB/NGO Committee for Development Cooperation. This committee is responsible for allocating about $5 million from the Australian Government aid funds to voluntary organizations through the Project.

Dr Ken McCracken, Chief of the Division of Mineral Physics, of CSIRO has accepted an invitation to become patron of the Space Association.

The Australian Physicist, Vol. 21, April 1984 — Page 70
Subsidy Scheme.

John Birch, who is currently National Chairman of the Community Aid Abroad (CAA) was in 1971 the foundation secretary of the CAA group at the National Measurement Laboratory in Sydney. This group has raised $20,000 over the last 13 years which it has used to support 30 self help village projects in Asia, Africa, the Pacific and Australian Aboriginal communities.

Mr T.J. Brown has been appointed Lecturer in Electronics in the School of Mathematics and Physics at Macquarie University.

1984 is the Institute of Electrical and Electronics Engineers' centennial year and 1984 medals are being awarded around the world. Peter Somlo from the Division of Applied Physics has received a medal and certificate in recognition of his service to the Institute and to his profession.

Professor Keith Cole of Latrobe University is to replace Michael Tracey on the Antarctic Research Policy Advisory Committee (ARPAC). Michael's term expired on 31 December last. He recently retired from the CSIRO Institute for Biological Resources. Keith Cole is a physicist who has contributed greatly to Antarctic science over the past twenty-five years.

Dr Kevin Sheridan, who recently retired from the Division of Radiophysics in Sydney, was created a Member in the general division of the Order of Australia in the Queen's Birthday awards announced in January.

Kevin's award was made for public service to science, particularly in the field of radio physics. Prior to his retirement in August last year, Kevin was a senior principal research scientist, in charge of the solar radio astronomy group within the Division.

He joined the Organization in 1945, and within a couple of years was responsible for the installation and trials of the Division's multiple track range for aircraft navigation while still a technical assistant. He subsequently graduated from the University of Queensland, as a Bachelor of Science, and in 1973, his scientific achievements were recognized when the same university awarded him an honorary Doctor of Science.

Dr. Marc Duldig, the new Tasmanian Associate Editor for Aust. Phys. works with the Cosmic Ray Section of the Antarctic Division, and has just been appointed an Honorary Lecturer in Physics at the University of Tasmania.

Dr. Peter Jarvis has been appointed a contract lecturer in the Physics Department, University of Tasmania and commences his appointment in March this year. He is a theoretical physicist specializing in quantum field theories.

Paul Eric Geissler has been awarded the Tasmanian AIP prize for undergraduate physics for 1984.

Prof. R. W. Home has been appointed Editor of Historical Records of Australian Science. This journal, formerly titled Records of the Australian Academy of Science, was restructured a few years ago with the intention that it should become the journal of record for the history of science in this country. Currently one issue is being published per year, though it is hoped in due course to increase this to two. Material submitted for publication should be sent direct to Professor Home at the Department of History and Philosophy of Science, University of Melbourne, Parkville Vic 3052.

Private enterprise, government and academia will need to combine forces in Australia if the country is to emerge "technologically" strong.

According to Professor Jim Piper, 37, who has just taken up the Chair of Physics, at the Macquarie University, there is not yet enough contact between those involved in some of the newer areas of science and technology, particularly where the expertise is thickly spread.

"In the United States nearly every scientist working in a university has outside consultancy work," Professor Piper said.

"This is relatively rare in Australia where most academics are left to work by themselves a lot of the time.

"Contact with outside organisations is going to be necessary in Australia and this is especially important as we are just starting off.

"Clearly to do it properly we have got to have the combined forces of industry, academia and government.

Professor Piper, whose main area of research is lasers, said he had been lucky in that he and at least half of the physics staff at the University were involved in projects with outside bodies.

He said that while the School of Mathematics and Physics at Macquarie would remain a small department it would become stronger in terms of student numbers.

"We will maintain our efforts within a framework of a basic physics degree to give our students a chance to do applied science, specialising in such areas as electronics, materials, science, and possibly, optical physics," Professor Piper said.

"There is a lot of evidence that students are returning to the basic sciences as a route into the more technologically-based disciplines.

"We have a responsibility to ourselves and to our students to do basic research but we can't ignore our responsibilities to commercial, government and community interests.

"It's a tightrope... we try to maintain a responsibility to the whole sector."

Professor Piper said more financial support was needed at both basic and applied research levels from private enterprise in Australia.

"However we probably won't be looking to established industry to fund research," he said.

"It's the smaller, new companies who will be taking up new products and going with them.

"However, Professor Piper was keen that having a good idea in technology and even a prototype did not guarantee success as the cost of getting a product on the market was often prohibitive, especially for small Australian companies.

He cited problems the Macquarie Laser Group (of which he is leader) and the Adelaide-based company, Quentron Optics Pty Ltd, were coming up against in getting their high powered gallium vapour laser for cancer phototherapy on the commercial market.

"Although we developed the idea first and have a patent pending we know that two other similar products have appeared on the United States market," Professor Piper said.

"If we don't get ours into the marketplace within 12 months we will probably be out of the running — having the best and first idea doesn't matter at all in this case."

Professor Piper, who lives in Pennant Hills, has been at Macquarie since being appointed Lecturer in Physics in 1975. In 1977 he was appointed Senior Lecturer before becoming Associate Professor of Physics in 1980. He holds a PhD from Otago University in New Zealand. From 1971 to mid-1975 he was at the Clarendon
Barry J. Allen, a Principal Research Scientist in the AAE's Applied Physics Division, has been awarded a Doctor of Science degree by the Faculty of Science, University of Melbourne. He has published over 100 papers on fast neutron capture γ-rays and capture cross sections, in studies of the neutron capture mechanism, stellar nucleosynthesis (creation of elements in stars) and nuclear data for fast reactors. The degree has been awarded in recognition of Barry's contributions to these fields, as represented by the forty or so papers included in his D.Sc. thesis.

Barry graduated B.Sc. (1961) and M.Sc. (Hons.) (1963) from Melbourne University. On joining the AAE in 1963, Barry established the neutron capture γ-ray facility at the 3 MV Van de Graaff accelerator. He was later attached to Oak Ridge National Laboratory (1969-72) where many high resolution capture cross section measurements were made with the newly installed 140 MeV electron linear accelerator. He established a highly productive collaboration with ORNL which endured for the next ten years.

Studies of capture γ-rays and resonance cross sections provided the basis of his Ph.D. thesis entitled "Neutron Capture Mechanisms in the Threshold Region." This degree was conferred by the University of Wollongong in 1978.

With changing AAE priorities, Barry is currently developing a research program relating to the medical application of nuclear techniques, specifically, boron neutron capture therapy for malignant melanoma.

He is particularly grateful to his many collaborators in Physics Division, at universities, and at ORNL and CBNM.

Visitors to Australia

Professor J.O. Rasmussen, University of California, Visiting Fellow, RSPhys at A.N.U. interests: Heavy Ion reactions; Experiment and theory, Nuclear Physics.

Professor A.R. Poletti, University of Auckland, Visiting Fellow, Nuclear Physicist at A.N.U., 10 January 1984; 15 February 1985, interests: Study of excited states of high spin in heavy nuclei.


Tim Guoliang from Academia Sinica in China has joined the Division of Water and Land Resources at CSIRO to work on the fundamental aspects of remote sensing applications for two years.

Mr Xu Chang Fang of the Institute of Geology, State Seismological Bureau, Beijing, China is visiting the physics department of the University of Queensland from February to end 1984. Activities/interests: Magnetotelluric techniques.

Obituary

Ronald G. Giovannelli DSc FAA FAIP, 1915-1984

An eminent Fellow of the Institute, Dr Ron Giovannelli, died in Sydney on 27 January 1984 after a long illness. His death ended a 44-year period of distinguished service to what is now the CSIRO Division of Applied Physics — in optics, solar physics, and scientific administration. Giovannelli was one of the original group of nine scientists recruited in 1936-40 by CSIR (now CSIRO) in order to establish the National Standards Laboratory (NSL), as the present Division was then known, and at the time of his death he was still scientifically active as an Honorary Research Fellow.

Born in Grafton NSW, Giovannelli was educated at Fort Street Boys' High School and the University of Sydney, graduating in Science in 1937 with honours in Mathematics and Physics. His first appointment, from 1937-39, was as a Research Fellow at the then Commonwealth Solar Observatory, Mount Stromlo, where he developed his life-long interest in the physics of the Sun.

Giovannelli's first year with CSIR, 1940-41, was spent under war-time conditions on a studentship at the UK National Physical Laboratory, Teddington. Here, along
with the eight other new recruits, he set about learning how to create a standards laboratory and reequipping the necessary equipment. His special responsibility was measurement in optics, photometry and colorimetry. He returned to Australia in 1941 and in the original NSL building in the grounds of Sydney University, he led the work of the Light Section until 1958.

Until the end of World War II in 1945 the NSL concentrated on special projects to assist the war effort. The Light Section worked on optical design, instrument manufacture and testing, night vision and the lighting of aircraft cockpits, and assisted the newly thriving Australian optical glass industry by measuring the refractive index of each melt.

After the war Giovanelli, with the rest of the NSL staff, got back to the task of establishing Australia's national standards of physical measurement. He recognized the necessity to leave the service aspects of his work with related research, and also build the strong technical support groups in areas such as optical working, vacuum coating, precision instrument making and scientific photography. His interest in finding practical applications of his Light Sections expertise led to considerable effort in fields as diverse as haemoglobinometry, retroreflection, industrial colour control and deep-sea photometry. In 1958 he succeeded Dr GH Briggs as Chief of the Division of Physics, a position which he held until he voluntarily relinquished it in 1974.

During the period 1959-76 he also served as a member of the National Standards Commission, thus contributing further to the growth of Australia's national measurement system. He was an exciting leader who set ambitious goals and demanding timetables. More importantly, however, he was a physicist of great talent and breadth, with an irrepressible and infectious enthusiasm for his interest of the moment.

Notwithstanding Giovanelli's contributions to standards and scientific administration, solar physics was always his principal research interest. After an early work at Mount Stromlo had won him an MSc degree from Sydney University in 1939, he had to give up observational astronomy until, soon after World War II, he set up a small observatory on the roof of the NSL. More sophisticated solar observatories followed, first at Fleurs near Sydney, and later at Cullora near Narrabri in northwestern New South Wales. To give the telescopes an outstanding capability he developed with the help of colleagues two tunable optical filters, a V.A. birefringent filter of large aperture and a servo-controlled triple Fabry-Perot interferometer, the latter being primarily for the measurement of solar magnetic fields.

Giovanelli's first research paper dealt with effects of solar flares, a subject to which he was to return many times. His 1947 proposal that flares are the result of sudden electric discharges in the Sun's atmosphere attracted wide attention at the time and received a detailed critique in Professor TG Cowling's classic article (1953) on solar electrodynamics. In 1949 Giovanelli suggested that thermal conduction was the dominant mode of energy transfer in the transition region between the corona and the much cooler, underlying chromosphere. Years later this idea was to be the starting point of much of the analysis of the extensive observations of the Sun's ultraviolet transmission obtained after the advent of rocket and satellite-borne detectors.

In 1959 Giovanelli showed how to apply Eddington's approximation to calculate the transfer of radiation in a non-uniform medium. This paper marked the beginning of the application of non-uniform radiative transfer theory to the study of the fine detail of the solar atmosphere, a topic which was quickly followed up by other workers.

Throughout the 1970s Giovanelli devoted much effort to semi-quantitative studies of velocity field and wave motions in the solar chromosphere. Towards the end of his career he became engrossed with the many difficult problems associated with solar magnetic fields, and one of his last major endeavours was an attempt to consolidate his ideas into a unified theory of the solar cycle.

Giovanelli's achievements in solar physics and optics were recognized by his being awarded a DSc by the University of Sydney in 1950 and by his election in 1962 to the Australian Academy of Sciences. He played a key role in the establishment during 1966 of the Astronomical Society of Australia, and served as its President from 1968-71. He helped in the training of many younger solar astronomers and optical scientists, some of whom are well known in Australia while others occupy very senior positions in astronomy in the USA.

Giovanelli's high international standing was evidenced by the many demands from prominent solar centres overseas for his services as a visiting lecturer and researcher. He was a Fellow of the Royal Astronomical Society and an active member of the International Astronomical Union.

To many of his scientific colleagues Giovanelli was also a close friend. His insistence on continuing his research and writing in his last years, despite deteriorating health, won much admiration. It was fitting that just prior to his death he completed writing a book entitled 'Secrets of the Sun'. The book is intended to enable the public to share his fascination with the Sun and, in particular illustrate his special interest and ability in exploiting novel photographic techniques.

RE Loughhead

RACI N.S.W. Polymer Group

Lecture to be held 18th April, 1984 at University of N.S.W. Applied Science Building, Room 319.

Subject: Industrial Radiation Processing: how will it effect your future?

Speakers: David Sangster, CSIRO Division of Chemical Physics, Lucas Heights Research Laboratories and Roger Mitieux, Research Chemist, Pilon Plastics Pty. Ltd.

Summary

Electron beam and gamma ray sources are being used industrially in Australia and overseas to modify polymers and cure monomers.

Radiation techniques have great advantage over pure chemical methods in effecting crosslinking, chain scissions, polymerisation and grafting. The various reactions involved will be outlined.

There are two electron beam processing plants and four gamma ray sources working in Australia. The type of products and factors involved in operating these facilities (Crosslinking of PE Foam, Cryovac Process), will be reviewed.

There are hundreds of radiation plants operating throughout the world, and applications relative to these will be discussed.

It is the intention of the abovementioned conversant speakers to relate overseas experiences to potential Australian applications.
Higher Degrees in Physics

X-ray and Optical Studies of Binary X-ray Pulsars
David John Watts, Physics Department, University of Tasmania, Hobart. Ph.D. Conferred April 1984.

Hard X-ray observations of the pulsar GX 1+4 have been conducted using the University of Tasmania/Imperial College, London (UTIC) balloon-borne X-ray platform. The platform consists of two large area detectors mounted in an alt-az configuration. The UT detector, with a sensitive area of 3200 cm², is a xenon-filled proportional counter sensitive in the energy range 20 to 100 keV. The IC instrument consists of 12 photomultiplier detectors of total area 1680 cm². An onboard microprocessor continuously updates and drives both telescopes to the altitude and azimuth of the object under investigation, with an accuracy of 8 arcmin rms. The platform, the UT detector and associated ground support equipment are fully described.

GX 1+4 was in a low hard spectral state at the time of the observation on 2nd Dec 1981. Comparison of the spectrum with previous observations shows GX 1+4 exhibits spectral variability similar to other luminous galactic X-ray sources. The source of the hard X-ray photons is suggested to be soft photons that have been Compton scattered from a region of hot electrons. Changes in the size of this scattering region can explain the observed hardness and luminosity variations provided the total number of electrons in the scattering region are preserved.

The white dwarf equivalent of the neutron star pulsars are in the intermediate polars. Optical and soft X-ray observations of 2A0526-328 and optical and infrared observations of V1223 Sgr have been accomplished. Spectroscopic data of 2A0526-328 confirm that the emission line radial velocity period is different from the photometric period and suggest the accretion process is controlled by the white dwarf's magnetic field. A model for the object is proposed in which a rotating white dwarf revolves in a 4 day period in a retrograde orbit with a subluminous red giant. Predictions on the nature of the secondary are given and some observational tests are proposed.

The first infrared observations of V1223 Sgr are presented and radial velocity measurements indicate a low mass system. The UV to IR spectrum is consistent with a disc model with no IR excess from the secondary being apparent. Upper limits to pulsed polarization at the spin period of the white dwarf are given.

Finally a simple light curve model of the intermediate polars is developed and compared to the observed photometric data of 2A0526-328, V1223 Sgr and H2252-035.

Supervisor was Dr J.G. Greenhill. Dave has accepted a post-doctoral position with the renowned X-ray astronomy group at the Max Planck Institute.

Transverse Vertices & the Gauge Technique
Christopher Nicholas Parker, Physics Department, University of Tasmania, Hobart. Ph.D. Conferred April 1984.

Field theories (including electrodynamics and gravity) are completely determined by their Green functions which characterise the many body response of a system to external sources. The thesis encompasses a study of electrodynamics — an example of a gauge theory — and the Green functions for it. The purpose is to find the behaviour of the Green functions at large, or small, separation of the particles without resorting to perturbation expansion and in a manner which respects the gauge invariance of electrodynamics as far as possible. It successfully achieves this aim through the use of a particular calculational scheme which provides the infrared (large-distance) and ultraviolet (small distance) behaviour of charged particle propagation.

This thesis is a self-contained treatise on the application of the Gauge Technique (GT) — a non-perturbative, self-consistent method for calculating gauge field theory Green functions — to Spinor and Scalar Electrodynamics. It includes a discussion of the elements that form the method, and a thorough review of the technique's development and uses.

The simplest and most primitive version of the GT determines the "longitudinal" components of the photon-amputated, connected, Green functions and efficiently reproduces the extra infra-red behaviour as well as the ultra-violet behaviour of the source 2-point functions; it is only gauge covariant in these asymptotic regimes. We present a new algorithm for extending the GT beyond the simplest version. The algorithm introduces transverse corrections into the GT in an intrinsically non-perturbative way and is a significant improvement on previously advocated methods. These transverse corrections are in order e' and are vital for restoring gauge covariance in subasymptotic momentum regimes and do not disturb the asymptotic results.

Supervisor: Prof. R. Delbourgo.

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The Australian Physicist, Vol. 21, April 1984 — Page 74
BOOK REVIEWS

Reviewed by D. Oldroyd, School of History and Philosophy of Science, University of New South Wales.

This volume is made up of ten authoritative papers, written by leading social historians of science, their common theme being the institutional aspects of nineteenth-century French science, technology and medicine. Special emphasis is given to scientific and technological education, and the relationships between science and industry. Each essay is based upon a detailed empirical study of the relevant historical data, with much inaccessible information being conveniently presented in tabular form. Yet the book is certainly more than a collection of dry statistics, and the texts are leavened with numerous references to individual events and to specific personalities - both 'great men' and 'little men'. A general knowledge of nineteenth-century French political history on the part of the reader is assumed.

It has commonly been supposed that French industrial performance declined in nineteenth-century France, relative to that in Britain and Germany, because of inadequacies in her education system - which in turn could be attributed to an over-bureaucratized administrative structure going back to the Napoleonic years. It is also often assumed that there was insufficient or inadequate interaction in France between science and industry. This volume casts doubt upon such generalizations, and the concluding essay (comparing France and Germany) suggests that the French scientific system was by no means unsatisfactory as tradition would have us believe. An additional essay, comparing the French and British scenes, would have been welcomed by this reader; but we are offered more than sufficient information to lead us to question the received view of a 'decline of science' in France through the nineteenth-century. We may, therefore, have to look elsewhere for 'causes' of the outcome of the Franco-Prussian War and the events of 1914-1918; while, on the other hand, we may find depicted here some of the solid foundation stones of France's present technological excellence.

This book may appear somewhat remote from the usual interests of readers of The Australian Physicist. But to understand science it is needful to understand its historical, philosophical and social dimensions, as well as its 'internal' features. The social structure of science can vary in both space and time and the volume of Fox and Weisz provides the reader with the authoritative account of an important region of its 'space-time'.

Reviewed by P.J. Jennings, School of Mathematical and Physical Sciences, Murdoch University.

This volume of this well known series is devoted to real space methods for electronic structure calculations on disordered solids and surfaces. It includes articles by four authors from the Cavandish Laboratory, P. Heine, D.W. Bullett, R. Haydock and M.J. Kelly. The volume thus has coherence in its presentation although its scope is not as wide or as representative as it might have been if other major contributors to the field had been included.

The first article by Heine provides an overview of methods for performing electronic structure calculations for systems such as surfaces, amorphous materials, liquid metals and spin-glasses for which three-dimensional periodicity does not exist. The results of methods such as the tight binding, Green's function and density functional formalism provide an understanding of local potentials and densities of states.

The subsequent articles focus on the major themes introduced by Heine and develop them in greater detail. Bullett describes the formulation and application of the modern quantitative form of the tight binding method. Haydock develops the recursive method for calculating the local density of states and explores its relation to other methods. Kelly develops the practical applications of the recursive method to surface electronic structure, phonon spectra, disordered and amorphous materials.

This book is a valuable reference work which will be of considerable interest to solid state theorists and, like its predecessors, it is an essential part of a physics research library.

THERMODYNAMICS OF LIFE PROCESSES, H.G.L. Coster, Univ. of New South Wales Press, Kensington, 1981 xi + 188pp., $12.95 (paper).
Reviewed by D. Gruen, Research School of Physical Sciences, Australian National University.

"A theory is the more impressive the greater the simplicity of its premise is, the more different kinds of things it relates, and the more extended is its area of applicability... It (thermodynamics) is the only physical theory of universal content concerning which I am convinced that, within the framework of applicability of its basic concepts, it will never be overthrown." From "Autobiographical Notes", in Albert Einstein: Philosopher-Scientist, edited by E.A. Schliip (Harper and Row: New York, 1959).

Characteristically arresting reflections. But thermodynamics is also, for me, one of the hardest areas of physics to master.

In spite of this, it has been a pleasure to read this book. It deals briefly with classical thermodynamics and in more detail with irreversible processes. Although my knowledge in this latter area is superficial, I found the analysis understandable, informative and enjoyable. This section (over half the book) is fairly technical theory, but it is frequently interrupted by discussion highlighting its relevance. The rest of the book details biological examples which are illuminated by the earlier analysis.

In order to appreciate this book, the reader should be knowledgeable about and comfortable with classical thermodynamics and vector calculus. Then, it provides a good introduction to the thermodynamics of a wide range of biological processes. It is definitely a good book for physicists who want a glimpse of biophysics, but also for senior physical science undergraduates interested in broadening their education. Life can be interesting physics.

Finally, this book is cheaper than most and hence (if demand is elastic as economists claim) it should be bought by many.

The Australian Physicist, Vol. 21, April 1984 — Page 75
The third chapter, for example, illustrates the macroscopic consequences of microscopic symmetries in crystals, such as the piezoelectric effect. In the fourth chapter, inter alia, there is an excellent discussion of the fluctuation dissipation theorem which brings some insight into its meaning. In the fifth chapter I found little new, however much of it is a chat about perturbation theory.

In summary the book is interesting, not very expensive, and graduate students particular would benefit from reading it.

COMBINED REVIEWS


Reviewed by P.E. Simmonds, Department of Physics, University of Wollongong.

The development of the study of excitons, both theoretically and experimentally, has been of considerable importance in the understanding of optical properties of insulators and semiconductors near the fundamental absorption edge. The authors of the book EXITONS present a partial account of activity in this area, chiefly in the late 1960's and early 1970's. Apart from the first two chapters (one the nowadays obligatory exposition of the basic theory within a Green's function formalism) the emphasis is on experimental studies.

In the detailed sections, the authors confine themselves almost entirely to providing what amounts to a review of the work on exciton and exciton — impurity optical phenomena with which they have been involved. A somewhat one-sided view is taken on some topics. Many of the experimental results and data listed are rather out of date. However, a very useful appendix contains more carefully prepared tables of material parameters. Unfortunately, some interesting developments are neglected entirely. The book would serve as an historical reference particularly to those working with semiconductors and materials technology.

One of the more interesting, if esoteric, 'uses' of excitons is in providing, under suitable conditions in e.g. Ge, a novel state of 'matter', the condensed electron hole liquid. For a detailed theoretical and experimental account of the phenomena, turn to the volume cited in the Solid State Physics Series. The two articles are written by four of the researchers most active in this area in the 1970's. This volume is suitable for specialists in Solid State or Thermal physics.


Reviewed by H.C. Bolton, Department of Physics, Monash University.
The Silver Jubilee of the Australian Academy of Science was celebrated by a three day symposium in 1979. Each day had a series of lectures on a theme and each of the three books reviewed here contains one day’s lectures. I attended the second day during which surveys were made of the changes in our views of the physical world during the last twenty five years and was pleased to meet the lecturers again in their published lectures. Altogether the three books contain twenty two articles and it would take more than one person to do justice to the range of specialties; even in the second volume there is too wide a range of physics for a conventional book review. Many authors in the volumes presented this paper that is valuable to use for physics?”. His lecture was the best of those presented and his article is worth reading for its long historical view of the development of physical ideas. But let me give the quotations:

Dyson: “Every physicist who learns to classify particles in terms of SU3, multiplets and broken chiral symmetry is, whether he knows it or not, talking the language of Felix Klein”.

R.H. Daltz: Are any particles elementary? “We now believe that these hadronic particles (p, n, x, x, σ) are composite objects, made up of the quarks q = (u, d) and the antiquarks $\bar{q} = (\bar{u}, \bar{d})$”.

J. Friedel: The physics of condensed matter “the complex processes through which macroscopic crystals can grow out of small aggregates still offer many unsolved problems”.

H. Charnock: Geophysical fluid motions “A series of measurements of the complicated eddy structure in the East Australia Current has been achieved of physical oceanography in this country.”

H.S.W. Massey: Space research “Some evidence of a hot interior for the moon has been derived from analysis of observations of distortions in the terrestrial magnetosical firm due to currents induced in the moon by the solar wind. From these an electrical conductivity profile within the moon is obtained which the temperature profile estimated from the laboratory data on the properties of lunar samples and similar substances”.

R. Hanbury Brown: Cosmology “Why, may we ask, has there been so much recent fuss about Black Holes? After all, the idea has been around since 1796 ... if the equations of general relativity show infinities at the centre of a Black Hole, then there is probably something wrong with the theory”.

364 It would be wrong of me to attempt even a selection of quotations from the third volume but there was one article that I felt I could follow and enjoy. It was G.S. Stent: Prematurity and uniqueness of scientific discovery as illuminated by the history of molecular biology, and it deserves to have the following quotations brought to our attention: “A discovery is premature if its implications cannot be connected by a series of simple logical steps to canonical, or generally accepted, knowledge.” “... it is quite true that we would not have had Titon of Athens if Shakespeare had not existed, but if Watson and Crick had not existed we would have had the DNA double helix anyway”. Mendel’s papers contain no useful information that cannot be obtained from any modern textbook or the current medical literature. In contrast, the modern writer, composer or painter still needs to read, listen to or look at the original works of Shakespeare, Bach or Leonardo, which, so it is thought, have not been superseded at all”.

I did not hear the speakers on the first day of the symposium; after reading the first volume I am left with one impression that science can be submerged by discussion and even by talk and that the talk can be of the most varied kind. The word “polity” in the title seems to get very close to politics and there is a wide variety of views about how to “manage” science. Again I think that I cannot do better than to offer certain quotations recognising that as I do so, I am myself exposing myself to judgement.

J.R. Ravetz: Induction “Talking about the development of the Polaris missile in the USA, “Beneath this bland veneer”, (of a formal management system) “the true work of the programme was on through informal chaotic personal interactions between the technical people, that bore no relation to the formal organisation charts. When this is what happens for a programme of specific engineering development, it should occasion no surprise that creative scientists oppose the imposition of such systems onto research in the natural sciences”.

J.R. Ravetz: The meeting of knowledge and power “Little more than a century ago it was remarked that science owed more to the steam engine than the steam engine did to science”.

Joseph Ben David: The ethos of science: the last half-century “If he (a scientist) refuses to work on socially desirable projects, because they are not scientifically interesting for him, he may be accused of selfishness, not of any breach of the scientific ethos”.

Lord Todd: The role of the national academy today with particular reference to the Royal Society “I do not believe myself that an academy should own or control research institutes; research is best pursued in universities or, where specific objectives are in view, by government (e.g. for defence research) or by industry”.

Yu. A. Ovchinnikov: The role of the Academy of Sciences of the USSR in the development of Soviet science “Whereas under tsarist Russia the Academy of Sciences had only one scientific research institute, a few laboratories and a number of museums, it now counts within its system up to 250 research institutes and other scientific organizations”.

Qian Sanjiang: Academia Sinica and its function “According to the 12 year programme for the development of science and technology formulated in 1956, measures were taken to set up a certain number of institutes to carry out research in fields of new technology, and at the same time attention was paid to basic science”.

J.A. Bernard: Activities, functions and role of the French Academy of Sciences “The prolongation in duration of human life, due in part to the work of Academicians, raises serious problems for the Academies ... By the year 2100, a scientist would be elected to membership only several years after his death”.

R. Hanbury Brown: Why bother about science? “...we must ... encourage, not only the writing of popular science by people who really understand what they are writing about, but also the idea that some knowledge of mathematics and science is part of a “ cultured” person’s stock-in-trade just as Latin and Greek used to be”.

We have to congratulate the Australian Academy of Science on reaching its silver jubilee in so strong a condition that it has produced these fine books. To set the existence of the Academy in its historical context it is worth referring to the article by M.J. Lewis, “The Royal Society of Australia can attempt to establish a national academy of science” in Records of the Australian Academy of Science 4 (1979-80) pp 51-62.

Because Monash University Library is now finding itself short of money I am donating my review copies to it.

The Australian Physicist, Vol. 21, April 1984 — Page 77
Reviewed by S.M. Hamburger, Research School of Physical Sciences, Australian National University.

Plasmas (at least the electric kind) are so widespread and multifarious that any attempt to describe their behaviour and applications must inevitably be selective, and largely reflect the writer's own interests and experiences. In this book, von Engel, who has (I think) been studying gaseous plasmas for longer than anyone else alive presents some of his ideas in the form of "extended essays" on a wide variety of topics.

The text emphasises physical concepts, simply and clearly presented and experimentally justified, and thus differs markedly from most current treatments of plasma physics which rely heavily on sophisticated theoretical models. As might be expected from its author's distinguished background in gas discharges, the book is at its best when dealing with the nature of discharges and the numerous collision processes which occur in partially ionized gases.

These are comprehensively treated in a manner which gives insight into the interactions involved. The discussion of other topics, such as fusion, plasma waves, and diagnostics, with which the author has been less involved is, however, in my view rather less successful, and somewhat out of date.

The book itself is well produced and illustrated (although some of the drawings are incorrectly labelled) and has a useful "further reading" list. There is some repetition and inconsistency in notation, plus some (mostly obvious) typographical errors.

The clear and generally straightforward, mathematically undemanding treatment would make the book a useful introduction to gaseous plasmas from senior undergraduate level upwards, particularly for those who wish to acquire some of the author's own understanding of the nature of collision processes and gas discharges.

Reviewed by B. Cornell, CSIRO Division of Food Research, North Ryde, NSW.

This text is a surprisingly wide ranging and expertly written description of the experimental techniques of modern Biophysics. These include NMR, ESR, Raman and Laser spectroscopy, X-ray and Neutron diffraction, small angle scattering and Electron Microscopy image reconstitution. Also included is a section on microelectrode voltage clamp techniques and one on the current models of ionophore transport and membrane permeability.

Although one can think of particular aspects of the various fields discussed within this book that have been omitted, the text provides a well informed and mathematically quantitative overview of modern Biophysics. As a natural consequence of the present state of Biophysical research, the physical studies of Biological membranes form a central theme of this book.

The introduction and development of each section is presented in a manner that would suit a post-graduate audience, in either chemistry or physics and could easily provide the basis for an honours or post-graduate course in Biophysics. This text is not written as any easy introduction for Biologists to the experimental methods commonly employed in Biophysical research.

PHYSICS ROUNDABOUT

Australian Developed Micro Analytical System Exported to the U.S.A.

The ETP Semra division of the ETP Group, has recently commenced shipping a new Australian manufactured SEM-based analytical system to the U.S. market.

The system — Compositional Analysis using a Robinson Detector — CARD for short, employs an entirely new concept in micro analytical techniques, and can quantify many materials according to their compound formula. The system has been exclusively developed by the ETP Group in conjunction with researchers at the University of New South Wales. ETP employs five graduates with Physics majors, as well as graduates in computing sciences and electronics, and all the software and hardware involved was developed by ETP. Since the release of the CARD system in the United States in 1983, orders have been received from IBM, Western Electric, Metchem, DuPont, Westinghouse and Chrysler.

CARD identifies a material according to average atomic number, and with some operator input, provides an easy translation to compound formula. Smaller phase differences are detected than can be seen on the SEM display.

CARD will find many applications in industry and research, where it is used as the only analytical tool. As well, it teams efficiently with a qualitative analysis (including light elements) quickly and accurately. Since it is a new concept, CARD will undoubtedly undergo much growth in applications and techniques. The software based approach ensures future expandability.

The Australian Physicist, Vol. 21, April 1984 — Page 78
New evidence sought on continental drift

With the help of the Royal Australian Navy, research scientists from the ANU and the Scripps Institution of Oceanography headed out into the Tasman Sea late in March on a project which should reveal important new information about the geological structure of the sea bed and the movement of the earth's crust.

Dr Ted Lilley, a Fellow at the Research School of Earth Sciences and leader of the cruise, hopes that the 10-day voyage in the Navy's oceanographic ship HMAS Cook will enable them to recover intact 21 sophisticated instrument packages which have been lying on the sea bed recording scientific data for the past three months.

The instruments, geophysical recorders are strung out in a line across the Tasman from a location at the edge of the continental shelf off Durras to a point well over half way to New Zealand. They were placed in position by the Cook on a cruise early in December. A timing mechanism should ensure that each instrument will automatically release itself from the ocean bed and pop up to the surface at the precise time the ship is scheduled to pass by on its recovery voyage.

The study, known as the Tasman Project of Seafloor Magnetotelluric Exploration, is a collaborative experiment between RSES, the Scripps Institution in California and the Royal Australian Navy Research Laboratory.

Its main scientific aim is to investigate the geological structure of the Tasman Sea floor by the magnetotelluric method, which measures changing magnetic and electric signals at the earth's surface.

Dr Lilley told the ANU Reporter a particular objective is to search for evidence of a zone of high electrical conductivity at a depth of the order of 100 kilometres, which might indicate the earth's atmosphere — a layer of partially molten material with low shear strength, held to be crucial for theories of plate tectonics. Such a layer would allow the earth's surface plates to move and collide with each other, as the theory postulates.

Dr Lilley said the electrical conductivity of the sea floor of that part of the Indo-Australian plate which forms the Tasman Sea is of especial significance in the northward movement of Australia from Antarctica. (This northward movement is still going on, as evidenced by earthquake activity in the New Guinea region, where plates are in collision, and at the mid-ocean ridge between Australia and Antarctica, where two plates are pulling apart and new ocean crust is being formed.)

The pattern of seamounts in the Tasman Sea suggests that in this region the Indo-Australian plate has moved over hot spots which may still be active, Dr Lilley said.

Knowledge of possible partial-melt zones beneath the sea floor would be particularly valuable in their interpretation.

The research team's instruments are clustered at nine sites on the sea floor at depths as great as 5000 meters — more than half the height of Mount Everest above sea level.

The instruments were brought to Australia for the project by their designer, Dr Jean H. Filloux, of the Ocean Research Division of the Scripps Institution, who is known world-wide for his work in this field.

Each instrument is designed to record fluctuations in one of several fundamental geophysical parameters — natural magnetic field strength, natural electric voltage in the sea water and hydrostatic pressure.

Sea water voltage is the most difficult to measure. It entails recording the most minute electrical signals, less than one millionth of a volt. Changes in the voltage of the water are caused partly by fluctuations in the earth's magnetic field, but also by changes in the velocity of the oceanic currents.

On launching, the instruments sink to the sea floor and begin recording data on magnetic tape at one-minute intervals.

The oceanic line of recorders continues across the ocean-continent interface to inland Australia, to allow a comparison between the geologic structure of the Australian continent and the Tasman Sea, and to investigate any contrast in electrical conductivity occurring between ocean floor and continent at the continental edge. RSES recording magnetometers have been set up as temporary observatories near Durras, Clyde Mountain, Braidwood, in Canberra at Black Mountain, at Coolac, Barellan and Ivanhoe in western NSW.

The Canberra magnetic observatory of the Bureau of Mineral Resources is also sited on the line, and the deep ocean/continent gap has been bridged by the establishment on the edge of the continental shelf off Durras of a moored marine magnetometer developed by Dr. A. White of the School of Earth Sciences at Flinders University, South Australia. This instrument, being operated by Dr White in co-operation with RSES, is being maintained with the help of fishermen with knowledge of local conditions.

While the sea bed instruments are in position, the RAAF has undertaken to make six flights with Orion reconnaissance aircraft across the western Tasman Sea in the research area. The aircraft are dropping probes to monitor changes in the condition of the East Australian current.

On the deck of HMAS Cook in mid-Tasman, Dr Jean Filloux explains the operation of one of his magnetometers. From left: Commander Peter Cooke-Russell, captain of HMAS Cook, Dr Lilley, Dr Filloux and Dr Phil Mulhearn, team leader for the RAN Research Laboratory.

At the end of the recording period, each instrument is programmed to separate itself from its ballast tripod and float to the surface where it will begin sending out a radio signal. The recovery ship will have to home in quickly on the beacon, as the transmitters have enough power to operate only for two or three days.

The first instruments were due to surface at daybreak on 27 March.

Once an instrument package has been located, a skidiver will go over the side of HMAS Cook to attach a line. The equipment will then be hoisted on deck by crane.

Bad weather is the main potential hazard. Rough seas would make location and retrieval much more difficult, although Dr Filloux's experience has shown that recovery can be expected under all reasonable conditions.

The project as a whole is under the auspices of the United States-Australia Agreement for Co-operation in

The Australian Physicist, Vol. 21, April 1984 — Page 79
Science and Technology. The participation of Dr Filloux and his team is supported by the US National Science Foundation.

The research will also be a contribution to the ELAS (Electrical Conductivity of the Aethosphere) project — an international project to search for the aethosphere by studying the electrical properties of the earth.

Dr Lilley said collaboration with RAN Research Laboratory arose naturally because the sea-floor data will contain information on sea current and tides. The study will be the first to provide date of this kind from oceanographic studies in Australia, with the sea-floor measurements complementing sea-surface measurements from HMSA Cook. Of particular interest will be results for the East Australian current, a major feature of Australian oceanography, which flows south down the western side of the Tasman Sea.

‘Marine geophysics is one of the frontiers of earth science,’ Dr Lilley adds. ‘Much of the most importance has come from research on the ocean floor.’

to the future. With it, and with the use of an orbital transfer vehicle, which will ultimately develop to move us to geosynchronous orbit, we will be able to operate routinely some 22,000 miles above the earth. And from there, perhaps we will begin to realize Wernher von Braun’s great dream of getting back to the moon to build a base, and from that base, mounting a manned expedition to Mars.

I believe that we will be able to accomplish all of these things within the next 25 years so that when NASA celebrates its Golden Anniversary in the year 2008, we will look back on our first quarter century of achievement as just the beginning.

“We celebrate 25 years of reaching for excellence and achieving it in space and aeronautics. The nation’s investment in our work has produced a steady stream of new technological discoveries which have benefited everyone on earth. And the returns on this investment will be even greater in the future as we continue our work.”

NASA’s First Quarter Century of Achievement — Just the Beginning

(From the Administrator of NASA, James M. Beggs)

We did not get our present position of leadership in space by accident. We got there because we had the imagination to dream great dreams and the national will to fulfill them. We got there because the partnership of government, industry and our universities, built up over the years, created a scientific and high technology base second to none. We got there for the good common sense reason that we have learned to build on our achievements as we go along — and to learn from our experience. As Shakespeare wrote: “Experience is by industry achieved and perfected by the swift course of time.”

We had our struggles and our successes in the program over the swift course of NASA’s 25-year lifetime. And they have been spread over the world to see, beginning with the launch of our first satellite, Explorer 1. They range from the succession of planetary explorers — the Mariners, the Pioneers, the Vikings and the Voyagers; through the Mercury, Gemini and Apollo programs to the development of the Shuttle.

All would never have been possible had we not built on past experience. And, largely because we have done so, we become the leaders.

With the Shuttle, we are making dramatic and timely progress in learning to live and work in space. It is a truly impressive vehicle, and as time goes on, we are finding that its performance surpasses even the expectation of its designers.

But the Shuttle allows us to stay in space for only a short time. And while we can extend that time to about a month we cannot extend it to long-duration, long endurance space flight.

To do work of long duration, to do all the things we have always dreamed of doing beyond low earth orbit, we will need a space station.

I believe that a Space Station, is indeed, an idea whose time has come. Sooner or later, this country is going to take the next logical step in space and will build one. And the sooner we do, the better it will be for us, because a space station is essential if we are to maintain our preeminence.

I see a Space Station as an essential stepping stone

Space Production

3M has announced that it will begin a long-range basic research program in space, with the aim of eventually producing commercial products in orbit.

3M is a worldwide manufacturing company with 86,000 employees in 53 countries.

The company’s initial experiments could be ready to fly aboard the space shuttle by August. The experiments deal with organic crystalline materials and the preparation of thin film that could have application in the fields of electronics, imaging, energy conversion and biology.

“We recognize that now is always the proper time to start building the future,” said Lewis W. Lehr, 3M Chairman. “And 3M is pleased, now, to make a significant commitment to basic research and industrial investment in the future of space.”

Declaring NASA “delighted”, Administrator Beggs said the Agency “stand ready to assist in this initiative.” The two organisations, he said, “have agreed to work together to develop a plan to explore the space frontier for potential commercial applications in materials processing.

Beggs announced that, on the basis of studies leading to the research program, 3M has advised NASA to consider establishing a series of advanced research institutes. These institutes would coordinate the activities of industry, government and academic institutions in basic long-term research that could lead to successful commercial products in specific disciplines.

“This idea has a great deal of appeal to us,” Beggs said. “We are pleased that 3M is willing to take a leadership role in helping us to evaluate it.”

“3M’s idea, Lehr said, “is that the institutes will help establish priorities for research in space chemistry and materials, as well as other scientific disciplines.”

“What they are doing is to establish a data base about the processing of organic minerals in space; it might take several years for any new technology to find its way into commercial products.

3M previously has supplied NASA with a variety of space-program products, ranging from fluorocarbon elastomer for the boot soles of lunar astronauts to nextel ceramic fibres for space shuttle heat shielding. Other 3M products used in the space program include a gold-foil tape to wrap the tether of previous space walkers and 3M’s Comtel digital image processing equipment to produce detailed color photographs from radio signals transmitted by the Venus space probe.

The Australian Physicist, Vol. 21, April 1984 — Page 80
Breakthrough in Radiocarbon Dating

Thanks to an unusual partnership between ANU researcher and a Finnish high technology firm the University has just become the owner of the most advanced radiocarbon dating equipment in the world.

The equipment, a high precision liquid scintillation spectrometer, is a prototype for commercial models soon due to go into production which will make most traditional radiocarbon dating equipment obsolete. It can detect low-level radiation with a sensitivity 10 times better than anything currently available from the world's major manufacturers of radiation detectors and it is confidently expected to extend the range of radiocarbon dating by 15,000 years.

The device is the product of two and a half years' collaborative work between Henry Polach, fellow and head of the ANU Radiocarbon Dating Research Laboratory and the Finnish nuclear instrument manufacturer, LKB-Wallac.

For fear of commercial piracy, the detector was kept a closely-guarded secret during its development stages. Its existence was only revealed when the experimental model named WANU to mark the Wallac-ANU collaboration was ready to be airfreighted to Canberra for installation in the Radiocarbon Dating Research Laboratory.

Henry Polach began his partnership with LKB-Wallac in 1981. He had devised the outline design for the new radiation detector, but had to search overseas for a firm to develop the idea because of the lack of any Australian industry of this type. The Finnish company has since invested nearly $500,000 in this area of research.

The WANU model, estimated to be worth $85,000, is LKB-Wallac's gift to the ANU Radiocarbon Dating Research Laboratory in recognition of the contribution Henry Polach has made to its development while spending his study leave in Finland over the past three years.

A 'windowless' counting approach pioneered by Henry Polach enables each pulse of radiation to be detected quantitatively. The desirable pulses are then sorted out from undesirable pulses by computer-based software. This quantitative analysis is expected to make possible high-precision dating. An accuracy of plus or minus 10 years, compared with the current margin of error of plus or minus 70 years, is expected.

The WANU detector promises to have important practical applications for the Quaternary research to which ANU radiocarbon laboratory is committed. It is expected to push the horizon for radiocarbon dating back from the present 45,000 to 65,000 years, a development which should enable researchers to test theories that Aboriginal man may have arrived in Australia considerably earlier than about 45,000 years ago.

In assessing botanical history, where often only very small carbon samples are available for analysis, it will make possible a widening of knowledge about the impact of man and climate on the evolution of vegetation.

WANU can also detect radioactive tritium emissions with the same degree of accuracy, making it potentially an important tool for environmental radiation monitoring in areas such as nuclear waste disposal and industrial pollution.

In the short time since details of the detector were first made known, at the beginning of this year, requests have already been received from radiocarbon dating specialists in Finland, India and China to work with the new equipment. Scientists from these three countries will be coming to the ANU Radiocarbon Dating Research Laboratory as Visiting Fellows later this year.

Henry Polach notes that whereas conventional radiation detectors give a background radiation count of five counts per minute, in WANU this interference has been reduced to less than 0.5 cpm. Multichannel analysers and analogue-to-digital converters enable up to four different spectra to be accumulated simultaneously.

Ozone layer is Still in Good Health

Experiments in Antarctica have produced new evidence that the Earth's protective layer of ozone is not being threatened, as had been feared.

People on Earth are protected from the dangerous ultra violet radiation of the Sun by a layer of ozone that spans the planet and absorbs the radiation. Many scientists have long been worried that fluorocarbon chemicals used in present spray cans could damage or break down the layer and expose people to radiation that might eventually make Earth uninhabitable.

Scientists at the British Antarctic Survey station at Faraday on a small island off the Graham Land peninsula, however, have just reported that their experiments show there has been no significant long term increase in the Sun's ultra violet radiation. They say this indicates that there has been no long term damage to the ozone layer.

The ozone layer can change considerably from day to day and even year to year. But over a time scale of many years, no permanent changes had been detected. The Faraday team says it is now satisfied beyond doubt that there has been no significant depletion of ozone over the last 30 years.

The scientists base their view on the findings from a spectrophotometer instrument that has been continuously pointed at the sky through the roof of the Antarctic base to measure the total ozone content of the atmosphere and its variations from day to day, season to season and year to year. A similar instrument is in use at another BAS Base at Halley.

Laser Printing Facility for CSIRONET

Users of CSIRO's national computer network, CSIRONET, will soon be offered an electronic printing facility as part of its basic service.

The facility, which includes technology that will be available for the first time in Australia, follows a collaborative agreement between CSIRO and an Australian-owned micrographics company, Microsystems Pty Ltd. Up to six new jobs will be created in Canberra, including two positions for research and development within the Division of Computing Research.

Under the terms of agreement, Microsystems Pty Ltd will make available some of the most sophisticated printing equipment in the world.

Three laser printers will be available, one each in Canberra, Sydney and Melbourne.

Laser printers provide high speed, high quality printing linked into computer technology. This is a more streamlined method of producing printed material.

For example, the service will offer printed A4 forms or letters at the rate of two per second, up to 7,200 per hour.
Conferences and Meetings

1984

April 30-May 2
Analytical Electron Microscope Workshop, Monash University.
Centre for Continuing Education, Monash University, Phone 03 5410811, Extension 37178

May 8-9
Science Technology Conference (ANZAAS and AIST), Sydney
Mr S. McKay, School of Biological Sciences, Macquarie University, NSW 2113.

May 14-18
ANZAAS “The Horizons of Science”, A.N.U.

May 23-25
Deformation, Failure and Strengthening of Polymers. Monash.
Dr. G.B. Guise, P.O. Box 224, Belmont, Vic, 3216.

May 28-June 22
Radioisotope Course for Non-Graduates No. 33. Lucas Heights.
Principal, Aust. School of Nuclear Technology, P.M.B. Sutherland, NSW 2232.

July 9-12
Chemistry and Physics of Elastomers, Sydney. Course and Seminar.
R.P. Burford, NSW School of Chem. Eng. and Industrial Chem. P.O. Box 1, Kensington 2033.

July 9-12
Mr I.A. Prince, 1984 ARPS Conf., G.P.O. Box 1701, Darwin, NT, 5794.

July 23-Aug. 17
Radioisotope Course for Graduates No. 30, Lucas Heights.
The Principal, Australian School of Nuclear Technology, Private Mail Bag, Sutherland, NSW.

July 30-Aug. 3
International Conference on Particles and Nuclear. Heidelberg.
Prof. G. zu Putlitz, Physikalisches Inst., Philosophenweg 12, D-6900 Heidelberg FRG.

Aug. 15-17
Progress in Optical Physics. Melbourne.
Dr. I.J. Wilson, CSIRO Divn. of Chemical Physics, P.O. Box 160, Clayton, Vic. 3168.

Aug. 20-24
Engineering and Physics in The Life Sciences, Adelaide.
EPLS '84 P.O. Box 24, Rundle St., Adelaide, SA 5000.

Aug. 24-30
5th International Congress on Mathematical Education, Adelaide.
ICME 5, G.P.O. Box 1729, Adelaide, S.A. 5001.

Aug. 27-31
3rd Int. Conf. on Solid Films and Surfaces, Sydney.
Prof. D. Haneman, School of Physics, UNSW, P.O. Box 1, Kensington, NSW 2033.

Aug. 27-31
6th National AIP Congress, Brisbane.
Dr. B.W. Thomas, Department of Physics, Q.I.T., G.P.O. Box 2434, Brisbane, 4001.

Aug. 27-31
ANZ Soc. for Mass Spectrometry Inc., 9th Conference, ANU.
Dr M.J. Lacey, 9th ANZSMS, Divn. of Entomology CSIRO, G.P.O. Box 1700, Canberra.

Sept. 6-11
3rd Int. Conf. on Multiphoton Processes, Crete.
Prof. Lambropoulos, Univ. of Crete, P.O. Box 470, Iraklion, Crete, Greece.

Sept. 10-15
XXIInd Ampere Conf. on Magnetic Resonance and Related Phenomena. Zurich.
Dr. R. Kind, Festkörperfysik, ETH-Hönggerberg CH-8093 Zurich, Switzerland.

Sept. 18-20
Centre National d’Etudes Spatiales, Dept. des Affaires Univ., 18 Ave Edouard-Belin, 31055 Toulouse Cedex France.

Sept. 23-28
Dr. E.A. Almond, N.P.L., Teddington, Middlesex TW11 OLW, UK.

Sept. 25-28
Dr. H.U. Jaeger, Akad. Wiss. der DDR, Zentralinst für Kernforschung Rosendorf, Posteschiff 19, 8051 Dresden, GDR.

Oct. 8-11
General Assembly, IUPAP, Trieste.
General Assembly, IUPAP, Trieste.

Oct.
Int. Conf. on Physics for Development, Trieste.
Prof. Bertocchi, Int. Centre for Theoretical Physics, P.O.B. 586, 1-341 00, Trieste, Italy.

Nov. 12-23
Computer and Computer Applications Technology (ATS) Melbourne.
Secretary, ATS, Clunies Ross House, 191 Royal Parade, Parkville, Vic, 3052

Nov. 26-28
9th Biennial Conf. of the Australian Clay Mineral Society, Canberra.
ACMS 9, G.P.O. Box 1929, Canberra, ACT 2601.

Dec. 3-7
K.R. Cook, Sec. AIP Conference, Dept of Applied Physics, RMIT, G.P.O Box 2476V, Melbourne 3001.

1985

Feb. 11-14
Polymer 85 (Characterization and Analysis of Polymers). Melbourne.
Polymer 85, RACI, 191 Royal Parade, Parkville, Vic, 3052.

May 13-14
World Chromatography/Spectroscopy Conference, Austria.
Dr. V.M. Bhutnagar, Atena Enterprises of Canada, PO Box 1779, Cornwall Ont K6H 5V7 Canada.

July
Dr. G. Kosorov, Ultrasound Institute, 5 Hickson Rd, Milsons Point, NSW, 2061.

July 9-11
Chief Executive Officer, AIMG, P.O. Box 310. Carlton South, Vic, 3053

July 28-Aug. 2
International Clay Conference, Denver.
1985 Int. Clay Conf. P.O. Box 25046, Mail Stop 917, Denver Col., 80225, USA.