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The Australian Physicist

EDITORIAL ADDRESS
The Editor, Australian Physicist
Box 363, Sutherland, NSW 2232
Telephone: (02)531-0111

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VIC Dr J. D. Cashion, Monash Uni., Clayton, VIC 3168
WA Dr R. de laeter, WAIT, South Bentley, WA 6102

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Reprints—printed separately, with any extra requirements by authors such as covers, special headings, etc.
LETTERS

Staff Secondment

SIR:— The cut-back in the expansion of Australian Government Research Laboratories and the proliferation of tertiary education institutions during the past five years has produced a serious dislocation of the distribution of research effort in the country.

In tertiary education institutions (particularly the CAE's) most of the staff are young and commencing their careers. They realise, very clearly, that research as well as teaching is an essential activity of an academic, however, they are frustrated by high teaching loads, lack of equipment and lack of technical support.

In the Government Laboratories the average age of the research staff is approaching 40. In many cases scientists would welcome an opportunity to teach. They are experts in their subjects and have a strong research background which keeps them up to date.

The AIP wishes to start a pilot scheme of staff exchange between education and research establishments. To make this work it must be administratively simple, require no special funding and be separate from sabbatical leave schemes, etc.

A convenient pattern would be exchange for 1 semester between staff at establishments in the same area on a secondment basis. No promotion prospects, superannuation and long service rights, sabbatical leave entitlements, etc. would be affected.

I invite scientists interested in this scheme to write to me. Do not be put off by possible administrative difficulties in secondment. If sufficient people show interest the Institute will negotiate directly with academic, public service and industrial employers.

—T.M. Sabine
New South Wales Institute of Technology,
Broadway, NSW 2007.

Promotion of Physics

SIR:— At the Adelaide AIP Congress held last year, Dr Ted Sandrock warned that unless Physicists were more active in promoting and publicising their discipline, Physics could go the way of Latin. Heeding Ted's warning, and on behalf of the Education Group of the AIP, I wrote to every Physics Department early last November, asking them to send to me any 35 mm. colour slides of Physics and/or Physicists in action. It was planned that the slides would be copied, and made available, for promotion and publicity purposes, to any Department wishing to use them.

At the time of writing this letter, only two Departments (Ballarat CAE and UNE) have been able to provide such slides. May I, through your column, remind other Departments of my request, and also invite individual members to contribute slides they may possess, or would care to take.

—P.T. Dobney,
Physics Department,
Darling Downs IAE,
PO Box 128, Toowoomba, Qld 4350.

Conference Report

RARE EARTHS

G.J. Bowden.
National Measurement Laboratory, CSIRO, Sydney.

The 11th Rare Earth Research Conference was held in Traverse City, Michigan during 7–10 October 1974. About 170 papers were presented in three parallel sessions dealing with (i) the physical properties of the RE metals and compounds (ii) industrial problems associated with the production of pure RE metals and oxides and (iii) bio-organic experiments involving RE ions.

The opening address was given by guest speaker Astronaut Harrison H. Schmitt on 'The Evolution of the Moon: 1974 model'. This address was followed by two review papers on the electronic band structures and magnetic properties of the RE metals by H.L. Davis of Oak Ridge National Laboratory and S.H. Liu of the Iowa State University. These authors noted that the electronic configuration of RE ions in the metallic state...
is more like (4f)\(^9\) (5d)\(^2\) (6s) than (4f)\(^9\) (5d)\(^3\) (6s)\(^2\). As a result the magnetic interaction between neighbouring RE ions is carried principally by d and not s electrons. Thus Liu's 1960 model of magnetism in the RE metals is presently being updated.

A large number of papers delivered at the Conference dealt with the properties of RE intermetallic compounds and in particular SmCo\(_5\) magnets. Dr. L. Martin of General Electric, Schenectady, described the properties of misch-metal-substituted SmCo\(_5\) and PrCo\(_5\) magnets which may replace pure SmCo\(_5\) magnets on a cost-effectiveness basis in many applications. In addition Martin described the performance of two prototype SmCo\(_5\) electric motors built for use in aircraft. Both motors produced 40–50 per cent. more torque than their heavier alnico counterparts. In private conversation afterwards Martin stated that General Electric is working on sixty applications of SmCo\(_5\) magnets. One of their most recent successes has been the development of an aircraft tachometer with a working life of 14,000 hours. This tachometer costs about the same as its alnico counterpart which has a working life of 2000 hours.

K.H.J. Buschow and collaborators from Philips Eindhoven gave an interesting paper on hydrogen absorption by several RE intermetallic compounds. For example LaNi\(_5\) can absorb and desorb hydrogen according to the equation

\[
\text{LaNi}_5 + x \text{H}_2 \rightleftharpoons \text{LaNi}_5 \text{H}_{2x}
\]  

where 0 < x < 6. The maximum value of x = 6 corresponds to a hydrogen density twice that of liquid hydrogen and so this compound is very suitable for hydrogen storage. Besides describing the kinetics of equation (1), for various intermetallics, Buschow described two novel uses for LaNi\(_5\). The first device was a noiseless 50 atmosphere hydrogen compressor with no moving parts, apart from a few pressure-operated valves. This involves cycling LaNi\(_5\) between room temperature and 140°C as illustrated in figure 1. The second application, known as the 'cold accumulator', employs LaNi\(_5\) to absorb hydrogen evaporating from a closed liquid hydrogen bath. In this way the pressure above the bath is kept constant so that the liquid hydrogen can be used as a constant temperature refrigerant until all the hydrogen is gone.

An amusing talk on the pressure induced electronic phase changes in SmS was given by Dr. A. Jayaraman of Bell Telephone Laboratories. Jayaraman argued that the Sm\(^{2+}\) ions in SmS abruptly convert to Sm\(^{3+}\) at 650 MPa. In popular terms a localized 4f electron is squeezed out of the ion into the conduction band. This electronic transition is accompanied by a striking colour change, from black to a brilliant golden lustre, as the SmS changes from a semi-conductor to a metal.

![Figure 1: Pressure-composition isotherms of La Ni\(_5\)H\(_{2x}\)](image)

Jayaraman reported that he felt like an alchemist when he saw the colour change for the first time. But alas, it was fool's gold since it disappeared when the pressure was removed.

The Conference honoured H. Spedding one evening with a special symposium presided over by A. Daane. Four of the speakers outlined some of the pioneering work carried out at the Ames laboratories and paid tribute to Spedding's contribution to RE research. Spedding himself traced out his fifty years in the field and expressed a great debt to G.N. Lewis who not only supervised his PhD but also profoundly influenced his view of science. He recalled that when Lewis was asked to define the limits of physical chemistry, he replied that to him, physical chemistry covered any field of science in which he was interested.

It is of course impossible in a brief review such as this to do justice to all the papers presented and there are some notable omissions. However mention must be made of the work by A. Clarke and J.J. Rhyne at the Naval Ordnance Laboratory on the enormous magnetostrictive properties of (RE) Fe\(_5\) intermetallic compounds. Deformations \(6\%\) as large as 0.3% have been achieved and Clarke noted that such distortions are accompanied by large changes in Young's modulus (150 per cent.) and the velocity of sound (60 per cent.). These materials therefore have potential as adjustable frequency resonators, filters and acoustic delay lines.

The Conference proceedings can be purchased from the National Information Service, US Department of Commerce, Springfield, Virginia 22151.

Price: Paper Copy $13.60. Microfiche $1.45
NOTES AND NEWS

A: General conferences designed to provide an overview of the entire field of interest to a Commission. Normally occurring at three-year intervals and with an attendance in the range 750 – 1500.

B: Topical conferences concentrating on broad subfields in the area of a Commission’s interest. Normally scheduled in the three years between type A conferences. Expected attendance in the range 300 – 600.

C: Special conferences on more specialized topics than in the case of type B conferences. Normally held in the years between type A conferences. Anticipated attendance in the range 50 – 200.

Commission on Thermodynamics and Statistical Mechanics – Fifth Conference “De la Physique Théorique à la Biologie” (C) – Versailles, France. June. Prof. M. Marois, Institut de la Vie, 89 Bd St Michel, Paris 5ème, France.


Commission on Cosmic Rays – 14th International Conference on Cosmic Rays (A) – Munich, BRD. 15–29 Aug. Prof. K. Pinkau, Max-Planck-Institut für extraterrestrische Physik, D-8046 Garching b. München, BRD.

Commission on Very Low Temperature – 14th International Conference on Low Temperature Physics (A) – Ouluniemi, Finland. 14–20 Aug. Prof. O.V. Lounasmaa, Low Temperature Laboratory, Helsinki University of Techn., SF-02150 Ouluniemi, Finland.


Commission on Semiconductors – International Conference on Amorphous and Liquid Semiconductors (B) – Leningrad, USSR. 10–16 June. Prof. A.R. Regel, A.F. Ioffe Physico-Technical Institute, 194021 Leningrad, USSR.


Low Lying Lattice Vibrational in Ferroelectrics and Superconductors (B) – San Juan, Puerto Rico, 1–4 Dec. Prof. M.I. Kay, Puerto Rico Nuclear Center, College Station. Mayaguez, Puerto Rico.

Commission on Particles and Fields – International Conference on High Energy Physics and Nuclear Structure (B). (Jointly sponsored with the Nuclear Physics Commission). Santa Fe, N.M., USA. 8–13 June. Prof. L. Rosen, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545, USA.

International Conference on Neutrino Physics (C) – Balatonfured, Hungary. 16–23 June. Prof. G. Marx, Department of Atomic Physics, Eotvos University, Budapest VII, Puskin Str. 5, Hungary.

International Symposium on Lepton and Photon Interactions at High Energy (B) – Stanford, California, USA. 21–25 Aug. Prof. J. Ballam, SLAC, P.O. Box 4349, California 94305, USA.


2nd International Conference on Clustering Phenomena in Nuclei (B) – College Park, Md., USA. 31 Mar. – 4 April. Prof. H.D. Holinger, Dept. of Physics, Uniu. of Maryland, College Park, Md. 20742, USA.

Sixth International Conference on Cyclotrons and Their Applications (B) – Zürich, Switzerland. 19–22 Aug. Prof. J.P. Blaser, Physikalisch Ins., Gloria Strasse 35, 8006 Zürich, Switzerland.

4th International Symposium on Polarization Phenomena in Nuclear Reactions (B) – Zürich, Switzerland. 25–30 Aug. Prof. W. Grubler, Lab. for Kernphysik, ETH, Zürich, Switzerland.

Atomic Masses and Related Constants Commission – 5th International Conference on Atomic Masses and Fundamental Constants (B) – Paris, France. 3–7 June. Prof. W.H. Johnson, School of Physics and Astronomy, Univ. of Minnesota, Minneapolis, Minnesota 55455, USA.


Atomic and Molecular Physics and Spectroscopy Commission – 2nd Laser Spectroscopy Conference (B) – Megève, France. 23–28 June. Prof. J.C. Pibay-Peyroula, Université Scientifique et Médicale de Grenoble, Lab. de Spectrométrie Physique, B.P. 53, 38041 Grenoble Cedex, France.

9th International Conference on the Physics of Electronic and Atomic Collisions (B) – Seattle, Washington, USA. 24–30 July. Prof. R. Geballe, Dept. of Physics, Mail Stop BJ-10, Univ. of Washington, Seattle, Washington 98195, USA.

4th International Conference on Beam Foil Spectroscopy (B) – Gatlinburg, Tenn., USA. 15–19 Sept. Prof. I.A. Sellin, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tenn. 37830, USA.
Other Conferences

**Courses in nuclear science**

The Australian School of Nuclear Technology will run the following courses in 1975 in addition to those previously listed.

- Radioisotope Course for Non-Graduates, No. 18, 15 Sep – 3 Oct.
- Radiocarbon Course in Medicine and Biology, No. 3, 10 Nov – 5 Dec.

Details are available from The Principal, ASNT, Private Mail Bag, Sutherland, NSW 2232.

**Thermo Fluids Conference 1975**

A conference on Energy: Transport, Storage, and Conversion will be held in Brisbane on 3–5 December, 1975. The topics covered are fuel policy, transport of fuels and energy, alternative forms of storage, and the whole range of conversion devices. For details, contact Thermo Fluids Conference, The Institution of Engineers, Australia, 157 Gloucester Street, Sydney NSW 2000.

**People and Institutions**

**Queen’s Fellowships in Marine Science**

Dr R.A. De Szoeks (Oregon State University) will study theoretical physical oceanography at a location to be determined. Dr J.D. Fenton (Imperial College) will work at Monash University on the effects of gravity waves of large amplitude on beaches and coastlines. Dr A.D. Short (Louisiana State University) will study sea-air-land interaction at Macquarie University. Dr R.H. Bradbury (CSIRO postdoctoral student at Dalhousie) will come to Sydney University to work on the numerical analysis of complex ecosystems.

**ANZAAS Medal**

At the January Congress, the ANZAAS Medal was awarded to Sir Frederick White for outstanding achievements as a scientist and administrator, and in recognition of his sustained interest in ANZAAS over 25 years. Sir Frederick was formerly chief of CSIRO Division of Radiophysics, then a member of the Executive of CSIRO, and served as Chairman of the Executive from 1959 to 1970. He has continued to act as an advisor to the Government on scientific matters.

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**Institute Affairs**

**THE REGISTER**

**CHANGES IN MEMBERSHIP FROM 12 NOVEMBER 1974 TO 12 DECEMBER 1974**

**Fellowship**

(a) *New Election*

Dallimore, P.J. Western Australian Institute of Technology

(b) *Transfer*

France, J.L.A. Monash University, Vic.

**Membership**

(a) *New Elections*

Barry, R.J. University of Sydney, NSW

Butler, J.M. University of Tasmania

Silverstein, R.B. Footscray Institute of Technology, Vic.

(b) *Transfers*

Harting, E. University of NSW

Kirby, J.A. Macquarie University, NSW

Oliphant, J.M. University of Adelaide, SA

Warren, T.J.H. Australian Atomic Energy Commission Research Establishment, NSW

(c) *Resignations*

Burke, M.J. (O/S) Quilty, J.H. (ACT)

Rumbold, B.D. (Vic.)

**Graduateship**

(a) *New Elections*


Bell, W.T. Australian National University, ACT

Botten, L.C. University of Tasmania

Johnston, R.G. Department of Science, ACT

Patterson, W.S. University of Tasmania

Robinson, G.R. University of Tasmania

Taylor, D.L. University of Tasmania

Turner, P.J. University of Tasmania

(b) *Transfers*

Abson, S.D. La Trobe University, Vic.

Collocott, S.J. University of NSW

Desplace, P. Bureau of Meteorology, Vic.

Horney, R.B. Monash University, Vic.

Hunt, A.J. CSIRO, Division of Radiophysics, NSW

Jenoyer, P.V. Department of Education, Qld

Kerr, I.R. Johnson & Johnson Pty Ltd. NSW

Moss, S.J. Department of Education, WA

Parkin, B. University of NSW

Scott, C.J. APO Research Laboratories

(c) *Resignations*

Pollard, L.E. (Vic.) Powell, W.D. (WA)

Smith, H.M. (NSW)

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Changes in Membership from 12 December 1974 to 12 February 1975

Fellowship
(a) New Election
Rand, R.E.
University of Western Australia

(b) Transfers
Boundy, W.S.
South Australian Institute of Technology

Brennan, M.H.
The Flinders University of South Australia

Edwards, P.J.
O/S

George, D.W.
University of Newcastle, NSW

Lawrence, R.
Western Australian Institute of Technology

(c) Resignation
Philip, J.R.
ACT

Membership
(a) New Elections
Alderson, A.L.H.
South Australian Institute of Technology

Greenhill, J.G.
University of Tasmania

Hornung, H.G.
The Australian National University, ACT

Kleppe, P.B.
Royal Perth Hospital, WA

Marzec, L.M.
Department of Education, SA

Smith, P.V.
University of New England, NSW

White, D.E.W.

Wood, N.R.
Australian Atomic Energy Commission Research Establishment, NSW

(b) Transfers
Denton, R.E.
Department of Education, SA

Field, D.W.
University of Adelaide, SA

Guy, I.L.
Macquarie University, NSW

Patt, G.J.
University of Melbourne, Vic.

(c) Resignation
Jesson, E.E.
(Vic.)

Malseed, C.F.S.
(Vic.)

Graduates
(a) New Elections
Ferris, R.H.
University of Tasmania

Griffiths, C.H.
Department of Education, WA

McKay, C.B.
Western Australian Institute of Technology

Ryan, D.A.
Department of Education, WA

Webb, G.M.
University of Tasmania

Wronske, S.C.
University of Tasmania

(b) Transfers
Department of Education, WA

Dorogy, S.
Kodak (A'asia) Pty Ltd, Vic.

Edwards, I.K.
La Trobe University, Vic.

Flint, F.H.
Royal Perth Hospital

Katefides, M.
Department of Housing and Construction, NSW

Miller, C.D.
O'Connor, D.J.

Percy, J.D.
La Trobe University, Vic.

Szajman, J.
Watterson, R.L.

(c) Deceased
Swann, R.B.
(Vic.)

(d) Resignations
Campbell, S.J.
O/S

Cram, J.A.
(Vic.)

Hardy, L.D.
(Vic.)

Ward, R.A.
(NSW)

Colgan, F.J.
(U/S)

Hurnahan, F.M.
(Vic.)

Lemke, B.P.
(NSW)

Associates
(a) New Election
(b) Transfers
Wilson, J.W.
(Vic.)

Fyfe, I.K.
(NSW)

Jonas, M.S.

Students
(a) New Elections
Anan, S.J.
(Vic.)

Briggs, R.R.G.
(Tas.)

Miller, G.J.W.
(Vic.)

(b) Removals from Register under By—Law 20
Adams, J.G.
(Act)

Atkinson, J.E.
(Vic.)

Burnett, A.N.
(NSW)

Bondarenko, E.J.
(Vic.)

Charles, S.J.
(Vic.)

Collins, G.C.
(Vic.)

Doney, T.G.F.
(WA)

Gates, A.D.
(WA)

Hart, D.N.
(SA)

Anderson, R.A.
(Tas.)

Atkinson, A.R.
(Vic.)

Beithy, M.J.

Campbell, E.K.

Clark, A.G.

Cox, G.M.

Eden, S.C.

Hair, R.J.

Hemings, F.M.

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TWELFTH ANNUAL GENERAL MEETING

AUSTRALIAN INSTITUTE OF PHYSICS (Incorporated in Victoria)

UNCONFIRMED MINUTES

MINUTES of the 12th Annual General Meeting of the Australian Institute of Physics held in the Physics Department, University of Tasmania, Hobart, Tasmania, at 3:30 pm on Wednesday, 29 January 1975.

1. Attendance

1.1 Present

The Vice-President Dr J.G. Campbell, was in the Chair and the following 20 other members were present:

Clarke, G. Condello, R.L. Craig, A.G. Fenton, J.R. Fox,
J.E. Humble, R.G. Johnston, P.M. McCulloch, J.K.
Mackenzie, D.R.A. McMahon, G.L. Millar, I.A. Newman,
W.D. Parkinson, T.R. Peter, P.A. Stamford, M.D.
Waterworth, R.D. Watson.

1.2 Apologies and Proxies

Apologies were received from the President, Dr F.J.
Jacka (overseas), Dr J.L. Rouse and Dr B.I.H. Scott.

Ten members of the NSW Branch had appointed Dr
P.M. McCulloch to act as proxy.

2. 11th Annual General Meeting

2.1 Minutes

RESOLVED that the Minutes of the 11th Annual
general Meeting held in South Theatre 1, The Flinders
University of South Australia, Bedford Park, SA, on
Tuesday, 21 May 1974, as published in the July 1974
issue of The Australian Physicist be taken as read and
confirmed.

2.2 Business Arising from the Minutes

At the 11th Annual General Meeting two resolutions
were passed as follows:

1. That Council investigate the desirability of having
alterations to Articles of Association. Subscriptions
and similar issues, dealt with by a postal ballot of
all corporate members of the Institute, and report
their findings to the next Annual General Meeting.

2. That Council investigate the desirability of the
Institute moving towards a national, rather than the
present federal, structure, along the lines of the
structure of the Canadian Association of Physicists,
and report the result of their investigations to the
next Annual General Meeting.

The Chairman presented and elaborated on the reports
from Council as set out as “Notes to Agenda Item 3” on
page 233 of the December 1974 issue of The Australian
Physicist as follows:

With regard to Resolution 1, Council advises that all
issues are aired through publication in “The Australian
Physicist” and through the Branches, and feedback from
individual members has always been welcomed.

Furthermore Council believes that the provisions under
Article 38 of the Articles of Association for a plebiscite
to be called on any question are quite adequate. The
first two sub-clauses of Article 38 state:

PLEBISCITE

38. (1) The Council may if it thinks fit, and shall
on requisition, obtain the opinion of the
members on any question by taking a
plebiscite.

(2) Each requisition shall be signed —
(a) by at least one third of the members
attached to a branch;
(b) by twenty financial members; or
(c) by the ten financial members
demanding a plebiscite at a general
meeting under clause 35.

With regard to Resolution 2, Council believes that the
Institute is already moving in the direction outlined in
the resolution. The entire Membership Committee activity involving the assessment of professional qualifications and the assessment of standard of courses is on a national basis. The activities of the specialist Groups are national, as also is the idea of a National AIP Congress.

Whilst the concept of a national structure has much appeal, some Branches believe that there is a great deal of scope for the extension of local branch activity in assisting the development of Physics interests in the States' country centres. The present structure of the Council ensures that each State is represented on it, whereas the alternative of a truly national structure would involve the election of the whole of Council by the whole of the membership.

There was no discussion.

RESOLVED that the above reports from Council be accepted.

3. 12th Annual Report and Financial Statements

The Chairman introduced the 12th Annual Report and Financial Statements which had been published in the December 1974 issue of The Australian Physicist, and emphasised that the year had been one of considerable progress for the Institute. In particular the Institute had moved into the arena of public affairs in response to the invitation by the Hon. W.L. Morrison MP, Minister for Science, to comment and make recommendations on the establishment of an Australian Science and Technology Council and on science policy. The Institute had submitted views on contentious points, had made recommendations regarding the membership of the Australian Science and Technology Council and other advisory committees, and had set up its own Science Policy Committee in order to be better prepared for further involvement. At the National Congress in Adelaide last May the Institute made a big effort to involve industry and the community, and more needed to be done in that direction.

Turning to the financial aspects of the report the Chairman indicated that the steeply rising costs of running the Institute were causing very great concern to Council which wanted to maintain and improve the services to members. At the 23rd Meeting of Council in November 1973 it was resolved that "in view of variations in costs there shall be an annual review of, and appropriate adjustment to, the subscription rates, based on the change in costs and the change in the level of activity of the Institute, to be effective from 1975" (reference The Australian Physicist January 1974 : 15). This was subsequently debated at Branch level in terms of a 5 per cent. increase so that when the 1975 subscription was debated at the 24th Meeting of Council in May 1974, Council decided in fairness to members that the increase should not be greater than 5 per cent.

The Chairman continued that no-one foresaw the extent to which inflation was soon to rise and the 5 per cent. increase for 1975 was seen in retrospect to be a gross under-estimate. The Institute faced a deficit of $7000 during the financial year which would completely wipe out the Council-controlled reserves. Council therefore called upon the Branches to transfer half of their reserves. In 1976 the prospect of a 50 per cent. increase in subscriptions must be faced if the services are to be maintained, to cover the effects of inflation over a two-year period.

In the discussion that ensued it was pointed out that in November 1973 there had been a re-organisation of the joint office following the resignation of the Assistant Secretary and the withdrawal of the International Solar Energy Society from the joint administration. This left the AIP and The Australian Institute of Refrigeration Air Conditioning and Heating sharing the office, and as both had had steadily increasing membership and service demand, it had been agreed that each appoint its own Assistant Secretary and share other secretarial assistance. These changes together with increases in salary, printing, stationery and postal charges, had made the administration costs rise fairly substantially. The printing costs were unusually high because during the year there had been a large re-printing of forms and a re-printing of the Articles and By-Laws.

RESOLVED that the 12th Annual Report and Financial Statements be adopted.

4. Resolution Proposed by the Victorian Branch

The Chairman presented the resolution prepared by the Victorian Branch as follows:

"The Victorian Branch considers that the action taken by the Federal Council of the AIP in reducing the accumulated funds by half in the face of its financial difficulties to be opportunistic, and not to solve the long-range problems of the Institute; that for the next twelve months the Federal Council should direct that The Australian Physicist be published bi-monthly, to effect an estimated saving of $4000."

and added that in the comments made available to the Annual General Meeting by the Editor of The Australian Physicist, Dr J.R. Bird, it had been stated that the figure of $4000 should be $2000.

Dr P.M. McCulloch spoke on behalf of the Editorial Committee in opposition to the motion. He pointed out that the amended saving of $2000 by producing The Australian Physicist bi-monthly would be partly off-set by loss of advertising. Once the journal became bi-monthly it would be difficult to restore it to monthly publication. The Editor and his committee had cut costs dramatically in 1974 and in fairness to the committee it should be allowed to prove its plans for 1975 for providing a wider coverage and better service at the same time as keeping costs down.

In the discussion that followed it was recommended that Council continue to explore ways in which costs could be cut, but basically it was agreed that you only got what you paid for and with escalation of costs throughout the community it was not unreasonable to expect to pay an increased subscription.

The Motion was LOST. There was a solid vote against the motion, no vote for the motion, and two or three abstentions.

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5. Appointment of Auditor

RESOLVED that Maxwell Witherow and Company of 131 Queen Street, Melbourne, be appointed auditors for 1975.

6. Other Business

Dr A.G. Fenton asked what efforts were being made to increase membership, and the Chairman outlined the programme of inviting students to become members and companies to become company subscribers. He pointed out that an estimated 40 per cent. of physicists were members of the AIP which was a very disappointing figure.

It was not generally known that the AIP, whilst not wishing to become involved in industrial negotiations, had in fact made recommendations that membership of the AIP be accepted as a basic standard in certain industrial awards.

It was agreed that these activities of the Institute should be better publicised.

7. Declaration of Election of Executive

The Chairman then declared the next Executive Committee to take office until the 14th Annual General Meeting in 1977 as follows —

   President          Dr J.G. Campbell
   Vice-President     Dr T.M. Sabine
   Honorary Secretary Dr J.R. Pilbrow
   Honorary Treasurer Dr J.K. Mackenzie
   Honorary Registrar Dr J.L. Rouse

The Chairman expressed appreciation of the fine leadership of Dr F.J. Jacka, the retiring President, and paid tribute to the work of the retiring Honorary Secretary, Mr K.H. Clarke.

The meeting closed at 5 pm.

OBITUARY

DR W.W. MANSFIELD

Friends of Bill Mansfield will be saddened to hear of his death on the 31st December, 1974, after a short illness. Bill had a long and distinguished career in the CSIRO. He joined the physical chemistry group of the Division of Industrial Chemistry in January 1946. Although he was then only 21 years of age, he had completed an Honours (1st class) BSc, and one further year of research at the University of Adelaide.

His first project with CSIRO was concerned with improving the methods of wool-scouring, and he was able to make a number of useful contributions to this process. In 1951 he worked for a year with the late Professor A.E. Alexander at the NSW University of Technology. Soon after his return to Fishermen's Bend he commenced work on the control of evaporation from water storages in hot, dry locations — a project which established his scientific reputation. He was able to show that a monomolecular film of hexadecanol when spread over the surface of the water storage, was the most efficient method of evaporation control when a number of factors such as cost, effectiveness and minimum pollution were considered. From 1962, Bill Mansfield spent a considerable amount of effort (in conjunction with an industrial research and development group) in modifying the method to improve the performance on smaller water storages.

After the Torrey Canyon disaster in the English Channel, the Australian Government convened an interdepartmental committee to develop a national plan to handle oil pollution to coastal waters from damaged oil tankers. Bill Mansfield was co-opted onto the committee and tackled the problem with enthusiasm. He carried out a number of laboratory experiments and then took part in some small field trials held in the Great Australian Bight. He was invited to give evidence at the Royal Commission examining the possible consequences of oil-drilling on the Great Barrier Reef.

Early in 1967, Bill Mansfield learned of the postulated existence of a new and more stable form of water, often to be described as polywater. He realized that the behaviour of this postulated species of water was inconsistent with the second law of thermodynamics and reasoned that the observed behaviour must be the result of experimental artefacts. He set out systematically to repeat many of the experiments that had been described in the literature. He correctly found that traces of silicates or lactates (from sweat) were responsible for the experimental observations. Unfortunately, he was a few months too early with this result and found the scientific journals unwilling to accept his papers, with the result that later investigators received most of the credit for these discoveries.

About 1970, Bill Mansfield began to consider the importance of the methods of physical chemistry (on a grand scale) to the study of the environment. He prepared a research proposal for the study of the distribution of CO₂ and other molecular species, in the atmosphere and their transfer to the oceans and to the soil. Bill transferred in June 1974, to the Division of Atmospheric Physics at Aspendale, in order to facilitate work on this project, which he described as atmospheric and oceanic chemistry.

Bill Mansfield believed it wrong to seek self-glory and worldly honours but moderated his position a little to obtain a DSc from the University of Adelaide, and to be elected to fellowship of the RACI and the AIP.
EXPLORING THE MILKY WAY

B.Y. Mills
Chatterton Astrophysics Department, University of Sydney.

Text of Pawsey Memorial Lecture presented at Brisbane on 15 October 1974

On any clear moonless night a faint irregular band of light several degrees wide is visible somewhere in the sky. This is the Milky Way comprising billions of distant unresolved stars which form the Galaxy to which our Sun belongs.

Exploration of the Milky Way began some three and a half centuries ago when Galileo first pointed his crude telescope at the faint luminosity and showed that under sufficient magnification it was resolved into innumerable stars, the vast majority too faint to be seen by the naked eye. The basis of our modern understanding was laid more than two centuries ago by Thomas Wright who suggested that the stars are distributed in a vast disk-shaped system which we are viewing from near the centre. The closest stars are seen distributed more or less uniformly over the sky, the very distant stars appear only as the undifferentiated band of faint luminosity.

This idea was taken up by the Herschels, father and son astronomers of the late 18th century, who made 'star counts' in different directions. If space is transparent and the stars are distributed with a constant spatial density then the extent of the system in any direction is proportional to the cube root of the number of stars in a given solid angle. The Herschels also concluded that the Sun is located near the centre of an irregular disk-shaped system of stars. Their results were qualitatively right but quantitatively quite wrong because space is not transparent as they assumed, but large quantities of 'dust' or 'smoke' are distributed among the stars in an irregular way. This dust dims the distant stars in all directions and blocks them out entirely in others and so we cannot hope to explore the whole system by optical observations alone. We are in a fog and, close to the plane of the Galaxy, can see only our immediate surroundings.

The general pattern of the system may be deduced from the form of similar very distant systems photographed with large telescopes, but these come in many shapes and sizes and it is not easy to decide which type represents the Milky Way Galaxy. Its general appearance suggests that the Milky Way is a spiral system. Compare, for example, in Fig. 1 the photograph of a typical spiral galaxy, seen edge-on with a 'whole sky' view of the Milky Way. Given this as a starting point we may attempt to determine the basic parameters of the system, its size and overall shape, mass and spiral structure.

But this is not all, there is a great deal to a galactic system besides the visible stars and the obscuring dust. Large optical telescopes reveal also vast clouds of ionized hydrogen (known as HII regions or emission nebulae) and expanding filamentary nebulae, the results of ancient stellar explosions (known as supernova remnants). Radio telescopes tuned to the 21 cm spectral line of atomic hydrogen show that the whole system is permeated by hydrogen atoms which comprise a significant proportion of the mass of the Galaxy and are organized into long streams of gas clouds forming spiral like features. In general radio telescopes are not affected by the dust which impedes the optical observations and can also observe HII regions and supernova remnants throughout the whole Galactic system. They detect the radio emission of the general flux of cosmic ray particles spiralling in the Galactic magnetic fields and the regular clock-like pulses of the rapidly spinning neutron stars known as 'pulsars'. Other less direct information about the Galaxy is carried by cosmic ray particles whose energy spectrum and galactic structure he joined the School of Physics of Sydney University as a Reader in 1960, accepting the opportunity to build up a radio astronomy group in the School. With financial assistance from the University's Nuclear Research Foundation and the U.S. National Science Foundation he and his group constructed a giant "Mills Cross", a very successful type of radiotelescope which he had developed while in CSIRO. This instrument was completed in 1967 and has been used subsequently for many studies of extra-galactic radio sources and the Milky Way.

Mills was appointed a professor and head of the Astrophysics Department in 1965. He obtained the DScEng degree from Sydney University in 1959 and was elected a Fellow of the Australian Academy of Science also in 1959, and a Fellow of the Royal Society in 1963. He was awarded the Lyle Medal of the Australian Academy of Science in 1957 and shared the Australia Britannica Award for Science in 1967.
Finally, several experiments have been made to detect gravitational radiation which is expected to arise from sudden redistributions of mass such as might occur in the collapse of stars.

However, the results are conflicting and no firm conclusions are possible at the moment.

Types of Observation

The above results are obtained with a very large variety of telescopes, each kind of telescope contributing its own quota of information. For example, the most important single piece of information is the absolute scale of the system. This is obtained entirely from measurements with optical telescopes, by triangulating on close stars using the earth's orbit around the sun as a baseline or even the sun's own motion over several years for longer baselines. Thereafter one steps out to greater and greater distances using features of the stars which are related to their absolute luminosity, for example their spectral classification or, in the case of some variable stars, their period. Roughly, the Milky Way Galaxy is some 100,000 light years in diameter and the sun is near one edge at about 35,000 light years from the centre of the system. Thus the picture of a near central location based on simple star counts is entirely wrong.

The total mass of the system and its distribution can be derived by measurements of the velocities of stars as revealed by the Doppler shifts in their spectral lines. Radiotelescopes also contribute greatly to this exercise because the Doppler shift of the 21 cm line of atomic hydrogen can be measured throughout the central plane of the system. From the derived velocity field gravitational forces may be calculated and, if the size is known, the mass distribution follows. The total mass is about that of $10^{11}$ Suns.

Having thus obtained a general picture of the whole system we may enquire about its composition and its history. Here again the primary information is provided by optical telescopes. By studying the spectra of individual stars and nebulae within the optically accessible region one can obtain an enormous amount of information but it is not always directly interpretable.

For example, the chemical composition of the surface layers of a star may be obtained from the line spectrum in which individual elements may be recognised. However, it is not easy to obtain quantitative results because the temperature and density of a star's photosphere exercise a powerful influence on the form of the spectrum since they control the amount of excitation and ionization of the elements and compounds present. Extensive theoretical analysis is required to determine the actual composition. This has been done and the composition is found to vary somewhat between different classes of star, but in a way which can be satisfactorily explained in terms of stellar ages. Overall the most abundant element is hydrogen with helium present at about 1/3 this abundance by mass and the remaining elements comprising only about 2% of the total abundance. Thus the general cosmic

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Figure 1

Comparison of a whole-sky photograph of the Milky Way with a photograph of a typical spiral galaxy seen edge-on.
abundance of the elements is profoundly different from what we observe on earth and, some fifty years ago, before this was known, it was a major stumbling block in the development of a proper physical understanding of the stars.

Similarly the optical spectrum of the interstellar gas may be studied when it is close to a hot star. The ultraviolet emission is absorbed by the gas as a result of the photo-electric effect; the ejected electrons then heat the gas by collisions forming HI regions. Temperatures of the order of 5000 K to 10,000 K are usual, and a rich emission spectrum is produced. But the spectra produced are even more divorced from the element abundances than in the case of stars because there is a complete disequilibrium between the radiation and the temperature of the matter. Because of the low density of the gas, far lower than any laboratory vacuum, and the correspondingly low collision frequency, transitions from excited metastable levels of atoms and ions (notably O and N) become very prominent. These 'forbidden' lines yield valuable information about temperatures and densities but complicate the interpretation of abundance.

Nevertheless, it has been shown that all such spectra are consistent with the abundance derived from measurements on stars.

However, the interstellar matter is largely the preserve of radio astronomy and with radiotelescopes one can not only observe the visible HI regions but penetrate the dust haze and observe similar objects right through the whole system. The hot ionized gas radiates directly in the radio band and at short wavelengths HI regions are recognized as strong patches of emission with a characteristic 'flat' spectrum. That is, their brightness is independent of frequency. In Fig. 2 a photograph is shown of the Great Nebula in Orion on which are superimposed the contours of radio brightness. At long wavelengths they become 'black bodies' and their emission falls off according to the Rayleigh-Jeans law. At sufficiently long wavelengths (say > 10 m) the brightness of the radio background exceeds that of the nebulae and they appear as absorption patches distributed along the Milky Way - just like the dust clouds at optical wavelengths.

This continuum spectrum is not all, however. The interstellar medium emits a host of spectral lines at radio wavelengths. HI regions provide lines right through the short wavelength end of the band as the result of high quantum number transitions in the excited hydrogen atoms. These 'recombination lines' represent the n to (n - 1) or (n - 2) transitions where n is about 100. Other elements such as He and C may also be observed in this way. The recombination lines serve to give information about the temperature of HI regions and, where these cannot be observed optically, to identify a radio source as an HI region. Further information is obtained from the Doppler shift of the lines which measures the radial velocity of the nebulae. From a knowledge of how the Galaxy rotates the velocity may be converted to a distance and the distribution of the nebulae through the whole system may be determined.

The rotational curve of the Galaxy, which measures the rate of rotation as a function of the distance from the centre, is a fundamental property which is determined by studying the well known 21 cm line of atomic hydrogen. The hydrogen is distributed throughout the Galactic system and in any direction the line is spread out by the differential Doppler shift of different parts of the Galaxy; by studying the shape of the line as a function of the direction of observation it is possible to derive the complete rotation curve, at least as far out as the Sun. The region around the Sun and the outer parts, in which the dust is less pronounced is filled in by similar observations of stars. Having derived the rotational curve, one can then derive the three dimensional distribution of atomic hydrogen throughout the system although it must be admitted that there are many uncertainties and ambiguities in the interpretation of the observations.

These lines, the recombination lines and the 21 cm line, are the only spectral lines of hydrogen in the radio band. A few other elements are also detected by their recombination lines. However, the short wavelength end of the radio spectrum contains the spectral lines of many different molecules and this number is being added to at an enormous rate. Already more than 30 are known. The first to be discovered, some seven years ago was the OH radical which has a set of four lines around 18 cm. This discovery was not unexpected because oxygen is also a fairly abundant element and a simple two-element combination is not unreasonable. Now, however, increasingly complex molecules are found, including many organic compounds. How such multi-atom molecules can be formed and exist in significant numbers in the hostile environment of interstellar space is not yet understood, but the whole

Figure 2
The Great Nebula in Orion, an HI region, with contours of radio brightness superimposed.
subject of galactochemistry has suddenly assumed enormous importance. People are beginning to wonder if we are here observing the beginnings of life in the synthesis of the elementary building blocks of protein molecules.

But this is a diversion as my subject is the Milky Way system, so we will continue to look at some of the important components of the Galaxy revealed by radiotelescopes. Nearer the long wavelength end of the radio spectrum the most prominent radio sources are not the HII regions but the supernova remnants. These are formed from an expanding almost spherical shock wave in the interstellar medium which results from the enormous explosion which signals the death of a massive star. Concomitantly with the shock wave which sweeps up and heats the interstellar gas, electrons and positrons of relativistic energy produced in the original explosion are trapped by the magnetic fields associated with the expanding shock front. The combination of relativistic particles and magnetic fields produces radio emission by the synchrotron mechanism. The expanding shell of gas behind the shock front is also visible optically where it fluoresces under electron impact producing a characteristic filamentary appearance. In addition, the very hot gas inside the shell is detectable by the X-ray telescopes as a strong thermal emitter. Thus a star may leave its imprint on the interstellar medium to be studied long after it has ceased to exist.

A further result of many a supernova explosion is a pulsar. These produce regular clock-like pulses of radio emission and, in one case, pulsed optical and X-ray emission in addition. They are believed to be spinning neutron stars representing the collapsed core of the original massive star which exploded, and are extraordinarily dense with a mass like the Sun and a diameter measured in tens of kilometres. The radio pulse appears to be produced at each rotation, but the physical mechanism is uncertain. The Crab Nebula, a supernova remnant which also contains a very active pulsar is shown in Fig. 3.

Pulsars may be used to explore the interstellar medium. The arrival time of a pulse is different at different frequencies because of dispersion in the ionized interstellar medium and if we can determine the difference as a function of frequency it is possible to calculate the number of free electrons in a 1 cm$^2$ column between the earth and the pulsar. The distance of a pulsar can often be determined by association with a supernova remnant or by 21 cm hydrogen line absorption measurements, thus yielding the mean electron density along the line of sight.

Radiotelescopes may also be used to estimate the interstellar magnetic fields. This is possible by two direct methods, firstly, by measuring the Zeeman splitting of the 21 cm hydrogen line, which gives a direct measurement of the longitudinal component of the field. This method is confined to measurements of the fields in dense hydrogen clouds through which is seen a bright radio source. Secondly, the Faraday rotation of the plane of polarization of a polarized radio source is proportional to the product of the free electron density and the longitudinal component of the magnetic field integrated along the line of sight. Measurements of the polarization angles at different frequencies allow a vectorial mean of the field to be measured over long distances, thus complementing the first method. Optical measurements of the polarization of starlight gives a measure of the direction of the transverse components of the field.

Finally, the radio telescopes show the synchrotron radiation produced by cosmic ray electrons and positrons spiralling in the general magnetic field of the Galaxy. This widely distributed emission is shown in Fig. 4. It reveals the shape of the Milky Way and allows the magnitude of the magnetic fields to be estimated throughout the whole system from the intensity of the radiation. A particular feature is represented by the nucleus of the Galaxy, which is a powerful radio source (shown in Fig. 5) exhibiting a highly complex appearance and spectrum. In other galaxies the nucleus is often a centre of great activity and strong radio emission. In our own Galaxy it is relatively quiescent but many believe that in the past it may have been the scene of an explosive event of which we still observe traces.

If I have seemed to spend an inordinate proportion of my time discussing radio observations it is because these carry so much more information about the organization of the Galaxy as a whole. Were it not for the dust which limits the optical view this would not be the case.

X-ray astronomy also promises much but is still a subject in its infancy. I have already mentioned the observations of supernova remnants but, as an oddity not yet fully understood, I should describe the compact and often wildly fluctuating X-ray sources. These are believed to result from a binary stellar system in which one of the stars has undergone a supernova explosion and remains as an invisible very condensed object, either a neutron star or a black hole. Gas ejected from the primary star falls on the condensed companion where

![Figure 3](The Crab Nebula, a supernova remnant. The small arrow points to the stellar remnants of the explosion, a pulsar which also emits pulses of visible light.)
The large scale distribution of synchrotron radiation over the sky at a frequency of 150 MHz. It is plotted in galactic co-ordinates and shows the enhanced emission along the plane of the Milky Way.

it is compressed and heated, producing X-rays in the process. The X-rays sometimes have a pulsar-like modulation imposed on them which is believed to be due to a spinning accretion disk.

The Overall Picture

I have now described briefly and with many omissions the kinds of observations which are made of the Milky Way Galaxy and to conclude I would like to say a little more about the overall picture — how these observations are related to each other and what significance they have to the system as a whole.

There are some well-established features such as overall size and mass which have already been discussed. Similarly, the rotation velocity as a function of distance from the nucleus is quite well determined, as are the general three dimensional distributions of the various stellar and interstellar components. When, however, we try to investigate the details of these distributions we run into problems.

The spiral pattern is the most striking feature of many external galaxies but, while there are many indications of a similar pattern in the Milky Way, it is extraordinary difficult to find the 'Grand Design'. We cannot see the wood for the trees. In other galaxies we see that a spiral pattern is marked out by the hot massive stars, gas (ionized and unionized) and the dust lanes. In the Milky Way we might add less conspicuous objects such as supernova remnants and pulsars as both these are believed to be the end products in the evolution of massive stars. Unfortunately, it does not seem possible to completely reconcile all the results.

The optical data can give only the local distribution of spiral arm tracers and here there is clear evidence that hot stars and emission nebulae are concentrated in spiral-like streams. The radio emitters, notably the atomic hydrogen, can be plotted right through the Galactic system. However, uncertainties and ambiguities in distances make it difficult to assign definite positions and shapes to the spiral patterns which are suggested by the data, and there are even greater difficulties in joining the 'radio' spiral arms to the local 'optical' arms.

The Galactic nucleus as seen by a high resolution radio telescope at a frequency of 408 MHz. The mapped area measures 6 x 6.

A recent plot of the atomic hydrogen and supernova remnant distributions shown in Fig. 6 does show some agreement in places, but not enough to give us any confidence that we are really plotting out the spiral arms. Likewise, the background radio emission at the longer wavelengths of approximately 3m gives clear evidence of a spiral pattern. If we remove all obvious point sources and plot the brightness of the emission around the galactic circle we find, as expected, a maximum in the direction of the Galactic centre but as one looks away from the centre the brightness does not fall off smoothly but in a series of discrete steps. If these steps are interpreted as spiral arm tangential points, a regular spiral pattern may be fitted which agrees in many ways with other radio data, but it is not unique.

A theory of the formation of spiral patterns has been developed in which the hot stars condense in a self-perpetuating spiral density wave, formed gravitationally in a flat rotating system. The theory gives results which are similar to, but not identical with, the observational results. We therefore conclude that we are close to establishing a 'Grand Design' but the details and irregularities are probably causing confusion. It appears most likely that the Galaxy is a rather close-wound spiral (opening out at about 7°) and that the Sun is either in a main spiral arm or in a 'spur' close to the junction with a main arm. That is about as far as we can go at present.

Another very important component of the Galaxy, and one which is related to the spiral arms, is the magnetic field. As we have seen, it is only the longitudinal component which can be measured directly and then only in particular directions. One is restricted to...
estimates of relative values of the local transverse component and the absolute value of the field. Generally, it is agreed that the field is largely aligned along the spiral arms but with many irregularities. It is not really clear whether it forms closed loops or not and it has even been suggested that the local field within a few hundred light years of the Sun may have a helical structure. Conventionally the field is taken as approximately $3 \times 10^{18}$ T, but this is uncertain by a large factor and may be much stronger in the inner regions of the Galaxy. The actual value is quite important because the magnetic pressure may become significant in controlling the stability or even the formation of spiral arms if the field should be much stronger than the accepted figure.

A related problem concerns the origin of cosmic rays and their confinement to the Galaxy. Here again the magnitude of the field and the irregularities are important in determining what happens. It would be nice to know whether all cosmic rays are generated in the Galaxy, say, by supernova explosions or pulsars, or whether those of high energy are extragalactic in origin. At present we don't know.

Finally, when we consider the Galaxy as a whole we are faced with the problem of attempting to understand how the primordial gas condensed to a flattened rotating system, producing stars in the process, and how these stars evolved, producing what we see today. Now we observe the death throes of stars as they explode into supernovas. We also observe very dense and compact HII regions which presumably represent the interstellar gas condensing to form new stars. The theory of the evolution of a star is well advanced and the way nuclear reactions proceed and gradually synthesise the heavy elements from hydrogen through helium seems to be understood. However, we cannot say with confidence what was the chemical composition of the original gas, as the present composition represents a great enrichment of helium and heavier elements which have been ejected in supernova explosions. Observations of the very old stars which are distributed in the form of a spherical halo around the Galaxy help here. These show little of the heavy elements in their spectra and it does appear possible that in the primordial gas such elements were absent. However, present theories cannot account for the observed abundance of helium without assuming that it was originally present in substantial quantities. This in itself is strong evidence that the gas out of which the Galaxy was formed was at one time in a state of high temperature and density so that nuclear reactions could take place — when else but at the time of creation of the Universe?

To conclude, I have attempted to outline some of the investigations which are now being made in the vast physical laboratory, the Milky Way. There we find all conceivable physical processes and many I am sure that have not yet been conceived. The range of physical conditions enormously exceeds anything possible in a terrestrial laboratory but we are limited to sitting back and observing the effects — we cannot modify the experimental conditions.

To continue the exploration we must devise increasingly refined and, I am afraid, increasingly costly instruments. The present state of knowledge is far beyond the conceptions of astronomers of only 25 years ago — one wonders what it will be like in another 25 years.

**THE CALENDAR**

**May**

7 100 years of Oceanography, Sydney (Dr F.Y. Talbot; Royal Soc. of NSW).
21–23 15th Conf. on Physics in Medicine and Biology, Sydney (AIP Biophysics Group and HPA).

**July**

21–25 2nd ANZ Conf. on Geomechanics, Brisbane (Inst. Eng. Aust.)
28–1 Aug. IICA 75, Melbourne (Inst. Instrum. & Control, Aust.)

**August**

25–29 5th Int. Conf. on Atomic Spectroscopy, Melbourne (AAS)

Reviewed by J.F. Nicholas, Division of Building Research, CSIRO, Highton, Vic.

This book does not purport to be, and is not, a reference text for research laboratories. However, it does purport to provide an introduction to the subject for "senior undergraduates ... or those beginning research work in the field or related areas". As such, I can only say that I found it disappointing and that, if this were my first venture into the field, it might well be my last.

The overall approach is bland and the message conveyed is that, by and large, we know all about such surfaces apart from a few details that will soon be filled in. I looked in vain for details of exciting areas of controversy but found, for example, that the lack of an adequate theory for the intensity of LEED or RHEED beams is passed over in one sentence, "A satisfactory theory for ... intensities ... has not yet been completely worked out ... ".

The book has no author index, an omission not inconsistent with the author's policy of giving as few references as possible, apart from summary review articles. Incidentally, the heavy concentration of review articles in the 1967–69 period suggests that the book was effectively written well before its nominal date of 1973. The restriction on references leads to the omission of many notable names from the text or else to a brief passing mention, e.g. "... first used by Mykura", or a figure legend ending "(After R. Gomer,...)" with a reference. In a field as alive and changeable as this one, any acceptable introduction must refer to the people vitally concerned.

On the credit side, the book is well-produced, has very few typographical errors and, on my reading of it, few if any serious errors of fact.

A SIMPLIFIED APPROACH TO SOLID STATE PHYSICS, M.N. Rudden and J. Wilson, Butterworth & Co, London, 1971. $10.00 (hard cover), $6.00 (paper).

Reviewed by R.H. Farrow, School of Physics and Materials, NSW Institute of Technology, Sydney.

A description of the fundamental principles of solid state physics is clearly presented in this book. It is suitable for undergraduates majoring in life sciences, computing science, civil engineering etc. where only a qualitative understanding of the subject is required. The depth of treatment is uniform throughout the text.

Our understanding of the atom is presented historically up to the Bohr theory. The solution to the Schroedinger wave equation for a particle in a box is derived and the resulting discrete energy levels used to exemplify the concept of quantization. Treatment of the one-electron atom and periodic table is left to reference sources.

Discussions of the merging of levels into bands, the Fermi level and density of states are followed by the classification of solids, crystal structures, X-ray diffraction and defects. Approximately half the book is devoted to electrical and magnetic properties of solids with particular emphasis on semiconductor theory. The rectifier equation is derived for a p-n junction and the physics of the bipolar transistor, zener and tunnel diodes is given.

The text is well illustrated but no worked examples are given nor are there any problems at the end of each chapter. A chapter by chapter reference list is given in an appendix.


Reviewed by A.H. Morton, Department of Engineering Physics, Australian National University.

The authors of this volume have put together the material of two courses of lectures to produce a text book for graduate engineering students. The first five chapters constitute an introductory course in plasma physics, skimming over a wide range of topics in the field. Had allowance been made for material covered by students in undergraduate courses, such as Maxwell's equations and diffusion theory, there would have been room within the confines of 158 pages for a fuller treatment of material which would be new to them. For example Saha's equation, introduced with only an implicit requirement of thermodynamic equilibrium, could well be supplemented by some discussion of ionization in the absence of thermodynamic equilibrium. The seven chapters on applications of plasma physics treat a number of interesting topics, from plasma diagnostics to thermonuclear fusion through lasers to solid state plasmas, to a depth which is adequate to give students some idea of what each topic involves.

Written for engineers the book tends to be a collection of equations held together by a minimum of discussion, sufficient to indicate how things happen rather than why. It cannot be recommended as a text book for physics students. However if found on a library shelf it could serve to show the browsing physicist what Plasma Engineering is all about.
BOOK NOTICE


Most of this book (about 70%) is a bibliography on pyroelectricity covering the years from 1900 to early 1973. There is an abstract with each entry and several indices, one author and eight subject indices. The latter include "Data and Measurement Techniques", "Crystal Growth and Crystal Structures" and "Pyroelectricity in Biological Sciences". This bibliography is preceded by a chapter on the fundamentals of pyroelectricity which includes pyroelectric measurements and pyroelectric detectors of radiation, and a chapter on the long history of the subject which may begin 23 centuries ago and has many famous names of the last century associated with it. This chapter includes the references to the subject prior to 1900.

BOOKS RECEIVED

The following books have been received recently for review. Space limitations will probably not permit the publication of reviews or notices of all of them. Would anyone interested in reviewing a particular book please communicate with the Book Review Editor, G.A. Bell, National Measurement Laboratory, Chippendale NSW 2008.


IS LABORATORY WORK NECESSARY?

"Laboratory work and the teaching of physics" was the topic of a symposium organised by the Victorian Branch of the Education Group at Melbourne University on 20 September 1974. Discussion, led by Robert Wilkinson (Melbourne University), of the educational process and the changes it should produce revealed that laboratory work is necessary to the study of physics. Not all were agreed as to methods or amount.

Following dinner, four short papers concerned with the practice of laboratory work were presented. Jack McDonell (Monash University, Centre for Continuing Education) asked "Who decides on student needs?" and described how student, demonstrator and department could have strongly differing conceptions of the objectives of an experiment or a laboratory course. John Pilbrow and Rob Tobin (Monash University) discussed the need for students to interact with professional, practising physicists and described a first year service course for biology and medical students based on this need.

Jack Liesegang (Latrobe University) commented on the place of manuals and notebooks in the laboratory and the need for clarity of expression. Many of those present are still trying to understand John's opening sentence, which was a fine indictment by example. Finally, Charles Don (Caufield Institute) came out in favour of assessment of laboratory work by examination, and pressed home the point by showing a videotape of how not to run a teaching laboratory. The high degree of audience attention given to the TV screen indicates a pressing need for educational television in Melbourne - for the educators to watch!

The symposium had a greater tendency to pose questions than to provide answers. Perhaps there are no answers, but we all benefit from a sharing of experiences and opinions. - P.E. Clark.
EXECUTIVE
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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

SECRETARIES OF BRANCHES AND GROUPS

ACT Branch: Mr C.S. Newton, Dept of Nuclear Physics, ANU, Box 4, Canberra, ACT 2600.

NSW Branch: Assoc. Prof. D.H. Morton, Dept of Applied Physics, UNSW, Box 1, Kensington, NSW 2033.

Qld Branch: Mr T.G. Lewis, Physics Dept, QIT, George Street, Brisbane, Qld 4000.

SA Branch: Dr R.T. Cahill, School of Physics, Flinders University, Bedford Park, SA 5042.

Tas. Branch: Dr J.R. Fox, Dept of Physics, University of Tasmania, GPO Box 252C, Hobart, Tasmania 7001.

Vic. Branch: Mr J.D. Buntine, Applied Physics Dept, RMIT, 124 La Trobe Street, Melbourne, Vic. 3001.

WA Branch: Dr M.J. Lynch, Dept of Physics, WAIT, Hayman Road, Bentley South, WA 6102.

Biophysics Group: Mr L.D. Oliver, Physical Sciences Dept, Prince of Wales Hospital, High Street, Randwick, NSW 2031.

Education Group: Dr C.F. Gauld, School of Education, UNSW, Kensington, NSW 2033.

Nuclear and Particle Physics Group: Dr R.F. Barrett, RSPhysS, ANU, PO Box 4, Canberra, ACT 2600.

Vacuum Physics Group: Mr R.L. Turner, Tosco Pty Ltd., 391 Tooronga Road, Hawthorn, Vic 3122.

LATE NEWS

Analytical Chemistry Symposium

The Analytical Chemistry Division of the Royal Australian Chemical Institute will conduct the third Australian Symposium on Analytical Chemistry at the Chemistry Department, Melbourne University from 27–30 May 1975.

The Symposium will include plenary lectures by overseas scientists, contributed papers and an exhibition of instruments and books. Topics will include trace and ultra-trace analysis, electro-analytical techniques, atomic absorption spectroscopy, X-ray fluorescence and environmental control standards.

Further information can be obtained from Mr J.T. Gemert, Kodak (Australasia) Pty Ltd, Box 90, Coburg, Victoria 3058.

NSW Branch Meeting — May

R. Strettan will speak on Meteorology from Satellites at 7:45 p.m. on 13 May, at the School of Physics, University of Sydney.

Recent Appointments at the Queensland Institute of Technology.

Dr O.J. Wordsworth formerly Head of the School of Applied Science at the Queensland Institute of Technology, has been appointed Deputy Director (Academic) of that Institute. Dr Wordsworth had been Head of the Physics Department at QIT from 1968 until his appointment as Head of School last year. With research interests concentrated on the effects of ionizing radiation on mammalian tissue, Dr Wordsworth has recently extended his work to assess the effects of magnetic fields and ionizing radiation on rat liver and the transplantable Yoshida sarcoma. Dr Wordsworth is a Fellow of the Australian Institute of Physics and has held the offices of Vice-Chairman and Chairman of the Queensland Branch. He is currently on the Committee of the Biophysics Group. Dr Wordsworth is a member of the Queensland Radiological Advisory Council and the Australian Advisory Committee on Standards for Science Facilities in Independent Secondary Schools.

Dr B.W. Thomas, Senior Lecturer in Nuclear Physics at the Western Australian Institute of Technology, has been appointed Head of the Department of Physics at Queensland Institute of Technology. Dr Thomas's current research activities are in applied nuclear physics, particularly dosimetry, applications of radioisotopes to industrial problems and nuclear techniques applied to solid state and medical physics. Dr Thomas, a Fellow of the Australian Institute of Physics, has held the offices of Secretary-Treasurer, Vice-Chairman and Chairman of the WA Branch of the AIP.
THE AUSTRALIAN NATIONAL UNIVERSITY
RESEARCH SCHOOL OF PHYSICAL SCIENCES
SENIOR RESEARCH FELLOW/RESEARCH FELLOW
DIRECTOR'S UNIT

The Unit established by the Director of the Research School of Physical Sciences (Professor R. Street, FAA) is undertaking an expanding experimental research programme generally in Magnetism and Low Temperature Physics. The intention is that the Unit is to be flexible and designed to take advantage of new experimental opportunities as they arise rather than to develop long term continuing programmes. High magnetic field (up to 3T) solenoids and other supporting facilities are available.

It is expected that successful applicants will have a background of achievement in Solid State Physics and a mastery or a range of relevant experimental techniques.

Salary on appointment will be in accordance with qualifications and experience within the ranges: Senior Research Fellow $16,025 – $18,701 p.a.; Research Fellow $11,250 – $15,000 p.a. Salaries shown are subject to legislation to come before Parliament.

Appointment is normally for three years in the first instance with possibility of extension to give years.

Reasonable travel expenses are paid and assistance with housing is given for an appointee from outside Canberra. Superannuation is on the FSSU pattern with supplementary benefits.

The University reserves the right not to make an appointment or to make an appointment by invitation at any time.

Further information should be obtained from the undersigned, with whom applications close on May 7, 1975.

P.O. Box 4
Canberra, ACT, 2600

G.E. Dicker
Academic Registrar

GRiffith University
BRISBANE

SCHOOL OF SCIENCE
LECTURER – EXPERIMENTAL PHYSICS

Griffith University commenced undergraduate teaching in March 1975, and is committed to interdisciplinary teaching methods.

The appointee, in addition to second year teaching duties, will have a particular responsibility, in collaboration with existing staff, for the development of third year courses. The research interests of the School are presently in the solid state, magnetic resonance and biochemical genetics. The intention in making the present appointment is not necessarily to expand existing areas of research; candidates whose present interests are in any field other than nuclear or high energy physics will be considered. The appointee should be prepared to be associated with interdisciplinary research projects, in addition to pursuing his own research interests.

Applications are invited from men and women for this position, which closes on 17th May, 1975. The appointment will be from 1st February, 1976.

The current salary range is:

Lecturer: $11,250 – $16,100

Further details and the method of application for this post can be obtained from the School Administrator, School of Science, Griffith University, Nathan, Brisbane, Queensland, 4111.