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AUSTRALIAN INSTITUTE OF PHYSICS

12th PAWSEY MEMORIAL LECTURE
in Honour of the Late Dr. J. L. Pawsey
will be delivered by
Professor Ronald D. Brown
of
Monash University
on
“Interstellar Molecular and the
Origin of Life”

Date: Wednesday, October 6, 1976
Time: 8:15 pm
Place: Bragg Lecture Theatre, Adelaide University

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President's Column

Saturday 23 October 1976 will be a memorable day for physicists particularly, and everyone else as well, in Victoria. If the sky is clear we shall see the total eclipse with the solar corona in its full glory. If not, then we shall just experience the frustration of an eerie darkness in late afternoon. Either way, it will be for most of us a once-in-a-lifetime experience.

The next AIP Council Meeting will be held in Melbourne on the Monday and Tuesday following the eclipse. Council members should have their feet on the ground again by then to consider details of the 1977 budget.

Other questions will undoubtedly arise out of the very successful Congress held in Sydney last month. Apart from the technical sessions, wide-ranging discussions were held on broader aspects of the physics profession. I should not be surprised if moves were made to hold these Congresses more frequently than at the present 2-2½ year intervals.

One criticism I heard of the policy discussions at the Sydney Congress was that the views expressed were only those of the "oldies and heavies". Younger members, it was claimed, did not speak. I wonder what we can do about this.

Perhaps it goes the other way round. A member who gets up and speaks finds himself, quite soon, on a committee, then an office-bearer, then labelled as a "heavy"!

In any case, in an Institute like ours there is no reason why any member need feel diffident about speaking his mind. Views of younger members are particularly welcomed, even if they disagree with the elder statesmen of the profession.

My congratulations go to the Organizing Committee of the Sydney Congress for their fine work in arranging such an excellent programme and for carrying it through so smoothly.

A quick look at the Congress

It was a busy week and the attendance of about 240 should have pleased the organisers at this time of marked financial stringency and the Committee is to be congratulated on the successful presentation of the second National Congress. There was a great deal that should be retained in future congresses. The strategically placed coffee machines among the commercial exhibitions and the poster sessions added greatly to the liveliness of and interchange between groups and individuals. The congenial nature of the meeting was reinforced by the opening address of Professor Street, the variety of general addresses and the two day sessions on Science Policy and the Future of Physics.

There was a constant feeling, not always coherently expressed, that the AIP needs to look at wider issues and there were many opportunities for expression of opinions and the asking of questions. If there was not as much argument and give and take of opinion as the organizers would have undoubtedly wished, it is perhaps, because we have yet to find a complete format for such talk to be productive. The use of smaller groups charged with the task of unifying the many points of view which arise in the general meeting may be one way, but the next Congress organizers have much to guide them in their thoughts about this important feature of the national meeting.

Apart from the general addresses and specialist and technical sessions, there were many meetings of particular groups looking at their own frontier problems. It is evident that some of these groups are looking at the relation between the Congress and the specialist conferences.

One meeting of particular interest that I attended, was that of the Science Policy Committee of the AIP and the value of self-nominated members for issues of public concern such as nuclear energy, was evident. Committees of this nature will do much to bind the members of the Institute together and will give an increased awareness of the wide range of disciplines and knowledge that is available on the Australian physics scene.

The function at Randwick and the social dinner at the Argyll Tavern were happy, noisy events that added much to the enjoyment of the week.

The AP intends to present the substance of many of the conference addresses over the next few issues.

Bill Boundy
Education
Harvard Project Physics
— extracts from the Authors

HOW IT BEGAN

In 1963 the United States National Science Foundation realized the need to start new approaches to the teaching of introductory physics. "The proportion of students opting to take physics in the last years of high school in the U.S. had been dropping ever since 1900... By 1960, less than 20% of the last year students were choosing any physics course... and by 1971 the fraction was down to 16%. The reasons for this pattern are by no means clear. The increasing difficulty in finding adequate scientific careers and the discontinuation of funds for teacher training in new curricula are now undoubtedly factors that add to those present in the early 1960's. Other, cultural trends may also play a role, including the rise of anti-rationalist or 'Dionysian' thinking."

The three authors, Holton, Rutherford and Watson, had begun to collaborate in writing a book and this beginning was expanded into Project Physics. "A total of 180 professional people—physicists, college and high-school teachers, historians of science, philosophers of science, psychologists, reading specialists, designers, filmmakers, etc.—collaborated to produce the successive versions of text, anthologies (readers), films, laboratory equipment, transparency, the test programs, and the rest of the course materials."

CURRENT STATUS

"There are now about 250,000 students in schools and colleges in the U.S.A. using the texts and at least substantial parts of the rest of the course materials. It would be difficult to say whether the course was responsible for at least a levelling off of the drop of students to 1971... but thousands of teachers have undertaken to be trained in modern methods using these materials... On the average our students do just as well on the Educational Testing Services tests as do all students nationally in any of the new or old physics courses."

It is not the intention to 'export' slavish translations of the U.S. materials to other parts of the world. "We hope to provide a model both of a style of going about making a curriculum development (e.g., involving scientists, teachers and historians of science from the beginning, doing careful evaluation of pilot editions, etc.) and of an approach to the subject matter. The latter—a humanistic conception of science—is really the heart of the program, rather than any particular piece of equipment, text chapter, topic sequence, use of films or other media, and the like... A good deal of pure and applied science is of course entirely international. Yet I see no reason why a student should be deprived of seeing the historical connections and present applications of physical science in his or her own country."

... Whether they will become scientists or not, it is essential that students have a chance to see the full vision of science and thereby be protected from narrow blinders or naïve euphoria just as much as from the false and hostile ideas about science and scientists which have been spreading in the last three decades, in industrialized countries particularly.

... Wherever knowledge and industry are hoped to be twin pillars of social strength, the base for science is dangerously weak if the vision concerning the place and scope of science is narrow."

REACHING A MORE VARIED AUDIENCE

"In the United States, only about 1000 students a year become Ph.D.'s in physics, out of an age cohort of three million young people... about 0.03%. But our ideas on how to educate in physics come too often from serving that small group up there—and from having belonged to it ourselves... It is the 50% or so of students in the middle range from which we have been trying to draw our audience... The large majority presents us with a mixture of very different kinds. Some are interested in social science, in humanities and the arts, in technology, in 'nothing yet particular', in verbal rather than mathematical learning, etc. Some may enjoy working in the laboratory on an intuitive basis, but are poor in verbalizing and writing things down clearly... The assigned work, and of course the tests must allow some choices or options, to permit different kinds of excellence to show up.

... We have found that the humanistic approach to science can enlarge the pool of prospective students. Thus the proportion of young women enrolled in the Project Physics Course in the U.S., is nationally about twice as large as in the traditional physics course."

Some of the most thoughtful physicists do believe that this approach to science education is really just as necessary for future scientists themselves—that those, in fact, need the humanistic and societal elements in a science course more than anyone else, since the narrowing spirit of graduate school will descend on them all too quickly."

CONTENT AND STRUCTURE

"The aim is a course to provide a vision of science at its best... a more encompassing view of the working of nature, of the style of life of the scientists, and of the power of the human mind..."

The physics course as traditionally given... is like a string of beads. One subject follows another, from Galileo's kinematics to the most recent advances in nuclear physics—the usual sequence that more or less parallels the historical developments of the science; few if any connections are shown with other achievements of human beings who are not physicists, with sciences other than physics and with studies and activities other than science.

... Links exist between all fields... If we drew all links between fields on the intellectual map, we would see that instead of the separate strings of beads there really exists a coherent crystal, or if you will, a tapestry, a fabric of ideas... it is precisely by seeing these connections between fields that one becomes educated rather than only trained."

... In the process of teaching good science, teachers can convey a proper sense of the dignity of scientific work as well as the serious civic responsibilities that are the consequences of its benefits and power."
THE RELEVANCE OF PHYSICS—SOME THOUGHTS FOR THE STUDENT

On the intellectual excitement of physics

"In the text we have been seeking overall principles that will unify many diverse cases, whether it be a falling leaf in one's backyard or the turning of an unseen solar system at the edge of the universe. Nothing is more astonishing than it is possible to have such a universal physics!

... We hope to have shown that physics is neither an isolated, bloodless body of facts and theories with mere vocational usefulness, nor a glorious entertainment for an elite of mathematical wizards... To be ignorant of physics may leave one unprepared for living in one's own time—as an intelligent spectator in the human adventures of our time no less than as an effective wage-earner and citizen."

On the immediate practical benefits to society

"There need be relatively little connection between today's basic physics research and current technological advance. The gadgets and devices being produced today by industry, even if they are as sophisticated as those used for space exploration, rely very little on new research in basic physics or on the discovery of new laws. They are mostly based on applications of well-known laws and of techniques developed long ago.

... At the heart of social problems created by technological advance is the absence of some specific basic scientific knowledge. This fact gives a whole new mandate and a new range of expectations for basic scientific research. Examples come readily to mind... The problem of bringing food to hungry people in arid lands that are near the sea, as in Peru or India or Egypt, is to a large extent political... But it is also a problem of basic science: Before it is possible to design much more economical desalination plants, a more fundamental understanding of the structure of liquids—one of the much-neglected problem areas in current physics and chemistry—and of the phenomena of materials moving through membranes will be needed.

These remarks should serve to oppose two widely current but erroneous notions: one, that basic science is an unnecessary luxury, and should be supported only if it is directed to immediate practical applicability; and second, that one way of stopping the abuses that come as by-products of technical innovation is to stop science."

On the long-range social benefits

"...every person alive today, whether or not he or she has studied science, is intellectually a child of Copernicus and Galileo, Newton and Faraday, Einstein and Bohr. Our imagination and intellectual tools were indeed shaped to a large degree by the advances in the knowledge of physics they and their contemporaries made, long before we were born... There are also the more material-long-range effects... From an understanding of how the steam engine works flowed a century-long transformation of society which now is studied under the name of the Industrial Revolution."

SCIENCE AS A STYLE OF LIFE

"In the whole world there are nearly 120,000 people who contribute to physics, and each does so in an individual way... But they all share a style or way of looking at the world and at life... This style has a number of components.

a) To them the world is not a succession of incoherent, unique events. Knowledge about nature gives them a sense of the relations of things—how the world hangs together in an ecological manner.

b) Those who have selected a science for their career, and who are at all good at it, are on a road through a changing landscape along which each can select his own problems to work on.

c) Nowhere more than in science is intellectual merit and skill honoured... There is in science an atmosphere of belonging to an international and cosmopolitan community... the young scientist is welcome and is brought as quickly as possible to participate at the growing edge of new science.

d) Scientists are prominent among those who take part in the process of examining the immediate social consequences of scientific and technical advance... Most feel that there is a happy complementarity between taking part in developing the human values of democratic society and taking part in the growth of science."

Source of extracts
People are Saying

Professor Peter Mason, School of Mathematics and Physics, Macquarie University

"The tapestry of pure science is complete in outline: filling in the gaps will be exciting, challenging and probably will go on for ever; but such work is now as much an art form as a science.

Now whilst natural science has a fully established basis, its social application is in the same pre-Newtonian stage of evolution as the conventional social sciences. They will involve moral and political problems: value judgements and democratic or authoritarian decisions.

I remember an argument between Linus Pauling and Edward Teller on the subject of fallout from nuclear weapon testing in the USA. The scientific facts were scarcely in dispute: so many curies of radioactivity would be released; so many people would probably die over the next 10 years (mostly children with leukemia). Pauling fervently argued that testing was tantamount to murder, and should be absolutely prohibited. Teller observed that the number of people dying would be far less than those killed in one year on the roads; a calamity which everybody accepts: surely this was a reasonable price to pay for National Security?

Their argument illustrates my next point, that the open and proper discussion of values could only proceed at all because the basic scientific facts were understood and agreed by both sides. I am concerned that this element of discipline, a major characteristic of basic science, should not be completely absent from the social arena. As long as we persist with the existing secondary school system and take university students directly from school, I feel that we would do better to start university studies in social science only in the second year, building on a first-year foundation of science treated in an historical as well as a technical, quantitative way. Let me add that the following two years could be as intensive as you wish. I am not afraid of specialisation in a course properly taught.

Quotations from Eric Ashby are in vogue, and I am reminded of his dictum that 'the path to culture should be through a person's specialism, not by passing it.' And in this context of the benefits or evils of specialisation I mention my next illusion, which may astonish those who know my involvement in general education courses. I think that general education courses should be given to members of staff. Students might, in exceptional cases, be admitted but the benefits should flow back through the mainstream courses themselves. This might remedy my feeling that, for example, there is not enough sociology in the science courses, nor enough science in the sociology."

Dr O. J. Wordsworth, Deputy Director QIT

"Physicists in Australia, along with scientists generally, because of the vastness of the country, the smallness of the population and the lack of scientific employment opportunity, have to put considerable personal effort into promoting professional interchange. It is all too easy not to do this and to drift along lethargically into the scientific land of nod. The format for this week is also important. I think the Vacuum Physics Group, in preceding the format conference with a short course in some aspect of Vacuum Physics certainly makes optimum use of this gathering of interested physicists.

As physical scientists committed sufficiently to be attending this national conference I know you will share with me a concern over the immediate future of science and technology in this country. Opportunities in scientific employment have always been minimal in Australia, largely because of the dearth of Australian based industrial research and development outside CSIRO. It has always been fairly difficult for those with a desire to apply to industrial use their knowledge and practical expertise in the physical sciences, to do so. Nevertheless the applications and uses of vacuum physics make it one field where one might expect this sort of opportunity to present itself.

There is then a lack of scientific opportunity within Australia today which reflects, unfortunately, a world wide trend exacerbated by the present economic difficulties in parts of the so called Western World. Moreover, within this world scene, Australian scientists are probably worse off than colleagues in comparable countries, and there appears little to gladden the heart in the immediate future.

I believe that an important contributory factor to the current state of affairs has been the end of the love affair between technology and the community in the western world. The community has been wooed and won by the non-scientist, the non-technologist, in fact one may say by the anti-scientist. A reaction to science and its applications has spread and continues to spread and in my opinion the root cause of this has been not the effects of technology on the environment but the failure of science education in its broadest sense in the primary and secondary schools, and perhaps even in the Universities.

Scientists in general have not given the necessary thought and action to basic problems of science education and the result has been not just a lack of interest within masses of school children, but an actual antagonism to science, stemming from lack of understanding. To be fair, however, there are other important forces at work which have assisted this trend -- these have been social forces resulting from the easy life which many of our young appear to claim as their right and heritage today. Unfortunately this has been going on for some considerable time, and society is now reflecting this antagonism to science -- and perhaps covertly an antagonism to mental effort -- in many ways. The non-scientific statements and personal prejudices expressed by many in public debates concerning uranium mining and certain ecological issues are manifestations of the lack of influence that real science has in today's society in Australia.

We are well and truly in the era of the soft option and the instant (untrained) expert. Persons with little real knowledge of ecology, biology, chemistry, physics, engineering or indeed sociology produce so-called environmental impact statements which may be politically useful but are largely scientific nonsense. We, as scientists, have individually to contribute our knowledge -- where appropriate -- in the public arena. I say "where appropriate" because if scientists buy into public debate on issues where perhaps they lack the appropriate knowledge or expertise then they in turn can be legitimately accused of using their positions without due regard to professional ethics."
Changes in Physics at the UNSW

The end of 1976 marks the retirement of Kit Milner, Professor of Applied Physics at the University of New South Wales, and the incorporation of the Department of Applied Physics in the School of Physics. Since its formation in 1968 the Department has been linked with the Department of Optometry in a separate School.

As from 1977 the School will contain within its structure two subunits, the Department of Applied Physics and the Department of Theoretical Physics. These departments will be primarily responsible for the training of Applied Physicists and Theoretical Physicists at both the undergraduate and postgraduate levels. The School as a whole will be concerned with the education of physicists who do not lie in either of the streams covered by the departmental structure.

The Department of Applied Physics

The Department of Applied Physics has had, and will continue to have, as its primary objective the training of students for careers in industry and government service. It has specialised in the physics of materials and in instrumentation and measurements. When the Department joins the School of Physics, its academic strength will be augmented by several members of that School and it will be headed by Julian Goldsmith, Professor of Experimental Physics. The interests of the staff will then cover the electronic, structural acoustical and mechanical properties of a variety of materials (including semiconductors, polymers, glasses and ionic crystals) as well as the development of measurement techniques in related fields.

The School of Physics will offer, through the Department, undergraduate programmes of study in Applied Physics at the pass and honours level. Research will be carried out in the following fields:

- Transient acoustic phenomena
- Acoustic propagation in materials
- Crystal growth and characterisation
- Grain boundaries in ionic solids
- Mechanical properties of strong solids
- Strength of surfaces of materials
- Physical properties of polymers
- Conduction and breakdown in electrical insulators
- Applications of transport effects in semiconductors
- Low temperature techniques.

The Department of Theoretical Physics

Heinz Hora was appointed as foundation Professor of Theoretical Physics in April, 1975, and he will be head of the Theoretical Department.

The School will offer a separate undergraduate programme in Theoretical Physics at the pass and honours level.

The interests of the staff lie mainly in the fields of interactions between electromagnetic fields and solids, both quantum, as in the Schwarcz-Hora effect, and classical, as in laser fusion, quantum electrodynamics and solid state theory.

The School of Physics

Paul George will continue as head of, and Ken Taylor will remain with, the main body of the School of Physics which will continue to be responsible for all service teaching, and for pass and honours courses in physics.

The research interests of the staff not involved in the two departments cover atomic physics, biophysics, nmr, crystallography, solar energy, materials irradiation, magnetic materials, surface physics and meteorology.

-H. J. Goldsmith

From the Journals

Rethinking graduate education

Having become an intrinsic, as well as expensive, part of our comprehensive system of higher education, graduate education is now required to justify its continued public support. Since the number of advanced degrees conferred is the most easily quotable measure of the "productivity" of a graduate program, the first question usually asked concerns the apparent overproduction of PhD's in our graduate schools. But, both from within the profession and from without, other questions about the value and viability of graduate education are being raised: Are graduate programs an expendable luxury in some institutions, tolerated in a period of expansion for the pleasure of a faculty that had to be indulged in a competitive market? Do our graduate programs have adequate support for the breadth and depth needed to provide quality education? Do they attract the best qualified students, and do they equip these students suitably for their expected careers? Do the university departments have the ability to renew themselves with gifted young physicists to ensure the continued vitality of the physics enterprise?: Eugen Merzbacher, Editorial, Physics Today, June, 1976.

Filling the information breach

"It is easy for outside observers (and most insiders, too) to be bamboozled by the dispersed nature of Australia's scientific organisation. This is not, however an argument for centralised control, but for at least one government sponsored effort to document in assimilable form the standing and overall progress of science on a national scale.

... not many scientists in Australia are more than dimly aware of what is going on in fields outside their own specialty...

The only organisation in Australia which has the drive and capacity to fill this information breach is the interim ASTEC. If, however ASTEC is allowed to survive in anything like its form under Labor which would make public reporting central to its functions, then the prospects of the scientific community and general public alike catching and keeping up with the hare of Australian research are quite bright. Or, is it a tortoise?"

-Peter Fockley
Letters

SIR,

Physicists and Employment

At several times during our recent Congress there was some concern about the future of Physics and the employment of Physicists. At the special General Meeting a motion was passed deploring (I do not recall the wording) that employers filling positions in physics development preferred Engineering Graduates with Physics majors.

It is one thing to deplore the perversity of employers: it is another to give cogent reasons why they should do otherwise. Consider two students entering University: the first to do Science with Physics majors, the second to do Engineering. The first will have made his choice because he finds Science congenial and Industry un-congenial. Nothing in his B Sc course will counteract this distaste for worldly practicality. He will be taught by lecturers of similar inclination. While his Engineering contemporaries are at his Drawing Board, or being instructed in Corrosion or Engineering Materials, our Science major will be dealing with Hamiltonians and Bloch wave functions.

This is quite proper. A Physics school cannot neglect its obligation to offer instruction in the major traditions of Physics. But, we must accept that any commercial enterprise which consistently hired B Sc's in preference to B.E.'s would soon bring bankruptcy on itself. All of the speakers who urged upon us the need to battle for wider employment of physicists were, if I remember correctly, Professors of Physics. The R and D scientists present found little to say.

If ever I resign from the AIP it will not be because I am dissatisfied with its management. It will be because I have come to believe that to maintain the exclusive identity of Physics may now do more harm than good to the cause of Science. The division between Physics and Chemistry in Universities has long been harmful in such major areas as properties of matter, thermodynamics, molecular structure, etc. Let us not, therefore, insist on our exclusivity as to extend the damage beyond Academe. We are not in the same position as the various Engineering Institutions. They are centred on well-defined, professional areas of employment. There are tasks in the world only which they can handle. No similar tasks await the graduate Physicist. They have been trained to do research within the academic paradigms of the subject itself. The proper role for Physics is to be, like Mathematics, one component of scientific or technological education.

A. W. Pryor

SIR,

Computer assisted timetables in High Schools

Some readers of this journal have possibly, at some time, had to determine a workable timetable for allocation of resources to enable a project to go ahead smoothly. When the resources are teachers, the problem becomes one of providing a class with a teacher who is not otherwise engaged.

As a trivial example of the allocation process, but one which nevertheless illustrates some of the requirements, let us consider that we have 7th and 8th year students and we are only interested in 4 periods. Let us assume that we are required to teach 3 subjects designated 81 (English), 82 (Science), 83 (Mathematics) for 8th year and 71, 72 and 73 for 7th year, with 1, 1 and 2 periods respectively. Subjects 81, 82, 71 and 72 require 2 teachers each (as each subject offers 2 alternative options, for example Science-Physics and Science-Chemistry). Four teachers designated A-D, are available and they teach respectively A (81, 82, 71), B (82, 83), C (72, 73), D (81, 71, 72). Teacher A, being the assembly master, is not to teach 1st period. We draw up a timetable skeleton.

<table>
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(that is 83 is 1st period)

7

which satisfies our 8th year students (all subjects are taught for the correct number of periods) and teacher A avoids teaching 1st period (so far). Perhaps you might like to complete the timetable, bearing in mind that a teacher cannot be in 2 places for the same period.

You probably found one of the available solutions with ease. If, however, we were to turn to an actual school situation, we might have years 7 to 12 to consider for 40 periods. Perhaps 7 subjects are to be taught for each year with 50 teachers available. Bearing in mind that multiple choice of subject options is common, say an average of 4 options per subject, and that teachers have a limited range of subject options that they can teach, the problem of setting up a workable timetable is extremely difficult (and typically for a large High School in NSW takes 2 person-months of effort). Even to determine that no solution exists can be very time consuming.

Over the past 15 years, efforts have been directed to the use of computers for establishing timetables in the High School situation. One such approach has been developed by the authors over the past 3 years (to be published) and has resulted in a FORTRAN program, MATIM. This program uses an adaptive Monte Carlo simulation of the type of trial and error approach we might have adopted in solving the trivial example. Last year, 12 NSW High Schools experimented with MATIM and were mostly satisfied with computer assisted timetable preparation. Perhaps this letter will help us contact others involved in the field who are interested in serving the local High Schools.

J. P. Pollard and Br A. E. Whelan,
St. Patrick's College,
Sutherland, NSW, 2232.

SIR,

With reference to my 1976 membership subscription, I regret to inform you that I will not be renewing my membership.

City members have a distinct advantage regarding Scientific meetings and such like. We, in the country areas, find it impossible to take advantage of these lectures and the dinners. This disadvantage would be fairly offset if lectures given could be printed and sent to all members. The increase in cost would be minimal as these notes could be enclosed with notice of meetings now sent out, ineffectively for country members.

B. M. Cottam,
Kooringal High School, Wagga Wagga, NSW 2650.
Applied Nuclear Physics at WAIT

B. W. Thomas and P. J. Dallimore – WA Institute of Technology

Introduction

The establishment of the Department of Physics at the W.A. Institute of Technology (WAIT) has been discussed previously (deLaeter, 1969).

The primary role of the Department of Physics has been the teaching of physics and its applications through lecture, tutorial and laboratory. The desirability of a staff member undertaking some form of applied research has, however, been recognized for development of both the staff member and his students. The applied research can be an investigation on behalf of the industrial community or a topic of one’s own choosing.

The Facility

The Applied Nuclear Physics Area is based on a 2 MeV Van de Graaff accelerator with a recently commissioned analysing magnet. This is housed in a comprehensive suite comprising an underground accelerator room, chemical preparation room, counting rooms, ‘hot’ laboratory and control room (Fig. 1). A ten ton, steel encased, hinge swung concrete door separates the control room and accelerator room when the accelerator is running. Ancillary equipment includes a 1024 channel analyser, and a Si(Li) detector. In addition silicon surface-barrier detectors, NaI(Tl) probes, Geiger counting systems, and radiation monitoring equipment are available.

At the present time, one analysed beam line is being used for charged particle work. A non-analyzed beam is used for producing neutrons. Pneumatic transfer tubes run from the target area to the counting room and the ‘hot’ laboratory, to enable samples to be conveyed to and extracted from the neutron flux while the accelerator is running.

![Diagram of Accelerator Suite](image)

**Figure 1. Plan of Accelerator Suite**

**KEY:** A - accelerator, B - bench, C - chemistry room, CC - control console, Con - control room, CR - counting room, F - fume cupboard, G - glove box, H - hot laboratory, M - analysing magnet, N - neutron flux position, P - pneumatic transfer tube, S - scattering chamber, Sh - shower, Sk - sink.

Use as a Teaching Facility

The nuclear physics for first year students is of an elementary nature and they undertake experimental work during their allocated laboratory period to demonstrate the characteristics of alpha, beta and gamma radiation. This involves such tests as range determinations, absorption characteristics and effects of magnetic fields, and statistical interpretation of data. Experimental and interpretive work is also undertaken on the scattering of high speed electrons by nuclei, using mechanical analogue apparatus.

Short lived radioisotopes for these laboratories are produced in the accelerator laboratory to enable students to investigate half-life characteristics of various elements. These radioisotopes have also been produced for use in secondary school science classes when requested.

In the second and third years, students in the Therapeutic Radiography course and those studying for the degree in Applied Science undertake experiments in counting techniques – Geiger counting, liquid scintillation counting, proportional counting, pulse height analysis. These techniques are then employed to undertake qualitative analysis of radioisotopes.

The accelerator facility is used to demonstrate charged particle interactions to these groups, e.g. $^4$He, $^6$He, $^2$H and $^3$He scattering from different target materials. In addition, students undertake investigations of the buildup of induced activity produced by neutron absorption reactions, and the determination of the neutron flux produced by the facility.

An additional low level counting laboratory and radiochemical room are located on the upper floor of the Physics building, adjacent to other specialized physics laboratories. These rooms are used as general counting laboratories by undergraduate students.

Laboratory Programme

As part of the laboratory programme, students undertake industrial type projects. The reasons for this have been discussed previously (Kerrigan and Terry, 1969). The Applied Nuclear Physics Area has catered for between two and four students per year on such projects. Some of the projects undertaken in the past include:

- Investigation of the Silver Content in Roman Coins of Different Ages using Neutron Activation Analysis.
- Feasibility Study of Using Neutron Activation Analysis as a Rapid Method of Assessing Aluminium Content of Bauxite.
- Pollution Studies of Air and Water in the Perth Metropolitan Area using Neutron Activation Analysis.
- Application of Charged Particle Activation Analysis to the Assessment of Fluorine in Enamel of Teeth.
- Determination of Thin Film Thickness using $^4$He Particle Scattering.
- Development of a Neutron Moisture Meter, using a Ra-Be Source.

Post Graduate Work

The Department offers a four year, part time programme, leading to the degree of Master in Applied Science. This caters for two broad areas of specialization – 'Physical Methods of Analysis' and 'Physics Education'.
— through lecture courses and a thesis.

A one semester (15 week) unit on nuclear techniques of analysis is provided by the Applied Nuclear Physics Area, as part of the Master's course work. The unit aims to introduce the operational functions, instrumentation and techniques required to undertake nuclear analyses. The material covered through lectures and laboratory work includes—gamma ray spectrometry; safe working procedures; statistics of radiation counting; the theory of activation analysis; a comparison of neutron, photon and charged particle activation analysis; the analysis of errors in the application of neutron activation analysis; chemical separations; particle backscattering; prompt nuclear analysis; detailed consideration of specific applications and analytical projects appropriate to the needs and interests of the particular students.

Interest in the nuclear techniques of analysis unit by agencies and persons other than those enrolled for the Master's programme has been evident. Consequently, people from government laboratories and the private industrial sector have undertaken the unit, along with the Master's students.

As students move into the third and fourth years of their Master's Course (the thesis stage), some will undertake projects in the Applied Nuclear Physics Area.

![Graph showing the energy yield of various isotopes of uranium.](image)

**Figure 2.**

Alpha particle spectrum obtained from uranium electroplated onto a stainless steel disk.

**Industrial Activity**

While industrial problems may not always be suitable as Ph.D. research topics, they provide useful practical experience for staff members and encourage good liaison with the industrial sector. In addition, a solution to a problem can frequently be found without the need for a great deal of sophisticated equipment.

Industrial work is fostered through a registered company set up by WAIT under the name of WAIT-AID. The type of work has varied and includes—borehole logging, paint thickness determination using beta particles; use of gamma radiation for locating air cavities in concrete piles; the application of gamma ray spectrometry to qualitative and quantitative analysis of radiation emitting soils; an assessment of the feasibility of using a radioactive tracer to determine flow rates in a kiln.

A current project is the investigation of the use of the Uranium series disequilibrium method for the determination of the age of fossil bones. The technique consists of first using the chemical procedures to separate the elements of interest and to then use alpha spectrometry to measure the activity ratios between the isotopes of the Uranium series. This information is then used to determine the age of the fossils. An example of the type of spectrum obtained is shown in Figure 2.

Co-operative projects with persons from other institutions have also been instituted. For example, neutron activation analysis was successfully employed to ascertain the efficiency of a chelation process to remove arsenic from a person who had been poisoned (Fleay and Thomas, 1975). This was undertaken jointly with the Medical Physics Department of a Perth Hospital.

Short courses relating to radiation protection have been given in co-operation with other agencies, for specific groups of people. An example is the provision of courses for industrial radiographers in co-operation with the State X-ray Laboratories.

**Research**

The accelerator has been used to implant $^{14}N$ in silicon. The purpose was to investigate the mechanism by which the fixed surface state change due to silicon-rich oxide near Si – SiO2 interface, is controlled by $^{14}N$ implantation near the interface and subsequent heat treatment (Sproul and Nasibian, 1974).

Present research involves the use of backscattering and prompt nuclear techniques applied to the analysis of biological samples. Future proposals include the setting up of a facility to undertake proton induced X-ray fluorescence studies of environmental samples. This would provide a useful supplement to the photon induced fluorescence facility already in existence in the department.

**References**

The Solar Eclipse

PATH OF TOTAL ECLIPSE 23 October 1976

Where to see the solar eclipse on 23 October

<table>
<thead>
<tr>
<th>Site</th>
<th>Time of maximum eclipse (AEST)</th>
<th>Magnitude*</th>
<th>Duration of totality</th>
</tr>
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<tr>
<td></td>
<td>$h$ $m$ $s$</td>
<td></td>
<td>$m$ $s$</td>
</tr>
<tr>
<td>Adelaide</td>
<td>16 37 53</td>
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<tr>
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<td>16 43 17</td>
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<td>16 32 29</td>
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<td>3 01</td>
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<td>Mt Gambier</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>Sydney</td>
<td>16 47 05</td>
<td>0.934</td>
<td></td>
</tr>
</tbody>
</table>

* The magnitude of the eclipse is the fraction of the solar diameter obscured by the moon at the greatest phase, measured along the common diameter.

TOTAL SOLAR ECLIPSE OF 1976 OCTOBER 23
Bureau of Meteorology Review Committee

The Minister for Science, Senator Webster, has announced the Government’s appointment of a Committee to review the functions and operations of the Bureau of Meteorology.

The Chairman of the Committee is Mr Phillip Walter Howson, OBE, former Deputy-General Manager, Qantas Airways Limited. Mr Howson has had a long association with the aviation industry and was a pilot in the RAAF.

He will be assisted by Dr John Law Farrands and Mr William Joshua Vines, CMG.

Dr Farrands, a distinguished Government scientist, is a former Chief Superintendent of the Aeronautical Research Laboratories and currently Chief Defence Scientist, Department of Defence.

Mr Vines is Chairman and Managing Director of Dalgety Australia Limited. He has held the positions of Managing Director of the International Wool Secretariat and Chairman of the Australian Wool Commission.

The Committee will examine, report and make recommendations on the relevance of the current functions of the Bureau, existing arrangements for the provision of services and the extent to which the Bureau should attract appropriate revenue for the services it provides. In carrying out its task, the Committee is authorised to consult all sectors of the community.

Scientific Agreement With The FRG

The Minister for Foreign Affairs, Mr Andrew Peacock, and the Minister for Science, Senator James Webster, announced today that an agreement for scientific and technological co-operation had been concluded between Australia and the Federal Republic of Germany.

The agreement was signed on August 24 by Senator Webster and the Ambassador of the FRG, His Excellency Dr H. Blomeyer-Bartenstein, at Parliament House.

The two Ministers said the agreement was intended to promote and facilitate increased scientific and technological co-operation between the two countries and substantial benefits are expected to flow from this increased co-operation with the FRG which possessed very considerable scientific and technical capabilities in a wide range of fields.

Some discussions had already taken place with the FRG authorities on co-operative activities of mutual interest that might be undertaken under the agreement and in this regard a scientific delegation from the FRG visited Australia in May 1975 for exploratory discussions on possible fields of collaboration. More recently, in June-July this year, a West German industrial delegation visited Australia to discuss the possibility of a joint Australian-West German study to examine the economic feasibility of establishing a large-scale coal liquefaction plant in Australia to produce motor spirit and basic chemicals from coal.

Baseline Air Monitoring in Tasmania

Preliminary trials for an Australian baseline air monitoring station have begun at Cape Grim in north-western Tasmania. The trials are a lead up to the establishment of a permanent station in Southern Tasmania, subject to Tasmanian Government approval.

This has been announced by the Minister for Environment, Housing and Community Development, the Hon. Kevin Newman, and the Minister for Science, Senator J. Webster.

The permanent station will study the levels of several constituents of the earth’s atmosphere with the aim of determining any long-term changes and predicting effects on climate. The station will be one of a world-wide network of about 13 baseline stations and one of three in the Southern Hemisphere – the others are in Samoa and Antarctica.

Tasmania is preferred for the baseline station because it is in the path of the permanent westerly winds which blow around the globe in the mid-latitudes.

Commonwealth funds for the project have been allocated through two departments. The Department of Environment, Housing and Community Development is responsible for Australian and international air monitoring commitments and the Department of Science is responsible for the establishment and operation of the station.

The initial equipment trials at Cape Grim will measure carbon dioxide and solid particles and examine the ozone content of the atmosphere. Later other equipment will be installed to sample fluorocarbons and oxides of nitrogen and to monitor atmospheric turbidity. These programs will ultimately be transferred to the permanent baseline site.

National Nuclear Magnetic Resonance Centre

The Minister for Science, Senator Webster, said that recent installation of an advanced specialised computer at Australia’s National Nuclear Magnetic Resonance Centre at the Australian National University would enable the centre to offer some additional experimental facilities.

Senator Webster said that facilities represented the latest advances in nuclear magnetic resonance spectrometry. Research chemists and biologists at Australia’s universities and the CSIRO had been using the centre for chemical and biological studies.

The centre was also available to research scientists in industry who had a need for the latest experimental equipment and instrumentation for the development of products. It could provide a total service comprising spectral measurements and interpretations to elucidate details of the molecular structure of new substances under development by industry. A nitrogen 15 probe, which would be useful in biological experiments, was being installed at the centre.

The Government recognised the value of a single national facility and proposed to update it to take advantage of new developments. This would overcome the need for a proliferation of similar equipment and provide a focal point for the most advanced research in this field in the Australian and Southern Pacific areas.
People and Institutions

Energy – Conservation of Energy Resources Committee, Victoria

The Victorian Parliament has set up an all party joint select committee to be known as the Conservation of Energy Resources Committee.

The functions of the committee are as follows:

(a) to inquire into and make recommendations on the extent to which energy resources in Victoria should be conserved, whether generally or in relation to particular resources;

(b) to inquire into and report on ways and means of implementing those recommendations and in particular in relation to recommendations for the beneficial use of energy resources, to inquire into and report on what variations are necessary or desirable in—

(i) building designs, techniques and standards;

(ii) the use of insulation in buildings;

(iii) vehicle and engine design;

(iv) transport systems;

(v) industrial and manufacturing processes methods, standards and plant;

(vi) methods of promotion of the use of energy;

(vii) other significant uses of energy;

(c) to inquire into and report on the costs of and benefits to be gained from implementing those recommendations; and

(d) to recommend what additional measures and programmes should be taken to encourage a responsible use of those resources.

The Victorian Branch Committee of the AIP would like interested members from Victoria or elsewhere to make submissions to the committee on any aspect of the enquiry.

Enquiries or submissions should be forwarded to:

P. J. Mithen, Secretary, Conservation of Energy Resources Committee, Parliament House, Melbourne Vic. 3002. Tel. 654 4155.

Solar energy in the House

During the autumn session of Parliament both Houses discussed solar energy. Answers to questions showed that in the last three years the government, through ARGC and CSIRO, spent over $1.5 million on solar energy research. The money was divided as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>ARGC</th>
<th>CSIRO</th>
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</thead>
<tbody>
<tr>
<td>1974</td>
<td>$13,166</td>
<td>$548,000</td>
</tr>
<tr>
<td>1975</td>
<td>$125,807</td>
<td>$648,000</td>
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<tr>
<td>1976</td>
<td>$149,051</td>
<td></td>
</tr>
</tbody>
</table>

The ARGC is providing support for 10 projects during 1976, the largest commitment being $62,834 for Professor L. E. Lyons of the University of Queensland to investigate solar energy conversion to electricity using photovoltaic cells with organic materials. It was also revealed that the annual production rate of solar collectors for water heaters had increased from 7000 m² in 1972-73 and 8000 m² in 1973-74 to 18,300 m² in 1974-75. (These figures do not include units constructed by small manufacturers or privately.) To emphasize the importance of solar energy, the Senate Standing Committee on National Resources is currently inquiring into it; the results of the inquiry will guide future solar energy research programs. On 17 and 18 June, submissions from CSIRO and the ANU called for increases in government spending in this field to over $8 million per year, the ‘carrot’ being an Australia self sufficient in energy by the end of the century.

An alternative incentive was proposed when it was argued that solar hot water systems should be tax deductible items. Treasury are looking into this! Search, August 1976.

Environment Group wants technologists

Dr. D. S. McCann and some fellow Sydney academics have formed a group to promote the development of technology which is ecologically sound and compatible with the socio-economic structure of a particular country. The group, APACE, (appropriate technology and community environment) will be based initially on the four major N.S.W. tertiary institutions. Emphasis would be on solving problems confronting developing countries, although research into future development of Australia would also be sponsored. In the Australian context, programs would be aimed at encouraging decentralized technology using local materials and particularly, such renewable energy sources as sun, wind and waste.

Dr. McCann is currently compiling a list of people who have skills in particular technological areas and who would be willing to offer their services to APACE. Interested people can contact Dr. McCann at Department of Chemical Engineering, Sydney University; Extension 3411. University News, University of Queensland, July 14, 1976.

Projects with India

Following an agreement between the Government of India and the Government of Australia on Cooperation in the Field of Science and Technology, applications have been opened for cooperative proposals. The Indian Department of Science and Technology has indicated that it will give priority to the following fields when considering proposals for support at this stage: agriculture and food technology, energy (solar energy and coal technology) and earth science, including mineral resources.

Proposals should be addressed to: The Program Manager, India-Australia Science and Technology Agreement, PO Box 449, Woden, ACT 2606. University News, June 30, 1976.

Atomic Clock now portable

Based on a commercially available rubidium standard, the U.S. N.B.S. has developed a portable rubidium clock much lighter than cesium clocks. This portable clock will assure easier high-precision national and international time comparisons. Dimensions, November 1975, p. 254.

Hydrogen as a Future Fuel

Physics is inevitably bound up with many matters of present and future interest; for example, hydrogen to replace increasingly expensive petrol for our cars, solar energy conversions for household and industrial power, or microprocessors for patient monitoring and safety in hospitals. Once again, in areas such as these, physics is exciting. We need to communicate this to the community so that non-physicists may have available to them the physics they need.

2. The AIP is concerned at the image of physics in schools. Physics is recognised, by students and teachers alike, not only as being a difficult subject, to be taken by the top students, but at the same time as being one of the least interesting subjects. A strange contrast!

We would like physics to be attractive to all students, whether as a subject in itself (as at HSC level) or as part of science in general. The physical concept of energy, for example, underlies the whole question of “energy resources” in our environment and their effective utilisation. It is also behind the growth and movement of all living things: from photosynthesis in plants to the muscles in our bodies.

The aims:

With these ideas in mind, and after consultation with teachers, the Tasmanian Branch of the AIP decided to convene a seminar with the following particular functions:

(a) To inform the AIP of the present content and approach in the physics component of secondary science teaching. We have asked several teachers to give introductory papers for this purpose.

(b) To stimulate, with a suitable invited speaker, discussion of the issues raised and the ideals to aim for in secondary school physics. We have invited Prof. Peter Mason, from Macquarie University, whom you may remember at the recent ANZAAS Congress as being a clear and innovative thinker in this area.

(c) As an outcome of the above, to suggest changes in secondary physics curricula or teaching methods. In particular to make recommendations to the AIP and to the physics profession as a whole on the way it can assist teachers to improve enjoyment and relevance of physics in secondary schools. It may include recommendations, to pass on to education authorities, on in-service teacher training.

Participants:

Anyone interested or involved in physics in secondary schools in Tasmania, in particular teachers, teacher educators, and members of the A.I.P.

Enquiries to Dr. I. A. Newman, Physics Department, University of Tasmania, GPO Box 252 C, Hobart 7001.
Conferences and Courses


September 28 - 30, 1977, Sydney, NSW.

A call for papers for this first national conference of the National Committee on Electric Power Engineering has been made. The deadline for synopses is Oct. 29, 1976, and all correspondence should be addressed to: The Conference Manager, Electric Power Conference 1977, The Institution of Engineers, Australia, 157 Gloucester Street, Sydney NSW 2000.

Chemical Data: Its Acquisition, Processing and Dissemination.

February 21 - 23, 1977. La Trobe University Melbourne.

A three-day symposium will be held at Menzies College, La Trobe University, Melbourne, between 21st and 23rd February 1977. The programme for the meeting will include invited review lectures from local and overseas speakers, dealing with current aspects of the wide range of techniques involved in the acquisition and processing of chemical data, basically through the use of computer technology. Research or discussion papers are also invited from participants.

For further information: Dr. J. B. Peel, Department of Physical Chemistry, La Trobe University, Bundoora, Victoria 3083, Australia.

Rheology of Suspensions Workshop

The British Society of Rheology (Australian Branch) is conducting a workshop on "Rheology of Suspensions" on Thursday, 4th November 1976 in the Department of Industrial Science of the University of Melbourne, 35 Royal Parade, Parkville.

The format will be similar to the previously held and very successful workshop on "Viscometry".

The rheological properties of suspensions of interest to a variety of industries will be measured using, where possible, rheological instruments developed by and peculiar to the particular industries.

Representatives of the paint, ink, adhesives, pharmaceutical, dairy and other industries will be invited to give short lectures on measurement of rheological properties of suspensions specific to their industries. The significance and application of the measurements in research and quality control will be emphasised.

One section will be devoted to the illustration of the mechanisms of rheological phenomena in suspensions.

For further information contact Mr. O. Delatycki, Department of Industrial Science, University of Melbourne, Parkville 3052, phone 341 6872.

Radioisotope Course for Non-Graduates No. 21

Australian School of Nuclear Technology, Lucas Heights, NSW, 7 - 25 February 1977.

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

The number of places at the course will be limited and those wishing to take the course should direct enquiries to: The Principal, Australian School of Nuclear Technology, Private Mail Bag, Sutherland, NSW 2232, Tel. No. 531 0111.

1976 Industrial Safety Convention

The 18th N.S.W. Industrial Safety Convention will be held at the Bankstown Town Hall, commencing Wednesday, 27th October next. The Convention will run for two days.

The theme of the Convention will be 'Systematic Safety - a New Dimension' and Mr. George A. Peters, author of the book 'Product Liability and Safety' will be keynote speaker.

Mr. Peters is an internationally known engineer, psychologist and attorney specialising in industrial safety and product liability litigation.

On the Nature and Scope of Measurement Science


Nuclear and Particle Physics Group AIP.

Third Biennial Summer School.

This will be held February 7 through 11, 1977, at the Sport and Recreation Centre, Jindabyne, NSW.

Enquiries to Professor B. Spicer, School of Physics, University of Melbourne, Parkville 3052.

Energy

A special series of information papers concerning aspects of the Uranium and Nuclear Power Industry has been a feature of recent issues of the quarterly publication from the AAEC — Atomic Energy in Australia.

October 1975 Vol. 18 No. 4

The Effects of Ionising Radiation on Man — G. M. Watson.

Radiation Hazards of Uranium Mining and Milling — R. M. Fry.

January 1976 Vol. 19, No. 1

Uranium Resources and Requirements — J. M. Silver and W. J. Wright.

Perspectives in Energy Requirements of Mankind — J. L. Symonds.


April 1976 Vol. 19, No. 2

Conditions Applying to Australian Uranium Exports — Safeguard Obligations under NPT — W. B. Rotsen.


July 1976 Vol. 19, No. 3

Illicit Diversion of Nuclear Materials — F. L. Bett.


Radioactive Metrology.
Physics in New Zealand
PHD's awarded in New Zealand since 1974

THE UNIVERSITY OF AUCKLAND

An experimental study is described of highly reproducible collisions between charged or uncharged water drops under conditions representative of the growth of raindrops in clouds. Theories are developed to describe the phenomenon of partial coalescence and the stability of drops oscillating in an intense electric field is studied. Results are parameterized for use in drop spectrum predictions and fits to observed drop distributions below clouds are excellent. Drop charging mechanisms are discussed and qualitative agreement found with drop charge spectra at the ground.


Solutions of the bound state spinor-spinor Bethe-Salpeter equation are examined. The symmetries of the coupling parameter are examined. Coupled radial equations are derived for the unequal mass system with zero bound-state mass and the behaviour of as a function of the ratio of the constituent particle masses is examined. Certain aspects of the equal-mass equation are examined and solutions examined for the exchange of both vector and pseudoscalar bosons.

UNIVERSITY OF CANTERBURY

Interaction effects between electrons and local mode phonons have been observed in the electronic and vibronic spectra of Er$^{3+}$ – H$^{-}$ ion pairs in CaF$_2$ crystals. Eigenvectors for the electronic energy levels of the Er$^{3+}$ – F$^{-}$ and Er$^{3+}$ – H$^{-}$ ion pairs were obtained from a satisfactory fitting of the energy levels and their magnetic splitting data. Various theories are tested against the observed electronic isotope shifts of rare earth ion transitions as the adjacent H$^{-}$ ion is replaced by its heavy isotopologue, D$^{-}$ and T$^{-}$. Some intensity and lifetime measurements of the spectra of Gd$^{3+}$ – F$^{-}$ and Gd$^{3+}$ – H$^{-}$ ion pairs in CaF$_2$ are also presented and discussed.


The electron paramagnetic resonance technique has been used to study alkaline earth fluoride crystals doped with both hydride (or deuterte or tritide) and gadolinium (or erbium) ions, and the spin Hamiltonian parameters have been determined for the various kinds of charge compensated rare earth ion site which occur. Isotope shifts (due to replacing H$^{-}$ with D$^{-}$ or T$^{-}$ ions) are interpreted by the electron phonon interaction between the 4f electrons of the rare earth ion and the localized mode of vibration of the light ion. The magnitudes of the shift, calculated on a point charge – point dipole model, are in good agreement with experiment.

Using EPR line broadening and dielectric loss measurements, the reorientation of the tetragonal Gd$^{3+}$ – H$^{-}$ sites could not be distinguished from that for Gd$^{3+}$ – F$^{-}$ sites. This result is in agreement with an interstitial model for the reorientation.


Selection rule tables for 3 and 4 photon Raman interactions have been calculated. The results show that it may be possible to measure, by means of high order Raman spectroscopy, energy levels which cannot be measured directly by conventional spectroscopic techniques.

In part II an experimental investigation of Co$^{2+}$ ions in CdCl$_2$ type crystals using conventional Raman spectroscopy is described. All Co$^{2+}$ electronic transitions between the lowest two manifolds were observed and close fits with crystal field theory calculations were obtained. A preliminary investigation of antiferromagnetic CoCl$_2$ is presented.


It is found that electron densities in the mesosphere above Christchurch can be affected by energetic particle precipitation. Evidence is also found for increases in electron concentration associated with a stratospheric warming, but apart from this there is no clear evidence for stratosphere-ionosphere coupling above Christchurch.


A narrowband filter spectrophotometer has been designed and constructed. Using the sun as a light source, a rotating disc of narrow pass UV filters measures the total-ozone content of the atmosphere in the region observed. A full analysis of all components is given. Stacks of 2 filters at each wavelength significantly decrease the transmittance of the leakage side bands. The establishment of criteria for accurate total ozone measurements is given.

This instrument has been patented by the New Zealand Inventions Development Authority. The International Ozone Commission of the World Meteorological Organisation have urged the continual development of the instrument.

1976 Johnstone, I. W. – Co$^{3+}$ ions in CdCl$_2$ type crystals.

Raman and infrared spectroscopy has been used to study the electronic transitions in Co$^{3+}$ ions in CdCl$_2$, CdBr$_2$, MnCl$_2$ and CoCl$_2$. Co$^{3+}$ pairs and antiferromagnetic CoCl$_2$ have been studied as well as the single ion energy levels. The theory has been developed to successfully explain all the spectra.

MASSEY UNIVERSITY
1975 Hendtlass, R. E. – Ionospheric Reflections at Medium Frequencies.

Transmission from a 570 kHz broadcasting transmitter 100 km distant have been used to probe the ionosphere. Ground and sky waves are separated at the receiver site by an interferometric technique. Disturbances in the ionosphere travelling South to North at speeds approximating that of sound waves at the level of the ionosphere have been observed and measured. Their origin is not yet known.

OTAGO UNIVERSITY
1974 McQueen, M. P. C. – Astronomical Measurements on Variable Radio Sources.

A meridian transit, metric wave radio telescope was designed and constructed in the form of a cylindrical f/0.3 paraboloid containing 128 collinear half wavelength dipoles. The telescope was used in a study of variable radio sources and in a search for transient electromagnetic events in the direction of the galactic centre.


The lifetime and Lande$^g$ factor of the A$^2$E$^g$ state of the nitric oxide molecule have been measured, using a combination of the line effect and the observation of transients in the fluorescence when a pulse of magnetic field (16 gauss for 120 ns) is suddenly applied to gaseous NO in a single vibrational rotational level of this state. In the latter experiment, the fluorescent intensity changes due to the depolarizing effect of the field and then
relaxes back (exponentially for an ideal pulse) with a time constant equal to the natural lifetime in the limit of low molecular densities. The collision cross-section is obtained from the dependence of the lifetime on gas pressure. Hanle effects are observed also in sensitized fluorescence from collisionally excited levels adjacent to the level initially excited.

1975 Surridge, A. D. — Tropospheric Acoustic Sounding

An acoustic sounder has been developed which detects the sound scattered from the first few hundred metres of the earth’s atmosphere. By measuring separately the amplitude and phase (relative to a reference oscillator) of the returned signal it is possible to obtain information on both the scattering cross-section and the vertical motion at various heights. The vertical motion produces a doppler shift in the received signal which appears as a progressive phase change when there is a steady vertical motion. The phase shift and hence the vertical motion has been found to correlate with the temperature gradient in the atmosphere. For phase shifts to be observed it is necessary that the atmospheric turbulence, measured by the structure constant, is not too great. A method for determining the structure constant based on the height to which phase measurements can be made is considered.


Dynamic spectra of the millisecond "S-bursts" in the range 22-25 MHz were made using a high resolution (10 kHz, 500 pulse) instrument designed and built as part of this project. Typical S-bursts were found to have bandwidths of ~60 kHz and frequency drift rates of ~25 to ~30 MHz/sec, consistent with cyclotron emission from electrons flowing up the Io flux tube.

VICTORIA UNIVERSITY OF WELLINGTON


Heat flow measurements were made in lakes in the Tauporotorua region of the North Island of New Zealand. Equipment was designed and built for operation from a trailer-operated launch. The results have been analysed in relation to the geology and plate tectonics of the region.

1974 Cave, I. D. — The mechanical properties of fibre-reinforced materials. The wood-water system.

The mechanical properties of wood have been investigated from a "quasi-static" point of view that makes allowance for variation of moisture content. It has been shown that wood may be regarded as a fibre-reinforced composite material, and appropriate models have been put forward and the constitutive relations derived. The approach has been tested by suitable experiments.


Geophysical data, primarily magnetic field measurements, bathymetry and seismic data, are presented for the region between N.Z. and Antarctica. The data have been interpreted in terms of plate tec tonics, using a new method for the location of poles of rotation. In addition to the determination of the plate boundaries and movements in the region, a detailed study has been made of the application of numerical correlation techniques to magnetic anomalies.

1975 Hurst, A. W. — Magnetic effects in volcanic regions.

A study using geomagnetic deep sounding and magnetotellurics was made in the Taupo Volcanic Zone in the North Island of N.Z. Low resistivity zones of considerable horizontal extent have been found and ascribed to the combined effects of hydration and high temperature associated with the Zone's volcanic and hydrothermal activity.

A further study was made of changes in total magnetic field associated with volcanic activity in White Island.

Wind Power — NZ

New Zealand's power generation pattern is unusual - 80% of the country's electricity comes from hydroelectric stations. Dr. D. Lindley in a report to the University of Canterbury mechanical and engineering department suggested that the N.Z. power picture could become even more unconventional — it is 'one of the several places in the world where it appears, on the basis of recent studies, that wind energy conversion systems could be economically viable today'.

Wind-driven generators are currently commercially available at ratings up to a few kilowatts. Schemes for public power depend upon units of around a mega watt. Dr. Lindley's study is part of an investigation commissioned by the N.Z. Energy Research and Development Committee. The study draws heavily upon current U.S. work, particularly that performed by Lockheed for the U.S. Energy Research and Development Administration (ERDA). Experimental generators of progressively greater power, up to 1.5 MW, are planned. Dr. Lindley suggests that more research is needed on the wind speeds available. Search, Vol. 7, No. 7, July 1976, P. 282.

Physics in Australia

Seeing in Colour

About one in twelve males suffers from defective colour vision. These people see colour in a different way from people with normal colour vision. This can be a problem in certain vocational situations.

The School of Applied Physics and Optometry, University of NSW runs a colour vision clinic for testing such deficiencies and up to 150 people are tested each year. While the clinic tests boys about 16 years of age, Dr. Stephen Dain, the clinic supervisor, believes there is a need to begin with young children at 4 or 5 years of age. The use of colour as a teaching tool is a problem for the colour defective child. Uniken, 12-25 July, 1976.

Search for New Upper Atmosphere Particles

Next month it is planned to release at Alice Springs a balloon carrying Japanese emulsion chambers designed to detect new particles in the upper atmosphere. Planning for this event has involved Professor D. Pease of ANU who has discussed the subject with Japanese physicists. It is hoped that the balloon flight will, next year, be followed by a workshop involving Japanese, American and Australian physicists in which new particle searches using emulsions and other techniques will be discussed. ANU Reporter, June 23, 1976.

The Australian Physicist, September 1976  Page 153
Books Received

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

Books received to 8/7/76

New Geology Journal

The Bureau of Mineral Resources has launched a quarterly journal, BMR Journal of Australian Geology and Geophysics. It will be an outlet for publications by (or co-authored by) BMR researchers, and for work commissioned or sponsored by the Bureau. It is noted that this policy does not confine the journal to work actually done in Australia. 

Search, August 1976

Book Reviews


Reviewed by R. Bird, Lucas Heights, N.S.W.

The message of this book is "Oppenheimer was right for the right reasons" in opposing the development of the hydrogen bomb. In 1949 the General Advisory Committee to the US Atomic Energy Commission, under the chairmanship of Robert Oppenheimer, recommended against responding to the first Soviet atomic bomb explosion by an all out effort to develop a superbomb. Others, including Teller, Lawrence, and Alvarez, vigorously campaigned for the super. On January 31, 1950 President Truman resolved the debate in favour of the proponents of the superbomb. Herbert F. York studied under Lawrence at Berkeley and became the first director of the second US nuclear weapons laboratory which was established at Livermore, California in 1952. After 5 years in this position and a further 12 years in service to the Executive Branch of the US Government, he has now become an active worker for arms control and disarmament.

York writes: "I do believe that the US has pursued policies which caused the technological arms race to advance at a substantially faster pace than was really necessary for America's own national security... The root of the problem has been... a sort of technological exuberance that has overwhelmed the other factors that go into the making of overall national policy. "It seems that if humanity is to survive, those who seek first to slow and stop the arms race and then to reverse it must succeed..."

Truman's decision followed the Berlin blockade and the Czechoslovakia coup, and came four months before the outbreak of the Korean war. It is hard to believe that he would have decided differently even if all the scientists had opposed development of the hydrogen bomb. It is also hard to believe that scientists throughout the world would unanimously refuse to participate in the arms race. This book does not help solve such problems, which have been compounded during the passage of a quarter of a century. However, it should be read by physicists for the insights that it gives about the 'Tellers' of our world and the momentum of technological exuberance.

ASTRONOMY AND COSMOLOGY, Fred Hoyle, W. H. Freeman, San Francisco, 1975 (711 pages) $19.15

Review copy supplied by ANZ Book Co. Brunswick, N.S.W. Review by R. Hanbury Brown, School of Physics, University of Sydney.

This book is published in America where I suppose it would be called an introductory text for a survey course in astronomy for University and College students. It is divided into six major sections, a First Look at the Universe, Basic Ideas and Instruments, Astrophysics, the Solar System, Radioastronomy, Cosmology. Each section is followed by appendices which supplement the text and can be omitted in an introductory course. There are also problems and questions. Compared with a conventional textbook much more space is devoted to astrophysics, radioastronomy, cosmology and the origin of the planets and of life. It is certainly more interesting to read than most textbooks. It has the freshness of outlook and challenge to convention which one expects from Hoyle and parts of it, especially the section on cosmology, are frankly controversial.

I shall put this book on the same shelf as the Feynman Lectures on Physics among stimulating books which are likely to benefit teachers more than students. I would not choose it as the main textbook for a course but I would strongly recommend it as students as auxiliary reading in fact, I recommend it to anyone who is interested in astronomy. It is well produced and beautifully illustrated with several remarkably fine colour photographs.
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Applications close 1st Nov. 1976.