President's Column ........................................... 85
Institute Affairs ............................................. 86
Letters ......................................................... 86
Polarimetry ..................................................... 88
Physics Roundabout ........................................ 91
Interactional Magnetoospheric Study .................... 93
Physics in Society ............................................ 95
Conferences, Courses & Awards .......................... 98
Books ......................................................... 99
The Australian Physicist

EDITORIAL ADDRESS
The Editor, Australian Physicist,
Box 1, Ingle Farm, SA, 5098.
Telephone: (08) 260 2055

EDITORIAL COMMITTEE
W. S. Boundy (Editor), E. R. Sandercock (Assistant Editor),
J. A. Westphalen (Secretary), R. D. Campbell (Treasurer),
A. P. Marks (Book Reviewer), P. E. Ciddor, B. L. H. Possingham,
G. Robertson.

Associate Editors
ACT Mr F. W. Brown, Box 378, Canberra, ACT 2601
NSW Dr N. Biggell, NML, PO Box 218, Lindfield, NSW 2070
QLD Prof. R. L. Segall, Griffith University, Nathan, Qld 4111
SA Dr G. Robertson, Physics Dept. University of Adelaide.
TAS Dr P. M. McCulloch, Tas. Uni, Hobart, TAS 7100
VIC Dr Judith Pollard, Caulfield Institute of Technology
WA Dr M. J. Lynch, WAIT, South Bentley, W.A. 6102.

SUBSCRIPTIONS
Non-members: $15.00 per annum (Australia)
$20.00 per annum (Overseas)
Single issues: $1.50 (Australia), $1.80 (Overseas)
All enquiries and correspondence concerning subscriptions to:
Australian Institute of Physics, Science Centre, 35-43 Clarence
St, Sydney, NSW 2000. Telephone (02) 29 7747.

ADVERTISING
All enquiries concerning advertisements to the Advertising
Manager: J. T. O’Mara, PO Box 39, Bondi Junction, NSW 2022.
Telephone (02) 389 9698.
All enquiries concerning advertisements to the Business Manager
and Treasurer: Dr R. D. Campbell, P.O. Box 1, Ingle Farm, S.A.
5098. Telephone 499 260 2055 ext. 2099.
Advertising Deadline – 15th of the month prior to the month of
issue.

COPY
Manuscripts (original plus one copy) should deal with topics
of interest to physicists in Australia, such as developments
in the teaching or practice of physics and reports on lectures,
conferences, Australian facilities, Institute Affiliates, etc. They
should be double-spaced typed on one side of the paper only,
with margin 40mm wide, and should follow the style used in
this journal. The recommended length is up to 3 pages for
articles (as printed with figures), up to 500 words for letters,
and up to 250 words for Notes and News.
Deadline – 1st month prior to month of issue.

Figures – High contrast originals, 80mm wide (or if essential,
168mm wide) and minimum necessary height are required for
printing. Larger originals can be used but authors are asked to
pay for preparation costs with the purchase of reprints.

References – are to be cited in the text thus:
[Brook, 1947] or [Brown [1971]
They should be arranged alphabetically at the end of the article
and be presented thus:
(New York: Publisher).

Standards – Concise Oxford Dictionary; Metric Units (SI),
Symbols, Units and Nomenclature in Physics, IUPAP Document

Copies – Two kinds of copies of items published are available to
authors:
Extracts – The relevant pages as they are printed in the journal;
Reprints – Can be printed separately at a higher cost, with any
extra requirements by authors.

The Australian Institute of Physics

EXECUTIVE
Prof. H. C. Bolton, President (03 541 0811)
Prof. N. H. FLETCHER, Vice-President (067 72 2911)
Dr J. R. BIRD, Hon. Secretary (02 543 3447)
Dr C. J. HOWARD, Hon. Treasurer (02 543 3609)
Dr J. COLLINS, Hon. Registrar (02 467 6319)

ADDRESS:
Science Centre,
35-43 Clarence St.,
Sydney, NSW 2000.
Telephone 29 7747. Telex 25578.

Corrections and Additions to “William Bragg and Lacrosse”,
AP, June 1980.
Page 75: Figure 1, two names omitted, viz. “S. A.
S. A. Davenport, Frank Goode” between S. H. Goode
and Lloyd Prince;
Page right hand column, second-last line, should read
“... blues” [Observer, 1887 g]. “Facet” succinctly
summarized ...”; 
Page 77 right hand column, line 10, reference should read
[Observer, 1889 b];
right hand column, 6 lines up from bottom, reference
should read [Observer, 1894 b];
right hand column, 5 lines up, “Australian” should read
“Association”;
Page 78 table, the heading “Goals” should cover columns
6 & 7 (not 7 & 8); and
left hand column, middle of second paragraph should read
“... teams are not the subject of the photograph.
Thus the Adelaide team os 1886 (Bragg’s first year)
remains. The three Observer reports of 1886 give no
names...”.

BOOK REVIEWS
A. P. Marks,
Book Review Editor.
The Australian Physicist,
648 Lilli Pilli Point Road,
Lilli Pilli, N.S.W.,
Australia 2229.

The statements made and the opinions expressed in The
Australian Physicist do not necessarily reflect the views of
the Australian Institute of Physics, its Council or
Committee.
I am sure that all students of physics have experienced similar thoughts during their education that can be expressed through the quality of surprise. Our common human experience is that of familiar, visible objects and our first thoughts are about such objects; the words we use to describe them, such as, for example, mass, motion, momentum, force and field, carry overtones about familiar and large-scale effects. When we continue to learn about physics, we discover the need to talk about the microscopic world of atoms or the large-scale world of astrophysics. But the only words we have are those we need used for the familiar, visible objects. We should expect to find that our unaided physical intuition receives some shocks when we are learning physics and simple, plausible expectations are not borne out by experience. I expect that we can all supply examples from our own experiences as students, and if we are teachers we meet them in every elementary course we give. “Surely mass is constant; why, I can see it.” “Momentum is represented by a differential operator? Never!” We have all been surprised at the way the exercise of our intuition was deceiving us.

If we are honest with ourselves, I am sure we would recognize that we, as practising physicists, are still being surprised. Even when we know that we are working within a framework of concepts described by a paradigm, to use T. S. Kuhn’s phrase, we meet detailed conclusions that we did not anticipate. Of course, there are rational explanations for the conclusions; the surprises are based on the imperfections present in our intuitions. It was appropriate then to read R. E. Peierls’ recent book, “Surprises in Theoretical Physics” (Princeton, 1979), in which he describes a series of such surprises from a wide range of physical topics. The point of the book is made all the more forcibly if we remember the number of the physical contributions that Peierls has made in the many fields in which he has worked.

There are eight Chapters, General Quantum Mechanics, Quantum Theory of Atoms, Statistical Mechanics, Condensed Matter, Transport Problems, Many-Body Problems, Nuclear Physics and Relativity; several problems are mentioned in each. In many cases references to the problems are given and often they are to the work of Peierls or of his own students. It would seem as if these students have been brought up on a series of surprises and occasionally paradoxes, which is another way of saying almost the same thing. The range of problems is so rich that it would be really unfair to select a few of the problems for an extended discussion, and all I feel inclined to do is to mention some of those that appealed to me, no doubt because at one time or another I have found myself surprised by the conclusions that have to be drawn. The first problem of all is the Born approximation for short-range scattering and the conditions for its applicability. Accounts are given of the uncertainty principle for waves and particles and the gamma-ray microscope. J. S. Bell’s recent rigorous revision of von Neumann’s proof of the absence of hidden variables in quantum mechanics is referred to and, in this case, the element of surprise is the fact that a vital point in the argument should have remained unnoticed for so long. Heitler and London’s approximation for the ground states of the hydrogen molecule has for long been the familiar first step in understanding the nature of a homopolar bond. Peierls examines their expression in some detail and points out the surprising fact that the accuracy of this classical method is harder to establish than is usually given by a simple statement of a small overlap integral.

Saha’s theory of thermal ionization of atoms is mentioned, removing the surprising result that a single atom in a large volume is in equilibrium in a state of ionization. Irreversibility in statistical mechanics has a good discussion, as does melting in one, two and three dimensions, a particular feature of Peierls. New experiments on adsorption of helium on various surfaces have had surprising results and the old argument against a melting point in two dimensions has had to be re-examined.

In the section of phonons there is a tantalizing side-comment on the momentum of light in a refractive medium which Peierls discussed during his visit to Australia a year or two ago. One of the surprises in the problem of thermal conductivity by phonons is that even to-day there are open problems. In a discussion of perturbation theory in transport problems, the simple-minded approach is shown to give the right answer and the doubts raised by a deeper examination are shown to be without foundation. Pauli called this the “law of conservation of sloppiness.” The shell model of nuclear physics went through a similar phase; given a potential well and a spin orbit coupling, the shell model became respectable.

As a result of reading the book, it seems that in addition to a “Fermi calculation,” physicists should add to their repertoire of their professional folklore a “Peierls’ surprise.” Having enjoyed reading the book so much, I find it a shame to have to criticise its production on two points. There is no Index; perhaps this is a small point since a reader would probably aim for the sections in the list of Contents. However, the binding of the book was so tight in may paper-bound edition that it was hard to keep it open: a book should always want to be read.

The Australian Physicist, July 1980

H C Bolton

Vol. 17 No. 6
INSTITUTE AFFAIRS

Change in Articles

The deletion of Article 9(b), which was proposed by Council in September 1979, has now been approved by the Victorian Corporate Affairs Office. As a result of this change graduates with qualifications recognised by the Institute may immediately become a Graduate member without the additional requirement for one year's postgraduate experience.

At the same time as this change is being implemented the membership Committee are acting on another recommendation of Council — "that candidates for Fellowship shall have demonstrated a high level of attainment or responsibility and to have made a substantial contribution to physics, or to the profession of physicist or to the teaching or application of physics".

A new General Information leaflet is being printed with up-to-date information on the institute and its activities. This leaflet will be used to bring to the attention to all physicists the advantages of joining (or re-joining) the Institute.

Retired Members

The Executive have decided to adopt a policy for fee payments by members approaching retirement, which mirrors that used for new members. If the date at which a member retires falls in the second half of the year, and he will then be eligible for remission of further fee payments, he will only be requested to pay half fees for that year.

AIP Representatives

Professor Howard Pollard has agreed to serve a further term as AIP representative on the Acoustic Standards Committee of Australia and Dr Tony Farmer has also agreed to continue as AIP representative on the Australian National Committee on Illumination. Both these terms will continue until the end of 1982.

Occupational Classifications

A considerable number of comments have been received from members on the extracts from the proposed Australian Classification and Dictionary of Occupations (ASCO) which were published in The Australian Physicist in March 1980.

A number of these comments drew attention to missing categories such as Geophysicist and Biophysicists. Some of these are included in different sections of the Canadian Classification which was proposed as a model for ASCO by the Department of Employment and Youth Affairs. Other comments were even more critical of the whole structure of the proposed Classification and various changes in wording were proposed.

All the comments have been passed on to the Department of Employment Committee and the AIP Employment has agreed to prepare proposals for changes which would take into account all the views expressed by AIP members.

Neutron Beam Users

The Australian Neutron Beam User's Group (ANBUG) has requested AIP support for two recommendations to the Minister for National Development and Energy:

1. Planning and development work should continue to ensure that neutron beam facilities — which are vital to many areas of scientific research and development — continue to be available in Australia in the 1990's.

2. Charging for use of neutron beam facilities on a commercial basis would only recycle Government money without achieving any worthwhile purpose.

The AIP Executive agreed that a letter be sent to the Minister supporting the views put forward by ANBUG.

Annual Council Meeting

The 33rd meeting of the AIP Council will be held in Melbourne before the commencement of the 4th National Congress (viz. on 22, 23 August 1980). The Council agenda will cover all aspects of the Institute's work including physics activities, physicists, publication, science policy, membership, finance and other topics. Members of the Institute who wish to make submissions or recommendations to Council should do so through their Branch Committee or directly to the Honorary Secretary (by mid-July).

R. Bird, Hon. Secretary.

LETTERS

WOMEN IN PHYSICS

Introduction

During May, Dr Rachel Makinson from CSIRO Division of Textile Physics, wrote to our secretary, Roger Bird, and her letter is printed below. It summarises what she believes is a very important statement about women in Physics in the USA in particular and by extension to women in science in other countries and other cultures. I have printed the letter in the hope that in our Institute in which women are almost an unseen minority, members will read the article referred to with a great deal of care and use their interest and influence to help overcome the difficulties so closely detailed by Professor Kistiaikowsky. My own belief is that much more must be done to turn girls towards secondary school science and mathematics and this requires a change in attitude from teachers (particularly women teachers) within schools. It also requires educational authorities to markedly increase the number of women teaching physical science and higher mathematics in schools.

Bill Bondy

Dear Roger,

About five years ago you were asking people what they saw as the reasons that there are so few girls entering physics. Are you still interested in this question? I have noticed a rather good article from USA, which surveys the whole background of women in physics. It is:


"Women in physics: unnecessary, injurious and out of place?" (The subtitle is a quote from Strindberg at the end of the 19th century, opposing the appointment of a woman mathematician to a chair).

The author discusses the evidence for genetic differences — only the spatio-visual thing still has the possibility of being genetic — and concludes that the reasons why girls enter physics less than boys are environmental.

Typical pressures which the girl experiences and the boy does not are taken in order as she grows up:

* She is rewarded for “feminine” behaviour.
* She is given “girls” toys.
* She finds or is given to understand that to attract boys she must be “feminine”; science and mathematics do not fit this image (N.B. single sex schools produce far more
FUNDING FOR SCIENCE

Dear Sir,

In view of an impending Federal election in Australia at some time within the next seven months, and the disappointing, to put it mildly, level of Federal funding for scientific research and development in this country, both within and without the universities, I should like to draw to the attention of the Executive and members of the AIP events in Canada before the country's general election earlier this year. It would appear that there was an organised campaign to alert election candidates to the need for greater science funding and an effort to obtain commitments from them. A more recent report (NATURE, 285, p124, 15 May 1980) shows that this campaign bore fruit as the funding for the largest grant giving body, the Natural Sciences and Engineering Research Council will be increased by 35%, and a commitment has been given to increase the proportion of the GNP devoted to R&D from 0.9% to 1.5% by the mid 1980's.

Could the AIP, perhaps working with other interested organisations, draw up material with which members may lobby their local candidates? In addition to funding, other questions that could be addressed are the relative priorities of basic and applied research and of development, the level and number of graduate awards, whether a national post-doctoral fellowship scheme would be implemented, what cabinet ranking a Minister for Science would have, and whether there would be a separate such ministry. It is also desirable that party attitudes to the encouragement or coercion of industry to support research be known.

I have the impression that present governmental, and public perhaps, attitudes to scientific research, particularly basic research, are such that if continued will have a long term result not dissimilar from that described in China IG. B. Lubkin, Physics Today, March 1980, p32 as a consequence of the Cultural Revolutions. Undoubtedly the position here now is not as bad as there then but Australia is heading towards at least a partial loss of a generation of research workers, and in the long term a serious shortage of physicists.

Yours sincerely, R. N. Lindsay

PROTEST

Dear Sir,

I notice that the Institute is joining the rest of the world in protesting to the Russian authorities about the treatment being meted out to their dissidents. This is as it should be but it leaves me with a feeling that perhaps we should put our own house in order first.

Russia is not alone in its maltreatment of dissidents; it happens right here in Australia. Those of us who are unfortunate enough to be in the Public Service know full well that to dissent in public is likely to end one's professional career. One can no longer be sacked for exercising one's democratic right of free speech, but one is liable to be put on the shelf irrespective of performance and record as a scientist.

I am one of these folk. Most of those affected lie low and hope that they will be able to live down their indiscretions.

Some think that ASIO is the evil influence. It is thought by some that ASIO cannot distinguish between free speech and sedition. This could be so because these folk are hardly noted for intelligence. Whoever is responsible, dissidents are harshly dealt with right here without going to Russia. The process goes on whether there is a Liberal or Labour government in office. It is an unrelenting process.

My crime was to object in public to the destruction of a radio telescope. This was hardly a breach of security. I was absolutely right as it has turned out and my only regret is that I did not take stronger action to prevent this particular piece of bureaucratic lunacy.

We have no effective way of fighting back. The services of the Ombudsman are not available to public servants and we have no freedom of information laws worth anything. Let's examine ourselves before getting too upset about the Russians.

David S. Robertson.
10 Milan Tee., Stirling, S.A. 5152

50th ANNIVERSARY

Sir,

The Australian Radiation Laboratory, one of several laboratories maintained by the Commonwealth Department of Health, last year achieved it fifthtieth anniversary. The Department has decided that this is an appropriate time to prepare the history of the Laboratory and has asked me to undertake the project.

The Laboratory was first established in 1929 as the Commonwealth X-ray and Radiation Laboratory and operated with the Department of Natural Philosophy at the University of Melbourne. It came into being as a result of the decision of the Commonwealth Government to purchase ten grams of radium for use in the treatment of cancer in Australia. The first head of the Laboratory was Mr A. H. Turner. He was succeeded by Dr C. E. Eddy in 1935, by Mr D. J. Stevens in 1956 and by Dr K. H. Lokan in 1978. The name of the Laboratory has changed three times. It became the Commonwealth X-ray and Radiation Laboratory in 1935, the Commonwealth Radiation Laboratory in 1972 and assumed its present name in 1973.

Although much archival material is available to me I would be pleased to receive items (which may be held by readers of your Journal) such as correspondence, photographs, newspaper cuttings, statements, reprints, references relating to the establishment of the Laboratory and to its subsequent development. Material sent to me would be returned to the sender if requested.

J. F. Richardson.
A.R.L., Lower Plenty Road, Yarrambie, Victoria 3085.

The Australian Physicist, July 1980
INTRODUCTION

The technique of polarimetry dates from the discovery by Arago in 1811 that a quartz crystal rotated the direction of polarization of linearly polarized light passing through it in the direction of the optic axis. In 1815 Biot discovered the rotation by liquids, accidentally it is said, and showed that it depended on the length of the path and the concentration of the optically active constituent but was unaffected by any inactive materials that were present.

Polarimetry thus provides an accurate method of measurement of the concentration of solutions of an optically active material of known specific rotation and the results are unaffected by other inactive materials. Its main commercial use is for the measurement of the concentration of sucrose in solution and it is used at many stages in the sugar industry from the juice entering the sugar mill to the syrups and molasses found at later stages in a mill or a refinery. It needs to be accurate because the results are used to control a large plant and to determine the rate of payment to a farmer for his cane.

VISUAL INSTRUMENTS

The first polarimeters were visual instruments (Figure 1) with a fixed polarizer at one end and a second rotatable polarizer, the analyser, at the other. Since optical rotation is dispersive, increasing with the frequency of the light used, these polarimeters were used with a monochromatic source, first a sodium flame (later sodium lamp), later a mercury lamp with a filter for the green line. Since visual setting to a dark minimum is not precise, a split-field polarizer was used. The two halves of the polarizer gave light polarized in directions differing by a small angle, about 4°, and the analyser was set to match these fields. These instruments are also known as polariscopes, a correct name for a visual instrument, but the name is also used for an instrument used to examine transparent materials between crossed polarizers for the presence of strain-induced birefringence.

Figure 2. Bates-Fric saccharimeter with quartz control plates.

A second type of visual instrument, shown in Figure 2, did not have a rotating analyser and angle scale, but balanced out the rotation in the solution by a set of quartz wedges. This instrument is usually called a saccharimeter, although the name is sometimes used for all sugar polarimeters. Since the rotatory dispersions of sugar and quartz do not differ from each other for red and orange light, but do for higher frequencies, a monochromatic source is not needed. White light is used with an orange filter, traditionally a bichromat solution.

Sugar measurements are made relative to a normal sugar solution that contains about 26 grams of sucrose per litre. In the standard tube used in visual polarimeters, which is 0.2 m long, this solution gives a rotation of a reasonable size for measurement, 34.6° for sodium light or 40.7° for mercury green light. This rotation is called 100°S (degrees sugar) or 100°PSS (international sugar scale) and in fact the subject abounds in “degrees”, that old term in physics for quantity measured (temperature being considered as “degrees of heat”). Thus there are degrees of angle, degrees sugar, degrees Ventzke (an early German sugar scale), and degrees Celsius.

As a check for these instruments, quartz control plates are used; thin plane-parallel plates of quartz cut normal to the optic axis and calibrated for rotation. The quartz plate that corresponds to 100°S and a tube of standard length is about 1.6 mm thick.

AUTOMATIC POLARIMETERS

The ornate saccharimeter shown in Figure 2 was designed by Bates (1942) at the US National Bureau of Standards in the 1920s and made by Fric in Czechoslovakia. At that time Bates and the NBS were leaders in sugar analysis.

The next main advance came in the 1950s from NPL, England, with the design of automatic polarimeters (Gates, 1958) with the eye replaced by a photocell and the operator adjustment by a servo system, which used an a.c. signal. This was obtained by modulation of the direction of polarization of the incoming light, at first done by a wheel.
of quartz disks of different rotations, later by a Faraday cell.

The Faraday effect, which is also dispersive, is the rotation of the direction of polarization by a transparent material in a longitudinal magnetic field. The rotation depends on the field, the length of path, and the Verdet constant of the material. Most Verdet constants are small, for the glasses with the highest values, the dense flint glasses, the rotation is about 0.1° (3 x 10⁻⁶ rad) per ampere-turn. Since any birefringence in the glass caused by poor annealing or strain from its mount affects the polarization of the light and disturbs a polarimeter setting, the glass cores used in Faraday cells must be selected free of strain. To avoid mounting strain, it is usual to use Pockels glass, which has a zero stress-optical coefficient; strain in it produces no birefringence.

An a.c. Faraday cell will modulate the direction of polarization. The detector drives a servo-system that either rotates an analyser or balances out the sugar rotation by a d.c. Faraday cell. The latter method has a limited range. The first NPL-designed automatic polarimeter had a range of only 1° of rotation and the sample of sugar solution had to be in a very short tube, 5 mm or so long. The extra precision of the photo-electric setting allows the use of this small sample without loss of accuracy but it has made standardization difficult; a quartz control plate would be too thin to make. The manufacturer, Bendix, later produced a model with water-cooled Faraday cells that allowed a range of 10° and NPL have succeeded in making quartz control plates for these.

The smaller Bendix instrument is shown in Figure 3. It is made vertical so that the earth's magnetic field through it does not vary if it is turned around. Of course all polarimeters can be affected by the earth's field but this effect is negligible in polarimeters without Faraday cells, even when large rotations are measured, since the Verdet constant of sugar solutions is much less than that of the glass Faraday cores.

Most modern automatic polarimeters use the Faraday effect only for modulation and have a servo motor driving the analyser to balance. An angle encoder reads the rotation, which is displayed either directly in angle or converted to degrees sugar for the wavelength used. As sources they have an incandescent lamp with a narrow-band interference filter to isolate a band that lies effectively at either the sodium or the mercury line.

There is, however, one instrument, made by a firm with the appropriate name of Optical Activity, that is based on a different approach. There is a fixed polarizer and a continuously rotating analyser. The detector receives a sine-wave signal and the phase of this is compared with that of the motor driving the analyser. The rotation is then the phase obtained with the sample present less the stored phase obtained with no sample.

THE NML POLARIMETER

The NML polarimeter provides an example of the methods used in automatic polarimeters, although not an automatic instrument itself. It was made to calibrate quartz control plates for Australian industry and other laboratories. To retain versatility, it consists of a set of components on an optical bench (figure 4). In order, the components are a water-cooled lamp house, a double monochromator to separate out the spectral line used, a polarizer and circle (usually left fixed), an a.c. Faraday cell, a d.c. Faraday cell, the temperature controlled housing for the quartz control plate, the analyser with circle, and a photomultiplier. Figure 5 shows a diagram of the optical system.
1000 s; when the light source is weak, a long integrating time is used. The total range of compensation possible by this cell, ± 16° 40′, is deliberately kept small to avoid heating the d.c. Faraday cell.

The circle has errors less than 3° and the uncertainty of calibration now is about 10° or 0.0075°. This should be reduced in future when a thick quartz sample has been made and built in to the polarimeter as a standard that will give simultaneously any correction required for errors in the temperature of the sample and in the effective wavelength of the source.

In design this instrument follows fairly closely those used by other standards laboratories such as NPL, England, and PTB, West Germany (Bunnagel and Oechring, 1966). Our instrument uses a thermo-electric element to control the temperature of the quartz control plate, while circulated water is used in the other laboratories.

INTERNATIONAL SUGAR SCALE

Since sugar is an important article of trade, there is an international standardization of the sugar scale used for its measurement. The controlling body is ICUMSA, the International Commission for Uniform Methods of Sugar Analysis. Its decisions are often as much political as scientific and are a balance between the demands of the sugar-producing countries and the sugar-consuming countries. Even among the former, there is a split between cane growers and beet growers.

The present definition of the 100°S point is a classical example of a double definition. It defines both the concentration of the solution that gives the rotation in a 20 cm tube and the rotation at 20°C for the green line of the mercury-198 lamp. This lamp is very weak and, at NML, we had considerable trouble to get readings with it on our polarimeter, only to find that, apart from a set of measurements made once at PTB, it is never used by other laboratories. Instead they use commercial low-pressure mercury lamps and make a small correction for the difference in effective wavelength. However, our use of the isotope lamp was interesting in that it showed that it was an unsuitable source. Our results varied with the setting of the monochromator, showing that other lines were present due to the argon filler gas. These lines are too broad to affect the earlier use in interferometry over long path differences, for which the lamp was made, but show up in polarimetry, which is essentially very accurate interferometry over a short path difference. We have now obtained a lamp with helium as filler gas but need for it has now passed, since ICUMSA is now reconsidering the definition of the sugar scale.

This is because photo-electric polarimeters with their increased accuracy have shown errors in the present definition. The first errors were tracked down to the weighing of the sugar: it was not completely free of water. Now that this has been overcome there are disagreements between rotation measurements made at the PTB, West Germany, which is now the leading laboratory in this field, and the US National Bureau of Standards, which has come back to sugar after a long gap (Olsen, 1973). ICUMSA has, therefore, requested a complete remeasurement of the rotations of quartz and sugar solutions at different temperatures, light frequencies, and, for sugar, concentrations. Instead of using weak spectral lines, the measurements will be made with a dye laser locked in turn to lines from hollow-cathode lamps. Unfortunately this puts the project right outside our means, although the collaboration of as many national laboratories as possible is desirable.

LASER POLARIMETRY

One result of this measurement should be the recognition by ICUMSA for international trade of rotations measured at 633 nm, the wavelength of the helium-neon laser, at present they recognize only measurements made with wavelengths between 540 and 590 nm. While the rotation is less for red light, this should be compensated by the extra power available and the better transmission of dirty solutions or solutions rich in molasses.

Laser measurements can be used within one country, although there is still a small discrepancy between them and those made with the mercury line on dark solutions. NML has collaborated with the CSR Central Laboratories in modifying a commercial automatic polarimeter by replacing the lamp by a He-Ne laser, with appropriate changes to the optics, and the photomultiplier by one designed for use with this laser. Its use is being evaluated by CSR at one of its mills; laboratory tests suggest a gain in sensitivity of about a thousand times.

ABSOLUTE INTERFEROMETRY

Fresnel explained optical activity as due to circular birefringence, the material having different refractive indices for left- and right-handed circularly polarized light. The incident linear polarization is decomposed into equal intensities of the two-circular polarizations. The components take different times to reach other end of the sample and so arrive with a phase difference. When they recombine to give linearly polarized light, the direction of this is rotated. A rotation of 180° corresponds to one wavelength of path difference.

Now in many two-beam interferometers it is possible to polarize orthogonally the two beams. This can either be as the two circular polarizations or as two perpendicular linear polarizations, which are converted to left- and right-handed circular polarization by a 1/4 plate at the end of the interferometer. The change of intensity due to the interference is converted to a rotation of the direction in which the light leaving the interferometer is polarized and fractions of a wavelength can be measured as angle by crossing this light with an analyser. While there are other methods of rading fringe fractions, most need some calibration. An angle measurement gives directly an absolute measurement of path difference.

If the limit of setting of a commercial automatic polarimeter is taken, it is limited by noise to 10°. This corresponds to 5 x 10⁻³, a figure well beyond most practical interferometry, although it has been approached in special circumstances. The reason for this accuracy is that, as an interferometer, an optically active sample is ideal. Both beams follow the same path with only the difference of index affecting them. Practical interferometers are usually much more sensitive to outside disturbances. But, if they can be eliminated, one millionth of a fringe should be the limit set by source and detector noise.

But most practical interferometry requires settings to about one hundredth of a fringe; that is, angle settings to one or two degrees only. A polarimeter with a very simple angle scale is then all that is needed. An example of such absolute interferometry is the measurements by Roberts (1975) of thermal expansions of solids to a sensitivity of 10⁻⁵ K⁻¹. Other proposed applications at NML are for the calibration of optical flats by a scanning interferometer and the measurement of the refractive index of air.

ELLIPTISOMETRY

Conventionally, the word ‘polarimetry’ is used for measurements of the angle of linearly polarized light. The study of polarized light in general is called ellipsometry, since the most general state of polarization is elliptical. Two measurements are required to specify such a state: for example, the angle of the major axis of the polarization ellipse and its eccentricity, or the relative amplitudes of two orthogonal linear components and their phase differences.

A modern ellipsometer is thus a doubled-up version of a photo-electric polarimeter. But there is one case where only a single measurement is required and then a modified...
PHYSICS ROUNDBOUGHT

Ceduna 2 ——
Looking to the Future

A new $10 million satellite earth station at Ceduna, South Australia is the first Australian station capable of meeting international standards necessary to gain access to the new series of satellites due to be launched at the end of 1980.

These standards include the ability to differentiate between two types of polarised signal (dual polarisation).

Ceduna 2 is the first Australian satellite earth station to be fitted with solid state low noise amplifiers (LNA) to achieve a noise temperature of 37 degK. LNA's being developed for the OTC and to be installed in the other earth stations in Australia will achieve a noise temperature of 30 degK, believed to be the lowest in the world.

Ceduna 2 is the fifth satellite earth station constructed and operated by the OTC and could be in operation by July — in time for the Moscow Olympics, should that be necessary.

The introduction of Ceduna 2 will give the OTC the capability of operating simultaneously the two satellites in the Indian Ocean region, thereby providing two separate direct paths between Australia and Europe. [Engineers Australia. March 7, 1980.]

Academy of Science

Joint Academies Project:
Liquid Fuels and Society

This project has recently been established as a joint initiative of the Academies of Science, Humanities, Social Sciences, and Technological Sciences. The purpose is to bring together the expertise within the four Academies to assess the impacts that are likely to occur within the next fifteen to twenty years as a result of changes in the availability of liquid based fuels. Particular attention will be focussed on employment and wealth distribution, mobility within Australia, rural production and life styles, and the location of business, industry and other functions including residential locations and life styles in major cities.

The project will be focussed on Australia, but the assessment will be made in setting of changes in the availability of fuels and economic, financial and other factors on a world wide basis.

A committee has been established to develop the project under the Chairmanship of Professor J. L. Dillon (University of New England) and the first phase of the project will include a workshop planned for September, 1980, to elaborate the project and to produce a position paper for

polarimeter can be used. This is for the measurement of retarders, birefringent plates of materials such as quartz or mica that produce a relative retardation between two orthogonal linear polarizations. The most commonly used are quarter- or half-wave plates. These can be measured on the NML polarimeter if a quarter-wave plate is added, as in interferometry, to convert the linear components from the retarder to circular components.

REFERENCES


In the second phase a seminar is planned for mid 1981, leading to a major publication, and the consideration of plans for further activities.

Further information about the project can be obtained from Professor W. D. Borrie, Director, Academy of the Social Sciences in Australia. National Library Building, Parkes Place, Parkes, ACT 2600.

Scientific Exchange Programme with Academia Sinica

The Scientific Exchange Program between the Australian Academy of Science and the Academia Sinica, Beijing, is now in its third year. A progress report has been published (Scientific Exchanges with China: 1977-1979, Australian Academy of Science, December 1979). The report includes assessments of four of the major areas of the exchange program: the earth sciences, entomology, plant sciences and animal sciences. The report also reviews the operation of the exchange program and lists the publications that have resulted from it. A Colloquium was held at the Academy of Science in Canberra on 14 December 1979, at which presentations were made on the achievements, problems and development of the exchanges, and plans for an extension of the program were discussed.

Copies of the report are available on request from the Executive Secretary, Australian Academy of Science, PO Box 783, Canberra City, ACT 2601. Telephone: (062) 48011. Search: January [February, 1980]

New Physics Professor

Dr Dick Collins, has just been appointed to a new Chair of Physics at the University of Sydney with initial responsibility for developing work on solar energy.

Currently Head of the Department of Physics at the N.S.W. Institute of Technology, Dr. Collins, regards himself "still as an industrialist rather than an academic."

After he graduated from this University in 1961, he spent nearly 15 years working with Amalgamated Wireless Australia (AWA) — with a three-year leave of absence at New York University where he was awarded a PhD — before joining the N.S.W. Institute of Technology in 1978.

Junior Research Fellow — Positions Created

A new position offering PhD students the opportunity of a reasonable salary while engaged in full-time research has been created by the University of Sydney Senate.

The new position, classified as Junior Research Fellow, comes after growing complaints that University Departments are unable to attract the best young graduates on research projects because of outside competition.

Announcing the creation of the new position, the Registrar, Dr Ken Knight, said there had been a demand for a new classification which would allow research workers to enrol for a full-time PhD in the same way that tutors may.

‘Until now, Research Fellows were only appointed after completing their doctorates’, he said, ‘and the position of Research Assistant would only allow part-time PhD candidature.

A five-step salary scale has been adopted which allows for an extra step for contingencies beyond the usual four years taken for a PhD degree.

The salary range will be from $7,748 to $8,929 per annum (classed as a taxable stipend), which represents two-thirds of the equivalent tutor rates for steps 1-5, and the rates will be adjusted in accordance with the national
wage determinations.

The new position will provide for cases where outside funding bodies are prepared to support PhD candidates at stipend levels higher than the standard postgraduate studentship rate ($4,200 per annum tax free), whereas in the past the University has sometimes had difficulty in finding appropriate position classifications for such cases. [The University of Sydney News, June 10, 1980]

Rolling out the defects

What sort of rolls are best for the rolling of hot aluminium strip was the subject of a recent 12-months' study leave trip to the Alcan Research Laboratories in Britain by Dr Tim Howes of the School of Physics. It had been found that the rolls developed a coating, which meant that defects appeared on the strips from the rolls, said Dr Howes, who studied the effect of changing the material on the rolls. It was considered that this study would also be relevant to potential developments in forming, extrusion, continuous casting and powder metallurgy processes, he said.

A small test mill was used to roll aluminium strip with pairs of rolls of different materials, including steels, new tough ceramics (silicon carbide and silicon nitride), and plasma-sprayed coatings of tungsten carbide and alumina on steel rolls. The roll coatings formed were examined and analysed by scanning electron microscopy and X-ray spectroscopy. It was found that the coating developed on the steel rolls for lubricated hot rolling, but rolls of silicon nitride developed least coating when the rolling contact was un-lubricated. The results are being interpreted in terms of the thermal properties, the surface roughness and the "wetting properties" of the different roll materials', Dr Howes said. [Uniken, May 30, 1980]

He$_3$ Cooled Infrared Detector operates at 0.4K

This sensitive detector of far infrared radiation has been in operation at the University of Canterbury since December 1979, and certainly sets a New Zealand record for low temperature operation.

The doped Germanium element is cooled to 0.4K by pumping on 1 cc or so of liquid Helium 3 isotope. The detector is surrounded by a bath of ordinary liquid helium whose vapour is pumped away to cool it to 1.7K in order to initially liquify to He$_3$.

The He$_3$ is in a closed system at 8 atmospheres pressure at room temperature. Once it is liquified a container of activated charcoal which is part of the He$_3$ reservoir is cooled so that the activated charcoal now absorbs the He$_3$ gas. This is effectively a maintenance free pump.

The work is being done by an M.Sc student, Rodney Vickers, supervised by John Campbell. The detector is initially being used to study the lattice modes of CdCl$_2$, type crystals but is part of the extension of spectroscopic facilities at Canterbury at low frequencies (5 cm$^{-1}$ or 2 mm wavelength).

Holography — For Bubble Chambers

One of the limitations in bubble chamber physics has been to obtain good spatial resolution of the bubble (and hence particle track) position while also retaining good depth of field for the photographs, so that tracks could be accurately located over most of the volume of the bubble chamber liquid. A possible solution to this problem is to use the technique of holography.

Two factors have swung attention back onto this subject in recent months. The first is the fashion change in bubble chamber physics towards small rapid cycling chambers used as vertex detectors in hybrid systems with electronic detectors. The second is a physics interest which can be met by higher resolution. The charged mesons, such as the D mesons, have lifetimes in the range of $10^{-10}$ to $10^{-8}$ s which is just tantalizingly beyond what can be seen with the resolution available in conventional bubble chamber optics. If resolution could be improved by some two orders of magnitude the special abilities of bubble chamber physics could be brought to bear on the particles composed of charmed and bottom quarks.

Another attraction of holography for bubble chambers is that a hologram can store many thousands of times more information than a conventional photograph. It would be possible to spread incoming particles over several planes separated by a few millimetres (enough to avoid tracks from interactions crowding on top of one another) and thus make use of the whole chamber volume. This would increase the event rate and allow the rarer interactions to be studied.

Rutherford Laboratory holograms have been taken of arrays of 5 μm glass fibres immersed in a liquid whose refractive index was different from glass by a factor of 1.1. This simulated the optical properties of gas bubbles in liquid hydrogen. The location of the 5 μm fibres could be very clearly reconstructed from the hologram.

At CERN clear resolution down to 2 μm has already been demonstrated over depths of field up to 16 cm and a field of 7 cm. Planes of wires, centimetres apart, can be easily picked out when scanning the holograms through a microscope coupled with a TV system. [CERN Courier, June 1980]

Laser Enrichment Research — at Lucas Heights

Although it is no secret, it is perhaps not generally realized that the Australian Atomic Energy Commission is continuing its research on the separation of isotopes using lasers. (One newspaper recently suggested that this work should be "dusted off" to help in comparing the costs of enrichment techniques developed elsewhere.)

There is more than one laser-based route to isotope separation. In one scheme, gaseous uranium is ionised using a wavelength chosen for one isotope, and the ionised isotope is separated electrically. In another, uranium hexafluoride is selectively dissociated, so that the subsequent isotope-separation step is chemical. Both methods have their problems: in the first case, the high temperature and low optical absorption of gaseous uranium; in the second, the closeness of the dissociation wavelengths for the isotopic variants of the molecule. The AAEc is following the molecular line of attack, but with molecules other than hexafluoride: mainly organic uranyl compounds — i.e., compounds containing the UO$_4$ radical — with various novel formulæ, to quote the 1978/9 AAEC annual report.

The annual report cautiously describes photodissociation as having "some possibilities as a means of isotope separation", and refers to the series of pulsed, tunable CO$_2$ lasers developed by AAEC for photodissociation experiments. One of them has a repetition rate of 20 Hz and an output power approaching 20W per pulse. A recent example is described in the March 1980 issue of AAEC's Nuclear News.

The device as described is claimed to have a life between services of 250,000 pulses — an advantage over many commercial CO$_2$ lasers — a uniform intensity across the beam, and an output of over 100 frequencies in the 10μm region. Tuning is by means of a diffraction grating. The length of the gas enclosure is about 75 cm. [Search, Vol. 11 No. 6, June 1980]
Many regional symposia on IMS results were held during the last few years. The first major symposium on results of the IMS was held at La Trobe University, Bundoora, Victoria, Australia from November 27 to December 1, 1979. The meeting was co-sponsored by the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) the International Association on Geomagnetism and Aeronomy (IAGA), the Australian Institute of Physics and the Australian Academy of Science, and was held as part of the XVII General Assembly of the International Union of Geodesy and Geophysics. 166 attendees from over twenty countries heard 126 papers from 270 authors on results acquired so far from IMS experiments.

Summary of Scientific Aspects of the IMS Symposium
The IMS Symposium was opened by the keynote address of Nobel Laureate Professor H.O.G. Alfvén entitled "Plasma in Laboratory and in Space". The major sub-divisions of the Symposium were in the areas of (i) Magnetopause and Boundary Layers, (ii) Auroral Substorms and Magnetotail, (iii) Auroral Arcs, Pulslations and Hiss, (iv) Lower Latitude Phenomena, (v) Electric Fields and Currents, (vi) Energetic and Thermal Plasmas, (vii) Waves.

New information was presented on the structure of the dayside magnetopause and boundary layer based upon measurements from the ISEE 1 and 2 satellites, of magnetic field, energetic particle velocity and pitch-angle distributions, and electromagnetic waves. Some data was consistent with reconnection of the earth and interplanetary magnetic fields occurring at least in small regions of the magnetopause. From the Intercoosmos 19 polar orbiting satellite results were presented showing small-scale and short-time fluctuations of soft electron intensities. Inside the boundary layer the flow is highly variable. Towards the flanks of the magnetosphere the boundary layer flow speeds can substantially exceed those of the adjacent magnetosheath. The magnetopause has been measured to reveal thicknesses of 500 to 2000 km, and evidence was shown for the transfer of magnetic flux from the dayside to the nightside of the earth of sufficient quantity to account for magnetic substorms. Field-aligned asymmetries of energetic ion fluxes near the magnetopause were interpreted as evidence for magnetic field tubes open to interplanetary space.

A vacuum ultraviolet-TV camera on board the Japanese satellite KYOKO (Exos-A) has produced about 20,000 images so far. Each image covers almost the whole of the northern polar region. This technique shows great promise for extending our knowledge of auroral morphology and its relation to magnetospheric electrodynamics.

Balloon-borne X-ray imaging of the upper atmosphere under auroral break-up conditions, were reported. With a spatial resolution of 10 km at 100 km altitude, structures of scale length about 10 km and motions of a few kms per sec. of aurora were observed.

Numerous rocket experiments on auroras and electric currents were reported combined with simultaneous ground-based measurements of drifts using radar systems. Synthesis of the results enabled determination of field-aligned and horizontal currents in auroras to be made. Studies of auroral zone ionospheric electric fields, conductivities and currents were reported from the Chukotka Radar System, the Scandinavian Twin Auroral Radar Experiment (STARE), the Siberia-IMS-70 expedition, the Finnish All-sky Camera Chain, the Scandinavian Magnetometer Array, the IMS-Alaska Meridian Chain, and the TRIAD satellite magnetometers. An aura of auroral research that received considerable attention was the relationship of electromagnetic and hydromagnetic waves to auroras.

Low-latitude work related to the IMS featured VHF doppler auroral radar measurements from Southern New Zealand, the morphology of the trough using measurements from the AE-C satellite and the distribution of magnetic pulsations from the pole to the equator.

The GEOS and ISEE spacecraft presented new measurements of electric fields in the magnetosphere on magnetic field lines connected with the auroral zones. Coupled experiments between the GEOS satellite and the Scandinavian Twin Auroral Radar Experiment related plasma drifts in the distant magnetosphere to those in the ionosphere. Long-period variations of magnetospheric drift often map fairly accurately along the geomagnetic field, whereas short period variations do not map very well. Balloon and rocket measurements of electric fields of magnetospheric origin measured under the auroral zone have been interpreted in terms of the development of anomalous resistance and longitudinal electric fields in tubes of force connected to the aurora. The MIT Millstone Hill Incoherent Backscatter Radar reported measurements of ionospheric drift in the invariant latitude range from 60 to 75° with a time resolution of 20 minutes.

Theory was presented on magnetospheric dynamic action, modelling of magnetospheric electric fields and on the process of formation of parallel electric fields in the magnetosphere, and wave-particle interaction.

Surveys of the heavy ion distribution in the magnetosphere were given. These important new results should bring new insight into the local acceleration process within the magnetosphere, and the relative importance of the ionosphere and solar wind as sources of heavy ions.

Important new results were described regarding the thermal plasma at the sites of GEOS 1 and 2 satellites using the mutual impedance experiments. The ionospheric experiments on the MAG-1K (Intercoosmos 18 satellite) produced new information on the dynamics of the ionospheric trough, ionospheric composition precipitated particles, and VLF and ELF emissions.

Multi-spacecraft observations were reported on such phenomena as the effects of sudden commencement on trapped particle populations and the variation of phase-space density of particles during a magnetic storm. Evidence was reported that electrostatic acceleration of charged particles may take place in the high latitude plasma mantle of the magnetosphere.

Results from the Japanese IMS dedicated satellite JIKIEN (Exos-B) demonstrated relationships between the VLF fields and energetic electron populations in the magnetosphere.

Experiments involving ground-based transmitters such as those at Siple Antarctic and OMEGA Network coupled with receivers on the ISEE 1 spacecraft, show that signals can propagate to the satellite through non-ducted paths, and new features of triggered ULF emissions emerged from these studies.

Auroral kilometric radiation was the subject of an extensive report from the JIKIEN satellite group. The source region is in the height range 3000 to 6000 km above auroras and is thought to be associated with electrostatic double layers.

Though progress has already achieved, much remains to be learnt about the magnetosphere in the areas of the cusp and boundary layers especially about M.H.D. turbulence, eddy convection and non-linear plasma physics.
The connection of the distant geomagnetic tail to the polar cap remains not understood as does the connection of current generating regions near the magnetopause to the ionosphere. More work needs to be done on the composition of the ring current and trigger mechanisms for substorms. The whole field of magnetosphere-ionosphere coupling and the deposition of energy into the neutral atmosphere, needs global study for its comprehension, not only from the point of view of physics but also from the point of view of application in radio communications.

The effectiveness of the International Magnetospheric Study has been most important in the recognition of the discipline of solar-terrestrial physics and of the clear necessity of a project-oriented interdisciplinary body such as SCOSTEP, which is required for the carrying out of international collaborative programs in solar-terrestrial physics. Academies, space agencies, universities and about 10,000 individual scientists contributed to the development and prosecution of programs of the IMS. A milestone in solar-terrestrial physics has been achieved by all their efforts. It is not an overstatement to say that solar-terrestrial physics is now recognized to be of fundamental importance to man in his attempts to understand and come to terms with his environment.

The IMS Symposium brought forth only a small amount of IMS material. IMS work on geomagnetic pulsations was reported separately at the IAGA meetings in Canberra in the week following the IMS Symposium. An enormous amount of work remains to be done with data collected during the IMS. This is a task for the Data Analysis Phase of IMS activities commencing in 1980 and going on for several years. We can expect many more new and exciting results. Abstracts of the IMS Symposium and of the relevant IMS material presented at the IAGA meeting are available in IAGA Bulletins numbers 42 and 43 respectively and are available from IUGG Publications Office, 39 ter, Rue Gay-Lussac, 75005, Paris, France.

The data analysis phase of the IMS will call for the same kind of dedication and commitment by academics, agencies, universities and individuals as did the experimental phase except, of course, that the emphasis will be on the analysis of data rather than experiments. Naturally many experiments will continue to run into the 1980's. It is clear that mechanisms for the interchange of data and information, and for the gathering together of scientists in workshops will be necessary during the data analysis phase. Agencies and universities are encouraged to provide the funding necessary in order to extract from the existing data the maximum amount of understanding about the magnetosphere.

It cannot be too strongly emphasised that progress in this area can only be made by intercomparison of simultaneous observations made on many different interacting phenomena and regions of space. The needs of magnetospheric scientists in terms of funding and interaction greatly differ from those of conventional laboratory physicists, who, by and large are in the happy position of being able to isolate the particular phenomenon they are interested in.

It is now clearly understood that magnetospheric processes contribute to perturbations of the minor constituents and the dynamics and electrodynamics of the earth's upper atmosphere, particularly in the stratosphere and mesosphere, and since these regions are now known to be an important component of man's environment, the magnetosphere, as a consequence, becomes also important as a component of our environment. Sooner or later the connections between the magnetosphere and the upper atmosphere have to be understood, and in order to do this the fundamental physics of the magnetosphere must be revealed.

The data analysis phase of the IMS can be expected to reveal important new insights into magnetospheric physics.

K. D. Cole.
President, SCOSTEP.

---

PUBLISHING DELAYS IN THE AUSTRALIAN JOURNAL OF PHYSICS

A healthy increase in the number of papers submitted to the Journal, coupled with production difficulties, has temporarily affected the Journal's fine record of rapid publication. But the situation is to improve.

Over the past months the average time of publication for papers in the AIP has increased considerably and issues have often appeared irregularly. In a letter to contributors to the Journal, the Chairman of the Advisory Committee, Dr R. W. Crompton, has explained the reasons for this hopefully short-lived situation.

Until 1979, the annual number of papers submitted to the Journal has been steady or slowly increasing but the proportion from Australian authors had been decreasing and there had been an overall reduction in the standard of the submissions. As a consequence much more editorial work was required for a smaller output of publishable material. In an endeavour to right this trend the Advisory Committee began a number of promotional activities at the end of 1978. The situation has now changed dramatically.

As a result of a most gratifying response from the physics community the Journal is now somewhat embarrassed with riches, with an increase in local support of near 100%. This result clearly demonstrates that Australian physics could well support a strong monthly international journal, with the obvious ensuing benefits for the national community. The Advisory Committee is now more convinced than ever that this should be its objective, but extra staff and resources are obviously needed. Measures have already been taken to increase the editorial staff (see the advertisement in the June issue of the Physicist) but additional resources across the board are required, and are being sought, to realize the objective of a strongly supported monthly journal. In the meantime the Editorial and Publications Service of CSIRO, who publishes the Journal on behalf of the Australian Academy of Science and the CSIRO, must attempt to cope with facilities that are not adequate to meet this challenge.

The Advisory Committee has expressed its disappointment and concern at the present undesirable delays. Nevertheless it is confident that, because a growing number of Australian physicists are becoming familiar with the high standard set and maintained by the Journal, there will be a sufficiently large and regular volume of submissions to justify the requests currently being made for the extra staff and resources needed for the monthly publication.
PHYSICS IN SOCIETY

F. R. BOND, Antarctic Division, Department of Science and Environment

Some people fail to recognise the role of physics in bringing about changes in society. Newtonian physics provided a basis for the Industrial Revolution, and we are now going through a change which historians may well call the Automation or Electronics Revolution. The corresponding change in economic thinking finds few adherents. Physicists not only solve problems for society, they also make problems. They have formulated the knowledge with which engineers and others have increased the output of goods with progressively less and less labour. A possible solution to this unemployment problem could lie in the gradual development of a dual economy; for those who prefer it, a self subsistence small-holding, a group of cottage crafts, and similar high quality labour intensive occupations could be encouraged and even, to a limited extent, subsidised. However, we may be wise to look at the alternative of a steady-state economy.

On reading the book "Toward a Steady-State Economy" one gets the impression that physicists ought to equip themselves to play a far larger role in society. The book consists of a series of essays by eighteen authors and is edited by Herman E. Daly, who is also one of the authors. It was published in 1973, but most of the book remains as pertinent today as when it was written.

The Introduction, part of which was originally published in "The Patient Earth", outlines the ordering of the essays in a kind of Aristotelian manner. With minor changes to suit the present purpose, the diagram to illustrate this ordering is reproduced in Figure 1. It would appear that this ordering can be taken as also representing the relationships between the various disciplines and activities which interest to form our society.

It will be seen that Physics is at the base of the pyramid on which the activity of society is based. There are a number of disciplines involved all of which, in a rational world, would be working in co-operation towards the Ultimate End of the general good of all living things.

The concept of a steady-state economy is not new. In 1857, John Stuart Mill wrote:

"It must always have been seen, more or less distinctly, by political economists, that the increase in wealth is not boundless, that at the end of what they term the progressive state lies the stationary state, that all progress in wealth is but a postponement of this, and each step in advance is but an approach to it ... ."

Dealing with the need for stricter restraint on population growth, Mill wrote:

"Nor is there much satisfaction in contemplating the world with nothing left to the spontaneous activity of nature, with every rudd of land brought under cultivation, which is capable of growing food for human beings; every flowery waste or natural pasture ploughed up, all quadrupeds and birds which are not domesticated for man's use exterminated as his rivals for food, every hedgerow or superfluous tree rooted out, and scarcely a place left where a wild shrub or flower could grow without being eradicated as a weed in the name of improved agriculture."

The modern concept of the steady-state economy is one in which the total population and the total stock of physical wealth are maintained constant at some desired levels by a minimum rate of maintenance throughout. (Fig. 2).

In Figure 2 the rectangle (E) represents the total ecosystem which for most practical purposes we may take as the magnetopause, the boundary of the magnetosphere. The ecosystem contains the total stock (S) of energy and materials, those which are useful being in the low entropy, or relatively highly concentrated form. It also contains people, animals and vegetation. These are the parts of the ecosystem with which we are concerned. The ecosystem imports energy from outer space, mainly from the Sun, and exports waste heat, high entropy energy, to outer space which acts as a sink.

Matter and energy in the stock (S), although convertible, in limited applications, are treated as separate entities. The reason for this is that, because of the applicability of the second law of thermodynamics, energy cannot be recycled. Energy is available in many forms, directly from the Sun, mined coal, oil in oil tanks, water on high ground, living things, wood and vegetable products and so on. The stock is maintained in a steady-state when primary matter (B) is equal to the waste matter (D) and primary energy (C) is equal to waste energy (F). For the steady state the throughput is equal to both input (B + C) and output (D + F).

Since the earth makes new supplies of extractable low entropy matter available at only a very slow rate, the total stock can be regarded as constant. The total stock will last for the longest period if the throughput is as low as practicable. This implies that the manufactured items should
be as durable as possible and that a maximum of low entropy matter should be salvaged by recycling (R). The optimum durability of an individual commodity at a given time is that period for which the marginal production cost of making the item more durable is greater than the marginal cost of recycling. In this concept of cost, the ecological cost should be included, but the determination of ecological cost is a problem which economists do not appear to have solved yet.

The question of the size of the stock in relation to people is most difficult to answer. People everywhere must be encouraged to limit the population by all means which are normally acceptable in each community, and which do not outrage the sensibilities of other communities. In general, the total size of the stock and the rate of throughput must not be so large that the natural processes of the ecological system are obstructed. Too large a stock of both people and material processes could become a malignant tumour which could kill the whole organism, the ecosystem.

The concept of a steady state economy discussed above differs from the neoclassical economic concept. The neoclassical economists assume constant wants and constant technology and investigate the relationship between physical variables and these non-physical parameters. The definition derived from Mill assumes constant physical parameters and also the non-physical variables, wants, better wants and technology can reasonably be adjusted to the physical parameters.

The current economic dogma for the cure of all problems is economic growth. It is said that poverty can be avoided by making the economy grow larger to provide more employment for the poor and more tax revenues for welfare programmes. Unemployment can be reduced by increased investment and growth which will increase aggregate demand, so increasing employment. The cure for inflation is to be found in growth by raising productivity so that more people will be chased by fellow dollars. Difficulties over balance of payments will be overcome if economic growth and productivity are increased thus increasing the quantity of exports. Pollution and depletion of resources will not be important if we promote economic growth so that we shall be rich enough to afford the costs of cleaning up, and to afford the cost of discovering new resources and new technologies. To meet the ever present danger of war, we must grow so that we shall be strong enough to have both butter and guns.

However, a major objection to continued rapid growth comes from Evsey Domar who in 1947 wrote:

"The economy finds itself in a serious dilemma; if sufficient investment is not forthcoming today, unemployment will be here today. But if enough is invested today even more will be needed tomorrow.

And later in the same article:

"So far as unemployment is concerned, investment is at the same time a cure for the disease and the cause of even greater ills in the future."

This is, as the reader is probably already aware, putting a case for an economy which grows only very slowly until it approaches a steady state in which new inventions and processes are brought into being as redundant processes are made redundant diminish. Redundant processes should remain as a skill, still to be taught, but largely to be practised in increasing leisure time.

The ultimate need for a steady-state economy is the fact of the slow rate at which the Earth replaces those items which form part of any "robber" economy: oil, coal and minerals. Undoubtedly substitutes for most of these will be found, but if the market is rapidly flooded with each new high profit margin substitute we shall be faced with an almost endless succession of boom and bust situations.

It is perhaps not surprising that some physicists and biologists have accepted the concept of a steady-state economy while most economists, have ignored, or failed to read, the quoted injunction from Mill.

As early as 1971 the American Association for the Advancement of Science was discussing

"How to live on a finite Earth?"

"How to live a good life on a finite Earth"

"How to live a good live on a finite Earth at peace and without destructive miscalculations."

By the same year American Economic Association did not discuss any of these problems, and it appears that concepts in the field of economics have not changed very much since that time.

Some physical concepts have wide application. The economic consequences of entropy are discussed in some detail in Daly's book. Economists also make limited application of Le Chateliers Principle. The generalised statement of Le Chateliers Principle can be written as follows:

"If a system in equilibrium receives a constraint then the components of that equilibrium will so dispose themselves to oppose or nullify the restraint."

There are of course qualifications, firstly the constraint must be relatively small compared with the size of the system, and secondly, time must be given for the new equilibrium condition to establish itself.

The question is: "Have scientists educated society at large to appreciate the full implications of Le Chateliers Principle?"

Physicists should see their place in society as taking part in all the processes which lead to the Ultimate End, not merely as the study of low entropy matter-energy and its multitudinous ramifications. Perhaps now is the time for the surplus of physics graduates to go into other disciplines, having achieved a grounding in physics, and for physicists with higher qualifications to seek openings in other activities. Is it not possible that some senior member of our discipline should take with him the innate honesty inherent in the subject and become a Prime Minister?

However, it is in economics that the physicist has the opportunity of making the greatest inroads. For example, the physicist is involved with new methods of analysing time-series and the subfield of econometrics is a field which may well involve the physicist.

The writings of the Steady-Staters in the seventies may be forgotten, or ignored, just as were the writings of Mill. But when physicists, together with chemists, and biologists, are called upon to measure, (and control) the effects of an increasing variety and quantity of pollution in our environment, they will be brought face to face with economic problems. It seems that the ideal solution would be for a proportion of physicists to become economists as well perhaps a proportion of economists to become physicists.

If our environment is not to be polluted, physicists and other scientists could well join together to encourage our economists to re-examine the possibility of moving towards a steady-state economy, and our teachers to include the concept of the steady-state economy in the teaching syllabus. Perhaps our politicians are too set in their views to take an interest in the steady-state concept. On the other hand a good politician like a good army general, is not afraid of an idea which is new to him.

It is not yet certain which of the arch-enemies will first cause alarm; the limit of the land (or sea) which can be made crable, pollution or population growth. Whichever occurs first the average amount of food per head and industrial output per head will start to decline. What is certain is that physicists should be encouraged at all stages in their education to take a wider interest and involvement within very aspects of life within our society.

REFERENCES:

1. Toward a Steady-State Economy. Edited by Herman Daly.
CONFERENCES, COURSES AND AWARDS

1980 EPS HEWLETT-PACKARD EUROPHYSICS PRIZE

The 1980 Hewlett-Packard Europhysics Prize of the EPS has been awarded to two physicists for their separate contributions towards achieving a quantitative understanding of the physical and chemical behaviour of solid state materials through the development of original methods for the calculation of their electronic properties. The award winners are: Dr O. Krogh Andersen of the Max-Planck-Institut für Festkorperforschung, Stuttgart; and Dr Andries R. Miedema of Philips' Research Laboratories, Eindhoven.

The prize, which is donated annually by Hewlett-Packard to EPS, is for "outstanding achievement in solid state physics".

Dr Andersen is honoured for his development of new methods for the numerical calculation of band structures. These have significantly increased the speed of making such calculations, transforming them into a highly efficient procedure and greatly extending the range of materials that can be studied. So effective is his approach, his method, and subsequent developments of it, are now used for elaborating the input data for more complex computations.

Dr Miedema is honoured for his essentially empirical approach to similar problems, which have had a striking success even though the underlying theoretical justification is not understood. His empirical alloy models allow a number of properties, notably those of a thermo-dynamic nature, to be derived and provide a powerful tool for studying new alloys and tailoring their properties to engineering requirements. [Europhysics News, No. 5, Vol. 11, May 1980]

THE HARKNESS FELLOWSHIP

For study and travel in the United States.

Announcing arrangements for the 1981 AWARDS from Australia.

The Fellowship programme was established in 1925 by an American philanthropic foundation, The Commonwealth Fund of New York.

FOUR FELLOWSHIPS, tenable for between 12 and 21 months are offered. The award includes return fares to the United States, living and family allowances, travel in America (with car rental allowance), tuition and research expenses, a book and equipment allowance and health insurance.

Candidacy is open to men and women in any profession or field of study who are over the age of 21 years. Preference will be given to applicants under 36 years of age. Candidates must, by 1st September 1981 have a degree, or an equivalent qualification conferred by a professional body, or an outstanding record of achievement in the creative arts, journalism or other comparable careers. In addition, candidates for the MBA must have had substantial full-time administrative experience.

Candidates must be citizens of Australia or have taken steps to have achieved citizenship. They must not, between their 19th birthday and 1st September 1981, have spent more than six consecutive months in the United States.

Selection of Fellows, which is made by the Australian Selection Committee, is based on personal qualities as well as on a proven level of academic or professional excellence and only those with outstanding records will have a chance of success. The Australian Selection Committee will interview selected candidates in Melbourne in November 1980.

The closing date for applications is 31st August 1980 or, in the case of public service candidates, such earlier time as notified in the relevant Gazette by the candidate's Public Service Board.

Application forms will not be made available after 15th August 1980.

Application forms may be obtained by individual candidates on request to the Australian Representative: Mr L. T. Hinde, Reserve Bank of Australia, GPO Box 3947 Sydney, NSW 2001.

ICO-12 CONGRESS AND TWELFTH ASSEMBLY OF THE INTERNATIONAL COMMISSION FOR OPTICS GRAZ/AUSTRIA

Monday, August 31-Saturday, September 5, 1981.

Topics for invited and contributed papers:

1. Astronomical and space optics
2. Unconventional image formation (including optical and hybrid methods, but not purely digital methods)
3. Optical materials

These topics will be introduced by invited papers.

Survey papers on some current issues in optics (by invitation only):

4. Quantum electronics
5. Optical measurements
6. Fiber optics
7. Non-linear materials
8. Tentative plans for an additional smaller conference on “Biomedical Applications of Optics” are prepared for the week of Sept 7-11, 1981.

Deadline for the submission of abstracts of contributed papers is March 31, 1981. Further Information: A list of invited papers, call for contributed papers (including time schedule), student support, details of the social events and information about travel and accommodation will be included in the second circular to be mailed in November 1980.

To obtain this second circular, please return the enclosed provisional registration form duly executed by September 30, 1980 to the address of the general chairman: Dr Klaus Schindl — ICO 12, C. Reichert Optische Werke AG, Hernaisser Hauptstrasse 219, A-1170, Vienna, Austria.

RADIOISOTOPE COURSE FOR NON-GRADUATES NO. 28.

November 10-December 5, 1980

The objective of the course is to assist personnel below graduate level to gain understanding and proficiency in radioisotope techniques to enable them to use these safely and efficiently. It will be presented by staff of the AARE Research Establishment and the University of New South Wales.

The fee for the course, exclusive of accommodation, subsistence and fares, is $375.

The performance at assignments and other tests and during practical work, will be used to assess the students' ability. A certificate will be awarded to students who demonstrate satisfactory performance.

* * *


(Reference 1 is from page 18, Reference 2 from page 19)
The number of places at the course will be limited and those wishing to take the course should complete the application form, detach it and forward it to The Principal, Australian School of Nuclear Technology, Private Mail Bag, Sutherland, NSW 2232. Telephone 543 3071, to whom all enquiries in respect of the course should be addressed.

The closing date for receipt of applications is 6 October, 1980.

OPTICS IN FOUR DIMENSIONS
August 4-8, 1980, Ensenada, Baja California, Mexico.
Some topics to be covered in this Conference are: Thick holograms: Interaction of light with acoustic waves; Three-dimensional displays: Imaging from projections (Tomography); Inverse Scattering; Doppler effect (Wave and photon aspects); Picosecond pulse physics; Temporal holograms; Space-time optics; Four wave mixing and phase conjugation; Holography; Image Formation. All inquiries related to organizational matters should be directed to: Marco A. Machado, Ciceee, Physics Department, AP Postal 2732, Ensenada, B. C. Mexico.

FIRST ANNOUNCEMENT
The 5th Solid State Physics meeting will take place at the Riverina College of Advanced Education, Wagga Wagga, NSW — February 10-13th, 1981. The facilities have been improved since the 1979 meeting. The College now possesses an air-conditioned lecture theatre which seats 280 people. Preliminary enquiries should be addressed to Dr. G. J. Bowden, School of Physics, Kensington, NSW 0233. Suggestions for invited speakers are welcome.

CANBERRA INSIGHT

Australia's politicians should take note of a little reported meeting in Melbourne last month if they want to remain secure in the belief that only they know what is good for the community.

THE AUSTRALIAN INSTITUTE OF ENERGY'S
Neither the Government nor the Opposition appears to be paying much detailed attention to the public perception of what will be Australia's energy future. Carrick is determined to use our energy resources as the springboard for decades of mining and secondary processing development, the like of which we have not yet seen in Australia. Keating, on the other hand, looks at energy resources rather more pragmatically as a long-term revenue base for a government committed to a high level of social welfare programs. In each case there are glaring discrepancies for those people who believe they know what Australia's energy future holds.

Therefore it was not surprising that a message of dissatisfaction with both parties' energy "policies" emerged from the AIE conference.

The lack of an Australian national energy policy was criticised strongly both by representatives of competing state governments and by organisations which believe they have a right for a place in the energy debate.

State government views tended to reflect the criticism made at this year's Liberal Party Federal Council meeting in Canberra — that while the principles espoused in the Government's energy doctrine may have validity these are not being sold to the community nor, for that matter, to the governments which have to live with them.

But the strongest views came from organisations such as the Australian Council of Trade Unions, the Society of Automotive Engineers and the NSW State Pollution Control Commission.

For the Government, and Keating, it was probably the ACTU view, expressed by one of its research officers, Bruce Hartnett, which had the most bite. His point was simple: the price mechanism should not be the principle means of conserving energy.

Hartnett's argument was based on social justice — a concept which is conspicuously lacking in the present Government's policy on energy and is capable of being swamped by a variety of competing interests under Keating's proposals.

It is clear that what is being forgotten in the energy debate in political circles is that for the foreseeable future energy is going to mean heating and transport for the people. It is no use removing the problem of excessive use of energy resources if you replace it with the sociological problem of hardship for an increasing proportion of the community.

In political terms cheaper petrol may win votes. In the longer term huge developments may produce an economic base for Australia in the 21st century. Yet neither policy appears to be giving the community what it is seeking which is a framework for its total energy future. [Deedaleus, Engineers Australia, June 13-20, 1980]
BOOK REVIEWS

NATURAL HAZARDS IN AUSTRALIA, R. L. Heathcote & B. G. Thom (Eds.), Australian Academy of Science, Canberra, 1979, xii + 531 pp. 520
Reviewed by F. C. Cattell, Centre for Environmental Studies, Macquarie University.

This book consists of 35 papers presented at a May 1976 symposium on Natural Hazards in Australia, together with three additional papers. Most of the papers appear in the five major sections of the book which cover the occurrence of natural hazards, changes in design or perception following hazard occurrence, and responses to hazards by individuals, community groups and public authorities. Three papers are included in each of two case studies (the Brisbane floods of January 1974 and the Darwin cyclone of December 1974). Introductory papers by R. L. Heathcote and G. F. White and a conference summary by R. W. Kates complete the book.

The major impact of hazards in Australia, at least as indicated by the $215 million in Commonwealth payments to the States (which neglects the high cost of Cyclone Tracy) over the period 1962-1974, results from droughts (51% of payments) and floods and storms excluding cyclones (42%). A large part of the book is devoted to these topics. Papers are also included on cyclones, bushfires, landslides, coastal erosion and soil degradation. Biological hazards such as plant pests and diseases get no more than a passing mention.

The book, which is well produced with few printing errors, is a valuable collection of information on natural hazards in Australia comprehensible to those with no specialised knowledge in the fields covered. It is valuable not only because it shows how far studies have gone but also how far they need to go before the impact of hazards can be assessed in terms of social cost as well as the conventional measure of physical damage.

It is a pity that it has taken three years from the symposium to produce the book. No record appears of the symposium discussion and at least one paper originally presented is not included in the book. Notwithstanding these criticisms, this book is recommended as an excellent compilation of information on natural hazards in Australia.


Martensitic transformations are one of the most intriguing of solid state transitions and should be of interest to a wide range of solid state physicists and materials scientists. For the uninhibited, Nishiyama's book provides an excellent introduction to this complex but important topic. At the same time it develops the subject in sufficient depth and detail to satisfy even the most experienced devotee. The book commences at an elementary level and guides the reader through the morass of jargon and mystique that permeates this subject. It then moves on to deal with the crystallographic aspects of the major types of martensitic transformations and summarises this information in a very useful table at the end of Chapter 2. This is followed by chapters on specialised crystallographic phenomena, on the kinetics of the transformation and on stress induced transformation and the stabilisation of austenite. The final chapter is devoted to a succinct review and comparison of the various crystallographic or phenomenological theories of martensitic transformations.

While some of the related topics such as the bainitic transformation, tempering and the strength of martensite are omitted (all to be covered in a proposed second volume), the coverage of the present book is extremely wide, uptodate and includes a comprehensive list of references. In the preface the author states — almost apologetically — that he has introduced his own opinions which "may in some instances be dogmatic or prejudiced". In a somewhat controversial subject this is most refreshing, since it highlights the often suppressed divergences of opinion, puts rival views into perspective and, most important of all, prevents the book from degenerating into a sterile, uninteresting collection of previous work.

In summary an excellent book, written with great clarity and fluency by one of the few true experts and pioneers in this field. One can only look forward with anticipation to the promised second volume.

Reviewed by P. E. Ciddor, CSIRO Division of Applied Physics.

Volumes 1-5 of this series, edited by R. Kingslake, constituted a broad survey of applied optics as it stood in the sixties. This volume is one of a new series, which will take the form of regular reviews of progress across the field, rather than subject-specific volumes.

Volume 7 starts with a survey of incoherent light sources by Eby and Levin, which very effectively complements its predecessor in Volume 1 by emphasizing modern incandescent, discharge, and solid state lamps, and also discusses flash lamps and natural daylight.

There are three chapters on modern optical materials. Parker describes optical glasses (including silica glasses), crystals, plastics, and infrared materials. Welham concentrates on the applications of plastics, and on methods of manufacturing plastic components. Barnes discusses the mechanical properties of materials suited to light weight reflective optics.

In a modern approach to photographic detectors, Shaw covers quantum efficiency, statistical properties of images, spatial frequency analysis, information storage, and detectors for electrons and X-rays. Kogelnik gives a succinct account of the propagation of laser beams, and presents the standard formulae of matrix optics, circle diagrams and Fresnel diffraction.

The ultimate limitation in modern instruments is often scattering from optical surfaces. Elson and H. E. and J. M. Bennett discuss methods for measuring and calculating scattering from surfaces, including dielectric multilayers.

Progress in instrumentation often depends on the dynamic correction of distortion, either in the transmitted beam or in the optical receiver itself. Pearson, Freeman and Reynolds survey a wide range of optical techniques, with applications in astronomy, laser resonator stabilization and communications.

This volume and its companions (Vol. 6, edited by R. Kingslake and B. J. Thompson has already appeared) promise to do for applied optics what Progress in Optics has long done for the academic aspects of this lively branch of physics.
SOLITONS IN ACTION, Edited by Karl Lonngren and Alwyn Scott. Academic Press, N.Y. 1978, xii + 293 pp., price SUS15

Reviewed by Alex. H. Opie. School of Mathematics, University of NSW

The soliton theory of N. J. Zabusky and others in the mid-sixties had the virtue of remarkable simplicity. Since then clever mathematicians and physicists from all fields have muddied (or should I say, perturbed) the soliton water whilst clarifying their own pools. Obviously such a fresh approach to the treatment of non-linear problems satisfied a widely-felt need.

This collection of papers surveys Solitons in Action in such diverse fields as deep-water waves (H. C. Yuen and B. M. Lake), vortices (G. S. Deem and N. J. Zabusky), transmission lines (K. E. Lonngren), plasmas (I. Ikezi), lattices (J. H. Bathe and J. D. Powell) and Josephson junctions (R. D. Parmentier). The mathematical basis is presented by the inverse scattering method (R. M. Miura) which is generalized (H. E. Moses) and given a differential geometry complexion (R. Hermann). The two papers which may have the most interest for the physicist are concerned with perturbations from soliton states (A. R. Bishop; D. W. McLaughlin and A. C. Scott); here they expand "the solution of an almost linearizable wave equation into a set of soliton plus radiation components'.

Solitons in Action does not have the instructive potential of a text-book but each paper is well-written and referenced. The authors have all played a significant role in soliton theory development and workers in the fields mentioned above will find at least one article to deepen their understanding and others to which they can relate.

CATALOGUE OF THE UNIVERSE, Paul Murdin and David Allen, with original photographs by David Malin. Cambridge University Press, 1979, 256 pp., $19.95

Reviewed by A. G. Little. School of Physics. University of Sydney.

One of the modern day success stories in science is to be found in the work of the Anglo-Australian Observatory and the U.K. Schmidt Telescope Unit, both located at Siding Springs in N.S.W. The two instruments involved are operated by a very enthusiastic band of professional astronomers who have taken many superb photographs of objects in the Southern sky. A very comprehensive collection of these photographs has been put together for our enjoyment by the authors of this volume. The accent on Southern hemisphere objects is to be commended and many of the photographs are appearing here for the first time in a popular book.

The text is very readable and wherever necessary optical radio or X-ray observations have been used in the discussion. There is in fact a wealth of information to be found in the book and one finds oneself picking it up again and again, each time finding new things of interest in the many excellent photographs. The introduction of coloured photographs, apart from the sheer beauty of the pictures, is a help to the layman in understanding how the gas and stars are distributed and in future publications perhaps more examples could be shown.

Another first for this book is the display of examples of the modern techniques used to enhance contrast and detail in astronomical photographs. The detail in the examples quoted is extraordinary, although perhaps it would have been good to have an 'uncorrected' photograph alongside for comparison. There is no doubt that this technique is a valuable addition to the tools available to the astronomer.

Not all the photographs are from these two observatories and the sections on the moon and planets include excellent photographs from many other sources including several space vehicles.

The book is organised in reverse order to the usual text book on astronomy. The first chapters are on galaxies and the last on the solar system. This is not a text book but is intended for a wider audience, and right from the start the reader will be fascinated by being introduced to the enormous variety of the objects so remote from us.

From a professional point of view, a couple of changes might have improved the book's usefulness as a catalogue. One would be to indicate a scale on the photographs and the other would be to have been consistent with the orientation of the pictures or to at least have indicated a direction.

Nevertheless, these do not detract from the fascination of the subject and I believe all readers will enjoy its very readable and up to the minute account of our knowledge of the Universe.


Reviewed by L. B. Harris. Dept of Applied Physics, University of NSW.

Crystal growth is itself a growth areas. The increasing requirement for better quality, more precisely characterized crystals in an ever-growing range of materials has produced a surge of information scattered throughout a large number of individual papers. Exchange of technical know-how is facilitated by the triennial international crystal growth conference, various national and regional conferences, and by textbooks. Several publishers, including Springer themselves, have a series of volumes dealing with the fundamentals of crystal growth, and there are other weighty tomes that deal with specific applications. Now Springer announce a further series: Crystals, Growth, Properties and Applications; and plan to bring out two 200 to 250 page volumes annually.

The only justification for a further series is that it should contain specialist information not readily available elsewhere. Volume 1, on Crystals for Magnetic Applications, is undoubtedly reserved for the specialist. It contains five articles, Crystal Growth of Magnetic Garnets from High Temperature Solutions by W. Tolksdorf and F. Welz, Gadolinium Gallium Garnet by F. J. Bruni, Liquid Epitaxial Growth of Magnetic Garnets by M. H. Randles, Hydrothermal Crystallization of Magnetic Oxides by L. N. Demianetskii, and Magnetic Spinel Single Crystals by Bridgman Technique by N. Sugimoto. It is a slim volume, whose main virtue is the wealth of practical detail provided by each practitioner in the type of crystal growth he describes. There are 96 pages on the state of the art of garnet growth up to mid-1977, 52pp on prototype YIG, 18pp on GGG, and 26 pp on garnet films. The 27 pp on magnetic oxides are somewhat selective, while the 15 pp on magnetic spinels is no more than an average article in a monthly journal. A limited beginning.

BOOK NOTICE

Adam Hilger, the book publishing imprint of the Institute of Physics, London, has brought to our notice their recent publication of a second edition of the book "Transducers in Measurement and Control", by Professor Peter Syleham of the South Australian Institute of Technology. The first edition of this book was successfully published here in 1975 by the University of New England.

The Hilger edition of this book, which is said to be extremely similar to the original, is available direct from Adam Hilger Ltd., Booksales Department, Techno House, Redcliffe Way, Bristol BS1 6NX, England, at £5.95 per copy, plus 10% for postage and packing.
SCIENTIFIC SESSIONS

There will be seven half-day sessions of oral presentations, as indicated below:

<table>
<thead>
<tr>
<th>SESSION</th>
<th>TIMINGS</th>
<th>ORGANIZER</th>
<th>INVITED SPEAKERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Resources</td>
<td>Monday 25 August</td>
<td>Dr. J. L. A. Francey</td>
<td>Prof. S. T. Butler, FAA A.A.E.C.</td>
</tr>
<tr>
<td></td>
<td>2.00 p.m. - 5.30 p.m.</td>
<td>Department of Physics, Monash University, Clayton, Vic., 3168</td>
<td>Prof. C. N. Watson-Munro, OBE, FAA University of Sydney</td>
</tr>
<tr>
<td>Physics of Condensed Matter</td>
<td>Tuesday 26 August</td>
<td>Prof. T. F. Smith</td>
<td>Dr. H. G. Smith</td>
</tr>
<tr>
<td></td>
<td>9.00 a.m. - 12.30 p.m.</td>
<td>Department of Physics, Monash University, Clayton, Vic., 3168</td>
<td>Oak Ridge National Laboratory, Tennessee, USA</td>
</tr>
<tr>
<td>Atmospheric and Environmental Physics</td>
<td>Tuesday 26 August</td>
<td>Prof. W. F. Budd</td>
<td>Dr. G. Paltridge</td>
</tr>
<tr>
<td></td>
<td>2.00 p.m. - 5.30 p.m.</td>
<td>Department of Meteorology, University of Melbourne, Parkville, Vic., 3052</td>
<td>C.S.I.R.O.</td>
</tr>
<tr>
<td>Nuclear and Particle Physics</td>
<td>Wednesday 27 August</td>
<td>Prof. B. H. J. McKellar</td>
<td>Dr. B. Hunt</td>
</tr>
<tr>
<td></td>
<td>9.00 a.m. - 12.30 p.m.</td>
<td>Department of Physics, University of Melbourne, Parkville, Vic., 3052</td>
<td>A.N.M.R.C.</td>
</tr>
<tr>
<td>Applied Physics</td>
<td>Thursday 28 August</td>
<td>Dr. M. J. Murray</td>
<td>Sir James Menter, FRS University of London</td>
</tr>
<tr>
<td></td>
<td>9.00 a.m. - 12.30 p.m.</td>
<td>CSIRO Division of Materials Science, Fishermens Bend, Vic., 3207</td>
<td>Dr. J. P. Wild, CBE, FRS C.S.I.R.O.</td>
</tr>
<tr>
<td>Radiophysics, Astrophysics and Gravitation</td>
<td>Thursday 28 August</td>
<td>Prof. G. I. Opat</td>
<td>Dr. G. Isaac</td>
</tr>
<tr>
<td></td>
<td>2.00 p.m. - 5.30 p.m.</td>
<td>Department of Physics, University of Melbourne, Parkville, Vic., 3052</td>
<td>University of Birmingham, UK</td>
</tr>
<tr>
<td>Electron and Ion Spectroscopy</td>
<td>Friday 29 August</td>
<td>Dr. R. C. Leckey</td>
<td>Dr. J. F. Williams</td>
</tr>
<tr>
<td></td>
<td>9.00 a.m. - 12.30 p.m.</td>
<td>Division of Electron Physics, La Trobe University, Bundoora, Vic., 3083</td>
<td>Queen’s University, Belfast</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dr. R. J. MacDonald A.N.U.</td>
</tr>
</tbody>
</table>

Each session will consist of two 40-minute invited papers and six 15-minute contributed papers.

Parallel poster sessions will be held in the foyer of the Hercus and Laby Lecture Theatres.

REGISTRATION

Dr. R. J. Fleming,
Honorary Secretary,
AIP Fourth National Congress,
Department of Physics,
Monash University,
Clayton, Vic., 3168, Australia
by 18 July, 1980
S Spectra-Physics Lasers

Highest quality and reliability.
Support from a team of specialists with over 30 years combined experience in advanced scientific lasers.
Proven on-going sales and service support from the largest Australasian laser company with a continuous record of over 10 years in the field.

QUENTRON are pleased to announce their move into new premises in Adelaide. Our 3 level, 14,000 sq.ft. complex includes 3,500 sq.ft. of basement laboratory space for advanced testing, calibration and R&D projects.

We are grateful for the confidence shown in Quentron by our customers over the years, and with the new premises will now be able to offer services not available from any other Australian company.

STOP PRESS
MAY 1989
Quentron have recently taken over FG & CORTEC and other lines marketed by ANAC (AUSTRALIA) Ltd. An office has been established in both Melbourne and Sydney, Quentron now covers the spectrum from Gamma Rays to Far IR.

We welcome all person engaged or interested in laser work to visit us and try their experiments with our equipment.

For all laser, E-O or optical needs just call us to discuss your application.

QUENTRON OPTICS PTY. LTD.
Laser Court, 75A Angas Street, Adelaide, S.A. 5000
Tel. (08) 223 6224 Telex: QTRON A82809
Postal Address: G.P.O. Box 2212, Adelaide, S.A. 5001
Branch Offices: Melbourne — Sydney.