the
australian
physicist

A PUBLICATION OF THE AUSTRALIAN INSTITUTE OF PHYSICS

Contents:

The Calendar ........................................ 113
Recent Meetings ..................................... 115
The Role of Nuclear Energy in Australia's Development .......... 117
Physics of the Earth—Book Review ..................... 118
The Lawrence Hall of Science—Elmar Laisk ............... 119
Institute Affairs ..................................... 122
Postgraduate Training ................................ 125
Notes and News ..................................... 126
Book Reviews ....................................... 127
The Register ........................................ 128

Vol. 9, number 8
AUGUST 1972

Registered for posting as a periodical—Category B
**CSIRO**
DIVISION OF TEXTILE INDUSTRY
Geelong, Victoria

**RESEARCH SCIENTIST**

**FIELD**: TEXTILE PHYSICS/ENGINEERING

**DUTIES**: To work on the physical aspects of yarn and fabric manufacture, particularly with new techniques in this field.

**QUALIFICATIONS**: A Ph.D. degree or equivalent qualifications, supported by satisfactory evidence of research ability.

**SALARY**: The appointment will be made within the salary ranges of Research Scientist or Senior Research Scientist: $7,588-$11,621 p.a.

**TENURE**: The appointment will be for a fixed term of three years but it could be extended by mutual agreement.

Applications stating full personal and professional details, the names of at least two referees, and quoting reference number 464/529, should reach:

The Chief,
Division of Textile Industry,
CSIRO,
P.O. Box 21,
BELMONT, VIC. 3216

by 22nd September, 1972.

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**CSIRO**
Division of Physics

Applications are invited for the following vacancy within the Division:

**EXPERIMENTAL OFFICER**

**FIELD**: PHYSICAL OPTICS.

**GENERAL**: The Division is one of two Divisions comprising the National Standards Laboratory and is responsible for the maintenance and development of standards of heat, light, viscometry and hygrometry. The Division also undertakes fundamental scientific research and provides an advisory service for industry and research. The Laboratory is located in the grounds of the University of Sydney, Chippendale, N.S.W.

**DUTIES**: To participate in the development of equipment for testing precision optical flats and to assist in research in physical optics.

**QUALIFICATIONS**: A degree or recognized diploma in physics or in engineering with a good training in physics, or equivalent qualifications. Experience in optics or electronics would be an advantage.

**SALARY**: The appointment will be made within the salary ranges of Experimental Officer Class 1 or Class 2: $4,655-$8,525 p.a.

**CONDITIONS**: This is an indefinite appointment which carries Commonwealth Superannuation benefits.

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Division of Physics, CSIRO,
University Grounds,
City Road,
Chippendale, N.S.W. 2008.

by 1st September, 1972.
THE AUSTRALIAN PHYSICIST

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only have extraneous material after the end of the article.
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extra material removed and clean spaces left in its place.
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and special headings added if required. Double sheets are
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of a manuscript. If authors do not wish to purchase
copies so as to cover the cost of blocks, there is the
alternative of reducing the number of figures; we must
remain solvent.

WHERE DOES THE MONEY GO?
With the prospect of increases in AIP membership
fees (see Institute Affairs), members will no doubt be
called to think about the value received for their
money. In 1971-72, one third of the annual expendi-
ture of the Institute has been devoted to the Australian
Physicist (corresponding to approximately $4.50 per
member). Providing value for this expenditure is the
problem facing the Editorial Committee. This problem
can be divided into two parts.

Firstly: What Do Readers Want?
The selection of material for publication can only be
guided satisfactorily if readers will comment occasion-
ally—either for or against a feature. Anybody who
would like to go through the 1972 issues of the Australian
Physicist and set down their opinions of items published
(e.g. on a 0-5 scale of interest) will help us to improve
our selection criteria. New ideas for material will also
help.

Secondly: Where Do We Find It?
A committee in Sydney cannot hope to know all the
interests of physicists throughout Australia or have
access to all possible copy. An Associate Editor and
Branch Correspondent in each State may be able to
solve this problem but if you have ideas for improve-
ments, why not telephone your Associate Editor and
discuss them with him?

Better still, if you will forward material to us (any-
thing from small news items to articles) you will help
us serve members interests properly. If you haven't
ever sent us anything, then you are presumably satisfied
with the status quo and will regard the fee rises as nothing
but the inevitable consequences of inflation.

THE CALENDAR

August, 1972
21-25 Twelfth Conference on Physics in Medicine and
Biology, Uni. of Tasmania (Biophys. Group-
AIP; see AP April 1972).
30-
Sep. 3 Conference on Electronics in the ACT, Copland
Building, ANU (TREER).

September
12 Holography.

October
16-17 Second AINSE Neutron Diffraction Conference,
Lucas Heights, NSW.

The Australian Physicist, August 1972 113
# METRIC UNITS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Unit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>ampere—electric current (SI base unit)</td>
</tr>
<tr>
<td>Å</td>
<td>ångström—length (10⁻10 m)</td>
</tr>
<tr>
<td>AU</td>
<td>astronomical unit—length (149 600 × 10⁸ m)</td>
</tr>
<tr>
<td>C</td>
<td>coulomb—quantity of electricity, electric charge (A·s)</td>
</tr>
<tr>
<td>°C</td>
<td>degree Celsius—temperature (K=273.15)</td>
</tr>
<tr>
<td>Ci</td>
<td>curie—activity of radionuclides (3.7 × 10¹⁰ s⁻¹)</td>
</tr>
<tr>
<td>F</td>
<td>farad—capacitance (C·V⁻¹)</td>
</tr>
<tr>
<td>G</td>
<td>giga—multiple (10⁹)</td>
</tr>
<tr>
<td>Gal</td>
<td>gal—acceleration due to gravity (10⁻2 m·s⁻²)</td>
</tr>
<tr>
<td>H</td>
<td>henry—inductance (Wb·A⁻¹)</td>
</tr>
<tr>
<td>Hz</td>
<td>hertz—frequency (s⁻¹)</td>
</tr>
<tr>
<td>J</td>
<td>joule—energy, work, quantity of heat (N·m)</td>
</tr>
<tr>
<td>K</td>
<td>kelvin—thermodynamic temperature (SI base unit)</td>
</tr>
<tr>
<td>M</td>
<td>mega—multiple (10⁶)</td>
</tr>
<tr>
<td>N</td>
<td>newton—force (m·kg·s⁻²)</td>
</tr>
<tr>
<td>Pa</td>
<td>pascal—pressure (N·m⁻²)</td>
</tr>
<tr>
<td>R</td>
<td>rad—exposure to ionizing radiations (2.58 × 10⁻⁴ C·kg⁻¹)</td>
</tr>
<tr>
<td>S</td>
<td>siemens—conductance (A·V⁻¹)</td>
</tr>
<tr>
<td>T</td>
<td>tesla—magnetic flux density (Wb·m⁻²)</td>
</tr>
<tr>
<td>V</td>
<td>volt—electric tension, electric potential (W·A⁻¹)</td>
</tr>
<tr>
<td>W</td>
<td>watt—power, radiant flux (J·s⁻¹)</td>
</tr>
<tr>
<td>Wb</td>
<td>weber—magnetic flux (V·s)</td>
</tr>
<tr>
<td>Ω</td>
<td>ohm—electric resistance (V·A⁻¹)</td>
</tr>
<tr>
<td>°</td>
<td>degree—angle (π/180 rad)</td>
</tr>
<tr>
<td>′</td>
<td>minute—angle (π/10 800 rad)</td>
</tr>
<tr>
<td>″</td>
<td>second—angle (π/6 480 000 rad)</td>
</tr>
<tr>
<td>a</td>
<td>atto—sub-multiple (10⁻¹⁹)</td>
</tr>
<tr>
<td>a</td>
<td>are—area (100 m²)</td>
</tr>
<tr>
<td>atm</td>
<td>standard atmosphere—pressure (101 325 Pa)</td>
</tr>
<tr>
<td>b</td>
<td>barn—effective cross section (10⁻²⁸ m²)</td>
</tr>
<tr>
<td>bar</td>
<td>bar—pressure (10⁶ Pa)</td>
</tr>
<tr>
<td>c</td>
<td>centi—sub-multiple (10⁻²)</td>
</tr>
<tr>
<td>cd</td>
<td>candela—luminous intensity (SI base unit)</td>
</tr>
<tr>
<td>cP</td>
<td>centipoise—dynamic viscosity (10⁻³ Pa·s)</td>
</tr>
<tr>
<td>cSt</td>
<td>centistokes—kinematic viscosity (10⁻⁶ m²·s⁻¹)</td>
</tr>
<tr>
<td>d</td>
<td>deci—sub-multiple (10⁻¹)</td>
</tr>
<tr>
<td>d</td>
<td>day—time (86 400 s)</td>
</tr>
<tr>
<td>da</td>
<td>deca—multiple (10)</td>
</tr>
<tr>
<td>eV</td>
<td>electronvolt—energy (1.602 19 × 10⁻¹⁹ J)</td>
</tr>
<tr>
<td>f</td>
<td>femto—sub-multiple (10⁻¹⁵)</td>
</tr>
<tr>
<td>g</td>
<td>gram—mass (10⁻³ kg)</td>
</tr>
<tr>
<td>h</td>
<td>hecto—multiple (10³)</td>
</tr>
<tr>
<td>h</td>
<td>hour—time (3600 s)</td>
</tr>
<tr>
<td>ha</td>
<td>hectare—area (10⁴ m²)</td>
</tr>
<tr>
<td>k</td>
<td>kilo—multiple (10³)</td>
</tr>
<tr>
<td>kg</td>
<td>kilogram—mass (SI base unit)</td>
</tr>
<tr>
<td>kn</td>
<td>knot—velocity (0.514 444 m·s⁻¹)</td>
</tr>
<tr>
<td>l</td>
<td>litre—volume (10⁻³ m³)</td>
</tr>
<tr>
<td>lm</td>
<td>lumen—luminous flux (cd·sr)</td>
</tr>
<tr>
<td>lx</td>
<td>lux—illuminance (m²·cd·sr⁻¹)</td>
</tr>
<tr>
<td>m</td>
<td>metre—length (SI base unit)</td>
</tr>
<tr>
<td>m</td>
<td>milli—sub-multiple (10⁻³)</td>
</tr>
<tr>
<td>m</td>
<td>minute—time (60 s)</td>
</tr>
<tr>
<td>mol</td>
<td>mole—amount of substance (SI base unit)</td>
</tr>
<tr>
<td>n</td>
<td>nano—sub-multiple (10⁻⁹)</td>
</tr>
<tr>
<td>n</td>
<td>nautical mile—length (1852 m)</td>
</tr>
<tr>
<td>p</td>
<td>pico—sub-multiple (10⁻¹²)</td>
</tr>
<tr>
<td>pc</td>
<td>parsec—length (30 857 × 10¹⁵ m)</td>
</tr>
<tr>
<td>rad</td>
<td>radian—plane angle (SI supplementary unit)</td>
</tr>
<tr>
<td>rad</td>
<td>rad—absorbed dose of ionizing radiations (10⁻² J·kg⁻¹)</td>
</tr>
<tr>
<td>rpm</td>
<td>revolution per minute—rotational frequency (0.105 rad·s⁻¹)</td>
</tr>
<tr>
<td>s</td>
<td>second—time (SI base unit)</td>
</tr>
<tr>
<td>sr</td>
<td>steradian—solid angle (SI supplementary unit)</td>
</tr>
<tr>
<td>t</td>
<td>tonne—mass (10³ kg)</td>
</tr>
<tr>
<td>u</td>
<td>unified atomic mass unit—mass (1.660 53 × 10⁻²⁷ kg)</td>
</tr>
<tr>
<td>µ</td>
<td>micro—sub-multiple (10⁻⁶)</td>
</tr>
</tbody>
</table>

## Typography

- 3517.7938 m 103 517.793 863 Hz 0.473 121
- N·m or N·m·s⁻¹ or m/s
- m·kg/(s²·K) or m·kg·s⁻³·K⁻¹
- kg/m³ not mg/cm³ cm³ = 10⁻⁶ m³

## SI and units accepted for use with SI

*Units to be used with SI for a limited time*

Additional units at present retained for use in Australia (AS 1000)

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114 The Australian Physicist, August 1972
RECENT MEETINGS

PROBLEMS IN THE PLANNING OF SCIENCE AND TECHNOLOGY

A report of an address by Professor Sir Rutherford Robertson, President of the Australian Academy of Science, to the ACT Branch on 6 June 1972 (extracted from an article in the Canberra Times, 22 June 1972).

Professor Robertson described the Prime Minister’s announcement on April 27 setting up an Advisory Committee on Science and Technology as “a big step forward in the attempts by government to interact with scientists” but the general public, including politicians, had only a vague idea of what science policy meant. The problem was what to plan and how to plan it.

Science policy could mean either a policy for the development and expansion of scientific research or it could mean the utilization of science to attain national goals and policies.

Some forward planning of science was necessary to avoid a situation where money available for research exceeded the supply of adequately trained scientists to make effective use of the funds. Research by its very nature was an expensive operation. Secondary research was not only a waste of money but resulted in the public and politicians developing a poor opinion of scientists.

The prime need was to decide priorities for different areas of research and technological development. How much money would be available for each area would depend on an overall decision by the Government determining how big a slice of the national income could be set aside for science and technology, compared with the needs for, say, health services, rural subsidies, education, defence.

Professor Robertson said he could envisage the Advisory Committee on Science and Technology being asked to give advice on the desirability of proceeding with technological projects involving expenditure of huge sums of money. For example, it might well be asked to advise on priorities for the expenditure of $200 million on a nuclear power station at Jervis Bay compared with $1000 million on a gaseous diffusion plant to enrich the Northern Territory uranium deposits before selling them to Japan and European countries which had committed themselves to the generation of electricity from nuclear reactors.

Professor Robertson discussed the machinery required to provide the Government with scientific advice. In theory it seemed easy but in practice it was full of difficulties. In 1970 he and Dr. J. G. Price, the chairman of CSIRO, had made a study of foreign science policies including those of the US, Canada and England. At about the time of their visit to the US, Dr. Edward E. David, jun, was being appointed science adviser to the President. His appointment had been welcomed by the scientific fraternity yet by April 1971 Dr. David was being criticised for unbalanced advice. Clearly no single man could adequately cover all fields of science.

A solution was to set up an advisory council or committee of scientific experts. But so many different scientific experts would be required to serve on such a committee that it would become of unmanageable size. It was necessary, therefore, to set up a smaller advisory committee on science and technology and let it consult with other scientists as required.

Only 145 scientists were Fellows of the Australian Academy of Science, which had 30 committees dealing with different topics. It also had 26 sub-committees. One way or another, as many non-Fellows as Fellows participated in the affairs of the Academy. The Academy aimed to be the Australian focal point where the advice of all scientists might be heard. When giving advice to governments the Academy strove wholeheartedly to express the authentic views of scientists.

He pointed out also, differences of opinion among scientists were unavoidable. Minority views must be reported but such reports inevitably led to trouble with politicians who were seeking clear-cut, definite advice. The Academy of Science had recently experienced at first hand difficulties in this context with its two reports on the danger to the environment of the continued use of DDT and the threat to the upper atmosphere of supersonic transports as well as ground level discomfort arising from supersonic booms.

It was difficult for scientists to be dogmatic when there was insufficient evidence to enable a unanimous decision to be reached. Scientists in general and the Academy in particular should undertake a patient program of education so that the ordinary citizen and politician would come to understand that there were ‘grey areas’ in science. On the other hand if governments wanted better advice then they should be prepared to spend larger funds on research, for the monitoring of the environment and for the collection of data which would indicate trends sufficiently clearly.

Professor Robertson said that there were two reasons why scientists must push ahead to help governments get better advice in making decisions of national consequence.

First, scientists were the most forward-looking members of society, and second, because of their training and general caution their predictions were more likely to be correct. He called for frequent interaction between scientists and the decision makers. Such interaction should be based on mutual trust and take place at all levels up to the most senior scientist in government employment.

Professor Robertson felt that “scientists had a social responsibility to provide the general public with the best possible interpretations of current and projected developments”.

Scientists should be willing to make use of radio and
television science programs and to write readable newspaper articles dealing with the impact of science on society.

Because science and technology pervaded almost every aspect of modern life it would not be wise for the Government to channel all research funds through a single source. At the present time substantial Commonwealth funds for research were distributed by the Australian Research Grants Committee, the Australian Industrial Research and Development Grants Board, the National Health and Medical Research Council, the CSIRO, the Australian Atomic Energy Commission and 30 different avenues falling under one or other of 10 different Commonwealth Ministers and their corresponding departments. "Some overlap and duplication of research is thus inevitable and may in fact be most desirable in critical areas".

Thirty scientists listened to Professor Robertson’s talk, including a former adviser to the Commonwealth on defence science, Sir Leslie Martin, who said he was astounded that Mr McMahon had explicitly stated that the Government did not require advice on medical research to be given by the Advisory Committee on Science and Technology. Mr McMahon had announced that responsibility for this area of science and technology would lie with the National Health and Medical Research Council.

The chairman of the CSIRO, Dr J. G. Price, who was also present said a notable omission from the Prime Minister's announcement on science policy was its failure to specify national goals which science and technology would be used to attain. Thorough study of previous government statements had failed to unearth any clear definition of national goals although some could be inferred, such as 'Developing Northern Australia'.

At the conclusion of Professor Robertson's talk he was the guest of the ACTI branch at a dinner in one of Canberra's leading hotels. The combination of talks and dinners has become a regular and successful aspect of the branch's activities in the last twelve months.—Ian Bissett.

SYMPOSIUM ON RECENT ADVANCES IN RADIO ASTRONOMY

The Victorian Branch of the AIP held the symposium in the physics department, Monash University on Tuesday, 30 May, 1972 from 4.30 p.m. to 10 p.m. It had been designed to present recent advances to an audience of physicists, many of whom would not be specialists. The three speakers, in order, were Dr J. P. Wild, Chief, CSIRO Division of Radiophysics, Mr J. G. Bolton, Australian National Radio Astronomy Observatory, Parkes, and Professor R. D. Brown, Chairman, Chemistry Department, Monash University. The symposium was very well attended, with 130 people in the audience for the last speaker.

Dr Wild's talk was called the "Radio Astronomy of the Sun" and was a survey of the work done on the solar flares in the corona, as measured on the 80 MHz radio heliograph at Culgoora. A CSIRO film was shown of the work of the Culgoora radio heliograph, which included the display of the polarized radio emissions from flares. This display could be followed in time and recorded on film; one radio flare was a continuation of a visible solar prominence in the corona. There were several appreciative comments about the high quality of this film and the intrinsic interest of its content.

Mr Bolton's talk was called "Extra-Galactic Astronomy". He concentrated on Quasi-Stellar Objects and the vast collection of data about them now available. The anomalies in the red shifts were discussed and in particular, the way in which galaxies and 'associated' QSO's sometimes have widely different red shifts.

The third lecture of the evening was given by Professor R. D. Brown with the title "Interstellar Molecules and Life in Space". The symposium was fortunately timed because a few days earlier Professor Brown had announced the second molecule to be identified at the Parkes radio telescope. After reviewing the earlier knowledge of the molecules from astronomical observation, he concentrated on the collaborative work between the microwave laboratory group in the Chemistry Department at Monash and the radio telescope. The molecules now being discovered are asymmetric tops and the structure of their rotational lines cannot be predicted in detail. Accordingly, before these rotational lines can be recognized in the signal from the radio telescope, they must be known from laboratory experiments. The latest molecule to be discovered is formaldehyde, CH₂NH; it is a 'biological precursor' and Professor Brown finished his talk with a discussion of the possible origins of life in the planetary system.

The good attendance and keen interest in this symposium suggests that this form of activity is a valuable one for an AIP Branch, and it is hoped that other currently developing fields will be similarly treated.—H. C. Bolton.

GLASS, PLASTICS AND OTHER MATERIALS

Over 60 people attended the meeting of the NSW Branch held at the Australian Consolidated Industries' Technical Centre on 13 June 1972. The activities of this centre, which provide the centralized technological support for the ACI group of companies, were described by Dr Brian Hickman in a short lecture followed by a tour of the centre. The centre’s activities in fields as diverse as mass spectroscopy, X-ray analysis, infrared and visible spectrophotometry, acoustics, properties of materials and mineralogy were summarised. The relationship of all these skills to the needs of the organization and the role of the centre as a hand-maiden to production were clearly apparent. ACI appear to have followed the usual Australian pattern of eliminating the
R from R & D. Developmental work in progress appears largely oriented toward the use of known materials in new ways (fibre glass as a reinforcement for concrete, plastic instead of glass for aerated beverage containers). There is also a considerable commitment toward the quality control of standard products.

The centre also operates a substantial technical library, which is making determined efforts to pre-digest technical information. Staff members whose fields of interest are specified to the library computer may obtain weekly a print-out of abstracts likely to be of interest to them. One feels that this information handling problem is taken very seriously; somewhere in the literature may lie the key to new profits.

This was a very interesting and enjoyable meeting and the hospitality of ACI was appreciated by all who attended.—D. Paix.

THE ROLE OF NUCLEAR ENERGY IN AUSTRALIA'S DEVELOPMENT

A report of the symposium held in Canberra on 1–2 June 1972 under the sponsorship of the Australian Academy of Science, the Society for Social Responsibility in Science (ACT) and the AAEC.

Programme

The programme for this symposium included the following papers.

Australia's Energy Requirements until 2000 (J. E. Hayes, SEC, Vic.)

Economic review of Australian energy resources (L. T. Gleeson, Dept. of National Development).

Need for a National Energy Policy (F. E. Stewart, MHR).

Current state of the art in nuclear power (F. H. Carr, AAEC).

Enrichment of uranium (K. F. Alder, AAEC).

A matter of nuclear priorities: water and/or electricity (H. J. de Bruin, Flinders University).

Environmental hazards of fossil and nuclear energy production (G. M. Watson, AAEC).

Radioactive wastes in the uranium mining industry (H. F. Mealouney, Mary Kathleen Uranium Ltd).

Radioactive wastes from irradiated nuclear fuels (G. Hardy and E. D. Haspe, AAEC).

International regulation and control of fissionable material (Sir Philip Baxter).

Legal, administrative and political problems of Australian nuclear power from the viewpoint of a constitutional lawyer (J. E. Richardson, ANU).

Fusion power prospects relative to fission (D. C. Peaslee, ANU).

Summary

A summary follows of the main points raised at the symposium. The principal use of nuclear energy in Australia is expected to be for electric power generation. Some of this power, however, will be applied to transportation, particularly if the electric car becomes popular. Although the present endowment of fossil fuels is high, the demand for electricity seems likely to keep growing rapidly; and the export of fossil fuels is growing even more rapidly. Accurate predictions are difficult to make, but several independent estimates for the year 2000 indicate an installed nuclear capacity in Australia of some tens of thousands of megawatts, based on a projection of current population growth. There is rather more uncertainty in extrapolating back from this figure to the date for the first 500–1000 MW nuclear plant; estimates range from 1975 to 1985.

On this time scale the first nuclear power station here would burn uranium fuel enriched in $^{235}U$. The anticipated transition to breeder reactors would occur gradually over the first decades of the 21st century.

Such a $^{235}U$-based power program might be jeopardized by having to send the uranium overseas for enrichment. The present most likely technique for an enrichment plant on this continent would be gaseous diffusion. The export of enriched uranium was pointed out as possibly the first substantial, if indirect, contribution by nuclear energy to Australia’s development. Projected needs for nuclear power overseas indicate the early necessity of additional enrichment capacity beyond that now available.

A review of practice to date showed a gradual trend toward light water cooled reactors with thermal neutrons. The next major development is expected to be the liquid metal cooled fast neutron breeder reactor, which should ultimately produce a net yield of nuclear fuel. At present about 1 per cent. of world energy production is nuclear. However, the current new installation rate of nuclear power plants is about five times that of all others. The biggest difference between the introduction of nuclear energy and the advent of air or space flight is that in those latter cases, no well established industry was already present. Nuclear power has had to make its way against a highly efficient fossil-fueled electricity generating industry. Viewed in this perspective, the present progress of nuclear energy may look quite satisfactory.

In the discussion of safety and environmental protection it was clear that no absolute safety exists in any industrial process, but that the cost of risk protection to any desired level for a nuclear plant could be fairly well assessed by standard means. Long-term (1000 years or more) storage of radioactive wastes from spent fission fuel was the most uncertain aspect of the problem. Although the experts were confident of the future, the fact remained that no present solution exists much beyond temporary storage as liquid in stainless steel tanks. It was pointed out that some desert areas in
Australia—suitable for storage of vitrified or ceramic solids—have been stable on a geological time scale of 150 million years. A more satisfactory picture was shown of current measures by the uranium mining industry for preservation of the environment; radioactive wastes were of low intensity and were immobilized by evaporation from dams.

On the constructive side, the use of radioactive isotopes in industry for analysis and indicating devices is growing rapidly in Australia. Even more prominent is the growth of isotopes use for diagnosis and therapy in nuclear medicine, where the benefits are generally accepted to outweigh the minor risks involved.

Legal and political developments relating to nuclear energy in Australia are in rather early stages. Constitutionally, the Commonwealth has no powers specifically relating to nuclear energy, and powers of industrial regulation appropriate to electricity generation are largely left to the States. In practice, however, the Commonwealth can probably exert a dominant influence over nuclear energy through its power to concludc international treaties, through control of interstate and overseas trade, through government of the territories, and through its massive financial strength. A call was made for the early establishment of a Commonwealth–State energy authority to formulate a long term, flexible national policy on fuel and energy and their export.

The advent of fusion power on the nuclear energy scene in Australia was discussed in general terms. On present indications this form of power generation will not be ripe for consideration here much before the middle of the next century.

Publication

Despite the diverse backgrounds of the speakers at the Symposium, the degree of consensus was surprisingly high. The collected papers of the Symposium reflect both this consensus and the degree of divergence relative to it. They are available for $3 per set by order from the Australian Academy of Science, Box 216 Civic Square, Canberra, ACT 2608.—D. C. Peaslee.

PHYSICS OF THE EARTH—BOOK REVIEW


Reviewed by R. Green, Department of Geophysics, University of New England, Armidale, N.S.W.

This book is the third in the Space Text Series by Wiley and one which fills a long-felt need for a text book for final year undergraduates or fourth year students who are entering into the subject of geophysics for the first time with a physics background.

In geophysics, there have long been excellent monographs on restricted topics such as 'seismology', 'palaeomagnetism' or 'physical geodesy' but no integrated text for students or professional physicists interested in geophysics. Such readers will find the book most valuable because it has the straightforward empirical approach of an experimental physicist combined with a thoroughly quantitative treatment as far as the complexities of the materials of the earth allow. The breadth of coverage provides a neat and accurate survey of the field of general geophysics and it has been achieved by a judicious use of order of magnitude arguments and energy calculations.

The book has been well arranged into nine chapters which form an orderly development of the subject matter. Chapter 1 deals curiously with the planets and in more detail with meteorites, and serves as a basis for later chapters dealing with the earth's interior and heat generation. This is followed by a neat theoretical discussion (Chapters 2 and 3) of the figure of the earth and its gravity field and the related problems of precession and tidal friction. Nowhere does the complexity of the analysis obscure the argument and it leaves the reader with a real appreciation of the magnitudes of the quantities involved.

It is Chapter 4 (Seismology and the Internal Structure of the Earth) that is the least satisfactory in the book—one can sympathize with the dilemma of the author—if the treatment of the subject is short it is superficial; if it were longer it would tend to dominate the book, and anyway, there are some good monographs just on general seismology. My feeling was that it touches too lightly on the very subject that has contributed most to a thorough understanding of the interior of the earth. The whole question of the densities of the earth's interior is omitted. However, the chapters on geomagnetism and paleomagnetism are excellent and it is pleasing to see how these topics effectively form a central theme tying together diverse strands in geophysics such as crustal tectonics and the physical state of the core and lower mantle. The chapter (No. 7) on creep and anelasticity in the mantle begins with a discussion of observed faulting and moves to a discussion of dislocation, creep and anelasticity in a natural and satisfying way but, because of the rapid and spectacular development of the theory of plate tectonics in the past few years, such recent tectonic theories are not mentioned and this is an unfortunate omission.

Radioactivity and the age of the earth (Chapter 8) is treated concisely and adequately. The thermal state of the earth's interior has long been a most difficult subject, but the manner in which the problem has been treated in the book, is a fine example of the clarity provided by a neat and orderly arrangement of facts and arguments. It is the best discussion of the subject available.

The references which are up to the year 1968 are extensive yet relevant, and will contribute much to the usefulness of the book.

Other useful features include the provision of appendices on—
1. Spherical harmonic functions.
2. Solution of the velocity-depth function from the seismic travel time curve.
3. Radiative thermal conductivity of a grey body.
4. Conversion of units.
5. Numerical data of geophysical interest.
6. The geological time scale.

One unfortunate feature is that the book still retains the e.m.u. system of units instead of the more widely adopted SI and hence the need of appendix 4.

In summary, the book is most timely and it is a good book in its own right and is likely to serve both as a text book for final year students in geophysics and for a reference book for geophysicists.

THE LAWRENCE HALL OF SCIENCE

Elmar Laisk
Macquarie University, North Ryde, NSW

The Lawrence Hall of Science, a memorial to the inventor of the cyclotron, "is dedicated to research in science education, the dissemination of scientific knowledge to the general public and school children, and the improvement of science teaching throughout the world".

Built in 1968 on a hill facing the University of California campus, it provides its staff and visitors a fine view of the San Francisco Bay and the 'City by the Golden Gate'.

The Hall provides exhibits, demonstrations and film shows in physics, chemistry, biology, mineralogy, computer science, space science and mathematics. It is also a proving ground for new teaching methods and has programs designed for both high potential and disadvantaged children. Good workshops and studio facilities provide opportunities for novel teaching projects.

Against the background of current lament about the decline of interest in science, the Lawrence Hall provides a unique opportunity for seeding long-term interest in science. Although the full impact of the current activities has yet to prove itself, the Lawrence Hall has in a relatively short time aroused new interest in science in the San Francisco Bay Area as well as throughout California, the USA and overseas.

Decline of Science?

It sounds very much like a new variation on a theme in Oswald Spengler's book 'Decline of the West', which half a century ago stirred, although somewhat unconvingingly, the minds of many men. However, remarks as provocative as 'Has physics become obsolete?', 'Physics-Phoney!' and 'The Flight From Science' appear now too often and are too well documented to be ignored. The hard facts put forward in recent articles [American Institute of Physics, 1971; Cartter, 1971] on the decline of science clearly reveal a decrease of interest in pure science. For some time enrolments have been dropping in undergraduate physics and more so in graduate courses [Baker, 1968]. What is more, this disinterest in science, and physics in particular, seems to germinate as early as the junior and senior high school levels.

A number of reasons have been made responsible for this flight from science: out-of-date teaching, declining importance of PhD's, lack of motivation, effects of socio-political agencies, cultural shock induced by the explosive progress in physics, or simply the lure of easy passes and degrees in arts.

Obviously, one has to consider the effects of all these possible explanations in their weighted interdependence and, in particular, the impact of new concepts in teaching like television, computer science, recording, games, student participation, self-instructional media and other new methods for motivating children in a social environment which lacks motivation itself.

Planned research and experimentation in science curriculum development already exist in many countries, but notably in the United States. In the US most of the science curriculum development centres are associated with the universities, who also provide the necessary funds. Besides directly serving college teaching, these centres are extensively involved with the science curriculum studies at the secondary and elementary levels—almost out of plain necessity, because these levels imply the kind and quality of material on which the universities build higher education.

Reports on Educational Research

A considerable number of educational research institutions are now in operation at colleges and universities. Many of these are dedicated to the study of
Table 1
Institutional Centres of Instructional Research

<table>
<thead>
<tr>
<th>Centre</th>
<th>Area of Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Centre of Curriculum Studies at the University of Minnesota (1965)</td>
<td>graduate, pre-college</td>
</tr>
<tr>
<td>2. Centre for Research in College Instruction of Science and Mathematics, CRICIAM, located at Florida State University, but sponsored by a group of universities in the S-E of US (1967)</td>
<td>undergraduate, computer-oriented general science courses</td>
</tr>
<tr>
<td>3. The Centre for Research in Education at Cornell University (1966)</td>
<td>early school to graduate teachers workshops</td>
</tr>
<tr>
<td>4. The Centre for Research on Learning and Teaching at University of Michigan (1963)</td>
<td>undergraduate, teacher training, programmed learning</td>
</tr>
<tr>
<td>5. Education Research Centre at the Massachusetts Institute of Technology (1960)</td>
<td>new science courses, unified science study, high school to undergraduate</td>
</tr>
<tr>
<td>6. Science Instruction Development Laboratory at Harvard University</td>
<td>undergraduate</td>
</tr>
<tr>
<td>7. Instructional Resources Centre at State University of New York (1960)</td>
<td>pre-college, undergraduate, teacher training</td>
</tr>
<tr>
<td>8. Lawrence Hall of Science at the University of California (1968)</td>
<td>elementary to undergraduate, high potential, disadvantaged, teacher training</td>
</tr>
<tr>
<td>9. Science Education Centre at the University of Texas (1959)</td>
<td>elementary to undergraduate</td>
</tr>
<tr>
<td>10. The Science Teaching Centre at the University of Maryland (1962)</td>
<td>elementary to graduate, inexpensive science equipment</td>
</tr>
</tbody>
</table>

new ways of instruction at all levels—college, secondary, elementary, and even pre-school.

As an intermediary between the numerous centres, there has been the Commission on College Physics, which sponsored a conference on institutional centres of educational research at Massachusetts Institute of Technology in May, 1970. The conference report offers a broad insight into the activities and policies of educational research in the US.

Another review of the activities of ten similar educational research centres is contained in a pre-conference paper prepared by John M. Fowler and Kathryn E. Mervine of the Commission on College Physics, and Alan M. Portis of the Lawrence Hall of Science. This report briefly describes the aims, facilities, curriculum development programs and publications of the centres listed in Table 1.

An earlier comparative evaluation of various educational projects in the US is given by John R. Baker [1968] in an article entitled 'American Physics Curriculum Projects'.

Evidently there is a variety of science curricula in operation, maintained by different centres; most being revised yearly, others operated on a pilot basis. Table 2 lists 13 well-known science curricula covering all levels of education. However, in all their excellence, most of the curricula provide a more or less conventional 'in-school' approach to science education. The Lawrence Hall of Science in Berkeley, stands out to an outsider in two ways; it provides out-of-school activities in science under experienced guidance and it facilitates the new teaching media and teacher training in an inspiring scientific surrounding.

The Lawrence Hall of Science

The Lawrence Hall is located between the Space Sciences Laboratory and the Bevatron complex of the Lawrence Radiation Laboratory in Berkeley. It provides 100,000 square feet (10,000 m²) of gross space at three levels. It accommodates the Education Building, the Lawrence Memorial, the Science Library and Information Center and two exhibit wings. The education building provides an auditorium, a large amphitheatre and laboratory-classrooms for physics, chemistry, biology and computer science; a television and film studio, various workshops and fifty offices for staff, graduate students and visitors.

In the spacious entrance foyer the life-like portraits of 26 great men of science, from Aristotle to Lawrence, are displayed on illuminated plastic panels. Their names were selected by ballots involving 1116 scientists in 49 countries.

On the ceiling of the entrance foyer hangs a huge artistic constellation called Stabile. It represents an artistic conception, by Carl Niecneider, of a superposition of a picture of Crab Nebula and a field ion microscope picture of atoms in a crystal.

Two exhibit halls accommodate visitor-operated displays and experiments in physics, chemistry, biology, mathematics and computer science, most of them provided with question-answer facilities employing film and magnetic tape loops. Thus, at the end of each experiment the visitor can find out whether he has learned anything from the exhibit or not.

There are about forty basic experiments covering physics, optics, chemistry, biology, mathematics and computer science. The underlying principles of each participation experiment or display are that it must (1) demonstrate a basic principle in science, (2) be operated by the visitor, (3) be attractive artistically and (4) be rugged and 'boy-proof'.

Some displays, like the giant Periodic Table of Elements employing several projectors, are used for regular lecture programs. However, the science demonstration lectures featuring timely science subjects are given in the large auditorium and are open to all visitors.

This auditorium has the best educational facilities
Table 2

Typical Science Curricula

<table>
<thead>
<tr>
<th>Name</th>
<th>Area</th>
<th>Grades</th>
<th>Director/Developer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (Harvard) Project Physics (HPP, PP)</td>
<td>Introductory Physics for HS and junior college</td>
<td>10-12</td>
<td>Holton, Watson, Rutherford</td>
</tr>
<tr>
<td>2. Physical Science Study Committee (PSSC)</td>
<td>Introductory Physics for HS</td>
<td>10-12</td>
<td>Zacharias</td>
</tr>
<tr>
<td>4. Chemical Education Material Study, CHEM study</td>
<td>Secondary School Chem.</td>
<td>11-12</td>
<td>Pimentel, Ridgway</td>
</tr>
<tr>
<td>5. Introductory Physical Science (IPS)</td>
<td>Study of Matter</td>
<td>8-9</td>
<td>Haber-Schaom</td>
</tr>
<tr>
<td>6. Intermediate Science Curric. Study (ISCS)</td>
<td>Natural Sciences, space science</td>
<td>7-9</td>
<td>Burkman</td>
</tr>
<tr>
<td>7. Earth Science Curric. Project (BSCP)</td>
<td>Earth and environmental science</td>
<td>8-10</td>
<td>Haller, Bisque, Welz, Romey</td>
</tr>
<tr>
<td>8. Science Curriculum Improvement Study (SCIS)</td>
<td>Physical and life sciences, model approach</td>
<td>Elem.</td>
<td>Karplus</td>
</tr>
<tr>
<td>10. Elementary Science Study (ESS)</td>
<td>Elementary Education</td>
<td>Elem.</td>
<td>Morrison, Hawkins, Watson, Griffin</td>
</tr>
<tr>
<td>12. Early Childhood Curriculum</td>
<td>Elementary Education</td>
<td>Elem.</td>
<td>Lawatelli</td>
</tr>
</tbody>
</table>

available plus several unusual features such as a rotating stage with three fronts for different demonstrations, remote controlled television cameras and audio–visual facilities with an associated control room.

Besides smaller halls, the auditorium is extensively used for film shows featuring, mostly, some aspect of science, but also topics of general interest. There are regular science sessions and film shows all day on Saturdays and Sundays.

With the cooperation of the Berkeley Unified School District, the Lawrence Hall of Science conducts after-school classes for talented students, an educational endeavour having somewhat similar aims to those of Opportunity Schools in NSW, except that it is an extracurricular involvement. Arrangements for the after-school enrolment of children are usually made through the school counselors and the Berkeley Association for the Gifted.

At the Lawrence Hall of Science, the interests of many younger children are centred in the computing classroom which always appears busy. Here the interested children, mostly from 8 to 16 years old, are first given simple instructions on how to operate computer–input teletypes and to write simple programs in the computer language called BASIC. Many of the students advance, at their own pace, to solving quite complicated problems. However, their progress is evaluated more by the element of innovation and creativity than by technical skill.

Science Curriculum Programs

The principal program at the Lawrence Hall of Science is the development of science curricula at all levels of learning—elementary, secondary and university.

The Science Curriculum Improvement Study, SCIS, is guided by Professor R. Karplus. It is a segmented six year elementary science program which introduces the fundamental concepts of physical and life sciences by the exploration, invention and discovery method of teaching. The methods have been outlined by Professor R. Karplus in a paper entitled 'Three Guidelines For Elementary School Science' presented to Section 1 (physics) of the 41st ANZAS Conference in Adelaide, SA, August 1969.

A high school chemistry course called CHEM Study, originally developed under the direction of Professor Glenn Seaborg, former Chairman of the US Atomic Energy Commission and now a Professor at Large at the University of California, maintains its offices at the Lawrence Hall of Science. Its Executive Director at LHS is David W. Ridgway.

The CHEM Study materials are used by a large number of schools in the US and have become popular in other Anglo–American and Latin-American countries, and India. They have been translated into Spanish.

The Chemical Technician Curriculum Project (Chem Tech) involves a two-year program for the training of chemical technicians at the technical college level (community college in the US). Chem Tech is directed by Professor R. L. Pescok of the University of Hawaii and Kenneth Chapman at LHS. The course is now run in a considerable number of pilot colleges in the US and its activities are published periodically in the Chem Tech Newsletter.

Another unique teaching project called Special Elementary Education for the Disadvantaged, SEED, is directed by a Berkeley teacher, William Johnz. His method of teaching math to disadvantaged children.
from 6 years of age has been highly successful and widely accepted. Johnzr believes that the poor performance of the disadvantaged in the school is a direct result of their poor opinion of themselves. If corrected and motivated, they usually grasp abstract mathematical concepts easily. SEED mathematics is being taught now in about half of the states in the US and it is becoming international as well.

A program for the development of a computer-based instructional course to introduce high school teachers to Project Physics is now in development.

Concurrently with curriculum development, the Lawrence Hall is also engaged in teacher training. In previous years, several summer institutes of six to eight weeks duration have been attended by over 200 teachers from all over the United States and foreign countries. Similar institutes have been organized for Science Supervisors, CHEM Study, Natural History, Physics, and Molecular Biology courses. These are planned mostly for the vacation period. However, the in-service science courses for teachers are conducted all year round.

There are several cooperative programs in progress at LHS involving Northern California science teachers, junior high school science teachers and community college physics teachers. Currently, in some courses, particularly at the junior college level, the emphasis is on the use of computer methods in physics teaching. Additionally, a number of programs for the use of film and television in science teaching, some of them "student-generated", are tested on an exploratory basis.

**The Operation of the Hall**

The Hall is operated by the University of California in Berkeley as an educational research and public service unit. The Director is appointed by the Chancellor. The administration of the Hall is supported by the Executive and Advisory Committees. At the present time the Lawrence Hall of Science employs more than 100 people both in academic and technical capacities.

Most courses at the Hall are directed by university professors from various science departments of the Berkeley campus. In teaching and other academic activities they are assisted by professional teachers of high standing.

**References**


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**Australian Institute of Physics**

**EXECUTIVE**

**Professor R. Street, President**

**Dr F. J. Jacka, Vice-President**

**Dr J. G. Campbell, Hon. Secretary**

**Dr J. K. Mackenzie, Hon. Treasurer**

**Dr R. D. B. Fraser, Hon. Registrar**

Assistant Secretary: Mrs J. A. Mackenzie.

**REGISTERED OFFICE**

Clunies Ross House,
191 Royal Parade,
Parkville, Victoria 3052.
Telephone: 347-4941.

All correspondence should be addressed to:
PO Box 52, Parkville, Vic. 3052.

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**INSTITUTE AFFAIRS**

**INCREASE IN SUBSCRIPTIONS**

It is six years since the Institute last raised its membership subscriptions, during which period most other organizations of all kinds, including learned societies and professional institutions, have made sizeable increases in their subscription rates. Rapid inflation particularly over the last few years has added substantially to the Institute's running costs, affecting not only general overheads such as paper, printing, and postage, but also salaries. Internal economies are made whenever practicable; we share an office with two other societies and a close watch is kept on the costs of "The Australian Physicist". In the opinion of Council no further economies are possible without severe curtailment of activities and services to members.

In broad outline the financial picture is as follows.

In the period 1967-71 for which actual figures are available membership rose by 20 per cent., income by 50 per cent. and expenditure by 55 per cent. The additional income over and above that expected from the increase in membership was mainly due to the introduction of Company Subscribers and to the investment of reserve funds. The increase in expenditure per member is almost the same as the increase of about 7 per cent. p.a. in the average earnings of males.

In 1971 the Institute as a whole suffered a deficit of $2000 while in 1972 it is predicted that there will be a deficit of $1500 in the funds directly controlled by Council and $1200 in the funds of "The Australian Physicist". "The Australian Physicist" receives income from both advertising and subscriptions and so is not
wholly supported by the Institute. Analysis of the activities of 'The Australian Physicist' over the last few years suggests that the Institute is bearing an increasing proportion of the publication costs and so the rate of increase of the cost of 'The Australian Physicist' to the Institute is higher than that for other expenditure.

It is not easy to predict what the future will bring but the guiding principle was that no further increase in subscription should be needed for at least three years and it was hoped initially that a 25 per cent. increase would be sufficient. However, realistic examination of the situation showed that this would be quite inadequate and Council reluctantly resolved to increase the subscriptions by 50 per cent. averaged over all grades.

The new subscriptions will be:

- Fellowship: $30.00
- Associateship: $20.00
- Graduateship: $13.00
- Student: $3.00
- Subscriber: $6.00

In addition there will be a Group annual subscription of $2.00 for each group to which a member belongs. Entrance and transfer fees are to be abolished in order to encourage new membership applications and transfer to higher grades. The new Group membership fee will not only be a source of Group funds but also a practical means of establishing Group membership. The fee for Subscribers remains unchanged on the grounds that most Subscribers are members of Groups and will therefore pay increased fees, anyway. There has been no change in the policy of allowing reduced fees in certain circumstances; these are advertised in the September issue of 'The Australian Physicist' just prior to the issue of subscription notices. Finally, members are reminded that subscriptions are tax deductible and that the real cost of the increase to a Fellow is no more than a few cents a week.—Honorary Treasurer.

20TH MEETING OF COUNCIL

The 20th Meeting of the AIP Council was held at Clunies Ross House, Parkville, on 18-19 May 1972. The President, Professor R. Street was in the Chair, and all Branch Chairmen were present.

General Policy

In accordance with recent practice, a discussion of general Institute policy was held before particular agenda items were introduced. Much of this centred on the development of Branch activities. The vital part played by 'The Australian Physicist' was also emphasized.

Finance

The Honorary Treasurer reported that income and expenditure were approximately on budget, except for 'The Australian Physicist' which was incurring higher expenses than had been anticipated. The overall deficit for the year would therefore be about twice the budgeted deficit.

It had been clear for some time that the subscription rates, which had been unchanged for six years, would need to be increased for 1973. It had been hoped to limit these increases to 25 per cent., but on a realistic examination of the situation that percentage had proved quite insufficient. Council resolved to increase subscriptions by 50 per cent. averaged over all grades, some more and some less, as well as to introduce a Group annual membership fee. At the same time entrance and transfer fees were abolished as from the end of the Institute's financial year. It was emphasized that the tax-deductibility of Institute subscriptions would reduce the impact of these increases on each member to a few cents per week.

Administration

Steps were taken to introduce a superannuation scheme for the full-time employees of the Institute office, which is operated jointly with The Australian Institute of Refrigeration Air Conditioning and Heating (Inc.), and the International Solar Energy Society.

Membership

The Honorary Registrar reported that corporate membership stood at 1395, and total membership at 1655 plus 26 Company Subscribers. The number of individual members in all corporate grades had increased, and in non-corporate grades had decreased.

Tertiary qualifications which received official recognition for graduateship were:

(i) Associate Diploma of Science (Physics) of the Darling Downs Institute of Advanced Education,

(ii) Diploma of Applied Physics of the Gordon Institute of Technology, and

(iii) Bachelor of Applied Science with a double major in Physics of the School of Mines and Industries, Ballarat.

The implications for the Institute of the trend towards multi-discipline science courses was discussed, and a special committee established, under the chairmanship of the President, to consider the Institute's policy with regard to this and other matters involving membership.

The Australian Physicist

Council accepted with regret the resignation of the foundation Editor, Dr. J. L. Symonds, after eight years in that position. Dr. J. R. Bird was appointed Editor in his place.

Company Subscribers

Dr. C. F. S. Malsted, recently appointed as Industry Liaison Officer, outlined a programme to involve Company Subscribers more closely with the Institute for the mutual benefit of both. A Bulletin was to be circulated to the Company Subscribers in the near future.

The Australian Physicist, August 1972
Conferences, Etc.
Reports were presented on a number of activities since the last Council Meeting, or planned for the future.

The 1972 Pawsey Memorial Lecture had been delivered in Sydney by Professor R. Hanbury Brown on 14 March. The 1973 Lecture was to be held in Tasmania.

Two Summer Schools were held in 1972, one in Canberra on 24-28 January and the other in Melbourne on 14-18 February. The Queensland Branch planned to hold a Summer School in February 1973.

A Conference on Radiation Damage was held in Sydney on 8-11 February 1972, and a Conference on Geophysics of the Earth and the Oceans was planned for 15-19 January 1973, also in Sydney.

Groups
The Biophysics Group was organizing the 12th Annual Conference on Physics in Medicine and Biology, to be held in Hobart on 21-25 August 1972.

The Vacuum Physics Group reported that the Third National Vacuum Symposium had been held in Adelaide from 28 February to 1 March 1972.

No representative of the Education Group attended the Meeting.

AMENDMENTS TO BY-LAWS

Notice is hereby given to all Members that, at the 20th Council Meeting, the following amendments were made to the By-Laws:

By-Law 9(3) was amended to read:
'The application shall be accompanied by the prescribed entrance or transfer fee (if any) and shall be submitted to the Honorary Registrar.'

A new By-Law 28(4) was added, reading:
'Notwithstanding other provisions of these By-Laws, no entrance or transfer fee shall be levied after 30 September 1972.'

By-Law 29(1) was amended to read:
'Annual subscriptions shall be as set out hereunder:

<table>
<thead>
<tr>
<th>Annual Subscription</th>
<th>$</th>
</tr>
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<tbody>
<tr>
<td>Fellowship</td>
<td>30.00</td>
</tr>
<tr>
<td>Associateship</td>
<td>20.00</td>
</tr>
<tr>
<td>Graduateship</td>
<td>13.00</td>
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<tr>
<td>Student</td>
<td>3.00</td>
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<tr>
<td>Subscriber</td>
<td>6.00</td>
</tr>
</tbody>
</table>

SUCCESS AT BRANCH MEETINGS

A discussion was held at the last Council Meeting on what factors make for success at Branch meetings. It was quickly apparent that Branch Committees know little of what is going on in other Branches in Australia. Consequently, Branch Chairmen are to be approached to find out any features which have been particularly successful in their meetings. Thoughts which come to mind include panels, debates, specialist or broad topics, the standing of the speaker, non-physics speakers, and controversial matters. No doubt there are others.

The purpose of this letter is to invite individual members of the AIP to advise me directly of what attracts them to meetings. It must be distinguished very clearly between what features have attracted the member to meetings in the past, as distinct from what might attract him or her in the future.

If sufficient replies are received a brief analysis will be made for the Australian Physicist. Individual replies should be dictated, typed or scribbled to:

Professor C. Ellyett,
Newcastle University,
NSW, 2308.
before 30 September.
NUCLEAR AND PARTICLE PHYSICS GROUP

A survey of potential members of such a group produced a favourable response from 112 physicists distributed as follows: VIC—32, NSW—24, ACT—18, QLD—5, SA—9, WA—3, NZ—21.

Following approval by the AIP Council a draft Constitution and Rules has been drawn up and plans made for circulation of a Newsletter and the holding of a Vacation School in May 1973. Anybody interested in participating in the Group activities should contact the Honorary Secretary of the Interim Committee—Dr M. J. Kenny, AAECRE, Sutherland, NSW 2232.

POSTGRADUATE TRAINING

UNIVERSITY OF SYDNEY

School of Electrical Engineering

There are several extensive research programmes in the School where graduates with a basic physics training have made major contributions. There is active interaction amongst these programmes and collaboration with other organizations is encouraged. The programmes are summarised as follows:

COMMUNICATIONS

Radio Astronomy

In the School of Electrical Engineering radio astronomy has found an important place in the postgraduate activity in as much as it provides a field in which the most advanced radio techniques can be developed.

At the Fleurs Field Station of the School some very large radiotelescopes have been constructed by staff and research students. One of these, recently completed, operates at a wavelength of 21 cm, is 1 km in extent and provides higher resolving power (40 seconds of arc) for southern sky observations than any other radiotelescope. The 128-channel receiver recently completed is one of the most advanced and complex in existence. There are plans to improve still further the resolving power and sensitivity of this instrument.

The second large instrument operates at a wavelength of 10 m and several other projects are planned for the future.

The radio astronomy group has close relations with the radio astronomy organization in the Netherlands and there has been a considerable interchange of staff between the Sydney University and the Leiden Observatory. In addition to this, the Schools of Electrical Engineering and Physics of Sydney University and the School of Electrical Engineering of Cornell University have formed a Research Centre for scientific cooperation and for the interchange of research staff.

Navigation Aids for Civil Aviation

A one-thirtieth scale model of an airport plus the antennas which are used to transmit radio courses for the guidance of landing aircraft have been constructed at Fleurs Field Station. The system has been comprehensively tested and operates more accurately than any known real-life system. A thorough investigation of antenna systems in common use is being carried out.

A study of radar 'angels', spurious returns which are thought to be caused by meteorological effects, birds and even insects, has commenced.

Ionosphere Research

A VHF polarimeter is installed at Fleurs Field Station and is used to measure continuously the Faraday rotation of signals from a stationary satellite.

Data-processing programs have been developed to enable the raw data from ionospheric backscatter observations made at Arecibo to be processed by computers in Sydney. A study is being made of the variations in electron density, electron temperature and ion temperature, as functions of height and time.

A large collection of data on travelling ionospheric disturbances has been accumulated in the laboratory. A reappraisal of some of this data is presently being undertaken.

ELECTRONICS & ACOUSTICS

Receiver Systems and Signal Processing

Development work is continuing on electronic systems for radiotelescopes. This includes the design of local oscillators and pump sources and extension of the work on low noise amplifiers. A 100 MHz bandwidth, IF polarimeter is being designed for use on a large disk-type radiotelescope.

Audio Systems

The design of high-quality audio systems is being investigated, including low-distortion amplifiers and wide-range speaker systems. Performance of cone type speakers in both sealed and vented boxes is being assessed and the transient behaviour of speaker systems investigated.

Pattern Recognition

The classification of targets in the far field by patterns in the reflected acoustic waves is to be investigated. The research involves theoretical investigation and implementation of an experimental system. A real-time computer is used both to enable signals to be extracted from the noise and reverberation that is present and to subsequently process the data.

PLASMAS, ENERGY CONVERSION & POWER

Plasma Engineering

A number of projects concerned with the production and applications of very high temperature plasmas are
being carried out. These include work with high-
power RF plasma sources, fast electric shock tubes,
chemical plasma reactors and an MHD generator.
Instrumentation available includes high-speed rotating-
mirror and framing cameras, several multipurpose
spectroscopes together with a variety of test gear for
optical, high-frequency, high-pressure and vacuum
work. Facilities are also available for manufacturing
high-temperature and other specialised components,
ceramic spraying, etc. Close associations exist with
Chemical and Mechanical Engineering Departments of
this University.

The major facility used in this work is a 50 kW RF
plasma generator and work on transport properties and
chemical processing, using static-plasma columns, is in
progress. The device is also being used in connection
with studies of shock collisions, reflections in plasma
and refractions at plasma boundaries. The MHD generator
studies are based on work using a 40 kW electric arc
torch and the major interest is concerned with surface
layer and plasma-electrode effects.

Electric Arcs and Circuit Interruption

Two synthetic-test facilities of 35 kJ and 150 kJ
capacity are available for high-current arc studies and
for proof testing of specialised high-power commercial
equipment. A wide range of high-speed optical and
other test equipment common to the plasma engineering
work is used for diagnostic purposes. Close association
exists with staff from the Mechanical Engineering
Department of this University and the Electricity
Commission of NSW.

The work is concentrating on high-pressure arcs,
blasts under unconfined conditions as well as under
the influence of a magnetic field and in tubular
confinement. Effort is also concerned with vacuum arcs
and triggered vacuum gaps.

Power System Simulation and Control

A central part of the research activity in power
systems is concerned with their behaviour under
abnormal conditions and the extent to which modern
control theory, including direct digital control and
optimal control, can alleviate these conditions.

CONTROL AND COMPUTERS

Computer Systems

The development of the ARCTURUS computer
control system is continuing. A number of hardware
features have been introduced so that ARCTURUS
may operate efficiently in a multi-user, realtime
environment. The peripherals which have been interfaced
with the computer include a 7M-word disc file, tele-
types, paper-tape reader and punch, a special-purpose
digital controller and a small hybrid computer.

Faculty of Engineering Data Acquisition and Control
Facility

This facility is located in the School and is being
used for on-line, real-time data acquisition and control
of a number of large-scale research experimental units
in the Faculty. The facility contains two PDP11
computers, an electrostatic printer/plotter, a disc and
other peripherals. Data links enabling the facility to
communicate with equipment in other departments
and with the Fleurs radioastronomy field station are
being constructed.

Circuit and System Theory

Theoretical investigation of the synthesis of multiprot
active networks is being undertaken, seeking procedures
which yield the minimum number of elements of each
type. An experimental study is being made of the
sensitivity of a certain class of networks to component
tolerances. Theoretical work concerned with energy
conversion statics, a new approach to the analysis of
physical systems, has continued. The possibility to
combine energy conversion statics and concepts of
irreversible thermodynamics has led to important
basic conclusions.

Postgraduate scholarships are normally supported by
Commonwealth and University of Sydney Scholarships
and others. Graduates with a good Honours degree in
Physics can enrol for MEngSc and PhD programmes,
others may be required to prepare for qualifying exam-
inations. Enrolment for the Master of Engineering
Science can also be on a part-time basis. Further
information can be provided on writing to the Head,
School of Electrical Engineering, University of Sydney.

NOTES AND NEWS

News from the ANU

Research School of Earth Sciences. Council has
approved the establishment of a separate School,
based on the present Department of Geophysics and
Geochemistry, probably in 1974.

Cyclotron Installation. A new 38 MeV proton
cyclotron is now operating, and will serve as injector for
the EN tandem accelerator.

Nuclear Physics. Professor J. O. Newton is visiting
laboratories in UK and USA to study heavy ion prob-
lems and to inspect equipment being built for the
Department. He will return in September.

Power Generation—Old and New

The Victorian Division of ANZAAS with the Mel-
bourne University Graduate Union have arranged a
series of discussions on this topic to be held on 30 August
and 6, 13 and 20 September.

Physics of Photosynthesis

This is the title of the conference address at the Hobart
Conference on Physics and Engineering in Biology and
Medicine and will be given by Prof. A. B. Hope
(Flinders).

It is also hoped to arrange a seminar during the
conference on the training and employment of bio-
physicists and medical physicists.
National Committee for Physics

The Council of the Academy appoints a National Committee for Physics whose function is to maintain contact with the International Union of Pure and Applied Physics and to advise the Council on Australian participation in the work and affairs of the Union. The present committee, which has recently been appointed for a three-year term, is: Dr J. S. Dryden (Chairman), Professor H. A. Blevin, Professor H. C. Bolton, Dr R. W. Crompton, Dr A. G. Fenton, Professor N. H. Fletcher, Dr J. de Laeter, Professor R. W. Parsons and Professor R. Street (representing the Institute).

Scientific Sessions of the 14th General Assembly of IUPAP


The US National Committee are inviting physicists in addition to those acting as delegates to the Assembly to attend these lectures.

Atomic Energy in Australia

The April issue of this AEC quarterly includes articles on Neutron Diffraction Facilities at the AAECRDE, Radioactive Series Disequilibrium in Uranium Economic Geology, A New Technetium Generator for Medical Diagnosis, A Review of the Activities of the Society for Nuclear Medicine, Intensification of Faded Photographs and Underexposed Negatives Using Radioisotopes, and a list of AAEC Research Contracts (1971).

Australian PhD Theses—1971

Degrees were awarded by the School of Physics (RAAF Academy) at the University of Melbourne to:

Philip A. Morgan—Electrification of fair weather free atmosphere;

W. R. Rawlinson—Gamma-ray astronomy;

J. A. Bennett—the application of variational techniques to radio propagation in the ionosphere.

US Trade Centre Exhibitions (Sydney)

Burroughs, Electronic and Computer Equipment (28 Aug.-1 Sept.); B.S. & B. Engineering, Industrial Pollution Equipment (6 Sept.); Schlumberger Instrumentation (11-14 Sept.); NS Electronics (5-6 Oct.); Electronics Exhibition (6-16 Nov.).

Electronics in the ACT

The IREE is holding a conference and exhibition in Canberra on 30 Aug.–3 Sept. Applications in Astronomy, Measurements, Instrumentation and Control, Television and Satellite Teaching will be included. Further information from PO Box 744, Canberra City, 2601.

Committee on Overseas Professional Qualifications

A new expert panel to study degrees in arts, economics and general science has been established. The Chairman is Professor K. C. Westfold of Monash University. (See AP May 1972.)

Mass Spectrometry Conference, Melbourne 1973

The Australian and NZ Society for Mass Spectrometry will hold its second conference at The Victorian College of Pharmacy on 12–14 Feb. 1973. Notice of papers on chemistry, GC-MS, data processing, isotope analysis, instrumental techniques or ion optics should be sent before 31 August 1972 to the Secretary, Mr P. R. Sadesky, Perkin-Elmer Pty Ltd, PO Box 216, Glen Waverley, Vic. 3150.

Micro-electrodeion

A discussion of the effects of direct application of small currents to the heart and other internal organs was held in May by the NSW Society for Medical and Biological Engineering. The redesign of equipment, power supplies, and catheters was discussed.

BOOK REVIEWS


Reviewed by W. A. Daume, C.S.I.R.O. Division of Chemical Physics, Clayton, Vic.

This monograph is very clearly written and the mathematical sections are exceptionally easy to follow. It deals in great detail with the application of Fourier methods to the solution of crystal structures and should be of interest to crystallographers who wish to push Fourier methods to their limit.

The application of Fourier methods to diffraction, crystals and crystallographic problems is clearly described as are the Patterson and various Patterson-type syntheses. Image seeking functions are also simply explained. The alpha, beta and gamma syntheses which assist in the deconvolution of the Patterson synthesis for partially known structures are described at some length, and the use of isomorphous replacement and
anomalous scattering are also explained in detail. Little is mentioned, however, of Fourier series used in neutron diffraction or those derived by direct methods.

Many diagrams and Fourier projections are included in the text which well illustrate the methods described and give the reader an excellent idea of the possibilities of the various procedures.


Reviewed by J. S. Dryden, National Standards Laboratory, Sydney.

This is not a text book on the dielectric properties of matter but consists of three long essays each by different authors. The first is on the theory of dispersion in polar dielectrics by B. K. P. Scaife, the second on the effect of hydrostatic pressure on dielectric properties by W. G. S. Scaife and the third, experimental techniques in dielectric studies by R. G. Bennett and J. H. Calderwood. These reviews may be of value to someone wishing to delve into recent literature on one of these subjects, but in my opinion the material in this publication will have limited value for teaching purposes. The part of the book dealing with experimental techniques covers bridge methods and measurements in transmission lines and waveguides with some mention of resonant methods. The concept and advantages of three terminal measurements could have been introduced with greater emphasis.


Reviewed by R. Hanbury Brown, Chatterton Astronomy Department, University of Sydney.

This book is based on a graduate course on cosmology given by the author in the Physics Department of Princeton in 1969. The first chapter is a short historical survey of the main questions and is written in terms of the period 1912-1950. The subsequent chapters discuss selected topics, homogeneity and isotropy of the Universe, Hubble's constant and the cosmic time scale, the mean density of the Universe, the primeval fireball, cosmological models, alternative histories of the Universe, and primeval helium. The writing is clear, well-informed, up-to-date and in parts is pleasantly ironic. I found the chapters on Hubble's constant, the mean density of the Universe and the primeval fireball particularly interesting. The book is written by a well-known theoretician, as a guide, mainly for experimentalists, to the principal topics of cosmology. It presupposes a considerable understanding both of cosmology and its mathematics; it is certainly not an intelligent layman's guide to the subject. For people who are deeply interested or actively engaged in the subject it is stimulating, informative and well worth reading.


Reviewed by W. H. Steel, National Standards Laboratory.

The original 'Atlas' had 45 pages of photographs of the more important optical phenomena, with explanations on the opposite page in English, French and German. This supplement has twelve pages of colour photographs of phenomena for which colour is an important aspect, and three pages of black-and-white photographs in the new field of holography.

For those who can afford it, this is a very useful collection for teaching optics; many of the experiments are not easy to perform. The book is very well produced, in fact, a work of art.

THE REGISTER

CHANGES IN MEMBERSHIP FROM 7 June 1972 TO 5 July 1972

Fellowship

New Election
Adams, C. A. Canberra, ACT

Associateship
(a) New Election
Rosalky, D. M. Australian National University, ACT
Shaw, R. J. Royal Melbourne Institute of Technology, Vic.

(b) Transfer
Shamsi, S. K. University of Karachi, Pakistan
(c) Reinstatement
Lokan, K. H. (O/S)

Graduateship
(a) New Election
Harwood, E. J. Attorney-General's Department, ACT

Lester, M. A. PMG Research Laboratories, Vic.
Smith, J. R. University of New South Wales
(b) Reinstatement
Aney, B. L. (Vic.)
(c) Resignation
Ramsey, G. A. (Vic.)

Students

New Election
Miller, C. D. (NSW) Percy, J. D. (Qld)

Subscriber
Resignation
Sinclair, V. A. H. (NSW)

128 The Australian Physicist, August 1972
CSIRO  DIVISION OF APPLIED PHYSICS

Applications are invited for the following vacancies within the Division:

RESEARCH SCIENTISTS

FIELDS: PHYSICS/ELECTRICAL ENGINEERING

GENERAL: The Division of Applied Physics is one of two Divisions which constitute the National Standards Laboratory located in the grounds of the University of Sydney. It is responsible for the establishment and maintenance of standards of measurement for mechanical and electrical quantities in Australia and is engaged in an extensive program of related research.

DUTIES: (1) The appointee will join a research group concerned with the development of precise standards and measurement techniques at microwave and high radio frequencies. Familiarity with modern digital computers and their programming techniques would be an advantage.

(2) The appointee will join a research group responsible for the maintenance of the standards of electric potential impedance and frequency. Research is aimed at improving the primary standards and developing new measurement methods, involving a wide range of modern physical techniques. A sound knowledge of electric circuit theory and electronic techniques is essential.

QUALIFICATIONS: A Ph.D. degree or equivalent qualifications, supported by satisfactory evidence of research ability.

SALARY: The appointment will be made within the salary ranges of Research Scientist or Senior Research Scientist:
$7,588-$11,631 p.a.

CONDITIONS: These are indefinite appointments which carry Commonwealth Superannuation benefits.

Applications, containing reference number 750/502, full personal and professional details and the names of at least two referees, should reach:

The Chief,
Division of Applied Physics, CSIRO,
University Grounds,
City Road,
CHIPPENDALE, N.S.W. 2008.

by 15th September, 1972.

University of New South Wales

PROFESSOR OF PHYSICS
or
PROFESSOR OF THEORETICAL PHYSICS

Applications are invited for appointment to one of the above chairs in the School of Physics. Applicants should have substantial experimental or theoretical research interests in some branch of physics. In the case of theoretical physics experience in solid state physics, surface physics or biophysics would be particularly welcome, although applicants with interests mainly in other fields will also be considered.

Other chairs in the School are held by Professor H. P. George, the present Head of School, and Professor H. J. Goldsmid. The new professor will organise and participate in teaching and research.

Salary—$15,368 per annum. Subject to the consent of the University Council, professors may undertake a limited amount of higher consultative work. The University reserves the right to fill any chair by invitation.

For details and conditions of appointment write to Appointments Office, P.O. Box 1, Kensington, N.S.W. 2033. Applications close 16th October, 1972.
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