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Optics in Australia

Dr. W. H. Steel, A.A.I.P.
C.S.I.R.O., Division of Physics, National Standards Laboratory, Sydney.
The author is Convenor of the Australian National Committee for Optics. The article is reprinted from Applied Optics with the permission of the Editor and the Optical Society of America.

Although Australia is geologically an old country, it is still young in terms of modern technology. Many of the major heavy industries date only from World War I, while instrument industries, including the optical industry, owe their origins to World War II. Research in optics began about the same time; between the wars, only two or three physicists worked in optics or had special training in it.

But as early as 1895, Australia was known in optics for the test rulings made at Melbourne University by H. J. Grayson. These consisted of sets of fine, accurately spaced lines ruled on microscope slides coated with realgar. Line spacings down to 4800 lines per cm were made. Grayson later made a grating machine that has produced a few rulings on speculum.

Since the major impetus to optical research came from wartime production of optical instruments, it is worth reviewing the history of these years. In 1940, Australia was cut off from its normal sources of military optical instruments; there was no optical industry and little precision-instrument industry in the country. The government, in consultation with the Australian Branch of the Institute of Physics, set up a Scientific Instrument and Optical Panel, with T. H. Laby as chairman, to advise on and assist in the production of optical munitions.

Techniques for making optical glass were developed by E. J. Hartung and by Australian Consolidated Industries, with technical advice from the U.S. National Bureau of Standards. After the start of the project, the first melts were poured by Australian Consolidated Industries' optical anneal. In all, over 800 melts were made, covering 13 glass-types, some of which were exported to allied countries.

Optical instruments were manufactured by firms whose previous experience had been in spectacle lenses or general engineering, in universities, in government laboratories, and at Mount Stromlo Observatory. There were only one or two experienced workers available, so spectacle makers, amateur telescope makers, or unskilled people were trained. Others were trained in the assembly of optical instruments. Some unconventional methods were used, pioneering a precision engineering approach to optics rather than the "old craftsmen" outlook. As overseas designs had to be altered to suit local glasses and as new designs were wanted, optical designers were trained; again, some of the methods of design were novel. At the same time, research was undertaken on night vision and dark adaptation. The emphasis placed on optics in university courses at this time became the basis of much of the later research in this field.

After the war, the production of optical glass ceased, and many of the manufacturers of instruments returned to their former fields. A few smaller firms remained to make instruments that were in short supply in the postwar years. For economic reasons, only four or five of these remain today. The weakness of the optical industry is a handicap to Australian research in optics. Although some of the research results can be passed on to industry, this is not often possible and some government optical patents have been licensed to firms in other countries.

UNIVERSITIES

With no major industries, optical research is confined to universities and government laboratories. Although all Australian universities took part in the wartime projects, optics remains a major research field only at the University of Tasmania. The wartime work in Tasmania was perhaps the most spectacular. As the smallest university, rather isolated geographically, it was left to its own resources more than most; yet, under the leadership of A. L. McAlay, it chose the difficult jobs of mass-producing roof prisms and of making camera
The Hobart Optical Annexe, built for this work, has now become the private firm of E. N. Waterworth. New methods of optical design for optimising correction by differential methods, developed by McCaulay and F. D. Cruickshank, were published after the war.

Cruickshank has continued his interest in optical design and in improved methods of teaching optics and the Physics Department at Hobart, Tasmania, provides undergraduate and postgraduate courses in optics, although attempts to found an institute of optics there have not been successful. In optical design, Cruickshank has worked out a systematic treatment of photographic objectives based on the Cooke triplet pattern; he is now studying automatic design with A. Buchdahl, now at Australian National University, Canberra, has worked extensively on the algebraic theory of higher-order aberrations and has produced a valuable contribution to optical design. This work has been published in a monograph 1. G. A. Hills has worked on the development of aerial camera lenses and their testing both in the laboratory and in the field. The method of design (involving the use of aberration coefficients of the third, fifth, and seventh orders) have been adapted to high-speed computers by P. W. Ford.

At the Mount Stromlo Observatory at Canberra, optical research is associated with astronomical instruments. T. Dunham has recently installed a Coelé spectrograph under the 1.88-m (74-in.) reflector and is now working on the application of image intensifiers and Fabry-Perot interferometers to astronomy. At Narrabri, 569 km (350 miles) north of Sydney, R. Hambury Brown and R. O. Twiss have built, as a joint project of the University of Manchester, England, the University of Sydney, an intensity interferometer for the measurement of stellar diameters. It has two 6.7-in. diameter collectors, each made up as a mosaic of 252 mirrors; these can be separated up to 18.8 m. Angular measurements down to the order of 10-5 sec. of arc are anticipated. At Sydney University, P. O. Bishop and R. H. Day are working on aspects of physiological optics, while new techniques in microscopy are studied there by Y. T. Teh and by E. Matthey in Melbourne. C. Caudle of the Institute of Technology in Adelaide is continuing his study of the photographic process.

AUSTRALIAN DEFENCE SCIENTIFIC SERVICE

The Australian Defence Scientific Service (A.D.S.S.) is a government organisation for defence science. Research in optics is done in two branches: at the Defence Standards Laboratories and the Weapons Research Establishment.

The Defence Standards Laboratories in Melbourne, with branches in Sydney and Adelaide, are concerned mainly with projects initiated by the armed forces or by other laboratories of the A.D.S.S.

The optics section, then under J. J. McNeill, took a leading part in the wartime production of optical instruments and in the supply of microscopes for postwar students. Now under J. A. Macdonald, the section is concerned with instrument design and testing and with image evaluation and improvement.

In other sections, high-speed photography is used for work on explosives, and schlieren techniques are employed to study the operation of air gauges. The technique of making interstitial gratings has been developed, based on the fact that certain glasses are electrolytes at elevated temperatures. The lines on these gratings are very well protected, being formed within the glass.

At Salisbury, near Adelaide, the Weapons Research Establishment has sections concerned with improving optical instruments and with testing their performance on the range at Woomera. Special aerial cameras have been developed, which use wide-angle lenses designed at the Establishment (see Fig. 1). Ground-based cameras of great focal length are also designed and tested. P. A. Dixon is using transfer-function methods in much of this work. Equipment has been built to record automatically the transfer function of optical systems, and an interference method for studying transfer functions of the photographic process is being constructed. A computer has been programmed to calculate transfer functions from the wave aberration or from measurements of spread functions.

In atmospheric optics, various groups in WRE are studying the effects of air turbulence and temperature gradients on the performance of long-focus lenses in the laboratory and on the range, the latter measurements being correlated with meteorological conditions.
measurements. Measurements of atmospheric transmittance are taken at regular intervals both from the ground and from aircraft, with the aim of predicting visibility from meteorological measurements. J. C. Burns, K. H. Lloyd, and E. R. Johnson are using optical studies of artificial chemiluminescent clouds to study the physical properties of the upper atmosphere between 100 and 200 km.

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

The C.S.I.R.O. is the Government non-defence organization and has laboratories throughout Australia conducting research in many fields of science and assisting primary and secondary industries.

In Melbourne, the Division of Chemical Physics works on optical problems associated with spectroscopy and electron microscopy. For spectroscopy, A. Walsh has developed the double-pass monochromator which, by use of a light chopper, converts a single monochromator to a double one. He has also developed the principles and techniques of atomic absorption spectroscopy. Most spectroscopic analysis uses the emission from atoms in excited states, whereas the absorption method has the advantages (a) of using the larger number of atoms that are in the ground state and (b) of simpler instrumentation. Suitable spectral lines for each element are produced by hollow-cathode lamps developed in the Division; this light is passed through the sample, and its absorption gives a measure of the amount of that element that is present. The associated optical systems are being designed by J. I. MeNeill, using gratings made on a ruling machine designed by D. A. Davies. At present, without any interferometric control, this machine rules 15 cm by 10 cm gratings with ghost intensities less than 0.01% of the parent line.

In the same Division, J. M. Cowley, now at Melbourne University, and A. E. Moodie have studied the formation of images of periodic structures at planes not at the geometric focus. These Fourier images have been demonstrated and studied optically and are of importance in electron microscopy.

The National Standards Laboratory in Sydney maintains the standards of measurement for the
Commonwealth, provides a calibration service for science and industry, and conducts research in various fields of physics. It is divided into the Division of Physics and the Division of Applied Physics.

The Light Section of the Division of Physics is concerned with optics and photometry. The Photometric Laboratory, under W. R. Blein, maintains photometric and radiometric standards and provides for calibrations in these fields. Blein has concluded an investigation of the reflectance properties of pigment mixtures, basing his work on a scattering theory developed by B. G. Giovanelli. He is now investigating the use of black detectors as a foundation for radiometric standards, and testing methods of spectrophotometry. One method being tried for this is Fourier spectroscopy with a two-beam interferometer, since these interferometers have higher, and probably more reproducible, transmission than do monochromators. The Optics Laboratory is concerned mainly with branches of physical optics. W. H. Steel has studied theoretically the effects of lens aberrations and coherence of illumination on optical transfer functions and has made equipment to record transfer functions of small lenses, such as microscopic objectives. This equipment uses the interference fringes produced by Savart polariscope of calcite. Steel is also developing interferometers for lenses testing and for Fourier spectroscopy. J. V. Ramsay has studied atmospheric seeing and designed an image monitor for use in seeing analysis. He has since worked on multiple-beam interferometers and has produced a servo-controlled Fabry-Perot interferometer (Fig. 2) that holds the two plates parallel and at any desired separation, the plates being mounted on barium-iridate rods whose length is controlled electrically. It is hoped to have this interferometer manufactured locally. He has used such interferometers to give frequency-modulated light and with the gas optical masers with which he is working. The Division maintains an optical workshop that is developing techniques for polishing very flat surfaces and for working optical crystals; a major achievement has been the construction of a laser beam-filter with a 0.1 bandwidth for the Division's program of solar research.

Most of the work in optics in the Division of Applied Physics is concerned with the application of interferometry to precision measurement. A group under C. D. Bruce has contributed to international research on the production and properties of highly monochromatic radiation for use as a standard of length. Associated with this and with the practical implementation of the optical definition of the meter, instruments have been developed such as scanning Fabry-Perot interferometers, photoelectric setting microscopes, and an interference comparator for establishing 1 m line scales and 50-m distances in terms of wavelength. Interferometry has been used by W. K. Clothier to measure the dimensions of a calculable capacitor developed as a basic standard of electrical units. The Division applies other optical methods to precision metrology and hopes to undertake a study of optical masers.

From this report it is apparent that optics in Australia is spread widely among various small groups: the National Committee for Optics, with whose assistance this article was prepared, holds its meetings by letter. Some unity is given to physicists in his field through the Australian Institute of Physics (until recently, the Australian Branch of the British Institute of Physics and the Physical Society). The Institute has twice since 1955 organized national conferences in optics, while the Australian Spectroscopy Conference, organized by the Academy of Science, appears to be an annual event.

REFERENCE

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**Letter to the Editor**

**The First Four Hundred Years of Modern Science**

While we are celebrating the four hundredth anniversary of Shakespeare's birth, let us not forget that 1644 is also the four hundredth anniversary of the birth of Galileo Galilei, the founder of modern science.

Galileo's telescope was one of the first scientific instruments, and with it he obtained factual evidence in support of the Copernican theory that the Sun, not the Earth, was the centre of the Universe. He discovered Jupiter's satellites, that the surface of the moon is mountainous, and that the Milkey Way is a collection of lesser stars.

As one of the founders of the science of mechanics, he investigated such problems as friction, centre of gravity, pendulum motion, projectile motion, and the motion of falling bodies.

However, to appreciate Galileo's greatest contribution to modern science, we must realize that scientific knowledge had progressed little in the twenty-two centuries between the Greek thinkers and Galileo. Moreover, Greek science, which was accepted without question by the world into which Galileo was born, consisted of a collection of elegant theories entirely unsupported by experimental evidence. In all these centuries no one had tried to dispute Aristotle's theory stating that the time of
Fall of a body is proportional to its weight, and that its velocity is constant throughout fall. By simple experiments, such as dropping two bodies from the Leaning Tower of Pisa, or timing the fall of an object rolling down an inclined plane, Galileo demonstrated facts which were unheard-of in his day.

Galileo was the first man to combine experiments with calculation, to apply mathematical analysis to physical problems, and to compare his results with theoretical predictions. His discovery and use of scientific reasoning stand as one of the most important achievements in the history of human thought. More has been discovered in the four hundred years since the birth of Galileo than in the whole of human history before that date.

(Mrs.) G. L. PYLE.

2 South Boulevard,
Tea Tree Gully,
South Australia.

Honorary Fellow

G. H. BRIGGS, Ph.D., (Cantab.), D.Sc. (Sydney),
F.Inst.P., F.A.I.P.

Dr. Briggs graduated in physics and mathematics at the University of Sydney in 1916 and was a member of the University's teaching staff as Lecturer and later Assistant Professor until 1939.

His initial research in Sydney cleared up some discrepancies about the behaviour of radioactive recoil atoms in various gases. In 1925-6 he spent two years at the Cavendish Laboratory working at Rutherford's suggestion on the straggling of alpha particles and on return to Sydney continued to work in the field of radioactivity—particularly on the measurement of the energies of alpha particles. In 1941 he was awarded the Lyle Medal of the Royal Society of N.S.W.

When the Commonwealth Government shortly before the outbreak of World War II founded the National Standards Laboratory under the aegis of the Council for Scientific and Industrial Research he was appointed head of the Section of Physics. The three Sections of the Laboratory subsequently became Divisions of C.S.I.R.O. Dr. Briggs retired from the position of Chief of the Division of Physics in 1958.

Dr. Briggs was elected a Fellow of the Institute of Physics in 1928. For several years he was Honorary Secretary-Treasurer and in 1950-51 President of the Australian Branch. In this period, with the concurrence of the Board of the Institute in London he took a leading part in putting forward a proposal by the Committee of the Australian Branch to convert the Branch into an independent Australian Institute of Physics. This proposal was considered by some members to be premature and it did not gain the stipulated two-thirds majority when put to a vote in 1952.

In 1946-7 he was, with Professor M. L. (now Sir Marcus) Oliphant, a Scientific Adviser to the Australian Delegation to the United Nations Atomic Energy Commission. This necessitated an absence of more than a year in New York and it enabled him to form a close liaison with the Low Temperature Laboratory of the M.I.T., which was of great value in the commencement of low temperature research at N.S.I.

For several years he represented the Australian Branch of the Institute of Physics on the Australian UNESCO Committee for Natural Sciences.

Since his retirement he has been an Honorary Fellow of C.S.I.R.O.

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South Australian Branch Activities

The S.A. Branch of the Institute held its Annual Dinner on Thursday, 30th July, at the Staff Club of the University of Adelaide. About 40 persons, members and their wives, attended the dinner and the evening, over which Professor J. Carver presided. Professor M. Trevaskis, Professor of Classics at the University of Adelaide, delivered an entertaining address and proposed a toast to the Institute. Professor M. Brennan responded on behalf of the Institute. During the address and reply the speakers attempted to outline some historical areas of common interest to physicists and classic scholars.

On Monday, 17th August, a combined meeting of the Institution of Engineers (Australia), the Institution of Mechanical Engineers (S.A. Panel), the Royal Aeronautical Society (S.A. Branch) and the S.A. Branch of the Australian Institute of Physics was held in the Chapman Hall, North Adelaide. Professor E. J. Richards, O.B.E., D.Sc., M.A., F.R.Ae.S., spoke on "Noise and its Control in Industry and Transport". Professor Richards is Professor of Aeronautics and Astronautics at the University of Southampton, England. He is an international authority on noise and vibration and recently has established an Institute of Sound and Vibration Research within the Faculty of Engineering at Southampton.

The August monthly lecture meeting of the S.A. Branch was held on Wednesday, 19th August, in the Observatory Lecture Theatre of the University of Adelaide. Mr. G. Durand spoke on "Neutrino Experiments". This lecture was chosen from the series of colloquia given by the Honours Physics Students of the University of Adelaide. Mr. Durand described the experiments which support the existence of neutrinos.

Phyllis Mary Nicol

All who have passed through the School of Physics in the University of Sydney during the last thirty-eight years will have known and had a high regard for Phyllis Nicol.

As a demonstrator and later lecturer, as tutor and Vice-principal in the Women's College, and through her role in the school examinations she long played a worthy and unique part in the training of today's physicists and science teachers.

Graduating in 1925, she became a part-time teacher in the Physics department and took an M.Sc. in 1926. She was closely associated with the Women's College until 1954, being appointed Vice-principal in 1933. She ran the first year laboratory for many years and more recently the second year laboratory.

Her colleagues remember her as a person who spared no time or effort to do thoroughly the teaching work she undertook. One assistant marker of Intermediate Certificate papers recalls having difficulty with allotting a mark to an offbeat answer to the question, "How would you determine the length of a quantity of string without unravelling it and with what accuracy?" It didn't come under any of the alternatives allotted a mark in the scheme carefully prepared by Phyllis. "Oh, that is only worth so much. I tried it out and the accuracy is very poor." She had tried all the possible ways.

Women students especially, who almost invariably had done no physics previously, found her an understanding of their difficulties and an unlimited readiness to help. Her name was synonymous with patient explanation and her interest in individual students meant much to very many of them, as they will gratefully remember.

N.S.W. Branch Sub-Committee on Senior Secondary School Physics

Activities of the N.S.W. Branch of the Institute in relation to matriculation physics and the changes in the fifth and sixth year high school syllabus will be of interest to members who have been following the "P.S.S.C." controversy in these pages. Universities and the Science Teachers' Association were invited to nominate representatives on a sub-committee whose terms of reference are:

2. Consider courses which may be implemented in this regard in N.S.W.
3. Advise the Branch Committee so that relevant bodies may be forwarded reports of the sub-committee findings.

The background of the activity is that the N.S.W. Board of Senior School Studies set up a Science Syllabus Committee to consider science courses for fifth and sixth years in N.S.W. secondary schools. The Science Syllabus Committee met for the first time on 30th July, 1964, and set up working parties to consider particular subjects and possible approaches to the syllabus.

The Branch sub-committee comprises Dr. J. Symonds (Chairman of Branch and Convener), Professor H. Meele (University of Sydney), Professor T. P. George (University of N.S.W.), Dr. T. H. Hbberd (University of New England), Dr. G. J. Aitchison (Australian National University S.G.S.), Dr. A. Hulke (S.T.A.). The first meeting was held on August 18, 1964. The discussions will be reported more fully in a later issue.
FOURTH ANNUAL MEETING OF PHYSICS
IN MEDICINE AND BIOLOGY

The tentative programme set down for the meeting to be held during the period from October 8 to 10, 1964, has been supplanted.

Thursday, October 8
Venue: Chevron Hilton Hotel, Macleay St., Potts Point, Sydney, in association with College of Radiologists of Australia.

9.30 a.m.-noon
"Comparison of Radioiodinated Hippuran Renogram and Intra Venous Pyelogram in Renal Dysfunction Associated with Carcinoma of the Bladder", Dr. H. Holden, Consultant Radiotherapist, Peter McCallum Clinic, Launceston, and Dr. B. Harkey, Radiologist, Launceston General Hospital.


"The Distribution in Sheep of Radioactive Rattlesnake Venom and Antivenin Labeled with Cr-51", Dr. P. A. Fassn, Dr. Starziotti, Dr. G. K. Horner, Dr. D. E. J. Holmgren, Departments of Medicine and Surgery, University of Sydney.

"Mechanism of Radiotherapy", Dr. P. T. E. Illberg, Department of Preventive Medicine, University of Sydney.

"Measurement of External Ultra-violet Radiation in Relation to the Incidence of Skin Cancer", Mr. D. T. Robertson, Researcher in Physics, University of Queensland.

2.30 p.m.-3.30 p.m.
Venue: Listerian Lecture Theatre, Department of Physiology, Old Medical School, University of Sydney.

Chairman: Professor J. M. Bennett, Professor of Computing, Department of Physics, University of Sydney.

"Application of Thermodynamics Techniques for Measurement of Cardiac Output and Regional Blood Flow", Professor P. T. Kornier, Professor of Physiology, University of N.S.W.

"The Recording and Analysis of Pulsatile Phenomena in the Arterial System", Professor M. G. Taylor, Professor of Physiology, University of Sydney.

"Some Advanced Techniques in Neurophysiology", Mr. R. F. Oakey, Department of Physiology, University of Sydney.

4.00 p.m.-5.00 p.m.
Demonstrations in Physiology Department based on above papers.

5.00 p.m.-5.30 p.m.
Business Meeting.

6.30 p.m.-7.00 p.m.
Dinner at University Staff Club.

Friday, October 9

10.00 a.m.-11.00 a.m.
"Nuclear Accident Dosimetry" by Mr. R. M. Fry, Health Physics Research Section, A.A.E.C.

"Measurement of High-Activity Sources—Facilities at Lucas Heights", Dr. G. C. Lowenthal, General Physics Division, A.A.E.C.

"Two Large Sample Medical Scintillation Counters", Mr. D. Pattrick, Physics Department, Prince Henry Hospital, Sydney.

11.30 a.m.-12.30 p.m.
"Thermoluminescence Dosimetry applied to Radiation Therapy", Mr. J. McGilvery, Department of Physics, University of Queensland.

"Whole Body Counting—its Application to the Determination of Body Composition", Mr. K. Wynne, Special Unit of Investigation and Treatment, S.W. State Cancer Council, Prince of Wales Hospital, Sydney.

"I-131 Labelling of Protein Hormones and their Application to in Vitro Measurements of Circulating Hormone Levels", Mr. J. D. Young, Physics Department, and Dr. L. Lazarus, St. Vincent's Hospital, Sydney.

12.30 p.m.-1.30 p.m.
Lunch at Canteen.

1.30 p.m.-2.00 p.m.
Film—"SJ 1 Reactor Accident".

2.00 p.m.-4.30 p.m.
Tour of Research Establishment.

Saturday, October 10
Venue: Dept. of Medicine, Blackburn Building, University of Sydney (No. 2 Lecture Theatre, Second Floor).

9.30 a.m.-10.30 a.m.
Chairman: Professor C. R. B. Blackburn, Professor of Medicine, University of Sydney.

"Search for a Pulsatile Element in Pulmonary Capillary Blood Flow", Dr. K. T. Fowler, and Mr. J. Maloney, Department of Medicine, University of Sydney.

"Servo Mechanisms in Biology", Professor E. P. George, Professor of Physics, University of N.S.W.

"Studies in Membrane Permeability in Cardiac Muscle", Mrs. N. House, Physics Dept., St. Vincent's Hospital, Sydney.

11.00 a.m.-12.30 p.m.
Demonstrations in Department of Medicine.

American Institute of Physics
Annual Report 1963

The Honorary Secretary has received a copy of the 1963 Annual Report of the American Institute of Physics from its Director, Dr. Elmer Hutchison. Apart from the wide and complex activities which
the report describes, it brings to the attention of members some "recent striking developments in what one might more properly call the sociology of physics". Australian physicists would do well to note the remarks and comments in their relevance to our own scene.

The first relates to the problem facing physicists and other scientists in that "the annual percentage increases in expenditures for basic research are three or four times greater than those in the gross national product". It has become very clear, the report goes on, that unless physicists and other scientists themselves analyse critically the needs of various areas of basic research, a competition for funds will develop which will be settled not by scientists but by others who may not see as clearly as scientists do the long-range implications of the research.

The second sociological development shows up critically in contrast to the very pertinent public interest in advances in basic physics. Education figures show that high school enrolments in physics courses have fared badly in comparison with biology, chemistry or general science. While enrolments in other sciences have more than doubled in the past decade, there is little increase in physics course enrolments and the percentage of all pupils taking physics courses has decreased. "Competent physics teachers, long in short supply, are rapidly disappearing from the national scene." In higher education, the report notes "a happy experience" in the number of physics majors in 1963, although the total number of all students has risen approximately five per cent, in the year. The American Institute of Physics indicates its concern by allotting high priority to problem solving in the Education and Manpower Departments.

The third development seemingly worthy of mention concerns the growing trend towards grouping or organizing scientists by broad projects rather than by traditional disciplines. This tendency, says the report, may have long-range implications for organisations like the American Institute of Physics which are based on traditional disciplines. It points out that a different "mix" may be required in publications to meet the needs of regrouped research workers. The topic is actively under consideration. The regrouping has had another effect—courses in colleges and universities are being re-grouped. While many features of the trend are to be applauded, standards have not been maintained in some cases and "none of the traditional discipline-oriented agencies feels a sufficient sense of responsibility to take corrective action".

The activities of the American Institute of Physics in meeting these challenges undoubtedly will be full-blooded and it will be interesting to observe what happens in the coming year.

Teaching of Physics in U.S. High Schools

It appears that Australia is not the only place where the problem of the education and recruitment of competent teachers dominates the secondary school scene in physics. A recent American Institute of Physics Education Newsletter reports on a National Science Foundation sponsored survey covering teaching environment, service loads, salaries, specialisation in subjects taught, and preparation of subject matter, in science subjects.

Some results for physics (with related findings for other subjects) were:

1. 12% of physics teachers had at least 30 semester hours of college credit in physics (compared 50% for biology teachers, 40% for mathematics teachers, 30% for chemistry teachers). 26% of physics teachers had less than 9 hours credit. 66% of the physics classes were being taught by teachers with less than 18 hours credit and of these, 35% had less than 9 hours credit in college mathematics.

2. 81% of physics class teachers had training covering one or two sections of physics. 63% of physics classes were taught by teachers who were devoting most of their time to the teaching of other subjects.

3. Of the physics teachers with bachelor's degrees from before 1950, 39% had taken courses in physics since 1950. Of those with bachelor's degrees received between 1950 and 1951, 34% had taken courses since taking their degrees.

It would be interesting to know the corresponding figures for Australia. The newsletter comments on the above figures in terms possibly suited to the Australian scene:

"The results of this study—although based on a limited sample—will not surprise physicists who have had occasion to teach in summer institutes for secondary school teachers. The schools have in the main had to turn the teaching of physics classes over in teachers who are not prepared in this subject. Physics is running significantly behind other sciences in this respect. The fact that there are some well prepared, enthusiastic and devoted teachers of physics in high schools only highlights the contrast. Where are the physics teachers coming from who will do justice to the new course materials now available or in preparation? What are the responsibilities of colleges and universities in educating such teachers and directing them into teaching positions in physics? What are the responsibilities of schools for establishing a teaching environment, work loads, and salaries that will be attractive to persons prepared to teach physics? Finding answers to these questions surely does not require the use of a computer. Concrete action needs to be taken to bring the 'head count' up to the 'nose count'."

THE AUSTRALIAN PHYSICIST, SEPTEMBER, 1964
The gyroscopes in the new Mirage aircraft of the R.A.A.F. are built in specially clean workshops and similar conditions are required for overhaul. As maintenance contractors, National Instrument Company of Essendon, Victoria, therefore undertook to build a suitable room. As the equipment is presumably only the first of many that will require such special facilities a set of workshops was designed to be capable of housing the expected needs for some years ahead. It consists of three sections, of different grades of cleanliness; the second grade is at present the largest but it can be improved to the highest grade when the need arises.

The design of the building had to begin with the conditions required. This occurred before the issue of U.S. Federal Specification 209 in December, 1963, which unified American requirements. It recognised two main types of room; in the first the air is treated and filtered, introduced into the room through diffusers in or near the ceiling and exhausted from return ducts near the floor. The amount of contamination introduced is limited by controlling the men, the work and the materials inside the room. Everything that enters is cleaned first and contamination inside is removed by elaborate cleaning processes. Air is brought into the second main type of room through a filter bank forming an entire wall or ceiling and exhausted through a similar complete surface. The flow in the room is approximately laminar, so that the air makes a single pass through any area and carries away any dust released, which is then spread only downstream and not dispersed about the room. The most critical work is done nearest the air entry. Restrictions on the operators and the type of work are minimised.

The specification for the N.I.C. room had to be prepared from a study of overseas practices then current and adjusted to meet the requirements of the R.A.A.F. and the manufacturers of the sensitive equipment. It is of the first kind mentioned above and the main features are:

**Class III**
- Temperature: 72°F ± 1°F
- Relative Humidity: 40% ± 5%
- Air Filtration (I): No particles larger than 1 micron.
- Air Filtration (II): Not more than 20,000 particles per cubic foot.

**Class II**
- Temperature: 72°F ± 2°F
- Relative Humidity: 40% ± 10%
- Air Filtration (I): No particles larger than 5 microns.
- Air Filtration (II): Not more than 50,000 particles per cubic foot.

**A New Dust-Free Instrument Workshop.**
The foreground shows part of the Class II area. In the background are three men in the Class III area.

**Class I**
Similar to Class II in services but used as a preparation area for Class II and fewer precautions taken over entry.

The quality of temperature and humidity control of the air supply is readily provided by good modern practice, but the filtering is much more elaborate. Combined return and fresh air are passed through a commercial filter and through a Vokes K.600 filter which removes all particles larger than 15 microns, and finally a "66" absolute filter which removes all particles larger than 0.1 micron for Class III, and a "55" absolute filter for Classes I and II. The final filters can be changed without causing contamination downstream.

Entry is by three airlocks, to allow a pressure gradient to be maintained from inside to outside to ensure a permanent outward airflow. Work enters the Class I area first and it is cleaned and moved from area to area through material airlocks, with double doors which are interlocked to allow only one side to be open at a time. A glazed viewing gallery is provided for visitors, connected by telephone to the inside.

The interior is as smooth and free from ledges as possible; there are no architraves or window ledges and the walls are covered to floor and ceiling. The floor and walls to dado height are covered with sheet vinyl continuously welded at the seams to avoid joints. Perspex panels with the lights behind them are set in the ceiling and a continuous film of sprayed PVC covers ceiling and walls from these panels down to the sheets at dado height.

Vacuum cleaning lines are built in and 60 outlets are provided; also washing and drying machinery for special clothing required is set up in one of the airlocks.

The cables carrying the many different electrical...
supplies run in ducts and end in plug outlets flush with the walls to preserve the smooth surface.

For checking contamination a cascade impactor which sorts particles into four different size ranges has been used, air being drawn from various places in the room at known speed through the impaction plates for a measured time. Results have varied with the location, from none to 70 particles per cubic foot in the early observations; the incoming air was free from dust and good housekeeping is expected to clear the rooms.

Firms concerned in the building were:

Architects and Engineers: H. Garnet Alsop and Partners.

Builders: E. A. Watts and Son.
Mechanical Contractors: Gardner and Naylor.

J. Darby

The Register

ELECTIONS to Membership of the Australian Institute of Physics—From April 1 to August 31, 1964.

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The Calendar

October, 1964
6-10 Biophysics Group — Fourth Annual Meeting of Physics in Medicine and Biology, Sydney (A.I.P. and I.P.A.); Mr. B. Y. Scott. (See this issue.)
13 Solar Interferometry (N.S.W.-A.I.P.); Professor B. Hanbury-Brown.
29 Closed Circuit TV Traffic Control System (I.R.E.-Sydney Division); R. French and others.

November, 1964
6 Radio Foundation Day Celebrations, University of N.S.W., (I.R.E.-Sydney Division).

December, 1964
23 N.S.W. Branch Annual Dinner; Guest Speaker—Professor Quenihly, University of N.S.W.

January, 1965
25 UHF Aerials for Broadcast Receivers (I.R.E.-Sydney Division); T. Davis, Electric and Control Engineering Ltd.

February, 1965
17 Annual General Meeting (N.S.W.-A.I.P.) and Chairman's Address; to be held at A.A.E.C.E., Leakes Heights, after visit.
24 N.S.W. Branch Annual Dinner; Guest Speaker—Professor Quenihly, University of N.S.W.

March, 1965
22-26 Radio and Electronic Engineering Convention (R.E.E.C.); Hotel Canberra and Albert Hall, Canberra, A.C.T.

May, 1965
5th Australian Spectroscopy Conference (Perth, W.A.), sponsored by the Australian Academy of Science: Dr. A. J. Parker, University of W.A.

August, 1965
16 International Conference on Electron Diffraction and the Nature of Defects in Crystals (A.A.E., I.U.C. and R.E.E.A.P.); Melbourne. (See May, 1st Apr; p. 28.)
Suggestions to Contributors

Manuscripts submitted for publication should take, in general, one of the following forms:

(a) An article on matters affecting physicists, including selected lectures given at Group and Branch meetings.

(b) An article describing the work of the various laboratories and teaching establishments where physics is a major discipline of interest. The text may run to about 600 words plus a photograph or to 500 words.

(c) A Letter to the Editor in which matters affecting physicists are discussed. Views of members on articles and letters previously published may also be expressed in a letter. In general, letters should not exceed 1,000 words, and figures and tables should be used sparingly.

(d) News and Notes may include institute activities, announcements to members, comments and announcements by overseas institutes of Physics and other local scientific bodies. The text will be short; in general, it should not exceed 400 words.

(e) Book Reviews will be undertaken when publishers submit books for review. Members will receive a formal approach from the Editor for a review of from 200-300 words normally, although this may vary within wide limits depending on the reviewer’s assessment. Unsolicited reviews may be considered in special circumstances.

(f) Where it is considered that an interest will exist, a New Product column will cover outline information and the source. Text should not exceed 300 words and a photograph may be included.

(g) News of the movements of members and other physicists will be received by the Editor and recorded in On Walkabout from time to time. The Calendar will be used to record events of interest to the physicist. For style, refer to previous issues.

Style: Where possible contributors should prepare two copies of manuscripts in a form suitable for sending to the Press. Manuscripts should be in double-spaced typing on one side of the paper only, and with a one and a half inch margin. For an article, the author’s name and the address of the laboratory should appear underneath the title. For a letter to the Editor, the author’s name should appear at bottom right, and his address and the date at bottom left of the letter. A suitable heading should be proposed for letters, and news and notes.

All pages should be numbered, including those with tables and illustrations.


References should be cited in the text by year of publication, e.g., Brusel (1947), and are to be arranged alphabetically at the end of the article, giving author’s name and initials, followed by year of publication, title of paper (if desired), title of periodical, volume and pages, thus:


Abbreviations of titles of periodicals should conform to those used in A World List of Scientific Periodicals. References to books should give author or editor, year of publication, number of edition, town of publication, and publisher’s name. Symbols and abbreviations should conform with those recommended in British Standard 1981: Parts 1-5: 1955-61.

Photographs should be good quality glossy prints of about quarter or half-plate size. Drawings should be done on good quality tracing paper or linen, or heavy drawing paper. Printing should be pencilled in and left to the Editor to choose style and size of print. Captions should be supplied. In unusual cases, seek the advice of the Editor.
Appointments Vacant

NATIONAL STANDARDS
COMMISSION

Appointment of Officer-in-Charge

The National Standards Commission is establishing a central laboratory for the approval of patterns of weighing and measuring instruments for use in trade in the Commonwealth of Australia and its Territories.

Applications are invited for appointment as Officer-in-Charge of the Approvals Laboratory.

The Laboratory will be situated in Sydney and will work in close liaison with the C.S.I.R.O. National Standards Laboratory and the Weights and Measures Departments of the various States. Initially there will be a staff of about five employed in the Laboratory.

Applicants should have a University Degree or Diploma in Physics or Engineering. Experience in the approval of patterns or in the design, use and maintenance of instruments and mechanisms is desirable but not essential.

Depending on qualifications and experience the appointment will be made within the salary range of £2971-£3337.

Appointment will be conditional upon a satisfactory medical examination and an initial probationary period of twelve months may also be specified. Confirmation of appointment carries with it Commonwealth Superannuation Fund or Commonwealth Provident Account privileges.

Applications quoting reference number 1141 and stating full name, place, date and year of birth, nationality, marital status, present employment, details of qualifications and experience, and of war service, if any, together with the names of not more than four persons acquainted with the applicant's academic and professional standing, should reach:

The Secretary,
National Standards Commission,
National Standards Laboratory,
University Grounds,
City Road,
Chippendale, N.S.W.
by 9th October, 1964.

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Physical Methods

Applications are invited for positions in a proposed new Section in the Central Research Laboratories at Ascel Vale (Melbourne) to be concerned with the application and development of physical methods in chemical research and technology. The work of the Section will be partly of a service nature with, however, scope for basic research in the development of instruments, techniques and theory. The laboratories give service to the whole of ICIANZ Ltd. and Associated companies, covering a wide range of manufactures including plastics, heavy organic and inorganic chemicals, biological chemicals, agricultural interest, dyes, pigments, surfactants, explosives and fertilizers. To a number of the fields the Laboratories are involved in original work aimed at the development of new products, processes and control methods, including instruments and computer applications.

Physical methods already in use include X-ray diffraction and fluorescence; I.R., U.V. and emission spectroscopy; light-scattering in high polymers and gas chromatography. Expansion in high resolution electron microscopy is being considered, and later to NMR and mass spectrometry.

Vacancies exist for specialists in the various fields or for those with suitable abilities for training as specialists. There is available also a senior position as a very well qualified man in the leadership of the Section. Technicians with suitable training, interests and qualifications are also sought.

Physicists with appropriate interests, and chemists with a strong background of instrumental interest would be equally acceptable.

Consideration would be given to payment of travelling expenses for suitable applicants to visit the Laboratories prior to making a final decision.

Contact from people not immediately but potentially interested in the future would be welcome. Melbourne applicants could arrange an informal visit by contacting the Research Administrator (Mr. R. M. Sanford), 37939.

Conditions of service are good and include a Company sub-skilled Pension Fund. Starting salaries will depend upon qualifications and experience.

Applications should be made in writing giving full details of experience, etc., and addressed to:

Personnel Department,
G.P.O. Box 911,
Melbourne.

AUSTRALIAN ATOMIC ENERGY
COMMISSION

Theoretical Reactor Physicist

A Senior Theoretical Physicist is required to supervise the work of Theoretical Physics Section within the Physics Division at the A.A.E.C. Research Establishment, Lucas Heights, Sydney, Australia.

He will be responsible for original and applied studies in reactor physics, computational and neutron cross-section analysis. The work is associated with the high temperature gas cooled reactor feasibility investigation into the use of beryllium, thorium and plutonium.

The appointment will be to the Principal Research Scientist or Senior Principal Research Scientist Grade, dependent on qualifications and experience. A Ph.D. degree or equivalent plus lengthy experience in the above and related fields is required. The appointment may be on a permanent basis or for a three year period.

Existing Salary Scales (at present under review) are:

P.R.S. £4200-£5000
S.P.R.S. £4600-£4100

Applications close on 30/11/1964.
For further information apply to:
The Director,
A.A.E.C. Research Establishment,
Private Mail Bag,
SUTHERLAND, N.S.W.

THE AUSTRALIAN PHYSICIST, SEPTEMBER, 1964 95
AUSTRALIAN INSTITUTE OF NUCLEAR SCIENCE AND ENGINEERING
POST GRADUATE RESEARCH STUDENTSHIPS, 1965
UNIVERSITY GRADUATES:

Post Graduate Research Studentships are offered by the Australian Institute of Nuclear Science and Engineering for suitably qualified persons wishing to undertake studies in the Institute’s field of interest for a higher degree at any Australian university.

Nominees must be persons who have completed, or who expect to complete within six months of nomination, the requirements for the degree of B.E. or B.Sc. (Hons.), or their equivalent at a recognised university and who are enrolled or expect to enrol within six months as a candidate for a higher degree at a university in Australia.

Studentships will be held at the nominating university but the student will be required to spend not less than one quarter of the total period of tenure of the award attached to the Institute at Lucas Heights, N.S.W., for the purpose of using the special facilities at the A.A.E.C. Research Establishment in connection with the approved research project. The research project shall be proposed by the nominating university and shall be directly concerned with the Institute’s field of interest.

Tenure shall initially be awarded for one year on stated conditions and may be extended for a second and third year. Tenure shall commence during the first half of 1965.

Remuneration will be dependent upon the student’s standing and marital responsibilities but initially will not be less than £1,100. In addition the Institute may provide reasonable funds for equipment, materials and computing time and meet costs involved in using facilities at Lucas Heights. The Institute will meet compulsory university fees with the exception of graduation fees and costs of preparation of a thesis.

For further particulars enquiries should be addressed to the:

Scientific Secretary, Australian Institute of Nuclear Science and Engineering,
Private Mail Bag, P.O., Sutherland, N.S.W.

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