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The Institute and Australian Science Education—An Editorial Commentary

After five years of operation as an Australian Institute, there is growing evidence that the Institute is becoming a truly national organization, representative of the physics community to an appreciable degree, though among some sections there has been a loss of interest. The Australian Physicist has helped to reflect Institute attitudes and those of its members. Reference to the five existing volumes shows the transition from the views of almost independent state entities to those of a more national body. The journal can be a valuable medium for exchanges of views but we have some way to go if we note the printed dialogues which occur in the proceedings of other scientific organizations in Australia. Are we, as physicists, less conscious of the social, economic, and other factors outside the direct control of the physics community even though that control may profoundly affect the development of physics in Australia? Or are we less accustomed to expressing ourselves in a way which may play a constructive role in relation to the increased national emphasis on planning in science and education?

If physicists are to play a constructive role through the Institute Council, Branches, and Groups, they must establish their priorities in relation to other demands which society makes. They must learn to make decisions free from pure self-interest and parochialism. In summing up the discussions at the recent Symposium of the Australian Academy of Science on Science, Technology and Society, Professor Encel (1968) remarked: 'Scientists sometimes criticize politicians as being crass because they will not spend money on research. I have no doubt that there are many specific instances where politicians do show this crassness, but I think it would be a mistake to generalize that this is always the case, or even that it is true in the majority of cases. Scientists, like most people whose lives depend on intellectual activity, are prone to believe that things which are self-evident to them are also self-evident to other people. I think they underestimate the shrewdness of politicians, and even more the practical wisdom of their official advisers who, in most cases, actually make the decision which is put into the politician's mouth. Treasury officials, for example, especially in Canberra, are hardheaded people with a good deal of experience in rigorous argument.' He goes on to point out that government officials are inclined to be sceptical about the assumption, which many scientists make, that science is a form of investment rather than belonging to the category of consumption goods where it must compete with other forms of consumption which the public, and not only the politicians, may regard as equally desirable. 'Science might do well to note how the idea of education as an investment was oversold a few years ago. Education is also a consumption good as well as an investment, and this has become painfully evident again.'

No doubt many will be wary of such an argument but it demonstrates the great need for a broader degree of shared understanding with social scientists, economists, and politicians; and for a common language to forge the links, because frequently the language of our own specialty cannot deal with the themes which the shared tasks set us. If discussions are to be a part of our activities, it seems evident that editorial comment must help to start them at least in these columns. The comments we offer may not always reflect the attitudes of the corporate body of the Institute (especially the unformulated ones)—this we will state clearly and in advance—though every attempt will be made to give a balanced appreciation of the problems under discussion.

Headlines in the national and scientific press are reflecting the turmoil which currently surrounds the teaching of science in secondary schools all over Australia—Crisis in Science Education; Science Syllabus Overloaded; New Warning on Lack of Teachers; Drift from Science to Arts. It is clear that everyone wants better education for their children so that they will make citizens capable of intelligently using the fruits of technology' (Crowther Report 1959). This latter aim is a major objective of scientific education but to achieve it presents serious difficulties. How many of our secondary-school students will pass on to become graduates in science or even research scientists? How do we achieve a balance between secondary-school science education for the general student and the demands
placed upon the education system to meet university entrance requirements? How do we get teachers with the right training? It is a multi-dimensional balance, an educational ‘mobile’, and to achieve it certainly demands shared understanding with other groups in our society. What is the aim of the accepted course, how hard and long should it be and who is to teach it? Couple these questions with another— who should decide the answers—and most of our society is involved.

What course should be adopted for the teaching of physics? ‘It is an ideal of education that each pupil should work at a speed and level of difficulty appropriate to his own ability and needs. Even though physics courses are aimed at the top half of our students, there is a great spread of ability and motivation within this group. It should be the major aim of those who plan and teach physics courses to provide for the average pupil, and at the same time challenge the superior student to work at full capacity’ (Hutchinson 1965). Such an ideal situation can only be reached by having different levels of course difficulty, yet this places a serious strain on the number of teachers and capabilities of the teaching staff. It is further suggested that the courses should not be too broad and that depth should be achieved by studying selected principles thoroughly, applying them to real situations and solving the real problems in various aspects. The human problems met in achieving these aims will be less troublesome if all parties involved in determining the courses can learn to understand when to make contributions and where their roles are limited. Schools have practical problems of staffing, scheduling, and dealing with individual problems of students, parents, budgets, etc. A syllabus or an educational idea which seems perfectly sound to a scientist may not be applicable in a school science programme because it would throw schools into a turmoil or because it would rob other equally deserving areas of the financial and academic support that they need. On the other hand, Education Departments should seriously consider recommendations of consultant expert groups in their determination of courses. However, both must learn the views of the experienced science teachers themselves since they are aware of the problems of presenting the courses and of the students taking the courses. The consultants and officials will be ‘flying without the benefit of their most sensitive radar’ if they do not consult the teachers or ignore what they have to say. Equally the teachers have an obligation to consider new ways of teaching, to objectively consider the courses and to make changes when necessary.

Given that a balance of views can be reached, what emphasis should the syllabus have for the various groups of students? For many of the students, the science they receive at school will be all they receive but it should be enough in some sense to help them understand the forces shaping their lives. For the small remainder, it must meet the require-

ments for entrance to tertiary education (either a university or a college of advanced education). Herein lie many problems. In allocating time for a good general education for all students, should the tertiary entrance demands set the pattern of upper school education? The problems have been tackled by different States in different ways. In Victoria, it has been stated that the physics course at top secondary level has a definite terminal characteristic and the university departments have acknowledged that it will be their lot to train professional physicists and to provide service courses for other disciplines. This is not true of other States where a stronger university attitude demands that the final secondary course should provide a very positive lead-in to the university course work even to the extent of prerequisite secondary school subjects.

In the context of secondary courses which are often overloaded in consequence of the demands of tertiary education, the teacher and the student are caught in the crossfire of conflicting opinion regarding what is classed as good education and what shall or shall not constitute a matriculation standard. It is therefore imperative that the true purpose for which the courses are designed should be resolved, and this requires a shared understanding of the problems.

No amount of syllabus planning and re-organization will solve the problem of teaching to that syllabus, if the teachers themselves are inadequately prepared to propound its content to the students. This inadequacy of preparation has two aspects—the first is the introduction of new material without adequate notice and without preparatory pilot studies; the second is the question of the teachers' level of academic preparation. The first aspect has been approached with care in at least two projects overseas. It is an observable fact that only in one Australian State so far has a new science course been introduced into secondary schools with some preliminary study of the possible effects and with attention to the practical requirements. A syllabus is only as valuable to the students as the teachers who teach it and as informative as the demonstration material and equipment will allow. The lesson has still to be learnt, in general.

The formal training—and retraining—of teachers is the vital second aspect which affects the whole impact of the subject material on the students. Probably no profession makes its demands in more varied ways than does teaching. In addition to the well-known requirement of a scholarly professional education, the teacher's job ideally calls for the organizing skill of an executive, the friendly warmth of the salesmen, the sensitive human understanding of the psychiatrist, the inspirational leadership of an evangelist, the sense of responsibility of a surgeon, and an ability characteristic particularly of teaching to operate effectively and with satisfaction at the level of children. In addition to these desirable attributes, found to a greater or lesser degree
in all successful teachers, the physics teacher must have technical understanding, considerable mechanical skill, and a willingness to continue studying for the rest of his professional life to keep abreast of his rapidly developing field.' (Hutchinson 1960).

How many such people do we have in Australia to carry out the task of inspiring and guiding pupils to their best effort and how many are in training?

There are certainly far too few and it is often found necessary to place, in charge of physics, a teacher of average preparation with a major subject in some other area. If he is fortunate, he will have one year of a university physics course behind him. Such a background is insufficient for effective teaching of the subject at top secondary level. He can lead his students along a well-defined path but it would be too much to expect him to bring the extra insight and appreciation necessary in his work to extend his best students. Extra training is an obvious solution but attaining this desirable end is both demanding and time consuming in an already full career. Too frequently he must achieve this extra training during evening hours, impairing his overall efficiency, or at vacation times when he is sometimes offered a summer course. Again, some balance must be sought because it is all too clear that the teacher will seek relief in another post in industry or research where it is expected that he will spend time in advancing his education and be given time to do it.

The blame for the teacher shortage and for the inadequate level of training is most frequently levelled at the Government or the Education Departments or both. Education Departments are faced with a dilemma which would daunt most people. There are always more and more students to be taught yet, while the fabric of schools may be erected in adequate supply, departments cannot equip them with teachers because of the problems of providing training colleges and staff for them. In a State such as N.S.W., it is certain that twice the number of teacher training colleges are required to supply the teachers to overcome existing shortages plus the normal retirements and resignations. It may well be possible to provide the buildings and equipment, but where do the training staff come from when there is a general shortage of qualified people for such posts in existing colleges, universities, government laboratories, and industry? Coupled with the relative decline in science enrolments, not only in Australia but in the Western World, we begin to see the severity of the problems facing the future of science education.

In his article 'The Drift from Science to Arts', Professor Thornton (1968) refers to the fact that during the last six years or so the relative popularity of science and science-based studies has suffered a marked decline among senior secondary school students and among new undergraduates, and notes that these disciplines had 46.6 per cent. of the 14.5 thousand enrolments in 1962 but only 37.6 per cent. of the 22 thousand enrolled in 1967. The Dainton Report (1968) parallels these figures very closely for British Universities. Professor Thornton believes that we are not dealing with any mere local passing phenomenon; we are dealing, it seems, with something pervasive, deep-seated, and continuing. Both Professor Thornton and the Dainton Report traverse causes and remedies which should be required reading for those concerned with the affairs of science. It is suggested that many able students are deterred by the rigour of school science, especially when that rigour degenerates into a grammarians formalism, when it is bolstered by an inordinate bulk of experimental work, and when it is overlain with vast bodies of factual information; young people are seeing science (and having it presented to them) as a pursuit quite lacking in imagination, out of touch with human and humane affairs, serving only material ends, raising moral and social problems it cannot solve. There is the further suggestion that young people see the scientist as committed to a dull life of intellectual routine, unable to exercise his own imagination—a prisoner of the traditions of his craft or the patient tool of managers and directors.

The obvious remedies are proposed: that those who teach science should reconsider what they demand in the way of routine experimental work and factual substrates; that those who employ and direct scientists should see to it that scientists have (and the world is made to know that they have) ample opportunities for the exercise of personal initiative, imagination, and decision. Just how difficult this will be requires only the thoughts that there are conflicts and tensions within the very traditions of science itself, and that it is impracticable to achieve a balanced approach in science teaching without some serious contact between the teachers of science and those who practise in the research and philosophy of science.

Whatever the causes of the dilemma, it would seem certain that science and scientists should be examined critically to determine the role they play in our society. We should be as critical in determining the social function of the faculty of science as Professor Johnson (1967) has been in his analysis of the social function of the Faculty of Arts. We reverse his opening two sentences, 'It is easy to see what a faculty of arts does for the personal development of its students—it is less easy to see what service it performs for society at large. It is easy to see what a faculty of engineering does for society, in training a class of specialists essential to modern society—it is perhaps less easy to see what it does for the personal development of its students.' Perhaps it is becoming less clear to teachers and students alike what the faculty of science can offer in the way of a vocational purpose and intellectual and spiritual growth of the individual.

Without doubt the problems are great, but we cannot afford to neglect them further. They can
only be tackled by developing a shared understanding of all the information available from all branches of our society. Our Institute has a role to play in this interchange of information through its journal if members will use it.

References


Performance of Wyndham Students in University Science

G. J. Atchison
Canberra College of Advanced Education, formerly Australian National University

Readers of this journal in New South Wales, and many others, will be aware that in 1962 a new system, the so-called Wyndham scheme, was introduced into secondary schools in the N.S.W. educational system (including the A.C.T.). For the information of readers who are not familiar with the system, we state briefly the following facts:

1. Secondary education has been increased from 5 years to 6.
2. Examinations are held at the end of the fourth and sixth years, these being known as the School Certificate and the Higher School Certificate examinations respectively.
3. Throughout all six years, Science, as distinct from the sciences, is taught.
4. In both examinations, subjects are examined at three levels (Advanced, Credit, and Ordinary in the School Certificate, and First, Second, and Third in the Higher School Certificate). In the particular cases of Science and Mathematics for the Higher School Certificate, the second level is further divided into Second level Full and Second level Short (2F and 2S), and students who pass both Mathematics and Science at the 2F (or First) level are thereby credited with three subjects.

The nature of the science syllabuses for the Higher School Certificate have been discussed in this journal by the Chairman of the Science Syllabus Committee, Professor S. T. Butler (Australian Physicist, 3 No 2, February 1966). Since that time, the following changes have been made:

1. On 5 October 1966 (i.e. when the first group of Wyndham students had nearly completed their fifth year of secondary study, which was the first of their two years of preparation for the Higher School Certificate), both the 2F and 2S syllabuses were virtually reduced in content by a statement regarding the provision of alternative questions in the examinations, and which was summarized in the statement: 'In effect, candidates will be required to answer questions covering 66% of the total syllabus, so that, where circumstances necessitate, only this percentage of the total syllabus need be taught'.

2. On 6 November 1968, revised 2F and 2S syllabuses were approved, each with the object of reducing its content by about one-third and it is now being issued as an interim syllabus to be examined as from 1969, pending further consideration of the Science courses'. It should be made clear that this was not a further reduction in content, for whereas the statement of 5.10.66 permitted teachers to choose which third of the syllabus they would omit, this recent revision formally reduces the syllabus by the same fraction and removes the choice previously permitted. Again it will be noted that the first students affected by this latest revision had already nearly completed their fifth year when the revision was made.

The references to 'an interim syllabus' and 'pending further consideration of the Science courses' seem to indicate an official recognition of a need for a more radical change than a mere reduction in the sheer quantity of material to be covered.

However, the nature of the syllabuses has not been substantially changed by this reduction in content, and those who are not familiar with their nature are referred to Professor Butler's article (loc. cit.)

The question has many times been asked as to whether Wyndham students would be better prepared, or otherwise, than their predecessors for study at tertiary level (though the present author would share with many others the view that, at least up to the School Certificate, the primary aim of secondary education should not be to prepare for tertiary education large numbers of students who...
will never enter a tertiary educational institution). In the specific case of Science, Professor Butler (loc. cit.) clearly stated his opinion: 'There would seem to me no question that the students should in future be much better prepared than previously to take up university study in physics, and indeed in any one of the science disciplines.' He was by no means unique in holding this opinion.

In 1968, the first Wyndham students entered the Universities. Opinions as to whether they were in fact better prepared than their predecessors varied widely, not least among scientists. In an article in the popular press by Donald McLean (Sydney Morning Herald, 21 September 1968), in which were quoted the comments on Wyndham students of some senior staff members of Sydney's universities, such phrases as: 'Catastrophic!', '... best group of students I have ever taught', 'no better than intermediate students under the old scheme', 'the present science course prepares for neither life nor university', occurred among the remarks of the physicists and chemists.

It seemed to the present author that the examination results of the Faculty of Science of the School of General Studies, Australian National University, might provide some sort of objective test of the success of Wyndham students, since, of the full-time students in that Faculty, an appreciable fraction (very approximately one-quarter) gained their matriculation from other than the N.S.W. system. Accordingly, a comparison of the performances of the students who gained their matriculation in the Higher School Certificate in 1967 with those from elsewhere, and a similar comparison of those who in previous years gained their matriculation in the N.S.W. Leaving Certificate examination with those from elsewhere, should together give a real comparison of the achievements of 1968 Wyndham students with those from the Leaving Certificate examinations of previous years, since there was no reason to suppose that there had been any change in the standard of those coming from elsewhere.

Such an analysis has been made for the students of 1963–64–65–66 regarded as a single group, and for those of 1968. (1967 was omitted because, with the change from a 5 year to a 6 year secondary school system, there was no full-scale Leaving Certificate examination in 1966. Thus the first year University students of 1967 were a relatively small and non-representative group).

For each group of students, there were calculated the two figures:

1. percentage of students who passed (including those gaining higher classifications — credits, etc.);
2. average mark obtained.

In each case these two figures were obtained both for the Wyndham (or Leaving Certificate) students, and for the non-N.S.W.—A.C.T. students, and the ratio of the two expressed as a percentage. Thus, if in a given subject, say 73 per cent. of the N.S.W. students passed, with an average mark of 59 per cent., and 81 per cent. of the non-N.S.W. students passed, with an average mark of 63 per cent., then, since 73/81 = 90 per cent. and 59/63 = 94 per cent., these would appear in the table as:

<table>
<thead>
<tr>
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<th>1963-66</th>
<th>1968</th>
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<tr>
<td></td>
<td>Pass</td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td>rate</td>
<td>mark</td>
</tr>
<tr>
<td>General Physics</td>
<td>108</td>
<td>104</td>
</tr>
<tr>
<td>Physics I</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
<td>General Chemistry and Physics I — total</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>General Chemistry (1964–66 — this course commenced in 1964)</td>
<td>98</td>
<td>96</td>
</tr>
<tr>
<td>Chemistry 1</td>
<td>106</td>
<td>102</td>
</tr>
<tr>
<td>General Chemistry and Chemistry 1 — total</td>
<td>101</td>
<td>100</td>
</tr>
<tr>
<td>Physics and Chemistry — grand total</td>
<td>102</td>
<td>100</td>
</tr>
</tbody>
</table>

* The numbers of non-Wyndham students in General Physics and General Chemistry were very small (14 and 12 respectively), so that these figures are of little significance. They are listed here only because they are included in the totals.

For the Biological sciences (Botany and Zoology) the results are:

<table>
<thead>
<tr>
<th></th>
<th>1963-66</th>
<th>1968</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Pass</td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td>rate</td>
<td>mark</td>
</tr>
<tr>
<td>Zoology I</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
<td>Botany I</td>
<td>104</td>
<td>104</td>
</tr>
<tr>
<td>Zoology I and Botany I — total</td>
<td>101</td>
<td>101</td>
</tr>
</tbody>
</table>
The results for Human Biology are not included because this subject was taught for the first time in 1968, so that there are no previous figures with which the 1968 results could be compared.

The following points should be mentioned.

1. (Relevant to Conclusion 2a below.) For Physics I an 'A' level pass at the Leaving Certificate examination or its equivalent was formerly required for entry to the course. A pass in Science 2F or its equivalent is now required.

2. (Relevant to Conclusion 2b below.) Wyndham students have studied the biological sciences for six years before entering the University. Few students from the Leaving Certificate entered the University with any previous knowledge of the biological sciences. It would therefore seem reasonable to expect a marked improvement in the performance of Wyndham students in Botany and Zoology relative to that of their predecessors.

3. Geology has been omitted entirely from this analysis because in 1968 there were only 7 full-time students in Geology I in the non-Higher School Certificate group; so that any conclusions based on their results would have been meaningless.

4. Any conclusions drawn from the table above must be treated with some reserve, because the numbers of students in the non-Higher School Certificate groups are in all cases relatively small.

5. The Wyndham students of this particular year may well prove to be non-typical, since they have been the first products of the new system throughout the whole of their secondary education. (N.S.W. readers will have heard the word 'guinea-pigs' applied to them throughout their secondary schooling.)

The following conclusions are drawn, with the reservation stated in point 4 above.

1. In the years 1963–66 there was no significant difference between the performance of N.S.W. Leaving Certificate students and others in either the physical sciences or the biological sciences.

2. In 1968—
   a. The performance of students from the Higher School Certificate in both Physics I and Chemistry I appears to be significantly poorer than that of those from outside the N.S.W. system.
   b. There is some indication that in Zoology, but not in Botany, the performance of students from the Higher School Certificate is better than that of those from outside the N.S.W. system.

The author is grateful to the Deputy Chairman of the Board of the School of General Studies, Australian National University, for permission to use the University's records for this analysis, and to Mrs J. Garnsey, who extracted the relevant information from numerous files and presented it to the author in readily usable form.

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Senior Secondary Science in N.S.W.

J. E. SHAW

National Standards Laboratory, Sydney

This article reports the resolutions affirmed by vote at the Science Syllabus Conference, organized by the Secondary Teachers' Association of N.S.W., and held at Sydney Boys' High School on Saturday, 7 December 1968.

Introduction

At the beginning of 1966, science students in the fifth forms of secondary schools in N.S.W. commenced a new two-year syllabus. The syllabus is arranged in three levels, each level containing a core of subject matter in the physical sciences with additional studies in the geological and biological sciences. Students who entered these courses had previously completed a general science course during the four years of junior secondary school. By the end of 1968, some of these students had completed their studies in first year tertiary science, thus providing all interested groups with information about the academic results of the senior school science syllabus.

By December 1968, when the Science Syllabus Conference was convened, three main factors had operated to produce the interest which was evident in the attendance and discussion at the conference. These were:

(a) the accumulation by secondary teachers of a number of criticisms of the syllabus both in its content and in its application;

(b) the announced intention of the Board of Senior School Studies to review the content and structure of the syllabus; and

(c) the provision of financial assistance by the Commonwealth government to support projects for curriculum development by two or more cooperating states.
The Conference

Attendance was recorded by 397 people, comprising the staffs of state schools, independent schools, universities, teachers’ colleges, technical colleges, and members of other interested organizations.

In his opening address, Professor B. R. Williams pointed out the differences which exist in the interests of schools, universities, and industry and commerce, observing that it is impossible to satisfy the requirements of all these interests with one syllabus. For this reason, he thought it important that the aims and objectives of a syllabus should be defined.

Guest speakers were Professor B. R. Williams, Vice-Chancellor of the University of Sydney; Mr. K. C. Lee Dow, University of Melbourne; Mr. J. M. Mayfield, Dept of Education, S.A.; Mr. R. H. Wilkinson, University of Melbourne; Dr. R. Tisher, University of Queensland; Dr. D. J. Carswell, University of N.S.W.; and Dr. Joyce Wylie, University of Sydney.

Those speakers from other states were able to summarize the individual approaches in these states to recent syllabus and curriculum development. In many cases, curricula have been adapted from those developed overseas for individual sciences. Mr. Wilkinson gave a full explanation of what was involved in the ab initio development of a physics curriculum and stated his case for a ‘third generation’ physics course to be produced in Australia. All speakers stressed the need for pilot classes to test all aspects of a new course before its general introduction.

Resolutions

The five resolutions, as amended and agreed by the Conference, are given in full below.

1. N.S.W. Senior Secondary Science Syllabus

The existing science syllabuses and methods of examining for the N.S.W. Higher School Certificate are unsatisfactory and this Conference demands that new syllabuses be prepared and that improved methods of examining be sought.

The new syllabuses should be prepared by a full-time paid Syllabus Construction Group, containing a majority of practising teachers, with experience in teaching the present syllabuses, seconded for the purpose for a limited time. This group should also investigate and report on methods of examining.

The Syllabus Construction Group should operate in association with the Senior Science Syllabus Committee and should commence work at the beginning of the school year, 1969.

New Interim syllabuses should be made ready for introduction to schools at the beginning of 1970. The Syllabus Construction Group should then proceed to test the interim syllabuses and refine them in the light of experience. No syllabus should be finally adopted until it has been proved by experience to be thoroughly satisfactory. It is envisaged that the total work of the Syllabus Construction Group will take several years to complete and that in view of the rapid developments taking place in the field of science it may be necessary for the Group to continue indefinitely.

During the preparation of the interim syllabuses and afterwards, the Syllabus Construction Group should release regular progress reports for full public discussion and should regularly seek opinions from teachers and other interested parties.

The first duty of the Syllabus Construction Group should be to examine thoroughly current developments in syllabus construction both in Australia and overseas, and then to draw up a clear statement of objectives expressed in behavioural terms to form a basis for further planning.

2. The Aims and Objectives of Senior Secondary Science

That the following be appended to the foregoing decision:

Senior secondary science syllabuses should provide courses which are based on the following behavioural aims:

awaken and maintain a sense of adventure and achievement and thus develop a student with an increasing tendency to be creative, imaginative and appreciative of natural phenomena, scientists and scientific endeavour;

foster an understanding of the historical background and philosophy of science;

develop the student’s powers of self-expression.

Further, that any Syllabus Construction Group should design courses which can be viewed in terms of the following criteria:

allow time for students to follow up the consequences of their own reasoning and observation; show the scope and usefulness of scientific method, while revealing the existence of uncertainties, boundary problems and alternative theories to explain the same set of facts;

the syllabuses should not be over-prescriptive and should allow for teaching to be flexible and progressive, taking advantage of new methods and new ideas, and tailored to the maturing abilities of the student.

As far as possible the specific material chosen should be:
(a) so important that no terminating secondary course is complete without it;
(b) capable of being developed honestly at a level comprehensible to secondary students;
(c) tied in with other parts of the syllabus so that it can be reinforced by practice.

The Syllabus Committee should publish the aims of any new syllabus, for public discussion and subsequent review, before any compilation of the syllabus itself is commenced.

3. Curriculum Development

That we call on the N.S.W. Government to co-operate with the governments of other States in establishing with Federal financial assistance a Senior Secondary Science Project to develop tested courses and study material for senior secondary students.

4. Teacher Education

That we request the N.S.W. Department of Education to set up a Committee including representatives appointed by teachers' organisations representing government and non-government schools, universities and Colleges of Advanced Education to seek methods whereby the Government may co-operate with tertiary institutions to:

encourage and assist non-graduate science teachers to improve their education and attain graduate status;

promote the continuing education of graduate science teachers;

and most importantly, introduce alternative four year training courses for science teachers which will promote improved recruitment and be a better preparation for the teaching situation;

provide improved facilities and incentives for the training and employment of graduate scientists and technologists as teachers;

raise the standard level of teacher training for all teachers to a four year co-ordinated B.Ed. degree programme in place of the current degree courses which are orientated towards the needs of industry and research rather than towards the needs of education.

5. Implementation

That the decisions of Conference be conveyed by those present to their organisations, schools, and universities with a view to having representations made to the appropriate authorities.

That a second 'Science Syllabus Conference' be held in 1969 no later than June of that year to review the results of the present conference and to extend, wherever necessary, the recommendations of the present conference. That the Director-General of Education be invited now to that conference.

Notes and News

Conferences to be sponsored by IUPAP in 1969

(Continued)

22. 9th Int. Conf. on Ionized Gases. Romania. Prof. I. Agarbiceanu, Inst. of Atomic Physics, Bucharest, P.O.B. 35.

Education Group (S.A. Section)

Some thirty members attended the Third Annual General Meeting of the S.A. Section of the Education Group, which was held at Pulteney Grammar School on Friday, 29 November. During the meeting, the following members were elected to form the Section Committee for 1969.

Chairman: Dr W. G. Elford, University of Adelaide.

Secretary/Treasurer: Mr C. V. Latz, Marion High School.

Committee members: Professor M. H. Brennan, Flinders University.
Mr G. Fuller, Henley High School.
Mr L. Gare, Pulteney Grammar School.
Mr A. W. Pybus, Weapons Research Establishment, Salisbury.
Mr C. G. Wilson, S.A. Institute of Technology.

Following the business of the meeting, Mr Lindsay Mackay, Lecturer in Education at Monash University, gave a talk on 'Senior School Physics Courses in Australia'.

The subject of Mr Mackay's talk was of considerable importance to members of the Section, many of whom were involved in preparation of the new Leaving and Matriculation Physics Course to be introduced in a trial form in some S.A. schools in 1969. Mr Mackay first outlined the difficulties which soon became apparent when an attempt was made to compare any two physics courses quantitatively. Syllabuses were a poor guide to senior physics courses in different States because the breadth and
depth of teaching involved depended on the expectations of examiners. Different facets of teaching were stressed in different States, which led to differences in emphasis on factors such as memory work or practical applications. Mr Mackay suggested the only way to proceed was to assume that the teachers and their facilities were the same in two different places and then suppose that the learning abilities and motivations of the associated student groups were equivalent. By suitable testing of the two student groups it should be possible to state, not whether one course were better than the other, but, rather, whether the introduction of a new course to each student group had brought about any desirable changes in student behaviour.

Mr Mackay contended that educational research could not, at this stage, compare the merits of new physics courses and their suitability for a given State. However, he thought that the battery of tests that he had devised for students could be extremely useful in assessing the extent to which a new school’s physics course had been successful in achieving desirable changes in student learning. This was extremely important to those responsible for course changes in high schools. He hoped that the results derived from his tests could highlight parts of a syllabus which did not come up to expectation and thus assist Physics Subject Committees in their task of revising their syllabuses.

Mr Mackay’s talk engendered a lively discussion which continued over refreshments which were served in the intimate atmosphere of the school tuck shop. Scepticism, optimism, and, possibly, a touch of cynicism were apparent in some members’ remarks, but, clearly, the lecturer succeeded very ably in making his audience think about a tremendously important educational topic. The Section is much indebted to Mr Mackay for coming from Melbourne for this occasion, and also to Mr Lloyd Gare and the Pulteney Grammar School for providing the venue for the meeting.

**Optics Communications**

A new ‘letters’ journal is to be published by North-Holland with editor Professor F. Abeles, Laboratoire d’Optique, Tour 33, 9 qual St-Bernard, 75—Paris 5, France. It will cover optics in its widest sense and include short papers on instrumental and physical optics, spectroscopy, and quantum electronics.

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**The Register**

**Changes in Membership from 12 November 1968 to 3 January 1969**

**Fellowship**

(a) Transfer
William, J. L. 19-21 Willesden Road, Hughesdale, Vic.

(b) New Elections
Feughelman, M. University of New South Wales.
Ward, J. C. Macquarie University, N.S.W.

(c) Resignation
Bowen, E. G. (N.S.W.)

**Associative**

(a) New Election
Brown, R. A. Macquarie University, N.S.W.

(b) Resignations
Benson, R. A. (N.S.W.)
Brett, P. R. (Vic.)
Swindell, W. (Vic.)

**Graduate**

(a) Transfers
Folkard, M. A. University of New England, N.S.W.
Sorell, G. C. Glossop High School, S.A.

(b) New Elections
Bryce, P. University of New South Wales.
Chapman, D. University of New South Wales.
Daniel, J. A. 3/29 Prince Street, Cronulla, N.S.W.
Donnelly, B. H. St. Ignatius College, Athelstone, S.A.
Evans, R. J. University of Melbourne, Vic.
Field, D. W. University of Adelaide, S.A.
Gasmier, D. McK. A.P.M. Research Laboratories, Alphington, Vic.
Heseltine, B. J. Gremorne Girls’ High School, N.S.W.
Lewis, T. G. Queensland Institute of Technology.
Outhred, R. K. University of New South Wales.
Palmer, I. D. University of Adelaide, S.A.
Thomas, I. L. R.A.A.F. Academy, University of Melbourne, Vic.
Treacy, B. J. University of New South Wales.
Wells, P. Monash University, Clayton, Vic.
Whiting, J. F. Queensland Institute of Technology.

(c) Resignations
Alderson, J. E. A. (O/S) Coates, M. S. (Vic.)
Eden, O. F. (S.A.) St John, V. P. (Tas.)

**Student**

(a) New Elections
Badham, C. B. (N.S.W.) Bahnson, H. L. (S.A.)
Bell, P. L. (Vic.) Byrne, J. C. (S.A.)

(b) Resignations
Davies, G. (S.A.) Downing, A. R. (S.A.)
Irish, J. L. (N.S.W.) Tooley, R. C. (Tas.)

**Subscriber**

Resignations
Bartlett, A. H. (Vic.) Haigh, J. E. (A.C.T.)
Harris, P. A. (N.S.W.) Waterlander, S.
Wilmans, G. R. (Vic.) (A.C.T.)
Annual General Meeting of the S.A. Branch
and Chairman's Address

The 1968 Annual General Meeting of the S.A. Branch was held on Wednesday, 11 December, in the Observatory Theatre at the University of Adelaide. The retiring chairman of the branch Dr W. S. Schwietzke took the chair and, following the adoption of the Annual Report and the Financial Report, the following committee was elected for 1969:

Chairman: Dr F. Jacka, F.A.I.P. (University of Adelaide).
Vice-Chairman: Mr E. R. Johnson, F.A.I.P.
Hon. Secretary: Dr E. R. Sandercock, A.A.I.P. (Bedford Park Teachers' College).
Hon. Treasurer: Mr D. Campbell, Grad.A.I.P. (S.A. Institute of Technology).

Under the item of any other business the chairman read a letter from the N.S.W. Branch seeking support for a request for the Institute Council to take steps towards attaining equal pay for female and male physicists. This topic engendered much lively debate, but ultimately a majority of Branch members present expressed their support for the general principle of equal pay for physicists, independent of sex.

Chairman's Address

At the conclusion of the business of the meeting the newly elected chairman Dr F. Jacka invited the retiring chairman Dr W. Schwietzke to address the meeting. Dr Schwietzke chose as the theme of his address 'some thoughts on the future of Physics'. In introducing his topic Dr Schwietzke outlined the remarkable manner in which Physics had developed since the discovery of the electron in 1895. During the subsequent thirty years until 1925, far greater advances in Physics were made than during any other period in the history of Physics. Physical theory was completely revolutionized when Planck introduced the photon and Einstein expounded the theory of special relativity in the early years of this century. A series of important experimental phenomena followed such as the photoelectric effect, the Rutherford atom, the Franck-Hertz experiment, the Compton Effect, and finally the de Broglie waves. This immensely productive era was guided mainly by European physicists of similar background who knew each other very well and pursued their researches in similar laboratory environments with comparatively meagre resources by modern standards.

A second fruitful era of experimental discovery followed which included the discovery of the neutron (Chadwick), artificial radioactivity (Joliot-Curie), deuteron (Urey), slow neutron interactions (Fermi), and nuclear fission (Hahn and Strassmann). The foundation of new research centres in the U.S.A. and the greater exchange of European and American scientists led to the greater involvement of Americans in this scientific discovery. The situation of increasing physical discovery underwent a radical change during the second world war when the tremendous technological progress which took place opened the eyes of political leaders and the general public to the large-scale possibilities of new applications of science. Large national and international laboratories such as those of CERN in Geneva and Dubna near Moscow were set up with large financial support from governments. The profound changes in the scope of scientific inquiry and the phenomenal increases in scientific manpower with the present 'doubling-time' of ten years for new physicists made science no longer the intellectual pursuit of dedicated coterie. Furthermore, the time lag between discovery and application has dwindled enormously. Dr Schwietzke expressed his personal concern deriving from these changes in outlook and expressed the viewpoint that physicists in particular were now faced with a dilemma.

They were hitherto respected by the community for their erudition and contributions to progress. Their essential desire was to work at the frontiers of knowledge extending those frontiers into new and exciting areas. Would the present community recognize this desire and give its continued support without demanding an immediate return for this support? Having posed this problem Dr Schwietzke then sought a justification for his own personal view that the community should recognize the benefits that have stemmed from the fundamental work of physicists and have sufficient faith in the future of the physicist not to demand an organized programme of discovery and application. Dr Schwietzke's justification was based on a survey of the work carried out by physicists in various categories since 1945. He used the broad classification of the areas of inquiry pursued by physicists published by the Physics Survey Committee of the National Academy of Science in 1966. According to this Committee physicists throughout the world were employed in the following branches of Physics:

- Particle Physics ............... 20 per cent.
- Solid-State Physics ............ 30 per cent.
Low-Energy Nuclear Physics ..... 20 per cent.
Atomic Physics .................. 15 per cent.
Miscellaneous (biophysics, gravitational physics, acoustics, etc.) ............ 15 per cent.

Dr Schwietzké examined briefly each of these main areas in turn.

From the fundamental point of view the outstanding discovery has been the non-conservation of parity in weak interactions. This and the development of quantum electrodynamics are post-war discoveries that have added something new to our knowledge of the very foundations of Physics. Under the heading of particle physics he suggested that the major discovery of the τ meson by Lattex, Occhialini, and Powell in 1945 had been followed by a continuing series of new particle discoveries which was related to vastly improved techniques. The study and classification of all these particles is one of the main interests of present-day physics.

The theory is lagging behind the discoveries and no practical applications could be foreseen in this area of inquiry. Solid-state physics had a tremendous boost following the discovery of the transistor which derived from the developments of superpure materials. Quantum mechanics was very fruitful in supporting solid-state physics but the analysis of the observed phenomena is often mathematically too complex for practical purposes and discovery tended to outstrip the theoretical progress.

In the area of low-energy nuclear Physics the technological advances in reactor production and accelerator development had led to the amassing of enormous quantities of data which in turn had highlighted a variety of correlations that were important in appreciating the detailed structure of nuclei but had not, so far, produced a general theory. The applications in this area of Physics were biased towards reactor engineering. In the field of atomic physics Dr Schwietzké mentioned the advances stemming from microwave technology which included radio astronomy, molecular spectroscopy, and the creation of the maser and laser with their promises of wide application. Finally, he pointed out that brevity prevented saying much about the work involved in earth science, biophysics, acoustics, etc. which were included in the miscellaneous category of employment.

Following this survey of the important developments in physical science, Dr Schwietzké contended that the greatest applications often occurred when there was no obvious demand for the need to predict development. Dr Schwietzké asserted that future applications of basic knowledge cannot be predicted hence the support of the community should be given to physical research for its intellectual value and its faith should be firm in the belief that research results were always used sooner or later.

The meeting concluded with a warm vote of thanks to Dr Schwietzké from Dr Jacka who expressed the views of all those present when he said that Dr Schwietzké's talk had given members much food for thought.

GEORGEY RUSSELL

Geoffrey Russell, Grad.A.I.P., was born on 8 November 1943, and was accidentally drowned on Lake Thunderbird, Oklahoma, on 13 December 1968. A number of Australian physicists will remember him with affection.

He was awarded the Byrnes Medal for the top pass in the Queensland Junior Public Examination in 1959, and was tenth in the State in the Senior Examination in 1961. On the basis of these results he was awarded National Undergraduate and Commonwealth Scholarships at the Australian National University, Canberra. He was awarded the degree of B.Sc. (Hons.) after specializing in Physics in 1964 and 1965; he presented a paper on his under-graduate project (Effect of discharge frequency on shock attenuation in a diaphragmless electrical shock tube) at the 1966 Symposium on Plasma Engineering, University of Sydney.

Russell joined the A.W.A. Physical Laboratory, Rydalmere, N.S.W., on graduation, where he worked on avalanche breakdown in silicon PIN diodes. In August 1966 he was offered a Research Assistantship by the University of Oklahoma for studies in plasma physics, and began studies for his Ph.D. degree there shortly afterward. On 26 November 1968 he married Diana Duff, of Sydney. Work for his Ph.D. was nearing completion at the time of his tragic death, in a boating accident which also claimed the life of his wife.

**Book Reviews**

Reviewed by H. M. Nelson, University of Sydney.

This fairly lengthy (641 page) text contains a somewhat strange and oddly ordered selection of topics in theoretical mechanics. It opens with three chapters on vectors, tensors, and matrices, which
seem somewhat out of place for two reasons: firstly, that they fall between the two stools of adequate mathematical rigour on the one hand and appeal to the motivation of necessity on the other; secondly, that they are not needed at all in the chapter immediately following. It seems strange, too, that so much space is devoted to the presentation of this readily available material without any illustration of its use in either the mechanics of deformable media or of fluids, both of which might have been expected from the all-embracing title.

The book is mainly concerned with an exposition of particle mechanics and with the derivative problem of the mechanics of solid bodies. It contains excursions into wave and relativistic mechanics. With the exception of its purely mathematical sections, which tend to be conventional, occasionally circuitous and somewhat pedantic, it is well presented. However, a book of this sort invites inevitable comparison with a classic such as Joos (‘Theoretical Physics,’ first published in English translation in 1934). All Bradbury’s basic material is to be found in Joos, but Joos’ ordering seems to be more logical and his presentation is no less acceptable.

The sections concerned with the solution of ordinary linear differential equations are unduly laboured and could have been presented much more succinctly, either by assuming an elementary knowledge of integral transformation methods, or by firmly introducing the phasor concept instead of elaborately skirting round it. The author is unduly restrictive, too, in his treatment of dynamical analogies. He chooses to write his equations for electrical systems with charge as the dependent variable. Had he chosen voltages instead he would have arrived at an equally valid, but different identification which, as has been pointed out by Trent and Firestone, has the advantage over the author’s choice of topological as well as algebraic similarity.

The book is well provided with problems for solution by the reader and some, but by no means all, of the chapters have appended references to related texts.

The errors and inadequacies of a textbook of this sort as a teaching aid often begin to show when it is used as such in other than its place of origin. It would be interesting to know if this experiment has yet been made.


Reviewed by K. J. Auburn, University College, Wollongong, New South Wales.

This is an excellent book. It is not a rehash of material from other books with similar titles but rather a clear presentation of the basic principles of electromagnetism in the context of the environment created by modern experimental and theoretical physics. The adjective ‘basic’ in the title is significant.

Professor Cowan (Professor of Physics at the California Institute of Technology) begins the book with the action at distance force law between accelerated charges and then develops the alternative approach through Maxwell’s field equations. Maxwell’s equations are deduced and their symmetry discussed. The electromagnetic potentials are introduced into Maxwell’s equations and gauge transformations discussed in relation to the quantum mechanical treatment of the electromagnetic interaction. The covariance of Maxwell’s equations expressed in tensor form is then examined.

Chapters 7 to 11 inclusive have headings as follows: ‘Energy and Momentum,’ ‘Dipoles and Multipoles,’ ‘Fields in Matter’ (including moving matter), ‘Boundary-Value Problems,’ ‘Simple Boundary-Value Problems with Waves.’ These are followed by five chapters where boundary-value problems are solved by all important methods (numerical methods excepted) and for all important rectangular curvilinear co-ordinate systems.

Chapter 17 is entitled ‘Scattering, Diffraction and Radiation’ and is an excellent concise introduction to the basic concepts. Then follow two ‘technological’ chapters—Chapter 18—‘Transmission Lines’ and Chapter 19—‘Electric Circuits.’

The chapter on electric circuits could be taken as an outstanding example of how a technology can be presented on such a sound physical basis that a physicist so trained can hope to extend the technology rather than become (as is often the case unfortunately) a third-rate technologist who falls into the many traps waiting for him.

The physical (rather than mathematical) nature of the descriptive passages and the copious small diagrams are features of the presentation which could be copied by other authors of (mathematical) physics texts, to the advantage of their readers. The use of specific references as footnotes and the carefully selected problems at the end of each chapter are other valuable features of the book.

This stimulating and erudite book should be compulsory reading for all Third Year Physics students regardless of other recommended texts.


Reviewed by C. F. Gauld, Cranbrook School, Sydney.

With changes that have been taking place in senior high school physics taught in Australia the original three volumes under the above title have been revised and re-issued as two. Volume 1 contains sections on mechanics, heat, and sound, all of which have been extensively re-arranged, added to and printed in a format a little less than quarto size with two columns on one page. In common with the previous edition the diagrams are attractive and helpful and section headings and bold type result in clear presentation.
The International System of Units (1960) is generally adopted but examples and problems employ FPS, CGS, and British Technical Systems where relevant. The normal axial-vector convention has replaced the opposite one used in the previous edition and relativistic extensions in the treatment of mass and kinetic energy are included.

The treatment is not one which critically looks at problems of definition, as do some modern American texts, but it attempts to be consistent in following out the implications of definitions chosen. Only rarely does inconsistency creep in as, for example, in the treatment of weight, force, and Newton's first law.

The few photographs are blemishes in an otherwise excellent book, being reproduced badly and adding little in the way of information. In spite of this, 'Basic Physics' is on school library shelves will do much to draw together pure and applied physics in high schools.


Reviewed by L. S. Eak, School of Physics, University of Sydney.

This volume constitutes the first of a proposed series designed to present comprehensive reviews of items of current interest in particle physics. This presentation appears to emphasize equally well the theoretical and experimental aspects of the subject, often in great detail, hence only a reader already well read in both would gain full value from the book.

The first contribution by Lederman and Tannenbaum on high-energy muon scattering is an excellent review article. Formulae are derived when used, and a comprehensive summary of existing muon beams with detailed diagrams is included.

The next article on matrix theory of design of spectrometer transport systems is too specialized to be in a review volume. Although the treatment by Brown is carefully developed, so that general equations of motion in a magnetic field with mid-plane symmetry are derived, such an article could only appeal to a very restricted public.

D’Espagnat’s coverage of weak interactions and symmetries is well put together; describing weak interactions in terms of unitary symmetries. Into this picture is incorporated octet enhancement for non-leptonic decays, the $|\Delta I| = 1$ rule, $P$ and $CP$ violation. Through no fault of its own, this review article will probably become quickly dated in a rapidly changing field.

Following on naturally from this is Sakita’s article on higher symmetries of hadrons. Starting simply, he introduces $SU_3$ symmetry and quarks, combines this with ordinary spin to give $SU_4$ and then discusses the problems of its relativization. A good treatment of the mass relations and their surprising accuracy is also included.

In such a book emphasizing both theoretical and experimental facets a summary of the many experiments being carried out around the world in search for quarks might have been a good idea.

Finally there is an excellent article by Willis and Thompson summarizing leptonic decays of elementary particles. The experiments are carefully presented and the theoretical backing is sound.

In summary, this volume is a series of articles written by specialists and designed for specialists—each one assuming fairly detailed knowledge from the reader.


These twin volumes, in an already well-known series whose Editor-in-Chief is L. Marton, live up to the high standard of presentation of experimental physics already established. Volume 4, as a whole, deals with methods and principles in experimental physics, applied to individual particles rather than to their interactions. The text is essentially directed towards atomic and electron physics, obviously with great attention paid to preventing undue overlap with techniques such as are used in nuclear physics and covered in Volume 5 of the series.

Volume 4A—Atomic Sources and Detectors—presents a comprehensive survey of the general methods available for producing electrons, positrons, atoms, ions and photons. Advantages and disadvantages are emphasized and many special techniques, not readily available, are succinctly presented and well illustrated. The latter third of the volume is devoted to the detection of these particles, under a variety of conditions.

Volume 4B—Free Atoms—is organized to give the properties of free electrons, positrons, atoms, and ions and methods by which the properties may be studied. The section on atomic physics, for example, covers optical, radio-frequency, and microwave spectroscopy, the lifetime of excited states, and polarized ion sources. Each of the topics is presented elegantly by leading exponents in their specialties. A third of this book is devoted to ultra-high vacuum techniques and gas-purification methods. In each case, the effort is reliably directed towards the best and most useful rather than an extensive review of the literature.

The two volumes can be readily recommended as worthwhile acquisitions to the library of experimental physicists at research level. The clarity of presentation with a balance of theory and technique will recommend their use as model guides for the young graduate, starting out on a career in experimental physics.
The Editors and contributors are to be highly commended for the production of two excellent compendiums of experimental physics methods.


Reviewed by L. W. Davies, A.W.A. Physical Laboratory and University of New South Wales.

This is yet another textbook in a well-ploughed field, but it is an extremely good one. Its strength lies in the continuing references throughout to physical and engineering situations relevant to the mathematics, and in the very extensive exercises at the end of each section which extend the text. For example, the section on modified Bessel functions is followed by one on thermal neutron diffusion theory, and the generating function and recurrence relations are introduced in subsequent exercises. Physics and engineering undergraduates who study from this text will doubtless be encouraged considerably by such indications of the applicability of the subject to ‘real life’ situations.

The book is designed for students with a knowledge of calculus, and leads them through vector and tensor analysis, complex variable, and special functions to Fourier series, integral transforms, and calculus of variations. (There is no discussion of numerical analysis, however.) I can confirm the publishers’ claim that the book encourages independent study!


Reviewed by H. M. Nelson, Department of Mechanical Engineering, University of Sydney.

This is a book about linear algebra, distributions, and Lebesgue integrals. It is stated by the author to contain introductory material for a second volume, which from the contents listed would appear to come close to what the physicist or engineer might regard as applicable mathematical methods of physics and engineering. It is intended as a text for students in the physical sciences, engineering, and applied mathematics and is not likely to appeal greatly to practising physicists or engineers who feel a need to come to grips with some of the notions in mathematics which have proved useful over the last decade or so. They will in the main feel the lack of motivation by examples of applicability or hints of the physically measurable quantities with which any of the generalized concepts can be associated.

The material covered is well presented and, for those who are amenable to the ‘pure’ approach, and can make the distance, the sections are interspersed with plenty of problems for solution by the reader. However, in my view, the reader would make satisfactory progress only if he had a thorough grounding in pure mathematics in earlier years and the benefit of some guidance from a tutor.


Reviewed by L. W. Davies, A.W.A. Physical Laboratory and University of New South Wales.

These are the first two to appear of a sequence of volumes intended to provide a complete treatment of III–V compound semiconductors, somewhat after the style of treatment of the Handbuch der Physik. Volumes 3 and 4 of the sequence are also devoted almost exclusively to III–V compounds, and we may take it that subsequent volumes will extend to the semimetals of the title. There are 11 chapters in the first volume, and 14 in the second, written by specialists in each area concerned. Although the inevitable disadvantages of ‘collective’ authorship are evident, such as non-uniformity of style, some repetition, and a somewhat variable depth of treatment, these are outweighed in my opinion by the collation in one reference of an immense amount of information on materials which will play an important future role in research in solid-state physics and in new semiconductor devices.

Volume 1 is concerned principally with electron transport in III–V semiconductors. An introductory chapter on key features of the compounds is followed by four chapters on band structure, including that of mixed crystals, and the effect of heavy doping. Almost half of the book is concerned with magnetic field effects. The book is worth purchasing for the final chapter alone — ‘Plasmas in Semiconductors and Semimetals’, by Dr Betsy Ancker-Johnson — which gives an excellent 100-page review on the subject. The chapter will be of particular interest to workers in gaseous plasma physics also.

In Volume 2 there are three chapters on thermal phenomena (conductivity and expansion, and heat capacity), and two on elastic properties and lattice constants respectively. The surfaces of III–V compounds, as revealed by low energy electron diffraction, are reviewed in Chapter 6; it is unfortunate that this treatment is not accompanied by a discussion of electrical properties of surfaces, but the situation will doubtless be remedied in a future volume of the series. The remaining eight chapters are grouped in sections concerned with magnetic resonances, photoelectric effects and photon emission, the latter including a chapter on nonlinear optics, and an authoritative 80-page review of radiative recombination by M. Gershenzon.

The series should certainly be in the library of university departments and other laboratories concerned with research in solid-state physics and devices, and will be especially valuable to graduate students commencing research on III–V semiconductors.
CSIRO
DIVISION OF BUILDING RESEARCH
Experimental Officer
(Architectural Acoustics)

SALARY: Depending upon qualifications and experience, the appointment will be made within the salary range of Experimental Officer Class 1, $3,265 – $5,118 p.a., or Class 2, $5,332 – $5,989 p.a. In the case of an applicant having extensive experience of an appropriate kind, consideration will be given to appointment within the salary range of Experimental Officer Class 3, $6,241 – $7,003 p.a. Salary rates for women are $428 p.a. less than the corresponding rates for men.

GENERAL: The Architectural Acoustics Section of the Organization’s Division of Building Research located at Highton, a suburb of Melbourne, is engaged in both long and short term research on aspects of the acoustical environment in buildings, including the efficient propagation of wanted sound within rooms, and the reduction of unwanted sound or noise originating inside or outside the buildings.

DUTIES: To assist in research in methods of measuring and describing sound fields, and design of low-cost building materials or components with required properties of reflection or transmission of sound or vibrational energy, with emphasis on the underlying mathematics and physics of the mechanisms involved.

QUALIFICATIONS: A degree or diploma in one of the physical sciences, mathematics, engineering or building science, or equivalent qualifications. Experience in computer programming and processing is desirable but not essential.

Applications, quoting reference number 390/399, and stating full name, place, date and year of birth, nationality, marital status, present employment, details of qualifications and experience, together with the names of not more than four persons acquainted with the applicant’s academic and professional standing, should reach:

THE CHIEF,
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