The Australian Physicist

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NOTICE OF MEETING

Notice is hereby given that the 15th Annual General Meeting of the Australian Institute of Physics will be held at 7.30 p.m. on Tuesday 14th March 1978, at the School of Physics, University of Sydney.

AGENDA
1. Apologies and Declaration of Proxies
2. Minutes of the 14th Annual General Meeting
3. Business Arising from the Minutes
4. 15th Annual Report and Financial Statements
5. Appointment of Auditor
6. Other Business

Any member may appoint another financial member of the Institute as proxy, and written authorisation of such a proxy shall be in the hands of the Honorary Secretary at least three hours before the time set down for the commencement of the Annual General Meeting.

– J. R. Bird, Hon. Secretary

AMENDMENT TO BY-LAWS

Notice is hereby given to all members that at the 30th Council Meeting the following amendments were made to the By-Laws:

By-Law 26(2) amended to read as follows:
“The Council may in any special case reduce or remit the entrance fee, transfer fee or annual subscription, or the arrears of annual subscription of any member, Associate, Student, Subscriber or Company subscriber.”

By-Law 30 amended to read as follows:
“Any member, Associate or Subscriber who has
(a) been a member for 15 years or more and
(b) retired from his chief professional occupation and
(c) attained the age of 60 years; may on application to the Council and if Council thinks fit be granted retired status and pay no subscription. In special circumstances Council may waive clause (c).”

– J. R. Bird, Hon. Secretary
President’s Column

In my last column I referred to the retrenchment of a physicist and the action the Institute was taking. In collaboration with APSA, the Institute has sought legal opinion of this matter. The opinion given to us is that, as the physicist concerned has found a temporary position, he has a weak case for arguing that retrenchment has caused him considerable hardship.

These matters should be covered by the contract of employment and we have found, through Dr. J. G. Campbell, the immediate past-President of the Institute, that RACI is very conscious of these problems and has set up a joint committee with APSA to define responsibilities in these matters.

One of the main speakers at the RACI national convention next year will be Dr. Eric Parker, Secretary and Registrar of the Royal Institute of Chemistry in London. That Institute has given a lot of time to industrial relations. The RACI has suggested that they and the AIP have a joint meeting in Melbourne when Dr. Parker is here to establish close liaison in the approach of the professional scientists to industrial relations. The Executive proposes to participate in this meeting.

College of Physical Scientists in Medicine

An Australian College of Physical Scientists in Medicine was formed in 1977. The college is intended to be a top qualifying body which will eventually parallel the Medical Colleges. There will be two grades of Membership, Ordinary Member and Fellow.

The objects for which the College has been established include the following:

(a) to promote and further the development of the sciences of physics, engineering, mathematics, and computing, (hereinafter called physical sciences) as applied to medicine, to facilitate the exchange of information and ideas amongst members of the College and others concerned with medicine and subjects related thereto, to disseminate knowledge related to physical sciences and their application to medicine;
(b) to hold meetings of the College for reading and discussing material relating to physical sciences and kindred subjects;
(c) to promote and hold congresses on physical sciences and their applications in medicine and exhibitions of equipment and the like connected therewith.

The College is in the process of establishing an Australasian Association of Physical Scientists in Medicine, embracing members of the College and other physical scientists not immediately eligible for membership of the College. This structure has been discussed at the State level with members of the Hospital Physicians Association (Australian Regional Group) and the Biophysics Group of the Australian Institute of Physics and has received overwhelming support from these two groups which will each wind up on 31st December, 1977.

The College has six branches and interim chairmen from whom enquiries can be made as listed below.

NSW & ACT — Mr. D. E. Robinson, Ultrasonics Institute, 5 Hickson Road, Miller’s Point, NSW 2000.
QLD. — Mr. N. M. Proctor, Queensland Radium Institute, Brisbane Base Hospitals PO, Hurston Road, Brisbane, Queensland 4029.
SA — Mr. B. W. Worthley, Royal Adelaide Hospital, North Terrace, Adelaide 5000.
VIC & TAS — Mr. R. J. de Groot, Cancer Institute, 481 Little Lonsdale Street, Melbourne, Victoria 3000.
WA — Mr. R. Stanford, Royal Perth Hospital, Box X22B, GPO Perth, W.A. 6001.
Disposal of Nuclear Wastes — a Seminar in Hobart

Rob Underwood, Hydro Electric Commission, Tasmania.

BACKGROUND
The Tasmanian Branch saw two opportunities and a difficulty in responding to the Uranium Sub-Committee's call for action to inform public discussion. None of us were "experts" — but we would be less ignorant if we had to do the homework. As a first move, the Chairman placed a letter in the local papers offering factual answers about nuclear questions. Moving outside to interact with other professions was also seen as an opportunity, so we invited ourselves to a joint meeting with the local Branch of the Australian Geomechanics Society on their regular Monday date, in this case 12th September. About 100 engineers, geologists, physicists and "others" heard reviews by a local 5 man panel on the subject of "Disposal of Radioactive Wastes".

THE MEETING
The audience was interested to hear the physics but this report emphasises Geomechanics because this topic is probably less familiar to readers of the Australian Physicist.

Bruce Scott (AIP) laid the foundation with a résumé of the Effects of Radioactivity on Man. He defined the radiation units — including the impeding SI ones; listed typical and recommended maximum permissible doses and maximum permissible concentrations for occupational exposure; and summarised the effects of external and ingested alpha, beta, gamma and neutron-active substances. Although well enough known to physicists, this sort of information is much appreciated by non-physicists who may have difficulty digging it out of the literature.

Digging out information from the Fox Report is not quite elementary either, according to Frank Kinstler’s (Geomechanics) review, because facts are widely dispersed in quantities of guarded prose. The geomechanics of the proposed pits, waste dumps and tailings dams at Ranger is evidently fairly standard, but both gamma radiation from ore and dust, and random alphas, could exceed maximum permissible levels at some places in some conditions. The Fox report recommends positive steps e.g. filtered air to truck cabins, and 2 metres of water over the tailings. Offsite, the hazard is in the release of liquids. Fox recommends no release unless discharge is unavoidable, in which case the developer’s proposal for controlled release after a few years would apply. Activity in Magela Creek could then double and this would still be a low level, but the effect on the end of the food chain is of importance, as the aboriginal diet already reaches 8,000 picocuries radium/year, which is equal to the maximum yearly International Standard level.

Moving down the production process to the Nuclear Power Cycle and its Waste Products, John Greenhill (AIP) identified $^{85}Kr$, $^{90}Sr$, and $^{137}Cs$, as well as $^{239}Pu$, as having the highest relative hazard indices. Discussion centred not only on hazard, but also on the dangers of accidents, leakage and plutonium piracy, and on the timescale of decay — measured in the time taken for the wastes to return to an activity about equal to that of ore deposits. Extraction of the actinides to burn them up in thermal plus breeder reactors would reduce this time from millions to thousands of years. On the other hand, the much-to-be-desired avoidance of a "plutonium economy" would increase the hazard, the bulk, and the time span of the already very difficult waste problem.

It was a relief to turn from such uncertainties to the relative certainties of a geological topic. Bill Croser (Geological Society) was able to convince everybody that Groundwater and Radioactive Wastes shouldn’t be mixed. Any input of fluids into an aquifer raises the hydraulic energy of the system, which may result in discharge. But there were some compensations: volumes of aquifers were vast; the presence of hydrocarbons, for example, is evidence for containment over millions of years. Fluid velocities in suitable aquifers were very low. Some evidence suggested that $Pu$ and Cs would adsorb very completely onto apatite and clay minerals given the correct pH, so that there was the possibility that the speed of the activity front could be several orders of magnitude slower still. In discussion, it was pointed out that the persistence of mobile substances such as Helium in natural gas traps gave a hint as to what to do with that troublesome material $^{85}Kr$ — given a technique to separate it from ventilation air.

Luckily in this context, aquifers are a small proportion of all rocks, and the final speaker, geologist Gordon Hale (Geomechanics), advocated long term storage in dry stable rock masses — and the reactors themselves could go underground too. Rock can be in favourable conditions virtually joint free, or those joints that are met with are water-tight under rock stresses. Engineers often tunnel long distances in such rock. They can engineer caverns to stay open, or to close in controlled fashion. Hale claimed that, world wide, there were plenty of such rock masses, well below the influence of imaginable climatic influences, having low deviatoric stresses, that haven’t distorted for many millions of years. These would safely contain even actinide wastes. Eager discussion of this topic and of vitrification ensued. Hale repeated that there is no water moving in the sort of rock he advocated, either virgin or after tunnelling, so no material transfer with the external environment would occur, even if the first line vitrification and second line canister sealing were to fail. What was required was a serious attempt at engineering investigation of such a disposal plan. What was the worst alternative was what was being done at present — temporary surface storage.

QUESTIONNAIRE
The opportunity was taken to administer the questionnaire from the June Australian Physicist. Thirteen responded, the modal respondent being a 45 year old honours graduate engineer or geologist doing R and D in geosciences in the State Public Service, with no direct experience in the nuclear industry. He thought government should listen to the scientific community, but
paradoxically should give least consideration to the opinions of physicists, whose role was to inform and educate. Half of him believed benefits outweighed hazards because the power was needed, but this was not a factor for the other half of him, who thought wastes and proliferation were unacceptable hazards. He would prefer geophysical energy sources on both a medium and a long term basis, but expected to be using fossil and nuclear power at year 2000, with solar power in the long run. Every prudent option for the development of Australian Uranium, saving not only the only open export policy, was equally acceptable to him, but he didn’t favour enrichment in Australia (he may have confused enrichment with reprocessing). All energy options were under-researched in his opinion but solar was underfunded as well.

**CONCLUSIONS**

We discovered a strong desire to engage in discussion and debate about nuclear power amongst our mainly professional audience. They were very wary of “public debate” but responded to the structured “learned society” format we adopted.

As Physicists we learnt again that it is always worthwhile to reiterate even the commonplace of our discipline, when talking outside our profession. And that other professions also have mysteries no less abstruse than ours.

## Physics and History

Two recent meetings of the Victorian Branch have been concerned with the history of physics in Australia. At the September meeting, Professor K. C. Westfold, Professor of Astronomy at Monash University, described “Astronomy in Australia”. He traced its history from the opening of the Colonial Observatory in 1778 to the establishment of the Anglo-Australian Observatory in 1974. Early observatories were operated by State Governments in Sydney, Melbourne and Perth, and were concerned with solar astronomy, investigations of the minor planets and astrophysical work. The Commonwealth Government became involved much later, with the establishment of the Mt. Stromlo Observatory in the 1930s and CSIRO’s entry into Radioastronomy after World War II. The interest of State Universities dates from 1950, and ranges from radioastronomy through optical and ultraviolet to X-ray astronomy, but accounts for less than 20% of the present annual expenditure of $9 million. In discussing possible future developments, Professor Westfold emphasised the need for a national astronomical advisory committee to advise ASTEC on priorities for expenditure on new facilities. During the discussion, he expressed his opinion that specific training in astronomy should be at post-graduate level, after a sound foundation in physics, chemistry, mathematics, spectroscopy and information science.

In October, Dr Ann Moyal, Director of the Science Policy Research Centre at Griffith University, spoke on “University Research in Nineteenth Century Australia”. When Chairs in mathematics and science were established in Australian universities in the 1850s, academic opportunities in Britain were limited and many excellent young graduates became our first professors. The universities saw their role as the production of trained men with a liberalizing education; therefore they had a strong respect for learning together with a commitment to serving the industrial society. It has been claimed that early Australian academics served an apprenticeship here before being permitted to return to England to do their real scientific work. However, Professors such as Lamb, Bragg, Lyle and Mason did excellent research in Australia, while carrying heavy teaching loads. The early 1900s brought a lack of funds for research facilities, forcing the universities to concentrate on teaching. This in turn provided the impetus for setting up the CSIRO, which was seen by its first Secretary, David Rivett, as “the ultimate university”. It was not until after World War II that the standard of scholarship in the universities matched that of the 19th century professors.

The relation between universities and CSIRO is now in need of reappraisal. In a very lively discussion, support was expressed for closer collaboration between them, but strong and divergent opinions were expressed about the relation between research and teaching in a tertiary institution.

*Judith Pollard*

"It looks as if in the long run we must depend on either solar energy or energy generated by nuclear fission, and we need to put a lot of effort into solving the problems of both areas. There are scientific problems of multitudinous kinds.

How can we control and employ the process of photosynthesis in plants to yield hydrogen? How can we produce better solar electrical cells? How can we best store energy?

These questions will not be solved by a special brand of solar or fusion scientists but by scientists in the general stream at the frontiers of their subjects. The world needs scientists now as never before if these problems are to be solved, and it needs them working in fields not necessarily tied up with solar or fusion energy."

Dr Clive Coogan,
W.A. Branch News

ANNUAL REPORT
A copy of the report shows an active group of physicists with a branch of Working Parties – High Technology Industry, Employment Survey, Third National Congress and Communications Working Party. The report of the High Technology Industry working party to the Senate Standing Committee on Science and Industry Inquiry into Industrial Research and Development has been published in the Australian Physicist in October.

The Employment Survey Working party is investigating job expectations and subsequent experiences of graduating students in physics from all tertiary institutions. The Council of the Institute has asked that the WA Branch extend its survey to all Australian States.

The Branch continues to award a prize in the WA Science Teachers’ Association Annual Science Talent Quest, and conducted a well attended workshop on a new syllabus proposed for the Physical Science Course in High Schools. It also provided specialist speakers for twelve public meetings on the Fox Report and Uranium Mining.

W.A. BRANCH MEETINGS 1977
Dr. T. Tombrillo, California Institute of Technology, "Nuclear Physics and Planetary Science".
Dr. D. Gemmell, Argonne "Fast Molecules Ion Beams".
Dr. P. Rye, "Physics of Surfing".
Prof. J. Duffle, Wisconsin, "Solar Heating and Cooling".
Dr. D. Stobbard, "Doppler Ultrasound in Cardiac Measurements".
Dr. T. Lyons, "Air Pollution Meteorology".
Prof. B. Mainbridge, "The Secret Life of Plants".
Prof. R. Rand, "Gravity, Strong Gravity and the Elementary Particles".
Dr. Tom Beer, "The Merry-Go-Round of Tropical Cyclones".

Energy

An Energy Policy for Australia
This is the title of the Institution of Engineers Australia prepared by its Task Force on Energy. The report of 30 pages costs $5 and can be ordered from the Headquarters of the Institution, 11 National Circuit, Barton, ACT 2600 or through the Division.
The report summarises the major needs as:
1. A coordinated long term national energy policy, recognising the specific responsibilities of Commonwealth and State Governments.
2. Related policies by State Governments, with coordination of energy instrumentalities or utilities.
3. Informal interaction of Governments and private enterprise, and most importantly;
4. A coordinated program of energy conservation, especially related to oil, and
5. The creation of new administrative organisations appropriate to respective needs at Commonwealth and State levels.

Among the recommendations is emphasis on the development of existing basic knowledge, for three reasons:
1. Our immediate problems can largely be solved by further development of existing knowledge.
2. The development of new processes for industry requires long lead times.
3. Practical emphasis needs to be given to those technological solutions which are already apparent and promising. - Engineers Aust., 2 Dec. 1977.

Solar Energy Index
A new quarterly publication 'Australian Solar Energy Index', is being issued by the CILES Information Service.
The first issue will include all papers mentioned in the 'Australian Solar Energy Database 1952-76', together with the first instalment of updated material from 1977.
CSIRO solar energy papers as well as those from other Australian research institutions are indexed.
From 1978 onwards the database will be updated on a current awareness basis.

Sun Lazing
We note with interest an item sent to us from David Collins in WA. It is a letter taken from the "Medical Journal of Australia". March 1977.

Sun Gazing
SIR: For thousands of years people have been gazing at the sun and worshipping it. Greeks, Egyptians, even English have worshipped the sun god. Their eyes have not been damaged. One of my patients has done it for 97 years and his vision is excellent. Yet when there is an eclipse many have burns of the retina. It would seem obvious that the interposition of the moon transforms the sun’s rays into a laser beam which causes all the trouble.

Oops
SIR,
In case some readers have become frustrated by the practical aspects of pattern recognition in attempting to compare the two images of the 30 Doradus Nebula on the cover of the December 1977 issue, please note that, due to some error in the publication process, one of the images appears rotated by 180° in the plane of the paper when compared to the other.

R. D. Watson,
Lecturer in Physics

4 The Australian Physicist, January/February 1978
New Centres of Learning
Michael M. Gore, Physics Department, School of General Studies,
The Australian National University.

In this paper I describe how a long accepted method of scientific teaching has found a new application resulting in the formation of learning centres with a difference.

I explain the philosophy behind these new style science museums, giving a detailed description of one such institution, and then go on to discuss how the concept might be introduced into the Australian education scene.

Teaching by Involvement
In recent years, there has been a development which has a new and exciting flavour, particularly for anyone involved in the teaching of science. In some cases, the concept which has emerged has been fostered by established museums of science and technology but it has also given rise to the creation of new and independent institutions. The underlying idea is simple and its theme is participation and involvement.

In contrast to the conventional style of museum exhibits a new type has begun to make its appearance. These exhibits are not primarily intended to be gazed upon reverently but require that the viewer must actually do something in order to achieve a real understanding of the underlying principles being demonstrated. This involvement does not simply mean the act of pushing a button to set wheels in motion, but rather that the exhibit is designed in such a way that it requires a reasoned sequence of manipulations on the part of the viewer to achieve the end results.

This “hands-on” approach, or “learning by doing” as it also has been called, is by no means a new idea for it is the rationale behind every secondary and tertiary laboratory course. What is new is the way the technique is used.

A Model - The Exploratorium, San Francisco
Numerous centres throughout North America1 and Western Europe have adopted this “learning by doing” concept, but in order to illustrate the idea I propose to single out and describe only one.

Perhaps the best example of the new trend is a centre in San Francisco called the Exploratorium.2, 3, 4. It is not part of a conventional “acquisition” museum, but has evolved independently under the directorship of Dr Frank Oppenheimer, a physicist and educator. It contains several hundred demonstration exhibits which visitors are able to manipulate.

Push buttons and glass covers are only resorted to for delicate or dangerous equipment; time, money and effort have not been spent in spending-up the exhibits. The philosophy is to keep the construction of exhibits simple and rugged and at the same time to ensure that they clearly demonstrate the principles involved.

The exhibits cover a wide range of subjects in the field of science and technology, and the project is reported to have evoked considerable interest in a wide cross section of the community. Although the centre is open to the general public, it reserves certain periods in the week for the exclusive use of school groups. There are normally no specially conducted tours for these groups, instead, the children are encouraged to explore the exhibits themselves. They are, however, able to seek help and explanations from the staff — and it is here that the Exploratorium has another rather interesting aspect.

Students as Teachers
The Exploratorium has developed a system whereby it employs teachers recruited from the ranks of high school and university students. Each week, these students attend a special course in which they study individual exhibits in order to become conversant with their operation and the underlying principles. This group of youngsters, who go under the title of “explainers” circulate in the exhibition hall and are ready to render assistance and to prove explanations. By creating a lively and informal atmosphere, the “explainers” assist in the smooth running of the centre, while at the same time developing their own knowledge and skills.

The Need for the Involvement Approach
Although much thought has been given to devising effective methods of teaching the concepts of science and technology, the notion that any science course should include an experimental component, in order to reinforce the theoretical approach, has never really been doubted. To read a description of an experiment, or to see an illustration of the apparatus used, is unlikely to capture the interest of the majority of students.

However, a student who has personally performed an experiment is more likely to remember what has happened, and perhaps understand why it has happened, than is the student who has had an experiment described to him, or even seen the experiment performed by someone else.

The exploratorium scheme of having student teachers is an interesting idea and immediately suggests yet another facet of student involvement. The harnessing of student skills could be extended to include the construction of demonstration exhibits and this may well be accomplished within the framework of the existing school curricula.

There is no necessity for a student’s involvement in the development of such a project to cease at the end of their school careers. Their continued interest, and perhaps even further contributions, will lead to the fostering of a wider community involvement. Everyone who contributes to the establishment of such a collection will have given something of their time and effort and will have a commitment to the ultimate success of the venture.

There is another point concerning the idea of the student being involved first in the role of constructor, and then as “explainer”. The former task will provide “on the job training” for the latter.
The Value and Appeal of the Concept

The potential appeal and value of such a collection of exhibits is by no means limited to students of high school age. There are many examples of scientific and technological concepts to which it is most useful to expose a primary school student. There is no reason for not allowing them to see what happens — even if they are not able to comprehend the reasons. The experience of living in a gravitational field is known and shared by everybody, but the actual mechanism which produces the field remains unknown. The fact that we don’t understand it has not prevented us making use of its effects.

The increasing diversification of the myriad branches of science and technology is resulting in the appearance of ever more sophisticated concepts. To keep pace with this trend, there has appeared a corresponding diversity in the courses being offered at both the secondary and tertiary levels of the education system. The effect of this trend is to introduce the need for a much wider range of demonstrations and this inevitably involves a greater input of time, skill and money. This being so, there seems much to be gained from a scheme which provides for the sharing of these resources.

The establishment of a collection of demonstration exhibits located so as to be accessible to a number of schools will help to alleviate the additional drain on money and resources, because implicit in the idea is the concept of pooling resources to gain the maximum advantage.

The notion of utilising the combined resources of a group of schools in order to establish such a centre has merit when the current financial structures on education are considered. Many suitable and worthwhile exhibits can be constructed on a shoestring but others require varying degrees of expense. By pooling resources, what little available cash there is could be made to go a lot further.

Where a collection of demonstration exhibits can be located in close proximity to a group of schools, it will not only provide a valuable teaching aid but would tend to eliminate the problems encountered in producing classroom demonstrations. It is generally time consuming to produce a good demonstration; for, having located the necessary apparatus — not always an easy task in itself — it must be set up and then made to function in the required manner. After use the demonstration must then be dismantled and the components returned to the storeroom. It would not be surprising if this process were frequently to daunt all but the keenest and most dedicated teacher. If, however, a demonstration were set up permanently, taking pains in doing so to find a sound and durable design, and if the design and development were the basis of a science project for students, then there would be considerable value both in the end product and the experience gained in its realisation.

An additional bonus which would be gained by exhibits being constructed in the schools is that it would need to draw on the combined skills of science and industrial arts departments. This form of interdisciplinary reaction already exists in some schools, but where it does not the project could help to establish such links. That such cooperation is important is evidenced by the long standing association of science and technology in industry.

It might also be possible in some areas, for secondary and tertiary teaching institutions to cooperate in the establishment of such a project, thereby making available a wider range of skills and resources and at the same time providing a valuable link between the two systems.

Philosophy of Design and Construction

Ideally an exhibit should be designed so that it does not require a high level of manipulative skill in order to make its point effectively. A good example of the technique is an exhibit aimed at demonstrating the relative merits of various types of block and tackle systems. By constructing several different systems side by side, ranging from a single pulley to various multiple pulley arrangements, the viewer is able to compare the relative amount of effort required by each system to lift identical weights.

Another important point is that exhibits must be designed so as to be rugged. It is to be expected that they will receive rough treatment at the hands of some users and the design should attempt to offset the problem, while at the same time preserving the effectiveness of the demonstration. Designs must not only pay special attention to durability, but also to safety. Precautions must be taken with this type of exhibit to minimise the risk of accidents. However, the main emphasis must be to ensure that an exhibit makes its point.

Ideally, exhibits should be presented so that they will have appeal for a wide spectrum of students and not solely those with scientific or technological interests. Thus, wherever possible, exhibits should be designed and constructed in such a way that their operation can readily be related to some commonplace everyday experience. Lowering a pocket transistor radio into a Faraday cage constructed from chicken wire can readily be related by the observer to the common phenomenon of car radios fading as the vehicle passes under a bridge or through a tunnel, and there would be many parents interested to learn that a house fully lined with earthed aluminium foil — ceilings, walls and under the floor would considerably impair the reception of their children’s transistor radios.

Difficulties and Precautions

The siting of such a group of exhibits must be done with care. It would best be located in such a way that it is not associated with any one school, for if it were it may well jeopardise the communal aspects of the scheme.

Obtaining the necessary materials will undoubtedly be one of the largest hurdles in the establishment of such a centre. However, whether or not money is available, there is much which can be achieved in the beginning by selecting exhibits which can be constructed from parts, salvaged for example, from defunct domestic appliances.

There are many simple but effective demonstrations which could be readily constructed at minimal cost. Once a core of exhibits has been established, and its success and popularity proven, it would have every chance of attracting the interest and support of both the private and business sectors of the community.

Another difficulty is the inevitable malfunction of exhibits. To overcome this problem it would be best to enlist the help of the participating schools in undertaking the task of recurrent maintenance. In this way,
succeeding generations of students will not only be involved in construction, but also solving problems caused by inadequate or faulty design.

**Conclusion**

I believe that the establishment in this country of centres which have the same basic philosophy as that of the Exploratorium in San Francisco would be a valuable addition to Australian education. Not only would the collection in itself be valuable, but the extrapolation of the idea to include their construction as an integral part of the scientific and technological training of high school students, lends considerable additional merit to the scheme.

The benefit to be derived from the liaison between secondary and tertiary teaching institutions in the development of such a project cannot be overestimated, and once established such a centre would provide a focal point in a given area for everyone concerned in the teaching of science and technology.

The San Francisco Exploratorium, and many other centres like it, have indicated that the scheme is important from a community point of view in that it provides a centre for continuing education. Of major importance is the wide appeal such centres have for the general public, and today more than ever before it is vital to stimulate interest in what for many people, are the mysteries and magic of science.

**References**


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**Non-Solar Energy Research**

15 energy research projects will receive a total of more than $206,000 from the Australian Research Grants Scheme during 1978. This is in addition to the $244,000 in grants in support of solar energy research projects.

Funds for fusion research have been awarded to the following scientists:

Dr R. C. Cross, Dr B. W. James and Associate Professor J. H. Lehane, University of Sydney, for work on wave propagation and heating in high-temperature plasmas ($34,747).

Professor M. H. Brennan and Dr I. R. Jones, Flinders University of South Australia, for work on the formation and properties of linear diffuse pinch ($12,700).

Dr L. C. Robinson and Dr J. Bigbel, University of Sydney, for work on a gyrotron development program ($22,081).

Professor C. N. Watson-Munro, Associate Professor D. D. Millar and Dr B. W. James, University of Sydney, for work on collisional shock waves in plasma ($6,438).

Professor M. H. Brennan, Flinders University of South Australia, for work on waves in current-carrying plasmas ($10,657).

Other scientists receiving grants for energy research are as follows:

Professor S. R. Siemon, Dr D. G. Evans and Mr R. S. Yost, University of Melbourne, for work on the development of processes for producing petroleum substitutes from brown coal ($14,125).

Professor H. K. Messerle and Mr B. Campbell, University of Sydney, for work on a combustion-driven magnetohydrodynamic experiment, with application in improving the efficiency of coal-fired power generators ($12,164).

Dr H. C. Watson and Mr E. E. Milkins, University of Melbourne, for work on energy conservation and pollution abatement potential from sequence control of traffic signals ($8,950).

Associate Professor R. C. Winkler, University of Western Australia, for work on experimental analysis of household demand for water and electricity ($14,500).

Dr D. W. King, University of Sydney, for work on seismic reflection investigations of coal deposits ($14,799).

Dr D. J. McCann, University of Sydney, for work on fermentation of cassava to ethyl alcohol ($9,000).

Dr H. C. Watson and Mr E. E. Milkins, University of Melbourne, for a study of ignition, flame propagation and emissions in prechamber engines ($14,432).

Professor D. J. M. Bevan and Professor J. O'M. Bockris, Flinders University of South Australia, for work on fluoride-related oxides as high-temperature electrode materials (potential application in deriving electrical energy from hydrogen) ($7,401).

Dr J. B. Hinwood, Monash University, for a study of cellular structure in a turbulent shear flow (potential application in the recovery of tidal energy) ($14,136).

Professor K. P. Stark, James Cook University of North Queensland, for a pilot study for a systematic multidisciplinary environmental survey of Cleveland Bay and adjacent sections of Halifax Bay and Bowling Green Bay (substantial application in the recovery of tidal energy) ($10,180).
Domestic Solar Energy and the Law
Ken King, Centre for Environmental Studies, University of Adelaide.

Introduction
One partial way of coping with the energy supply crisis is the use of low-energy or alternative technology. A financial policy with a "proper" pricing of resources should succeed with industry where it is common for cost-benefit analyses to be made on alternative processes. The same is not true with respect to the domestic consumers of energy because building practices and energy supply patterns have become standardized by custom and law and because the average consumer has little opportunity to choose among alternative energy sources. In this article, the law is examined as it affects the use of domestic solar energy.

The principal tasks which can be performed by solar energy are lighting, cooking, drying, water heating, space heating, and air conditioning. The major tasks for the law are to guarantee adequate access to light, to ensure proper construction of solar devices, to encourage the use of solar energy wherever practical, and to limit any disamenity that may be incurred in the process.

The relevant common law has origins in English law, while the relevant statutes and regulations in Australia are specific to each state. However, the tasks and problems are similar in all states.

Ancient Lights
Solar devices work well in direct sunlight, and best during the four or five brightest hours of the day. This energy is usually sufficient for heating purposes as it can be stored in the heated water or building walls. But it is necessary to guarantee that the light is not significantly affected by shadows as diffuse light is not enough. The guidance of law will be necessary to sort out the conflicts of interest involved.

Historically, English law has recognized certain rights (in addition to normal property rights) which can be exercised over adjoining property. These rights are called "easements", and one of the more important easements was to the right to light, viz. "ancient lights".

For an easement to exist there must be a so-called "dominant tenement" which benefits from it and a "servient tenement" upon which some burden falls: for example A may have a right of way through B's adjoining property, or, of interest here, a right to the uninterrupted passage across B's property of light from the sky. Easements are always attached to land, and exist only with respect to properties which are under different ownership. At common law, proof of the use of an alleged right since "time immemorial" was regarded as giving a prescriptive right to it; in practice the length of time "whereof the memory of man runneth not to the contrary" was reckoned as being the period of time beginning with the first year of the reign of Richard I (i.e. A.D. 1189). Difficulties of proof of course abounded, so that it became necessary to evolve in the courts the doctrine of "the lost modern grant", whereby it was assumed that a grant to the right had been given at some time since "a long time ago" (A'D 1189) and it was subsequently lost. This was the development of common law which passed to the Australian states in 1828. 1

The particular easement of ancient lights has an interesting history. This right to light passed to Australian states as received law. A celebrated case 2 in the High Court in 1904 established this; namely, on the fiction of the lost grant, that a prescriptive right to light existed on the basis of lengthy enjoyment. The appellant had enjoyed access to light from across the respondent's property for more than forty-five years. He sought damages or an injunction to restrain the company's construction programme adjacent to his property. The Court ruled in his favour and held that the English law of prescription as to ancient lights was a law that could validly be applied in New South Wales.

It was to block such recourse that the New South Wales Government passed a law 3 in 1904. During the debate 4 the familiar arguments raged over the conflict between individuals' rights (to light) and progress (i.e. the improvement of property). The prescriptive right was then removed 5 in every state for similar reasons. (Western Australia 6 had actually done this already two years before NSW.) These ancient lights acts have since been consolidated 7 within statutes concerning the law of property, except in Tasmania where it has been repealed 8.

These acts and subsequent consolidations have only removed the prescriptive right, and do not affect the acquisition of a right to light by express grant, implied grant, or statute.

The development in England was different. The Prescription Act 1832 9 assisted the claim to ancient lights by shortening the time of legal memory. It made it impossible to defeat a claim to servitude based on custom, grant, or prescription merely by showing that the right could not have been exercised at some point of time after A.D. 1189. It declared that certain specified periods of use were sufficient proof of the right claimed and made it unnecessary to resort to the unsatisfactory fiction of the lost modern grant.

Specifically, if access to light had been enjoyed for twenty years then a claim to a prescriptive right could not be defeated unless the access had been by consent. 10 (Interruption of the access of less than a year was not counted 11.) The owner of a property that could become a servient tenement could of course block the access to the light before twenty years had elapsed, perhaps with a special screen for this purpose if he was unable to construct his proposed building in time. A modern statute 12 allows him to "build" a fictitious screen by registering a notice of intent in lieu of building a physical obstruction 13.

Ancient lights would seem therefore to have application in the sphere of solar energy. However some important distinctions need to be made between the traditional easement and what would be required:

(i) There is no right to direct sunlight (or to reflected light or a view for that matter). Only light from the sky is the subject of ancient lights. This omission perhaps reflects the English origin of the doctrine!

8 The Australian Physicist, January/February 1978
(ii) The easement, where it exists, refers only to the “normal enjoyment” of the light. Solar heating does not fall in this category.

(iii) The easement is defined with respect to an aperture (such as window), and not to a roof, wall, or garden plot.

(iv) The energy value of the light has never been of any relevance in itself.

Planning Regulations and Building Codes in Australia

The laws in the various states could be revised in order to allow people to plan their utilisation of the natural energy of the sun. It is too cumbersome to rely on easements, and in any case prescriptive rights to light were abolished on the understanding that regulations would fill the gap. Furthermore, prescriptive time periods (say, twenty years) are too long; development is rapid and people must be able to plan ahead.

Most of the problems will arise in closely settled areas where a proposed new building or a growing tree threatens to be larger than a neighbouring solar structure and to block out its direct sunlight. Solar panels for hot water systems are likely to be on the roofs of buildings, but the whole north-facing wall of a house can be a collector of solar light and/or heat even if it is not specially designed or adapted. Problems in present urban areas can be reduced by proper zoning rules. A statutory requirement should be the provision and maintenance of direct sunlight to all dwellings. New subdivisions should enable all buildings to have an east-west orientation (to maximise the absorption of solar energy on the north wall). Subdivisions must also allow sufficient room for buildings so that they can be built so as not to occlude light from neighbours. Rights of light could still be created by deed where the access sought was greater than that which was normally necessary (that is, greater than the extent allowed in a revised planning act). Prescriptive rights could be reintroducted to cover situations occurring outside recognised planning areas, although recourse to such a law would probably be slight. Building designs themselves should never be approved unless good use is to be made of solar energy.

Construction of Solar Energy Devices and Solar Houses

It will be necessary to ensure that he construction and installation of solar devices is done competently. In South Australia, there is presently no specific regulation relating to them although there is scope within existing legislation. The CSIRO has pioneered a lot of work into solar energy and an Australian standard, based on this work, could be adopted by the states.

Solar water heaters would be permissible provided normal requirements of drainage, water proofing, structural soundness, and pipe fittings were met, although unsightly roof tanks might attract the wrath of the local council.

The best utilisation of solar energy comes from houses that have been especially constructed around the principle. These houses, while pleasant to look at, are often unusual in design and may run foul of conservative inspectors and referees unless they are specifically mentioned in regulations.

Encouraging the Use of Solar Energy

There are a number of ways to do this through statute and regulation.

(i) Daylight saving (solar lighting).

(ii) Subdivision. Land should be such that east-west orientation is possible and such that normal buildings will not cast shadows on neighbouring roofs.

(iii) Insulation and draught-proofing. Minimum standards should apply.

(iv) Approval. This should be subject to solar energy being used effectively in the new dwelling.

This is not a radical step as there are already standards which effectively encourage the use of “solar lighting” in houses and other buildings. Rooms must have windows of certain sizes and in certain positions depending on the nature of the dwelling and the purpose of the room. The case of solar heating is no different in principle even if the social purpose (conservation of electricity) is. A builder is not given the option of building windowless bedrooms lit and ventilated entirely electrically.

(v) Incentives for existing houses to use solar water heaters, even if these are to be leased from the electricity authority.

(vi) Tariffs on electricity and gas which discourage excessive use.

(vii) Use of new designs in new cities (e.g. Monarto).

Summary

The doctrine of “ancient lights” looks like a possible means of guaranteeing solar rights, but the problems of refurbishing it for the modern age make planning regulations the more effective means. Building codes can be used to encourage the use of solar energy and conservation techniques.

Acknowledgements

The author would like to thank the following for helpful comments and discussions: David Cole (lawyer, Department of Community Welfare, S.A.), Rob Fowler (Law School, University of Adelaide), and Professor John Carver (Chairman of the School of Physics, University of Adelaide).

References

1. Australian Courts Act 1828 s. 24 (Imperial).
2. Dobhney v. Permanent Trustee Co. of New South Wales (High Court of Australia 1904) 1 CLR 583.
6. Light and Air Act 1902 (Western Australia).
9. As this statute was passed after 1828 it was not received law in the Australian colonies.
10. Prescription Act 1832, s. 3.
14. Parliamentary debates on the ancient lights acts. For example, see footnote 4.
15. The requirements are more stringent than for “ancient lights” because of the desirability of direct sunlight for solar collectors.
16. These amendments can be made to the relevant building acts, and associated regulations in each state.
HOKKAIDO Diagrams
A Geometrical Representation of Permutations
H.C. Bolton, Physics Department Monash University, Victoria.
N.H. Fletcher, Physics Department University of New England, Armidale, N.S.W.

During a recent study leave at Hokkaido University in Japan, one of us (NHF) ate lunch regularly with a party of graduate students in the Physics Departmental common room. A particular delicacy on these occasions was the soy bean cookies (manju) which had to be bought from the cafeteria, and the party decided that there were several small tasks associated with their purchase which should be distributed at random amongst its members. These tasks included collecting the orders, fetching the cookies and paying various amounts towards their purchase. The novel method used to make this random choice can be formalized into four rules:

1. Draw as many parallel lines on a piece of paper as there are members of the party. In the figures that follow, these are vertical.

2. Each member inserts an arbitrary number of cross-links between nearest-neighbour lines.

3. No neighbouring crosslinks can occur at the same horizontal level.

In a different version cross-links could join any pair of lines but we restrict ourselves here to links between nearest neighbours. An example for a party of three members is given in Figure 1. The three tasks X, Y and Z are put at the top of each line.

4. Each member A, B and C of the party starts at the bottom of his line and follows it upwards. When he meets a link he moves to the neighbour line and so on until he reaches a task at the top. If this is done in Figure 1 it will be found that A gets task Y, B gets task X and C gets task Z.

Each member of the party contributes in a “democratic” way by having the opportunity of adding as many links as he likes.

We are going to call the diagrams “Hokkaido diagrams”. The first result that we can deduce from the rules is that each member can get only one task. This follows from rule 4 by considering the simple diagram in Figure 2. The only link present allows member A to move from the left-hand line to the middle line and simultaneously member B moves from the middle line to the left-hand line. The link interchanges or transposes the members A and B on their two lines and thus each member’s line will end on a single task. This interchange can be more readily seen by putting arrows on the diagram as in Figure 3, indicating the direction taken by a member of the party in reaching his task; a link carries two opposed arrows. Since from rule 1 there are only as many lines as there are members of the party, the pattern of the symbols A, B, C . . . attached to the top of the lines is then one of the permutations of the symbols A, B, C . . . at the bottom. Thus a Hokkaido diagram is a geometrical representation of one of the permutations of the permutation group of degree equal to the number of members in the party. Figure 2 is the permutation BAC of the three members ABC. We notice that the diagrams are “time-ordered” because a member starts on his line at the bottom of the diagram and ends at the top at a later time; time runs upwards in the diagrams. If we wish we can talk about “before” and “after” a diagram meaning respectively below and above geometrically.

There is an unlimited number of Hokkaido diagrams for each permutation because each member of the party can insert any number of links. At first sight this means that a Hokkaido diagram can be very complicated but it can be simplified by reducing the number of links while preserving the permutation; we will call this the “reduction” of the diagram. One way in which this reduction can be done is by successive application of rule 4. Consider the diagram in Figure 4. Application of rule 4 shows that the interchange of A and B by the first (lower) link is reversed by the second (upper) link and the consequence is that A is left with the task immediately above him. A more complicated example is given in Figures 5 and 6. Figure 5 shows the two diagrams in which A and C are interchanged. In Figure 6 we give the four ways in which these two diagrams can be combined to leave the pattern at the top the same as at the bottom. We note that the first and fourth diagrams in Figure 6 can be reduced by three successive applications of Figure 4 but the second and third diagrams cannot be so reduced. We now see that the use of the rules allows us to reduce a diagram to minimal diagram which is defined as that diagram which gives the permutation in question with the least number of links. There is not
always a unique minimal diagram; we define the number of minimal diagrams as the minimal degeneracy. We now recognize that Figure 5 shows the minimal diagrams for the interchange of A and C and the minimal degeneracy is two.

We can now give in Figure 7 the minimal diagrams for all permutations of a party of three members; these permutations form the symmetric group of degree three, $P_3$. Each diagram of Figure 7 the lines are assumed to be labelled A, B, C at the bottom.

The reduction to a minimal diagram can sometimes be made by adding intermediate lines. We give an example in Figure 8. Suppose that in reduction we had reached the first diagram in Figure 8. Since two interchanges of B and C leave the permutation unchanged, we do this in the second diagram by adding two links, shown dotted, one below and one above and the final reduction to the third and minimal diagram is achieved by twice using the result of Figure 4.

These Hokkaido diagrams should be contrasted with the representations in terms of twisted strings or crossovers. (Heine, 1960, p.50). We give these latter diagrams in Figure 9; each diagram has underneath it the parity of the permutation, which is the number of consecutive interchanges needed to get from the original arrangement (here, ABC) to the final arrangement.

Comparing Figures 7 and 9 we see that the parity of a permutation is the number of intersections of neighboring lines in the diagrams of Figure 9 and also the number of links in the minimal Hokkaido diagrams. Using our language, the twisted string diagrams are non-degenerate.

The symmetric group $P_3$ is isomorphic to the group representing the symmetries of a plane equilateral triangle (Heine, 1960, p.22). The identity operation and the two operations, rotation by $2\pi/3$ and $4\pi/3$ form a subgroup of $P_3$. The corresponding Hokkaido diagrams are ABC, BCA and CAB in Figure 7, referring to them by the symbols at the top of their diagrams. The remaining three diagrams of Figure 7 represent the rotations through $\pi$ about the three apices of the triangle.

In Figure 10 we give the Hokkaido diagrams for the 4! permutations of four objects; these make up the symmetric group $P_4$. The symbols underneath each diagram refer to the group generators. These allow a compact description of diagrams.
We define the identity I and the generators $a\beta$ for $P_4$ in Figure 11 (Carmichael, 1937, p.34). The defining relations are

$$aa = \beta\beta = 1$$  \hspace{1cm} (1)

$$a\beta \beta a \beta = 1$$  \hspace{1cm} (2)

In using equations (1) we must remember that the diagrams are time-ordered; our convention is that the first generator in a word or a relation is at the earlier time. Thus $a = I$ represents Figure 3. The diagrams in Figure 7 are described by

$$I, a, \beta, a\beta, \beta a\beta = a\beta$$

For the group $P_4$ we choose the generators $a, \beta, \gamma$, as in Figure 12.

The relations are

$$aa = \beta\gamma = \gamma\gamma = 1$$  \hspace{1cm} (3)

$$a\gamma\beta\gamma a = 1$$  \hspace{1cm} (4)

$$\gamma a\beta a\beta\gamma = 1$$  \hspace{1cm} (5)

We must also note the three subsidiary relations

$$a\beta \neq \beta a$$  \hspace{1cm} (6)

$$\beta\gamma \neq \gamma\beta$$  \hspace{1cm} (7)

$$\alpha\gamma = \gamma\alpha$$  \hspace{1cm} (8)

Returning to Figure 10, we note that the diagrams in the first set are given by adding one vertical line to the diagrams in Figure 7, those in the second set are given by premultiplying those in the first row by $a$, those in the third row by premultiplying those in the second by $\beta$ and those in the third by $\gamma$. The minimal diagram with the largest number of links is that for the complete reversal DCBA namely $a\beta\gamma\beta\gamma$. This technique can be readily extended to the symmetric groups of any degree $n$ and we see that for $P_n$, the largest number of links is given by the sum of the first $(n-1)$ natural numbers, namely $\frac{n(n-1)}{2}$.

Acknowledgement
The final form of this article owes much to the helpful criticism of Professor G. B. Preston of the Department of Mathematics, Monash University.

References

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Conferences

Gas Discharges
Organized by the Science, Education and Management Division of the Institution of Electrical Engineers in Association with The Institute of Physics and the Institution of Electronic and Radio Engineers, the 1978 conference in gas discharges will be held on 11 – 15 September 1978.

Optics '78
The Optical Group of The Institute of Physics will hold its biennial conference at the University of Bath from 20 – 23 September, 1978.

The following topics have been suggested as especially suitable for discussion:
- Optical Design – optical measurements, optical metrology.
- Holographic imaging systems
- Physiological optics
- Application of photon counting techniques
- Fabrication, coating, testing and alignment of optical components.
- Speckle phenomena and their applications
- Solar energy collectors and converters.

Offers of papers should be sent as soon as possible to the Honorary Secretary and certainly before 1 April, 1978. Contributions should be in the form:
- TITLE, AUTHOR(S), AFFILIATION and ADDRESS, ABSTRACT (about 50 words).

An exhibition of equipment and devices will run in conjunction with the conference.

Abstract and programme enquiries should be addressed to Mrs. D. L. Harmer, Royal Greenwich Observatory, Herstmonceux Castle, Hailsham, Sussex.

Exhibition enquiries should be addressed to Mr. J. N. Davidson, Rank Precision Industries, Langston Road, Debden, Loughton, Essex.

Further details and application forms for attendance may be obtained from The Meetings Officer, The Institute of Physics, 47 Belgrave Square, London SW1 8QX.


The CSIRO Conference on Electrostatic Precipitation offers an international forum for the dissemination and discussion of the latest progress in the subject, and will take place from 21st to 24th August, 1978, at Leura, a resort in the Blue Mountains, 90 km west of Sydney, Australia. The conference will be immediately preceded by an optional 1½ day Awareness Course for those engineers, scientists and industrial users who desire a more complex understanding of the principles and practice of electrostatic precipitation. Course lectures are expected to include Professor S. Masuda of the University of Tokyo and Dr E. C. Potter of CSIRO Minerals Research Laboratories.

For information: Mr C. A. J. Paulson, Conference Secretary, CSIRO Conference on Electrostatic Precipitation, PO Box 136, North Ryde, NSW. 2113.
Physics in Australia

Australian Participation in US Space Programs

The Department of Science, which co-ordinates participation by Australian scientists in NASA space programs, has endorsed three new Australian proposals and these have been accepted by NASA.

The proposals involve investigation of the behaviour of human blood cells in space, the analysis of data obtained by an experimental earth resources satellite, and a study of the Martian ice caps.

The blood cell experiment will be undertaken by Dr Leopold Ditzenfass, a world-renowned specialist in blood rheology and Director of the Haemorheology and Biohemeology Department at the Sydney Hospital.

The experiment will involve a comparison of the behaviour of human red blood cells in the weightless environment of space with their behaviour on earth. The results could eventually lead to the development of new methods of diagnosing disease by studying the viscosity of blood.

It is believed that the experiment, which will be conducted during one of the early missions of the Space Shuttle, will be the first Australian experiment to be actually carried out in space.

The Space Shuttle, from which the experiment will be conducted, is a unique, re-usable transportation system which will enable scientists from around the world to place complex experiments in space and return them to earth for subsequent analysis.

Research scientists from CSIRO and the Royal Australian Navy Research Laboratory will participate in the NASA heat capacity mapping mission, which will be carried out by a satellite to be launched in April 1978. The purpose of this mission is to evaluate the feasibility of producing thermal maps of the Earth's surface and measuring soil moisture content.

Dr Ken McCracken, Chief of the CSIRO Division of Mineral Physics, will lead the team of CSIRO scientists taking part. The Navy scientists is Dr Paul Scully-Power.

The scientists plan to conduct experiments using data gathered by the satellite as it passes over Australia. They will then compare this data with data gathered by conventional methods on the ground. The scientists hope to determine the extent to which satellites could be used to replace the ground-based methods.

A third group of scientists, led by Dr U. Radok, of the Meteorology Department of Melbourne University, will undertake a detailed study of the dynamics and thermodynamics of the Martian ice caps using techniques developed and tested on the Antarctic ice sheet.

The scientists will be using data gathered by the Viking spacecraft which landed on Mars last year.

Dr Radok will be assisted in this study by Dr D. Jensen, of the University of Melbourne, and Dr W. F. Budd, of the Antarctic Division of the Department of Science.

People & Institutions

Dr Farrands Appointed Science Head

Prior to his appointment as Secretary of the Department of Science on 10 October, Dr John L. Farrands was Chief Defence Scientist.

Before being appointed Chief Defence Scientist in 1971, Dr Farrands was Chief Superintendent of the Aeronautical Research Laboratories (1967 to 1971), Superintendent of Research, Defence Standards Laboratories (1964 to 1967), Assistant Contoller, Research and Development, Department of Supply (1961 to 1964), Scientific Adviser to the Australian Military Board (1956 to 1961), Principal Scientific Officer, Chemical Physics, Defence Science Laboratories (1954 to 1956) and Physicist, Munitions Supply Laboratories (1946 to 1951).

Dr Farrands holds a B.Sc. from the University of Melbourne, Ph.D. in Physics from the University of London and a Diploma of the Imperial College in Electrical Engineering.

He is a Fellow of the Institute of Physics, a Fellow of the Australian Institute of Physics, a member of the Institute of Electrical Engineers and a Fellow of the Australian Academy of Technological Sciences. – Science News.

Theoretical Physics in Queensland

Professor Frank O. Goodman has been appointed to the Chair of Theoretical Physics in the University of Queensland.

He is currently Professor of Applied Mathematics in the University of Waterloo, Ontario, Canada.

Professor Goodman is an internationally acknowledged expert in the quantum mechanical theory of gas-surface scattering phenomena and has published widely in this and related fields. He will take up his appointment on June 1, 1978 — University News Queensland.

Professor Lawrence Aller, Professor of Astronomy at the University of California, Los Angeles, is currently Postdoctoral Research Fellow in the Physics Department.

Professor Aller will collaborate with Dr J. E. Ross and Dr B. J. O'Mara on atomic physics problems. His major interests are in the physics of gaseous nebulae and stellar atmospheres. – University News Queensland.

Dr Leo McNamara, a physicist with the Ionospheric Prediction Service, has taken a research grant awarded to him by the United States Co-operative Institute for Research in Environmental Science (CIRES) in Boulder, Colorado. Dr McNamara will spend 12 months working on research problems of concern to IPS, at the National Geophysical and Solar-Terrestrial Data Centre (NGSADC), which is part of the Environmental Data Service of NOAA.

Don Swingler of the Division of Chemical Physicist, CSIRO, has accepted a French Government Scientific and Cultural Scholarship and will work with Professor Castaing at the Scientific Division of the University of Paris at Orsay for 4 months.

During this period, he will represent the Vacuum Physics Group of the Australian Institute of Physics at four council meetings of the International Union for Vacuum Science, Techniques and Applications, (IUVSTA) of which he is an Australian Member.
Letter

SIR,

I am again on about the matter of professional standards. The Institute is the national body representing professional Physicists.

Before I start my tirade let me make myself clear. I do not regard the possession of a PhD degree as being the only hallmark of a physicist. We all know that there are many of us who do not require this stick to lean upon. Most of the nice, and not so nice, old tyrants that knocked my generation into shape to the best of their ability were not PhD graduates. However, looking back, most of them ultimately received DSc degrees. In short, I do not regard the non possession of a PhD as being a bar to promotion in the profession. Without the label it should be harder because one has to prove PhD “equivalence”.

This is where my tirade starts. More and more I see people, particularly in the Government, that are appointed to positions that call for PhD or “equivalent”. Very often, the successful applicant turns out to be an “equivalent” who is in no way equivalent. I would say that more often than not the type that gets appointed is just plain dull. More often than not he is the type that could never get a PhD in a lifetime. It takes imagination to succeed in research. It takes little imagination to get a pass degree and become PhD equivalent by cultivating the right contacts.

Australia is particularly prone to this brand of humbug for the following reason.

When Sputnik went up, Physics was king, infact Physics was emperor. Off we went to the arbitration court to see Mr. Justice Castelau. He gave us huge salary hikes on one condition, each man had to be assessed to see whether he was doing real research. Research was a magic word—hence today, social scientists “research” the culinary habits of Tibetan migrants and so on. The most mundane occupation is now “researching”.

To return to the point, scientific merit and salaries became initially associated. To get the dough one either had to have a PhD or be a poor soul who should have had one but who had been passed over by an unappreciative world.

In the upper echelons of the public service 85% are poor souls who didn’t make the degree. They, in turn, bestow equivalence on their mates and so it goes. The whole thing is utterly incestuous.

Today, we have the real product coming out of our universities, unable to get jobs, while this cynical operation of PhD equivalence goes on and on.

It is high time for the Institute to intervene and establish its own grade of membership to denote true PhD equivalence, recognised by the profession rather than having our profession rigged by unscrupulous public servants.

David S. Robertson, FAIP

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Slow Electrons easier to capture than Fast Electrons

D.R.A. McMahon, University of Tasmania.

The classic Franck and Hertz experiment in quantum physics is today a popular one in undergraduate laboratories. However, there is one important point not widely appreciated, and indeed, it seems to have escaped the attention of textbook writers. Electrons are accelerated from a hot cathode by a potential applied to a grid situated just in front of an anode. In elastic collisions with gas atoms at particular, regularly spaced potentials, cause some electrons to be captured by the grid as recorded by maxima and minima in the anode current. The common error arises from thinking that slow electrons are prevented from reaching the anode only by a retarding field between the grid and anode. In fact, at pressures that Franck-Hertz tubes are usually operated (4-20 torr), this has little to do with the mechanism for forming the characteristic maxima and minima in the anode current although a retarding field will improve the resolution.

This is very easily demonstrated experimentally simply by having an accelerating potential difference between the grid and anode. Typical results are shown for mercury vapour using a Leybold tube. Each curve corresponds to a different accelerating potential between grid and anode as indicated in volts. The spacing is the 4.9 volts resonance potential and the shift of peaks (~3 volts) is related to a contact potential. The first peak at 1.8 volts is not observable under normal retarding conditions, and hence the manufacturers incorrectly put the displacement of the peaks at +1.7 volts.

An explanation comes from diffusion theory. The diffusion constant is $D = L^2/3$ where $L$ is the mean free path and $u$ the mean electron speed. The slower electrons diffuse more slowly than the faster ones and thus by spending more time near the grid they are more likely to be captured. Nevertheless, it is intriguing that separation of electrons into two energy 'bins' merely requires two electrodes in proximity without other external agencies!
Books

Books Received

EUROPE’S GIANT ACCELERATOR, M. Goldsmith and E. Shaw. Taylor and Francis, 1977. x + 261 pp. £35.75.


Book Reviews


Reviewed by L. J. Tassie, Australian National University.

Summer schools are now a very important way for the spreading of advanced knowledge in physics, and the publication of their proceedings provides some compensation to those who cannot attend them. Some of the articles in these two volumes have been partly overtaken by recent rapid developments in particle physics. For example the problem discussed by Llewellyn Smith in lectures entitled "Is theoretical physics able to explain e-e annihilation into hadrons?" in volume 12 has been changed greatly since then by the experimental discovery of e+e- particles. Even so, the most part of Llewellyn Smith's lectures describe the basic theoretical ideas, and so still remain useful. In particular, they provide a good brief introduction to the renormalization group in this context.

Amongst the articles in volume 11 there are reviews on baryon and meson spectroscopy, including an informative lecture by A. H. Rosenfeld on "From Argand Diagrams to Physics", and lectures on spontaneous symmetry breakdown and gauge fields. About half of volume 11 is on theoretical topics and the other half on experimental topics.

Volume 12 is divided into several sections including 296 pages of theoretical lectures, 232 pages of review lectures, 232 pages of seminars on special topics and 108 pages on highlights in other fields (animal memory, correlations in nuclei, black holes) and two historical reviews, "Fifty Years of Quantum Field Theory" by F. E. Low and a talk by R. Peterls entitled "The Glorious Days of Physics" which is the same as a talk he gave during his visit to Australia.

Every institution with graduate students in physics should have a standing order for the proceedings of the Erice school on subnuclear physics.


Reviewed by F. P. Larkins, Monash University, Clayton, Vic.

Although the radiationless de-excitation of an excited atom was first reported by Auger in 1925 the last 10 years have seen the rapid development of a field of research known as Auger electron spectroscopy. The primary goal of this book is to develop the fundamental theory of Auger transitions for atoms. The book is certainly not for the beginner in the field for it requires a sound knowledge of atomic structure theory including aspects of angular momenta coupling theory and Wigner algebra to be fully appreciated. It is well written and reasonably comprehensive in its coverage of the literature up to 1972-73. There have been many important theoretical developments for atomic systems since 1973 that have not been included. Nevertheless, the book will provide a useful reference for specialists and would-be theoreticians in this difficult field as it is the first major theoretical book on Auger electron theory since Burhop's 1952 work.
The final chapter is somewhat out of character with respect to the other sections of the book. It mainly provides a synopsis of the experimental aspects of Auger electron spectroscopy, but does not integrate well with the preceding chapters on fundamental theory. Experimentalists will find superior treatments of experimental procedures elsewhere.


Reviewed by A. F. Collings, CSIRO National Measurement Laboratory.

This is unquestionably one of the best books to have been written on the physics of the liquid state. The cover jacket blurb is characteristically optimistic in suggesting that undergraduates in physics and chemistry will be readers. This book however would be an excellent basis for a graduate course on the statistical mechanics of dense fluids, it is both a good introduction for the new research worker and an excellent review for the more established liquid state physicist.

As might be expected from two of the foremost practitioners of the computer simulation of fluids, this aspect is thoroughly discussed but not unduly over-emphasised. Though water hardly qualifies as a simple liquid, it is unfortunate that recent simulation studies of it were not reviewed. All the expected material is covered, good treatments of scattering physics and phase transitions being welcome bonuses. If I were to find fault with the book, it would be in that the authors have set themselves too narrow a brief. The origin of the intermolecular potential apparently still lies outside the scope of such a book. On the other hand experimentalists would welcome a readable theoretical discussion of molecular liquids rather than the ubiquitous argon.


Reviewed by R. W. Parsons, University of Queensland.

The three areas of gaseous microwave spectroscopy, electron spin resonance and nuclear magnetic resonance are brought together in this book, which draws quite substantially on a much earlier book by Dr. Ingram, "Spectroscopy at Radio and Microwave Frequencies". However, while the earlier work was for the research scientist, it is stated in the preface that the present book has been written "for both physicists and chemists at about their second year of study". It is doubtful whether second year students in this country would have the background required - while there is very little mathematics, a quite wide knowledge of the vector model of the atom and elementary quantum theory is assumed. None of this is advanced, but it is quite extensive and permeates the whole book. For the student who already has the necessary background, the book makes interesting reading and provides a valuable and different insight into aspects of atomic, molecular, and solid state physics which are normally discussed in the language of mathematics. It could be read with advantage at the end of his third year by a student of Physics or Physical Chemistry who was contemplating further study in molecular or solid state physics.

A recurrent theme which is of great interest to Dr. Ingram is the two-way interchange of ideas between the pure scientist and the technologist. Attention is drawn to this throughout - gaseous microwave spectroscopy, for example, owes its development largely to the technological development of the klystron during the Second World War, and it is from such spectroscopy that practical devices such as masers and atomic time standards have been developed to the benefit of the technologist. This theme is continued in the final chapter which is devoted to the application of radio and microwave spectroscopy - some of these such as the determination of nuclear spins and quadrupole moments are relevant to the further development of pure science, but others, such as the study of radiation damage or the measurement of magnetic field intensities have clear technological implications.

The book is well written and will be a useful addition to any undergraduate library.


Reviewed by S. C. Haydon, New England University, Armidale, NSW.

At the fundamental level there has been a remarkable growth in our knowledge of negative ions since the diminutive 2nd edition of this classic monograph appeared in 1950. For those who are concerned in their researches with negative ion behaviour, Professor Massey's monumental 3rd edition will be welcomed with enthusiasm. It provides an excellent perspective of the intense activity that has occurred over the past 25 years. It is also a timely reminder of the continuing need for further studies.

Early chapters on the quantum theoretical background and later detailed descriptions of collisional and photo-detachment phenomena, ion-molecule reactions and ion-ion recombination ensure invaluable sources of information for students in many disciplines. It will be an essential companion for the research worker with any serious intention of coming to terms with the complexities of negative ion phenomena although he should not expect immediate solutions to practical problems. Indeed the final chapter concerned with applications is not entirely satisfying simply because the precise role of negative ions in many biological, chemical, astrophysical and engineering phenomena remains obscure despite the impressive precision now associated with fundamental measurements.

For those presently attempting to extend tunable laser facilities into the UV and VUV regions, by exploiting the properties of rare gas monohalides in high pressure, transient glow discharges, therefore, this new edition will not resolve the complexities of negative ion influences. It will nevertheless provide a wealth of essential reading as a pre-requisite to success.
The Eleventh Conference will be held at the University of Queensland, Brisbane from 28th August to 1st September 1978.

PROGRAMME
Papers are invited in any branch of Atomic and Molecular Spectroscopy and it is hoped that symposia will be arranged in most of the following areas.

1. Microwave - Infrared Spectroscopy
2. Electronic Spectroscopy
3. Instrumental, Analytical Developments and Applications
4. Light and Particle Scattering
5. Plasma, Atomic and Molecular Beams
6. Astrophysical Spectroscopy
7. Lasers
8. Multiple Resonance Spectroscopy

INVITED OVERSEAS SPEAKERS who have so far accepted include—S. Baskin (Arizona), R. G. Brewer (IBM), G. Chantry (NPL, UK), V. A. Fassel (Iowa), R. E. Hester (York, UK), R. Hochstrasser (Pennsylvania), E. R. Pike (Royal Radar Est.), S. A. Rice (Chicago), J. L. Steinfeld (MITO.), J. W. White (Grenoble), D. Koroda (Tokyo).
6th. Australian Vacuum Conference
PERTH, W.A. 16-19 MAY 1978 – W.A.I.T.

The Western Australian Branch of the Vacuum Physics Group of the Australian Institute of Physics is organising the sixth conference in what has become a biennial series of vacuum conferences in Australia. The conference will be preceded by a course on vacuum technology aimed primarily at industrial applications.

Vacuum Technology Course
This course will be held on the 16th and 17th May 1978. It will start from first principles and the emphasis will be on practical applications rather than theory. It should be suitable for all those who need to use vacuum equipment, or make decisions about its use, but who are not well versed in its technology.

National Vacuum Conference
This conference will be held on the 18th and 19th May 1978. The topics to be covered are vacuum technology, vacuum pumping and gauging, vacuum processes in industry and medicine, teaching vacuum techniques, and research carried out in the medium and high vacuum range.

Trade Exhibition
A trade exhibition will be organised in conjunction with the 1978 course and conference. It will include equipment used in heavy and light industry and in the refrigeration and medical fields.

Registration, Fees and Call for Papers
People contemplating attendance at either the course or conference are requested to signify their interested as soon as possible to the Conference Secretary (address below) who will supply registration forms and further information.

The fee for the course (including attendance at the conference) is $50, and rebates for students and apprentices will be considered. The fee for the conference is $25, with a rebate of $7 for members of the Vacuum Physics Group.

The deadline for abstracts of contributed papers to the conference will be 24th March 1978.

Travel and Accommodation
It is hoped that Ansett Airlines will be able to arrange package deals on air tickets and accommodation.

Further Information and Registration Brochures
Please contact: Dr. K. W. Terry, Conference Secretary, 6th A.V.C. & V.T.C., Physics Department, W.A. Institute of Technology, Bentley, W.A. 6102. [Telephone (09) 350 7544].

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