Both are all solid-state, identical except for current suppression
And each is priced surprisingly low.
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C.S.I.R.O. National Standards Laboratory,
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A.D.A.M.E.L.

DILATOMETERS
THERMOBALANCES
and
LABORATORY
FURNACES

AGENTS
PHILIPS
Scientific & Industrial Equipment
The Buckland Park Antenna Array

B. H. Briggs and W. C. Elford
Department of Physics, University of Adelaide

The arrangement of the 89 crossed dipoles which form the array. The transmitter and its associated antenna are adjacent to the main array.

Introduction

A new type of antenna array comprising 89 crossed dipoles has recently been brought into operation at the Buckland Park Field Station of the University of Adelaide. The dipole antennas are arranged in a rectangular lattice with a roughly circular outline, as shown in Figure 1, and may be used on either 2 or 6 MHz. The 370 acres of land required for the project were purchased by the University of Adelaide.

A novel feature of the array is that each dipole is provided with a separate underground coaxial feeder running to a central laboratory building. The result is a very flexible instrument which can be used in a number of different ways for experiments in upper atmosphere physics. In some experiments the dipoles will be connected as a conventional broadside array. Other experiments will require observations of the amplitudes and phases of the voltages induced in the individual dipoles.

Figure 2 shows a view of the array from the air. The separate dipoles, constructed of wire, are not visible but the pattern of disturbed ground due to the underground cables can be seen. Forty-four miles of cable was used in connecting up the array. The attenuation of the signal from the most distant of the dipoles is about 6 dB. The laboratory building can be seen at the centre of the array in Figure 2.

Figure 2

A view of the array from the air. The routes of the underground cables can be clearly seen because of the disturbance of surface vegetation during installation. The diameter of the array is approximately 1 km.
In order to preserve phase, the electrical length of each feeder line has been adjusted to be a multiple of half a wavelength at both operating frequencies. The excess cable lengths are stored in a 'phasing room' adjacent to the main laboratory building. The cables are finally terminated in the output panels shown in Figure 3. The left-hand panel provides connections to the set of dipoles polarized north-south, and the right-hand panel to those polarized east-west. An experimenter can connect his equipment to individual antennas, or can connect rows in parallel by means of the connecting bars which can be seen on the right-hand panel. When used as a broadside array, the direction of the beam can be changed by introducing phasing cables between the rows. Each pair of crossed dipoles can also be used to provide circular polarization if required.

Some of the uses of the array will now be described.

**Observation of Ionospheric Drifts**

The principle of this experiment is shown in Figure 4. Pulses of duration about 100µs are emitted from a nearby transmitter, and the echoes from the ionosphere are detected by the 89 dipoles of the array, connected to 89 radio receivers. Because the ionosphere does not behave like a smooth mirror, but is irregular, the amplitude of echo is different at different points on the ground. The antennas of the array sample this random pattern, which moves over the ground as the ionosphere drifts horizontally overhead. It can be shown that the speed with which the pattern moves over the ground is twice the speed of drift of the ionosphere.

The speed and direction of movement of the pattern are determined in two different ways. In a 'visual' method, each of the 89 radio receivers controls the brightness of a small light globe in such a way that the brightness is proportional to the amplitude of the echo from the ionosphere. The globes are arranged in a similar pattern to the
antennas of the array, so that, after smoothing of the light pattern by a piece of ground glass, a reasonable reconstruction of the radio wave pattern is produced. The moving pattern of light is then recorded on a cine-film, and played back at a speeded-up rate. Figure 5 shows the bank of receivers which is used for this experiment. The light globes (without the ground glass in front of them) can be seen at the top right-hand corner of the equipment. Photographs showing typical patterns are reproduced in Figure 6. The motion of the pattern from one picture to the next can be clearly seen.

Observations will also be made by a second method in which, instead of using light globes, the receiver outputs will be recorded in digital form on magnetic tape. A scanner will sample the 89 channels sequentially, each channel being sampled five times per second. The magnetic tape will then be processed on a C.D.C. 6400 computer. The drift velocity will be found by computing the two-dimensional spatial cross-correlation function between two complete scans separated by a known time interval. This function will have a maximum value at some point corresponding to the vector displacement of the pattern between the two scans. From this the vector velocity can easily be found. It can be shown that this method gives the true velocity even if the pattern changes in form as it moves.

These observations will be made both on the basic frequency of the array (2 MHz) and also on the third harmonic (6 MHz). In this way, both the E and F regions of the ionosphere can be observed, at heights of about 100 km and 300 km respectively.

The basic method described has been extensively used in the past, but with only a small number of receiving antennas (usually three). It is then necessary to use a complicated statistical procedure to obtain the drift velocity, and it is necessary to make a number of assumptions about the statistical nature of the pattern (Briggs, Phillips and Shinn, 1950). The new method avoids these uncertainties. It can also record more rapid changes of velocity than was possible with the older methods. The only comparable previous work is that of Haubert and Doven (1966), carried out at Garchy in France. The Buckland Park array has an area thirty times larger than the area of the array used by the French workers.

Observations of the D Region of the Ionosphere

If a high power transmitter is used, weak echoes can be observed from heights which lie in the D region of the ionosphere (60–90 km). These are quite different from the total reflections observed from the E and F regions, and are usually attributed to scattering from small irregularities of electron density.

For the study of these weak echoes, a transmitter of 100-kW peak power will be used. The array will be used for reception, the dipoles being used either singly or in various combinations. When all the dipoles are connected together, the resulting broadside array has a beamwidth of about $\pm 4^\circ$ at 2 MHz.

In one type of experiment, the method of Gardner and Pawsey (1953) will be used to determine the electron density as a function of height in the D region. This involves measuring the ratio of amplitudes of left- and right-handed circularly polarized echoes, as a function of height. The polarization of both the transmitting and receiving arrays will be switched rapidly from the left- to the right-handed form.

In other experiments, winds are measured in the D region by recording the fading of the echoes on individual antennas of the array. In this way it is possible to work on echoes which are too weak to operate the globe display. While this method is a return to the statistical methods which were criticised earlier, the availability of a large number of antennas at different spacings enables some of the assumptions of the statistical analysis to be checked. For example, it is possible to use three antennas with different spacings and to see whether the drift velocity depends on the spacing used.

By selecting scattered echoes returned from different heights in the range 60–90 km a 'wind profile' can be obtained. This will be compared with results obtained at the same time from the drifts of meteor trails, using a separate equipment which operates at 27 MHz. (Weiss and Elford, 1963.)

Experiments in Meteor Physics

For meteor studies the antennas will be connected so as to form a broadside array, and the phasing between the rows adjusted to set the beam at an elevation angle of about $45^\circ$. The basic observations will be measurements of the range and direction of the reflecting segment of the meteor trail. The
range will be determined from the echo delay, and the direction of the reflected wave will be determined either by comparing phases in adjacent halves of the array, or by beam swinging.

These observations will be carried out simultaneously with meteor observations at the same site on a frequency of about 27 MHz. From a comparison of the echoes on the two frequencies it is hoped to establish a technique for identifying meteor echoes on 2 MHz in the presence of strong ionospheric echoes from the E region. If this is achieved, meteor studies at this low frequency will be possible by day as well as by night.

One reason for studying meteors at these low frequencies is the possibility of obtaining echoes from trails which occur as high as 140 km. Almost all post and present radio studies of meteor trails have been carried out at frequencies above the penetration frequency of the ionosphere. However, observations at these higher frequencies are normally limited to trails below 105—110 km, because at greater heights the ionized trail rapidly diffuses to a diameter comparable with or larger than the radio wavelength, so that the reflection coefficient is extremely small. The effect of this experimental 'ceiling' on the determination of the influx of meteor particles from echo rates is one of considerable controversy at the present time, and it is hoped that the new lower frequency observations will be able to settle some of the issues involved.

If a significant number of trails can, in fact, be observed at heights above 100 km, it is proposed to study the trail drifts from the Doppler shift of the reflected waves. This will be an extension of similar work already being carried out at Adelaide on a frequency of 27 MHz (Weiss and Elford, 1963).

Other experiments will involve the study of the decay of the ionization from observations of the rate of decrease of echo amplitude with time, the study of the fading characteristics of echoes, and studies of D-region absorption by comparisons of the amplitude of high and low frequency meteor echoes.

Acknowledgements
The design and construction of the array and the associated electronic equipment have been carried out by Mr J. W. Smith, Mr D. Rossiter, Mr D. G. Felgate, and Mr C. B. McGee. Computer programs are being written by Mr M. G. Golley. The mechanical installation was the responsibility of Mr I. A. Hettner assisted by Mr N. Wilde. Grants in support of the work have been received from the Office of Aerospace Research, U.S. Air Force (Grants 864—65 and 864—67), the Australian Research Grants Committee, the Radio Research Board (Australia), and the University of Adelaide.

References

Conference on Ionic Solids

N. H. Fletcher
University of New England, Armidale, N.S.W.


A major problem confronting the organizers of any scientific conference in Australia is the selection of a topic. Let it be too narrow and only a handful of people will attend, while a broad topic, though drawing a larger audience, will almost invariably fail to be really successful because each person can find but a few papers in which he is really interested. In the United States or in Europe the problems are different—the general conferences are so huge that there is more than enough for everyone, while a decent audience can be found for the most esoteric of specialties. In Australia, with our limited scientific population and a pattern of research activity which is in many ways a consequence of events twenty or more years ago rather than accurately reflecting the balance of current research fields in the world as a whole, the path between the Sevilla of specialization and the Charybdis of generality must be steered with hairbreadth precision.

In solid-state physics, representing, as it does, nearly half of current research in physics on the world-wide scene (though not expenditure!), the problem is particularly acute. A small conference on solid-state physics would be hopelessly general, one on III-V semiconductors might involve only people from one or two laboratories, and so on. Two possible recipes for success are either to concentrate on a technique, such as n.m.r. or e.s.r., which is widely used for the study of many materials, or to choose a small group of well-known materials which can be studied from a wide variety of viewpoints.

It was this latter approach which was followed by the N.S.W. Branch in the organization of a fully residential Conference on Ionic Solids, held at New-
port, near Sydney, on 29-31 May. Forty-seven people from five Australian Universities, four C.S.I.R.O. Divisions, the A.A.E.C., and one industrial laboratory joined the Conference and there were two visitors from overseas, so that there was excellent opportunity for interchange of techniques, results and speculations. The group was of a very convenient size for general discussion and the coherence of the subject matter gave a unity of purpose seldom found in larger meetings.

The simple ionic solids have, over the past 40 years, been the subject of more intense study than any other crystalline system, with the possible exception of simple metals. It is, perhaps, surprising that there is still so much left to discuss. It is true that the general outline of their behaviour is well understood in quite a wide variety of circumstances, but this very fact makes them an excellent testing ground for the elucidation of subtle effects and the evaluation of general theories.

Of the 17 papers presented during the two days of the Conference, four dealt with the thermal properties of essentially pure crystals. A. W. Pryor (A.A.E.C.) discussed the lattice dynamics of ionic solids with particular reference to the way in which neutron diffraction can give direct information about the lattice structure; G. K. White (Physics, C.S.I.R.O.) reviewed the present state of knowledge of the thermal and elastic properties of alkali halides at low temperatures; and J. G. Collins (Physics, C.S.I.R.O.) showed how theory can explain many of these features, in particular their thermal expansion which is in some cases negative at very low temperatures. A rather more complicated situation was revealed in the case of silver iodide (N. H. Fletcher and C. M. Perrott, University of New England), where heat-capacity measurements show and theory describes an order–disorder transition between silver ions and silver-ion vacancies in a complex lattice.

Many of the most interesting aspects of solid-state physics concern, however, not pure crystals but crystals containing small amounts of specific impurities. P. L. Pratt (Imperial College, London) presented recent work on the behaviour of divalent manganese ions in alkali halides, the formation of these into ordered structures (Suzuki phases) and their experimental study by ionic thermoelectric measurements, while H. F. Symons (Physics, C.S.I.R.O.) discussed his recent p.m.r. experiments on the kinetics of aggregation in the same system. J. S. Dryden and G. G. Harvey (Applied Physics, C.S.I.R.O.) reported their applications of optical techniques to similar studies of Pb⁺⁺ ions in NaCl and KCl, and J. R. Pilbrow (Monash University) discussed his c.s.r. studies of Cu⁺⁺ in NH₄Cl.

Not all defects, however, are due to impurities and J. C. Kelly (University of N.S.W.) showed that the formation of the most classical defect, the F-centre, is not really properly understood on a microscopic scale, measurements of the ejection of ions from the crystal under irradiation having rather remote resemblance to theoretical predictions. Irradiation can also produce important effects upon the macroscopic elastic properties of ionic solids, as discussed by In Sup Kim (University of N.S.W.) and, by dislocation pinning, upon the ultrasonic absorption (H. Pollard, University of N.S.W.). W. Robinson (D.S.I.R., New Zealand) discussed this internal friction in more detail for KCl crystals and showed how its behaviour is related to the effective charge on the dislocations, which is in turn a function of temperature.

A paper by I. D. Campbell and C. K. Coogan (Chemical Physics, C.S.I.R.O.) dealt with the static field gradients in lithium iodate from a point-charge model and from n.m.r. evidence, while I. Hanscomb (University of N.S.W.) discussed dielectric breakdown in alkali halides, relating this to a thermal impulse mechanism.

In terms of the original planning of the Conference, and despite its short title, simple oxides were included in its scope and three papers took them as subject matter. A. J. Mortlock (A.N.U.) described work on the diffusion of divalent ions in magnesium oxide and delineated regions where the mechanism is either intrinsic or extrinsic. L. Williams and C. E. Warble (Applied Mineralogy, C.S.I.R.O.) presented electron micrographs of the recrystallization, growth, and stirring of refractory oxides and J. Hensler (University of Melbourne) discussed the mechanism of creep in magnesium oxide.

In many ways this Conference might well serve as a model for future specialist meetings arranged by the Institute. It was, in every way, an outstanding success and the organizers, Stuart Dryden, John Collins, and John Birch, are to be congratulated on the result.

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The Calendar

August 1968

20-22 Conference on Geomagnetic Micropulsations (N.S.W.-A.I.P.), University of Newcastle.


September


October

16 S.A.-A.I.P., Mr N. Jones, Weapons Research Establishment. (Topic to be named later.)

THE AUSTRALIAN PHYSICIST. JULY 1968
AUSTRALIAN INSTITUTE OF PHYSICS

Financial Statement, 1967

AUDITORS REPORT TO THE MEMBERS

WE REPORT that in our opinion the accompanying Balance Sheet and Income and Expenditure Statement are properly drawn up in accordance with the provisions of the Companies Act 1961 so as to give a true and fair view of the state of the Institute's affairs as at 31st December, 1967, and of the result for the year ended on that date. The accounting and other records (including registers) of the Institute examined by us are properly kept in accordance with the provisions of the Companies Act 1961.

Signed: GORDON QUINN & CO.,
Chartered Accountants.

Melbourne, 26th March, 1968.


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</tr>
<tr>
<td>Total Expenses</td>
<td>6 469</td>
<td>6 469</td>
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<tr>
<td>Surplus of Income Over Expenditure</td>
<td>1 865</td>
<td>1 865</td>
</tr>
</tbody>
</table>

100  THE AUSTRALIAN PHYSICIST, JULY 1968
GENERAL ACCUMULATED FUNDS

Balance, 1st January, 1967 $4,318
Add Advances to Australian Physicist written off $3,590

Add Vacuum Physics Group Bank Account now brought to account 197
Surplus for year ended 31st December, 1967 1,863
Transfer from Reserve Funds 2,089

8,467 Balance, 31st December, 1967 4,877

RESERVE FUNDS DURING YEAR ENDED 31ST DECEMBER, 1967.

<table>
<thead>
<tr>
<th>Balance</th>
<th>Less Interest</th>
<th>Add Unspent 1967 Grant</th>
<th>Add Bank 31,12,67</th>
<th>Subtract Total</th>
<th>Add Interest</th>
<th>Balance 31,12,67</th>
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<tr>
<td>A.C.T. Branch</td>
<td>1,167</td>
<td>1,167</td>
<td>104,00</td>
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<td>282,62</td>
<td>16,95</td>
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<tr>
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<td>1,052,11</td>
<td>200,00</td>
<td>351,18</td>
<td>2,24</td>
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<td>Queensland Branch</td>
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<td>186,66</td>
<td>55,99</td>
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<td>10,83</td>
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<td>S. A. Branch</td>
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<td>Education Group</td>
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<td>132,89</td>
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<td>225,00</td>
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<td>12,12</td>
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4,850,22 1,792,70 1,137,79 1,318,83 5,694,14 324,52 6,018,66

Includes balance of $126.14 on Exhibition Account.

STATEMENT OF DIRECTORS

We, Herbert John Frost and James Gordon Campbell being two of the directors of the AUSTRALIAN INSTITUTE OF PHYSICS, do hereby state that, in the opinion of the directors, the accompanying statement of income and expenditure is drawn up so as to give a true and fair view of the affairs of the Institute for the period ended 31st December, 1967, and the accompanying balance sheet is drawn up so as to exhibit a true and fair view of the state of affairs of the Institute as at the end of that period.

Dated 16th April, 1968.

For and on behalf of the board
Signed: H. J. FROST
J. G. CAMPBELL.

DECLARATION BY THE SECRETARY

I, James Gordon Campbell, Secretary of the Australian Institute of Physics, do solemnly and sincerely declare that the accompanying balance sheet and statement of income and expenditure are, to the best of my knowledge and belief, correct.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the provisions of an Act of Parliament of Victoria rendering persons making a false declaration punishable for wilful and corrupt perjury.

Declared at Glen Waverley in the State of Victoria this 16th day of April, 1968.

Signed: J. G. CAMPBELL.
Before me: J. Sampson, J.P.

Institute Affairs

COMPANY SUBSCRIBERS

In 1966 Council decided to introduce a new Membership Grade of Company Subscriber so that companies and organizations in Australia who wish to support the Institute, or whose business and operations are closely concerned with physics, could associate themselves with the Institute. This decision was in line with policies adopted by other scientific institutes in Australia and by corresponding associations of physicists in Britain, Canada, and the United States of America.

It was not possible to proceed with this scheme immediately since it was first necessary to amend our Articles of Association and to have these amendments approved by the Minister administering the Companies Act in Victoria and by an Extraordinary General Meeting of the Institute. These formalities were completed during 1967.

The details of the new Grade of Membership are given in a pamphlet "Information for Company Subscribers", copies of which are available from the Branch Honorary Secretaries.

The unit of Company Subscription has been set at $50 per annum and companies may subscribe for any number of units. It is not possible to adopt a rigid system for determining the appropriate number of units for any particular company since this will be determined by the extent to which the company’s production depends on physics and physicists as well as on the capital of the company. The appropriate subscription for a given Company Subscriber is usually determined by the discussion with Officers of the Institute.

For each unit subscription each subscribing com-
pany may nominate two representatives who will be entitled to attend all regular meetings and conferences of the Institute but will not have any voting rights. Each representative and the company will receive copies of "The Australian Physicist" and other publications of the Institute.

Council believes that companies supporting the Institute in this way will contribute to the healthy development of physics in Australia and will receive real benefit from a close association with members of the Institute.

The first invitations to become Company Subscribers were circulated to a group of companies in March 1968 and it is gratifying to see that there has been an enthusiastic response and twenty Company Subscribers have already been elected. The names of these companies are listed in the Registers of New Members.

TRANSFERABILITY OF SUPERANNUATION

At the Fifth Annual General Meeting of the Institute, it was resolved that this meeting feels very strongly that there should be transferability of superannuation, thus facilitating the ready movement of physicists, and recommends that Council take urgent action to convey the views of the Institute to the Prime Minister. The following letters have been exchanged.

Dear Mr Prime Minister—The Members of our Institute have been pleased to learn of the steps being taken by the Federal Government to permit a transferability of superannuation between Commonwealth public services and universities.

We consider that any such move, permitting as it would a much freer interchange of physicists between various establishments, would be of tremendous help in allowing physicists to be employed to best advantage. We therefore appeal to the Government to regard the subject of transferability of superannuation as one of great urgency.

Yours sincerely,
A. WALSH, President.

Dear Mr Walsh—I have been asked to reply to your letter of 9 April referring to the examination of proposals for the transferability of superannuation between the Commonwealth Public Service and universities.

As you know Sir Leslie Melville has undertaken an examination of superannuation benefits within the public sector with a view to making recommendations to the Commonwealth on the transferability of superannuation rights. Examination of Sir Leslie's recommendations is proceeding and when this has been completed the Government will no doubt make a statement on this matter.

Yours sincerely,
C. L. HEWETT, Secretary.

Letters to the Editor

Sir—I wish to protest in the strongest possible terms against the ruling by the Council of the A.I.P. which resulted in the rejection of an invitation from the American Physical Society to hold a joint meeting in Hawaii in September 1969.

The American Physical Society is without doubt the most important organization in the world sponsoring the progress of physics in all kinds of ways, from the holding of meetings (at which many important developments are announced for the first time) to the publication of outstanding journals. That the A.I.P. has rejected an offer by such a body to collaborate with it is incredible; that it should do so without consulting the membership at large, for apparently the most flippant of reasons and without any attempt to raise finance or canvass support, is inexcusable.

One has only to know the tremendous benefits which accrue to Canada and Mexico as a result of holding joint meetings with the American Physical Society in their cities to realize the folly of this decision. A heaven-sent opportunity to boost the international standing and prestige of our organization has, it seems, been treated by Council in the most cavalier fashion.

The question of how many A.I.P. members would attend and of how many invited papers would have been contributed from the Australian side is quite irrelevant to the main point, namely, to make a start with significant operations on a less parochial level than we have hitherto experienced.

As a member of the American Physical Society as well as the A.I.P. I must now question seriously the value of continuing my membership of the latter organization. I propose also to write a joint letter with other like-minded members of this department to the American Physical Society dissociating myself from this ruling by a short-sighted, unenterprising and parochial Council.

K. C. HINES
School of Physics
University of Melbourne

The following statement of the circumstances relating to the approach by the American Physical Society to the Institute regarding a joint meeting and its consideration is published by direction of the Executive.—Ed.

In February 1968 a number of letters were received by physicists in Australia from the Chairman of the Division of Fluid Dynamics of the American Physi-
cal Society advising that the Council of the A.P.S. had instructed him to open informal negotiations with acquaintances in Australia, to see whether the A.I.P. would agree to combine with the A.P.S. in organizing a joint meeting in Hawaii in September 1968. One of these letters was directed to the Institute.

This was considered at a meeting of the Executive on 20 February when the Hon. Secretary was instructed to seek further details. The Secretary’s letter of 21 February stated, *inter alia*:

“The immediate reaction among those of us here who have discussed the idea is that we would like such a joint meeting to come about, not only because Hawaii is a favourite stopping-off point for travelling Australians, but also because this Institute is anxious to promote more contacts with the member societies of the American Institute of Physics.

However, before we could enter into any agreement we would need to know in some detail what would be involved in the joint sponsorship. In particular the financial obligations would need to be defined carefully, because being a small group of about 1000 members we could not consider taking on any open-ended financial commitment.”

A hope was expressed that a concrete proposal would reach the A.I.P. in time for a Council meeting in April.

An approach was also made about the same time by Professor W. W. Havens Jr., Executive Secretary of the A.P.S., to the Editor of the Australian Physicist, Dr. J. L. Symonds, (a personal friend).

On 1 April a letter was received by the Institute from Professor Havens formally proposing that the A.I.P. join with the A.P.S. in holding a joint General Meeting at the University of Hawaii in Honolulu from 2 to 4 September 1969. It was proposed a joint programme committee be appointed to arrange symposia on specific topics and sessions of general interest and that the A.I.P. would invite appropriate speakers from Australia.

In discussing probable fields of interest Professor Havens stated that as the University of Hawaii was particularly strong in electron and atomic physics, particles and fields, and solid-state physics the A.P.S. would expect those Divisions of the A.P.S. to arrange programmes. The Division of Fluid Dynamics, which had initiated the suggestion of a joint meeting, would also arrange a programme. Professor Havens did not think that the Divisions of High Polymer or Chemical Physics would participate very substantially and, because of other meetings about the same time, did not expect very strong programmes from the Nuclear- and Plasma-Physics Divisions. The A.I.P. was requested to indicate the Institute’s attitude to the invitation in time for an A.P.S. Council meeting on 24 April.

The matter was very fully discussed at the A.I.P. Council meeting on 4 and 5 April, which was attended by representatives of each Branch of the Institute except the Tasmanian. It was reluctantly concluded that there was unlikely to be a sufficient number of A.I.P. members likely to attend such a meeting to justify the Institute’s name being associated with the meeting. Although concession fares of SS06 would be available if 15 members and relatives attended, Council as a whole did not think this number would be reached because of the non-specialized nature of the meeting. It concluded that attendance would be limited to those who could organize travel arrangements so as to be passing through Honolulu at the time.

Accordingly Council unanimously resolved that the invitation of the A.P.S. be declined with regret, but that assistance be offered in publicizing the meeting in other ways. As Council had been advised by Dr. Symonds that he expected to see Professor Havens in Vienna shortly thereafter, he was asked to explain the position to Professor Havens personally.

Council’s decision was conveyed to Professor Havens in a letter from the Hon. Secretary dated 10 April. The letter conveyed Council’s regret at declining the invitation and indicated that this was because Council felt too few of our members would be able to attend such a meeting to justify their being associated with it. The concluding paragraph read: ‘I can assure you that this decision was reached with a keen sense of disappointment. We will be glad to co-operate in other ways to help to make the Honolulu meeting a success, such as by publicizing the details among our members. However, we do not believe that we could make a contribution commensurate with what joint organization would require.’

At a recent meeting on 19 June the Executive decided that a further effort should be made to determine if Council’s conclusion that no significant representation of the Institute could be expected at such a joint meeting was correct. Any member who would expect to attend such a meeting on 2—4 September 1969 is therefore asked, urgently, to advise his Branch Chairman of this fact and whether he would propose to submit a paper.

**SI Units**

Str.—As an alternative to assisting in distributing publications on SI units, as suggested by A. R. Brown in your May issue, you may care to publish the appended list of publications which has appeared in recent issues of the Monthly Information Sheet of the Standards Association of Australia.

- AS 494—1967 The International System (SI) Units
- BS 3763:1964 International System (SI) Units
- PD 5686 (April 1967) The Use of SI Units

**THE AUSTRALIAN PHYSICIST, JULY 1968**
ISO/R31, Part I—1965 Basic Quantities and Units of the SI (International System of Units) $2.50
ISO/R31, Part II—1958 Quantities and Units of Periodic and Related Phenomena $1.00
ISO/R31, Part III—1960 Quantities and Units of Mechanics $2.50
ISO/R31, Part IV—1960 Quantities and Units of Heat $1.00
ISO/R31, Part V—1965 Quantities and Units of Electricity and Magnetism $3.15
ISO/R31, Part VII—1965 Quantities and Units of Acoustics $2.50
ISO/R31, Part XI—1961 Mathematical Signs and Symbols for Use in Physical Sciences and Technology $1.25

Macquarie University  
North Ryde, N.S.W.

Notes and News

IUPAP News

News-Bulletin No. 6 from the International Union of Pure and Applied Physics includes the following items.

Executive Meeting

The Union Executive will meet in London on 27 September 1968. It is at this meeting that the sponsorship of international conferences for 1969 will be decided. Applications for sponsorship should be made through the appropriate Commission by July.

13th General Meeting

The next General Assembly of the Union will take place on 14-16 September 1969 in Dubrovnik, Yugoslavia. At this Assembly, National Committees from the Union's 36 member countries will hear reports from the Executive and 15 Commissions, consider the admission of new countries, discuss matters pertaining to I.C.S.U. and the Union's Conference program, and set policy for the 1970-72 period.

Optics Technology

A new international journal, Optics Technology, will be published by Iliffe Science and Technology Publications later this year.

The journal will carry articles on optical methods and techniques and their application to science and industry. It will present articles on specific applications, reviews of special fields, and papers emphasizing the practical significance of work that may have been presented more theoretically elsewhere.

Dr R. I. Garrod

Dr R. I. Garrod has been appointed as Assistant Secretary in the Science Branch of the Department of Science and Education. Dr Garrod is a Fellow of the A.I.P. and of the I.P.P.S.

Since joining the Defence Standards Laboratories in 1947, and later transferring to the Aeronautical Research Laboratories, Dr Garrod has taken a leading part in crystal-physics research in Australia and has been an energetic member of the Australian Institute of Physics, playing a leading part in its formation.

In 1965 Dr Garrod organized a very successful International Conference on Electron Diffraction and the Nature of Defects in Crystals. He is at present Defence Research and Development Attaché in the Washington Office of the Department of Supply.

In his new position an early task will be the compilation of a record of all scientific research in Australia in both public and private sectors, including both Social Sciences and Physical Sciences. His Branch will be responsible for the Australian Research Grants Committee, the Queen Elizabeth II Fellowship, and for relations between the Department and the Academy of Science.

The Institute is proud to have one of its Members appointed to such an important post.

Overseas Visitor

Professor John Lamb, Electrical Engineering Department, University of Glasgow, will be visiting Australia for a few weeks later this year. Professor Lamb and his colleagues have made major contributions to the study of the viscoelastic behaviour of liquids and polymers through their research on ultrasonic relaxation processes. He is on the Council of the Faraday Society and a member of the Technology Sub-Committee of the University Grants Committee. Professor Lamb plans to arrive in Australia near the end of August. Further details can be had from J. S. Dryden, National Standards Laboratory.

On Walkabout

The President, Dr Alan Walsh, has been invited by the American Society for Testine and Materials to deliver an address at their Annual Meeting on Physical Aspects of Atomic Absorption. He will be absent from Australia from 22 June to 22 July.
FELLOWSHIP
(a) New Election
May, R. M. University of Sydney, N.S.W.
(b) Deceased
Price, W. L. (N.S.W.)

ASSOCIATESHIP
(a) Transfer
Westcott, M. E. University of N.S.W., N.S.W.
(b) New Elections
Harding, B. C. Australian National University, A.C.T.
Robinson, D. E. Commonwealth Acoustic Laboratory, N.S.W.
(c) Resignation
Morgan, W. V. (Overseas)

GRADUATESHIP
(a) Transfers
Alsop, R. J. L. Commonwealth X-Ray and Radium Laboratory, Vic.
Bahr, J. L. University of Adelaide, S.A.
Beek, J. J. H. A.C.T. Technical Centre, N.S.W.
Boreham, B. W. Australian National University, A.C.T.
Buselli, G. University of Adelaide, S.A.
Gardner, J. L. University of Adelaide, S.A.
Kemm, R. E. University of Melbourne, Vic.
Palmer, J. E. Blackwood High School, S.A.
Rossiter, D. E. University of Adelaide, S.A.
Vaughan, A. E. University of Sydney, N.S.W.
(b) New Elections
Allen, G. H. Australian National University, A.C.T.

Blesing, R. G. University of Adelaide, S.A.
Cottam, B. M. Deniliquin High School, N.S.W.
Egan, T. M. N.S.W. Institute of Technology, N.S.W.
French, I. E. University of N.S.W., N.S.W.
Griffith, M. University of N.S.W., N.S.W.
Hov, R. D. Mt Stromlo Observatory, A.C.T.
Lund, T. Monash University, Vic.
McKenzie, D. R. University of N.S.W., N.S.W.
Miatt, R. W. Royal Melbourne Institute of Technology, Vic.
Price, J. H. Monash University, Vic.
Richards, J. University of N.S.W., N.S.W.
Seymour, R. S. University of N.S.W., N.S.W.
Starr, J. University of Melbourne, Vic.

STUDENTS
New Elections
Schafe, L. M. (Vic.) Varga, I. K. (S.A.)

SUBSCRIBER
New Election
d'Helin, J. (Vic.)

COMPANY SUBSCRIBERS
A.C.T. Technical Centre
Broken Hill Associated Smelters Pty Ltd
Broken Hill South Ltd

Note to all new members: The return of your obligation form is necessary for formal completion of your admission. Its receipt by the Registrar serves as an acknowledgement of the letter of admission.

Book Reviews


Reviewed by B. M. Spicer, University of Melbourne.

This is a text book whose standard is suitable for advanced undergraduate and beginning graduate courses in nuclear physics in this country. The authors' stated aim is to show the mathematical details behind the various theories of nuclear models and processes and the extent to which the various theories are verified by experiment. By and large, they succeed. It is in many ways unfortunate that the discussion of alpha-decay is absolutely minimal, since the work of Perlman and others on this topic has provided some of the most convincing evidence for the applicability of the Nilsson model in heavy nuclei. The other substantial lack of this book is that of any reference at all to actual methods of measurement. It would add very considerably to, for example, the section on nuclear magnetic moments if there were some indication as to how this quantity is measured. This is as much a part of nuclear physics as the attempts to account for experimental values of the magnetic moments in terms of the various nuclear models.

The generally high standard of discussion of the physics behind mathematical formulae is marred by a few cases of loose statements; for example, the rather poor explanation of why the quadrupole moment of an $l = \frac{1}{2}$ nucleus is zero. Also, in a well presented book it was surprising to find the name of Elliott consistently mis-spelled throughout the chapter on the shell model.

These are, however, minor blemishes in a book which is a very worthy edition to the teaching texts on nuclear physics.

THE AUSTRALIAN PHYSICIST, JULY 1968 105
NETWORKS AND SYSTEMS, Peter H. O'N. 

Reviewed by D. B. Pike, School of Electrical Engineering, University of Sydney.

The book is largely devoted to an approach to the formulation of equations describing networks and systems. The approach employs linear oriented graphs from network theory and involves the construction of "branch" and "chord" equations. These equations have the advantage over "mesh" and "node" equations in the featuring of variables which are capable of direct measurement. Application of this technique to systems is thereby facilitated.

This approach is developed in the first four chapters, commencing with network graph theory and finishing with multiterminal network components and their interconnection. An independent chapter on state variables and the formulation of state equations then appears. This is followed by the final chapter applying the developed approach to mechanical, hydraulic, electric, and mixed systems.

The author's clear and detailed presentation of this method has been enhanced by liberal inclusion of illustrative examples. Well-compiled appendices on Laplace transforms, Fourier series, and matrices appear.

The book is an excellent reference for the formulation of network and system equations. It also has the non-intended result of providing excellent means of constructing electric network analogues. However, for a wide coverage of solution techniques and reasonable penetration of network and system behaviour, other sources must be consulted.


Reviewed by H. C. Bolton, Monash University.

It is at first sight rather surprising that we should have here a new book; very largely based on the classical electromagnetic equations of Maxwell and yielding so many new results in crystal optics. We are accustomed to think of classical crystal optics as being a subject explored very thoroughly in the nineteenth century. Birefringence and their frequency dependences are tabulated in the standard reference books and the refractometer is now rarely met in physical laboratories. The interpretation of crystal refractivities was one of the first major steps in solid state theory; the classic work of Ewald in 1916 analysed the electric field of a light wave inside a crystal in terms of the electric dipoles created in the atomic units out of which the crystal is constructed. Ewald used lattice sums in his analysis of the light wave propagated through the crystal. Although there are still many problems in the atomic and ionic interpretation of crystal refractivities, these are problems of details rather than of fundamentals. In this classic area, there still remains the difficult question of understanding crystal optics in terms of Bloch functions and this will be resolved when more and better band orbitals become available and their perturbation by electric fields can be handled.

The effect of frequency dispersion on optical properties of crystals is large; optical frequencies are just those of the absorption regions of the electrons in crystals and the frequency dependence of the complex refractive index, or more strictly the dielectric-constant tensor, is dramatic. Absorption regions are well known and associated problems of wave fronts, group velocity, and signal velocity are all familiar. The wave field in Maxwell's equations is defined in both time and space, and the consequent spatial dispersion is much less familiar. This book by Agranovitch and Ginzburg is a very full discussion of spatial dispersion very largely from the point of view of Maxwell's equations and their solutions. The function carrying the information about the dispersion is the dielectric-constant tensor which determines the response of the medium to an applied electric field. The reason why spatial dispersion in a crystal is physically not as important as temporal dispersion in the optical region is because the wave vector of visible light is much smaller than a reciprocal lattice vector, where significant changes in properties occur near the Brillouin-zone boundaries. In other words, there is a characteristic length a in a crystal (such as ionic radius or inter-nuclear distance) and if a is the optical wavelength then λ/a is much less than unity. The X-ray reflections when λ = a examples of large effects of spatial dispersion. Optically active crystals (or gyrotropic crystals as they are called in this book) are, of course, examples where spatial dispersion is influential in the optical region, and examples such as quartz have been known for a long time. At about the same time as Ewald, Born and Oseen separately, in 1915, discussed the influence of crystal structure on optical rotation. As Agranovitch and Ginzburg say in their book, classical crystal optics is a special case of crystal optics with spatial dispersion.

The first of three very long chapters in this book discusses the complex dielectric-constant tensor and electromagnetic waves in both isotropic and anisotropic media. A second chapter discusses the dielectric-constant tensor in crystals and treats the behaviour of the equations in the various crystal classes. Thus far, the book has been an extension of classical electromagnetic theory in anisotropic media with both temporal and spatial variations included. In the third long chapter, the problems are specialized into those of crystal optics; there are many graphs of the results showing how the
complex refractive index varies near absorption lines; there are a few, but only a few, experimental results to match them. There are a large number of original papers both experimental and theoretical in the references, especially from Soviet laboratories. On this score alone, the book is valuable. The macroscopic theory is very firmly laid down in these three chapters, which form the major part of the book, and it seems clear that there are many more experiments likely to be stimulated by the book. The last chapter gives the microscopic theory especially for excitons in terms of conventional perturbation theory and wave functions for the crystal. Second quantization methods are only slightly touched on; the conventional approach is probably adequate for most problems, though one particular microscoplc aspect, namely the interpretation of the dispersion curve when photons and excitons interact, is much more readily understood in terms of a linear combination of the free-photon and free-exciton operators, as Hopfield showed in 1938.

This is a specialist's book in which the two authors have very fully and at times enthusiastically explored many new aspects of classical electromagnetic theory. It is highly recommended on these terms. The translation from the Russian has been serviceably done but there are several minor roughnesses which checked the reviewer occasionally.

University Appointments

UNIVERSITY OF NEW SOUTH WALES

invites applications for appointment to the positions of

PROFESSOR OF PHYSICS

and

PROFESSOR OF THEORETICAL PHYSICS

within the School of Physics

As a result of re-organisation within the Faculty of Science, a School of Applied Physics and Optometry has been separated from the School of Physics. For the time being Professor E. P. George will be Head of the new School of Physics.

The University is seeking applications from physicists of distinction to fill two newly-established Chairs in the School of Physics.

The main interests of the School are in the area of solid state physics but the University would be pleased to receive applications from persons qualified in any area of physics.

Salary will be $12,000 per annum.

Subject to the consent of the University Council, Professors may undertake a limited amount of higher consultative work.

Prospective applicants are urged to write to the Appointments Office for supplementary information on the School of Physics and for details of duties and conditions of appointment, including superannuation, study leave and housing scheme.

The University reserves the right to fill either Chair by invitation.

One typed copy of the application, together with the names of three referees and a recent photograph, should be forwarded to the Appointments Office, P.O. Box 1, Kensington, N.S.W. 2033. The closing date for applications is 12th August, 1968.

E. H. Davis, Bursar.

**NEW WILEY BOOKS IN OPTICS**

**ELECTRO-OPTICAL PHOTOGRAPHY AT LOW ILLUMINATION LEVELS**

By H. V. Soule, Astro-Electronics Division, RCA. 1968 5192pp $15.95

This book presents the unique characteristics of low light level imaging systems. The physical characteristics of both vacuum tube and solid state image intensifiers are detailed, and the image intensifier cathode and vidicon characteristics are also presented.

The author outlines, in detail, the image intensifier camera and high-speed television line scan recording techniques, including the high density linear recorder, the electron beam recorder, and the cathode ray tube recorder. He also presents the basic characteristics of light sensitive and electron-optical sensitive recording media.

A considerable amount of detail is featured on natural light radiation sources and the effects of weather and time on their radiation characteristics. The techniques used to record low energy radiation, x-rays, infrared, visible, and near-infrared radiation are fully explained, and enhance the value of the book.

The extensive appendix contains nomenclature identification and a summary of radiation conversion relationships.

**APPLIED OPTICS: VOLUME 1**

**A GUIDE TO OPTICAL SYSTEM DESIGN**

By Leo Levi, City University of New York. 1968 620pp $18.95

Modern optical theories and techniques are emphasized in this complete and systematic presentation of material required for designing optical systems and selecting optical components. For the specialist, the book offers a practical reference with many-to-one topics, formulae, tables, and graphs. For those—on the other hand—who have no previous knowledge of optics, a self-contained introduction to optical system design is adequately provided.

**VOLUME 2: OPTICS FOR COMMUNICATIONS AND DATA PROCESSING . . . in preparation**

**OPTICAL AND PHOTOGRAPHIC RECONNAISSANCE SYSTEMS**

By Niels Jensen, Reconnaissance Intelligence Laboratory, Litton Data Systems Division. 1968 211pp $13.95

A brief and eminently readable description of the fundamental factors that affect image formation in optical and photographic reconnaissance systems.

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