The Australian Physicist

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The Australian Physicist

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Correction
In the article “On the Feasibility of the Light-Sabre”
in the June issue 1979 page 85, the author’s name is
Stephen Bewlay not ‘Bewley’.

The statements made and the opinions expressed in The Australian
Physicist do not necessarily reflect the views of the Australian
Institute of Physics, its Council or Committees.
PRESIDENT'S COLUMN

There has been a great increase in the number of museums in Australia in the last few years; I visited one recently and would like to commend it and the spirit behind it to the membership. It is the Post Office Museum in Melbourne, established in 1974, housed in the old Richmond South Post Office at 90 Swan Street, Richmond. The building itself is a pleasure to visit and has a fine timbered ceiling. I passed over the collection of stamps and envelopes, even though probably many visitors would be attracted to them, and looked at the instruments. There were several from the Morse era, including especially a Morse receiving machine by J. R. Bunnell and Co. of New York dated 1891; this used paper tape on which the dots and dashes were recorded by a pen. This instrument came from the Post Office of Bridgewater, near Bendigo. This receiver was succeeded by the Morse being heard on the telephone, an early example of the way technology simplifies with time, and reminded me of the substitution of masses of paper output of the computers of a decade ago by the visual display units of today.

There is a working model of a telegraph put into the context of the Overland Telegraph from Adelaide to Darwin made by Charles Todd. There are several photographs of the Todd Expedition which were assembled for the Centenary in 1972. I learnt that the Post Office made a film for the Centenary. It now seems an act of supreme confidence to have relied on the single wire of the Overland Telegraph.

Visitors can appreciate the improvements that have been made in telecommunication technology by examining the working automatic exchange using electromechanical switching. There was a large number of moving parts and it is no wonder that servicing and maintenance were major problems. No doubt details of the communication satellite processes will appear in the Museum.

The exhibits are planned to be varied several times each year which would give me, at least, the chance to see the way improvements in electric resistance measurements were involved in telegraphy. Older physicists were trained on that practical example of Wheatstone's Bridge, known as the Post Office Box, and there is a good review of resistance measurement on p. 692, Volume 2, of the Dictionary of Applied Physics. The Post Office Museum in its booklet calls for loans or gifts of material with links with the Post Office development; there may be some members of the Institute who can help.

H C Bolton

EDITORIAL

SPONSORS WANTED — HELP A YOUNG RESEARCH SCIENTIST!!

Government support for basic research appears to be on the decline and if this trend cannot be reversed in the immediate future some alternative support must be found for this most necessary endeavour.

Today is the day of the sponsor. It is the Sponsor with a capital S who makes possible a whole range of human activities both amateur and professional. Music, sport, art, theatre and a host of national and local events seem to attract large sums from a great variety of commercial and manufacturing organisations. National and international names are featured on bags, jackets, cars, advertisements, TV screens and hoardings but there is little obvious support for one of the last bastions of amateurism — small basic research. Now it is true that basic research is not the most spectacular human activity with great drawing power as far crowds or viewers are concerned and it is probably also true that the wearing of advertising signs on jackets would have little appeal to working scientists. On the other hand it is possible that some firms and groups would be prepared to invest money in the future of applied science and technology and this can best be done by investing in basic research. I venture to say that the returns from quite modest investment in the work of our younger scientists will show a return in 30 years time that will socially far outweigh the ephemeral investments in other areas.

—Bill Boundy
VICTORIAN BRANCH NEWS

The Victorian Branch meetings for this year started in March with the Address entitled 'Superconductivity - Fact, Fiction and the Future' given by the new Branch Chairman, Professor T. F. Smith, Monash University. The facts were presented as a brief historical account describing the growth of understanding of superconductivity since the accidental discovery of the phenomenon in the Leiden laboratory of H. K. Onnes in 1911.

The lectures which were exposed were concerned with claims to the discovery of very high superconducting transition temperatures and included sodium-liquid ammonia solutions, the organic superconductor TTF TCNQ and the most recent claims associated with CuCl.

In considering the future, emphasis was placed upon the application of known superconductors rather than hopes for new materials with higher transition temperatures. The importance of superconducting magnets for research in high energy physics and their potential application to the generation and storage of electric power were described. Recent developments in the use of superconductors for magnetic levitation in high speed ground transportation and the superconducting power transmission line were also covered.

During April the Branch was very fortunate to have Professor J. Friedel, University of Paris, as speaker at a special meeting. Professor Friedel was visiting Australia for the 25th Anniversary celebrations of the Academy of Science.

Professor Friedel's grandfather had been the early pioneer in France of the classification of liquid crystals; materials which appear to possess properties formerly thought to be 'characteristic' of both solids and liquids. The dislocations in liquid crystals depend on the structure of the liquid, which is related to the arrangement of molecules. What we might call the morphology of the dislocations reveals new and surprising patterns, which are being verified by new experiments done in Paris.

The scheduled April talk, 'Enriching Australia's Uranium - Are Lasers the Answer?' by Dr. A. W. Pryor, Australian Atomic Energy Commission, Lucas Heights, considered the problems associated with uranium enrichment. After a general discussion of the diffusion and centrifuge techniques, Dr. Pryor concentrated on laser enrichment and the technical difficulties of the photo-ionisation of uranium atoms by tuned dye lasers. Although theoretically attractive from an economic viewpoint, there are still severe technological problems which have to be overcome before the technique can be applied to large-scale enrichment.

In spite of the last minute on/off situation due to industrial unrest in the S.E.C., the Assistant General Manager, Mr. R. G. Chapman was able to present his talk 'Future Transportation - the Role of Electric Vehicles' to the May meeting. In view of Australia's major energy resources of coal and uranium for the production of electricity, the electrically powered vehicle could be an attractive proposition for Australia. In reviewing this possibility Mr. Chapman noted that the use of electrically powered vehicles was already widespread in industry and played an important role in public transportation. However, the importance which Western society attaches to individual mobility places a special emphasis on the development of an electric car. Mr. Chapman described a number of prototype models and highlighted his talk by bringing one for inspection. His silent departure in the vehicle at the end of the evening provided ample testament to one of its virtues.

The irregular report of the Branch meetings over the past few years, in spite of a varied array of interesting topics and speakers, has been of great concern to the Branch Committee. It is encouraging to report that, with the adoption of Melbourne University as a fixed venue and whenever possible the second Thursday of the month as a fixed date, attendances have improved considerably. To judge from the response, the invitation to Members to join the speaker and the Committee for dinner prior to the Meeting has also been a popular move. Indeed, on some occasions the conversation over dinner was so lively it almost seemed a pity to have to break it up for the Meeting.

J. Pollard
T. F. Smith

SOLID STATE PHYSICS CONFERENCE 1980

Sponsored jointly by the
Australia and New Zealand Institutes of Physics

The 1980 "Wagga Wagga" conference will be held on Pakatoa Island, near Auckland, New Zealand from Tuesday 22 January to Thursday 24 January.

The organising committee will be chaired by Professor D. Beaglehole, Victoria University of Wellington, New Zealand. Australian coordinators are Professor T. F. Smith, Monash University; Dr. D. Price, ANU; and Dr. J. Dunlop, NML.

The first notice will be mailed to past recipients in July 1979. Others who wish to be placed on the mailing list should write to the Chairman at the address above.
PROSPECTING FOR WIND ENERGY
A Regional Wind Survey in New Zealand

P. J. EDWARDS, Department of Physics, University of Otago, N.Z.

*Lecture delivered in Canberra at joint seminar sponsored by CSIRO Division of Land Use Research, CSIRO Division of Mathematics & Statistics and Canberra Meteorological Society.

Introduction
New Zealand’s wind energy resources have often been favourably compared with those of other countries. Putnam does so in his classic, “Power from the Wind”. Indeed, it has become generally recognised that the high mean wind speeds in NZ are a consequence of its long coastline, the exposed and elevated nature of the terrain and its mid-latitude situation in prevailing zonal westerly winds. Similar comments may be made about the south coast of the Australian mainland, Flinders and King Islands, and Tasmania.

In the view of those who are reluctant to accept the installation of nuclear power plant, concerned at the environmental impact of hydroelectric development or worried about the long term effects on climate of increased fossil fuel burning, the wind is ideal. It is a renewable, non polluting energy source which many argue must sooner or later become economically competitive with fossil fuels. Realistic economic and engineering feasibility studies depend however on a better understanding of the characteristics of the wind energy resource.

Survey Methodology
In 1974 several New Zealand University research groups independently requested support for wind energy research projects from the then newly formed New Zealand Energy Research & Development Committee, a body similar to NERDDC. These submissions led to the formation of a national Wind Energy Task Force. This unique body currently comprises representatives from physics and engineering groups in four tertiary institutions, the NZ Meteorological Service, Ministry of Works and Development, Electricity Division of the Ministry of Energy and the initial funding body, NZERDC.

The task force was charged with coordinating a national wind energy resource survey. The main goal of the survey was to quantify these resources on a national basis. A secondary goal was the identification of prospective aerogenerator (“windmill”) sites suitable for further investigation. It was assumed that viable wind energy conversion systems would use moving blade windmills coupled to electrical generators rated between 100kW and several megawatts.

The task force has met regularly since its formation. It has concerned itself with budget proposals, methodology, project guidelines, work statements, progress reports and the like along the lines of current US practice in the R. & D. area.

The results of phase one of the survey, the analysis of existing meteorological network data have already been published in preliminary form (Cherry, 1976). This report shows that a large proportion of New Zealand is exposed to moderate to high (>200 W/m²) annual mean wind energy fluxes. These were calculated from wind speeds measured with anemometers mostly located within 10 metres of ground level near airports, urban areas and at some harbours and lighthouses. While confirming the conventional wisdom that held the country to be well endowed with wind energy, the report clearly pointed out the inadequate sampling of the surface wind field by existing instruments, particularly in less accessible regions.

In order to enlarge the data base, phase two of the survey was implemented on a regional basis by a group from our Physics Department at the University of Otago in Dunedin and another from Agricultural Engineering at Lincoln College near Christchurch. These two groups since joined by a third from Auckland University Physics Department undertook to develop, install and maintain wind speed recorders in their respective regions and to retrieve, archive and analyse the data under the general direction of the task force.

Our own experience in logging and retrieving astronomical and atmospheric data proved to be very useful.

![Figure 1. Data flow in the wind energy survey showing intermediate steps involving processing and analysis.](image-url)

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in the regional survey in Otago which covered an area of 2.5 x 10^6 ha centred near 45° latitude. We had previously developed magnetic tape recording systems for field station use. With the modifications necessary to permit operation at remote unattended anemometer sites these provided continuous 30 day data blocks with a time resolution of a few seconds. Instruments giving coarser time resolution were installed at other locations. Figure (1) summarises the data flow from some 30 instrumented sites. It shows the two final products of the survey: an estimate of the energy resource on the one hand and the identification and characterisation of potential aerogenerator sites on the other.

The details of the methodology of anemometer siting and of the hardware and software are given in two recent reports (Dawber & Edwards, 1978), (Edwards et alia, 1978) published by NZERDC.

In brief, a geographic and topographic classification of sites served as the basis of an interpolation procedure for the entire survey region. Annual and shorter term mean wind speeds and the wind speed frequency distribution (probability density function) were measured at selected sites over a three-year period. Wind energy fluxes were calculated and extrapolated to generator “hub height” (30 - 50 metres) using conservative micro-meteorological theory. In addition the spatial and temporal variability of the wind is being determined in a continuing programme of statistical analysis.

Preliminary Results

We found that a single site parameter, the annual mean wind speed was all that was needed to calculate the average energy fluxes with sufficient accuracy for the purpose of estimating the overall resource magnitude. This simplification arises in part from the relative invariance of the shape of the wind speed frequency distribution from site to site despite large variation in their annual mean wind speeds.

By interpolation an approximate inventory was made of the total energy available in Otago. It turned out to be ~ 85 T Wh per annum, corresponding to an average power of almost 10 GW, over four times current New Zealand consumption. A rather more realistic assumption, namely that of 10% land use gives about 1 GW average, close to the current hydroelectric output in Tasmania.

This estimate makes a number of assumptions based both on the physics of the atmospheric boundary layer and on the current state of the art of wind energy conversion technology. While the former may be (and is being) subjected to more detailed field investigation, the latter does not seem to have progressed a great deal since the early 1940's when the 1.25 MW machine described by Putnam failed spectacularly. Indeed, the operational history of large wind generators seems to have been marked by machine failures and by performance outside design limits.

At the core of most of the problems of utilizing wind energy are two factors.

(a) Low energy density (½ρV^2 ~ 6 x 10^3 J/m^3 for V = 10 m/s).

(b) Variability (the normalised standard deviation in the hourly wind speeds is typically σ/V ~ 0.5).

Low energy density implies low energy flux (½ρV^3 ~ 0.6 kW/m^2 for V = 10 m/s) and blade diameters of typically 50 metres for a power rating in the region of 1 MW with consequent problems in structural dynamics. Although the energy estimate in the Otago survey is substantial, the control and maintenance of some 10,000 machines even when grouped in energy “farms” is a daunting prospect. It is important to realise that while high energy sites such as those near the coast may have typical wind energy fluxes of ½ ρ<V^3> ~ ρ<V^3> ~ 1 kW/m^2, the power yield per unit land area is much lower, of the order of only 1 W/m^2.

This is similar to the yield from hydroelectric storage lakes. Unlike solar energy collectors the swept area of wind turbines is limited to about 1% of land area by the need to separate generators by more than 10 rotor diameters.

Variability (see Fig. 2) on time scales ranging from those of turbulence (seconds) through the diurnal and synoptic scales (Fig. 3) to monthly and seasonal fluctuations introduces additional considerations related to blade fatigue, dynamics of the wind generator/electric grid system and energy storage.

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**Figure 2.** A typical wind speed frequency distribution over one month from a survey site. The mean is 5.1 m/s. The solid curve is the maximum likelihood Weibull distribution fit to this data with Weibull shape parameter K = 2.2.

**Figure 3.** Autocorrelation function showing the diurnal and shorter term fluctuations in the wind speed at an Otago site.
The intensity of turbulence at a site is an important second parameter which we have found can be easily measured (Hurst et alia, 1977). On longer time scales we have recently found the persistence properties of wind speed, currently the subject of a study supported by the International Energy Agency, to be remarkably invariant between sites. The level-crossing time interval statistics of wind speed appear to be similar to those encountered in communication channels subject to Rayleigh fading and to raise questions of a fundamental character in stochastic theory.

![Figure 4. A cross correlation function computed from hourly wind speeds at two island sites separated by 60 km showing their high correlation over a ten day period.](image)

The variability imposes strict upper limits on the utility of power generating windmills. In common with other workers we have found that wind generators when operated to minimise the unit cost of electricity have a plant factor (Average Power/Rated Power) of only about 20%, much less than hydro and nuclear sources. When operating in this optimum mode they extract approximately 20% of the wind energy flux. This is the figure on which the Otago resource estimate was based. Raising the plant factor reduces this efficiency. Unfortunately the high correlation between the wind speeds over baselines of order 100 km (Fig. 4) means that even extensive arrays do not overcome this problem.

**Summary**

Although aero-generators may contribute to the peak capacity of a system, a conservative view would be to regard them as a fluctuating negative load. As such they can operate as fuel savers.

In the New Zealand and Tasmanian systems and others with high hydroelectric storage capacity a limited wind energy content seems feasible and awaits the availability of “off the shelf” hardware. In the meantime it appears that physicists can assist by establishing a better understanding of the characteristics of the large, diffuse and fluctuating power in the wind.

**References**


LASER FUSION AND FUTURE ENERGY SOURCES
—SOME RECENT RESULTS

HEINRICH HORA, Department of Theoretical Physics, University of N.S.W.

This is the first of a two-part article derived from a Colloquium in the Department of Theoretical Physics. The second part will be concerned with the theoretical developments which are influencing the new directions for research in this area.

Part 1

After comparing the concepts of magnetic field confinement and inertial confinement for energy production by controlled thermonuclear fusion, the highlights of laser compression of inertially confined plasmas are given and recent results discussed. These new reasons for following the alternative of short laser pulses, imply nonlinear processes which are described in some detail. Results of very general calculations for perpendicular incident plane waves confirm the generation of "low" temperature, thick, fast compressing plasma blocks for a nonlinear – force – fast pusher scheme with high efficiency (low entropy production). Longer interaction causes a fast thermalization of the corona by a soliton decay, favourable for the Nuckolls thermal ablation-compression scheme. Oblique incidence for resonance absorption is no longer necessary. Interaction for more than 20 psec (Nd) or 2 nsec (CO₂) will result in pulsations of reflectivity and further complications at high intensities.

I. FUSION ENERGY

Nuclear fusion energy, if it can be made to work, can provide a clean, inexhaustible, safe low-cost and highly concentrated source of energy for the future. At present, exothermic fusion reactions on earth have been produced in the H-bomb only. The task of providing these reactions in a controlled way is considered as the most challenging task of our century. After solving the basics of nuclear fission technology, and after the flight to the moon, fusion energy is the next large region for highest level organized research.

The principal reaction is the burning of heavy hydrogen (deuterium D) with superheavy hydrogen (tritium T)

\[ D + T \rightarrow ^3\text{He} + n + 17.6\text{ MeV} \]  

(1.1)

This basic reaction was discovered by Oliphant, Hartleck and Lord Rutherford in 1934 and on these studies about 500-1000 million dollars are being spent per year at present. The radioactive tritium must to be bred by the neutrons (n) from lithium surrounding the reacting materials.

\[ n + ^6\text{Li} + T \rightarrow ^4\text{He} + 4.6\text{ MeV} \]  

(1.2)

Another reaction is

\[ D + D \rightarrow ^3\text{He} + n \text{ or } T + P \]

and the further reaction

\[ H + ^{11}\text{B} \rightarrow ^3\text{He} + 9.8\text{ MeV} \]  

(1.3)

which is much more difficult to achieve than (1.1), but is absolutely clean. No active material is produced (a side reaction of $^{14}$C results in 10-times less active material than that produced by firing coal for an equal energy gain), no neutrons are produced, boron is plentiful while lithium is limited, and the heat pollution of power stations can be reduced drastically by direct conversion of the energy of the charged $^3$He products in electric fields.

There are two main ways to achieve fusion energy: confinement of the reacting plasma at the necessary temperature of $10^8$ K by magnetic fields or confinement by the inertia of the expanding plasma. Inertial confinement has been realised in bombs: fission reactions are sufficiently fast to ensure the ignition of the fusion plasma before its expansion and cooling. The same may be done in small controllable dimensions: ignition of small pellets of fusion material by very short laser (or particle beam) pulses and the release of more reaction energy than that needed for ignition.

2. MAGNETIC CONFINEMENT

During the last few years, the magnetic confinement by a toroidal configuration (Tokamak) with strong ohmic heating (as a secondary loop in a gigantic transformer) has been favoured. This was discovered by Artzimovich in Moscow and by Liley in Canberra. The success in 1978 was the achievement of temperatures of 60 million degrees Kelvin for low densities and the production of nearly $10^{13}$ fusion neutrons from DD reactions, when 1MJ neutral beam pulses of 30 keV energy were injected into a tokamak to give improved heating. (Ohmic heating is limited to less than 10 million degrees). It has been shown, however, that all the $10^{13}$ neutrons were not genuine fusion neutrons. The 30 keV injected particles were not fully thermalized, and the energy distribution of the plasma ions was not Maxwellian, but had a second maximum at 30 keV. Genuine fusion neutrons were essentially less in number.

One essential problem for the tokamak is the difficulty of achieving a sufficiently high $\beta$-ratio, $\beta$ is the ratio of the thermometer kinetic pressure of the plasma over the magnetic field pressure. The analysis of Pfirsch³ demonstrated that the $\beta$-values are above 1% for short times only. For the whole discharge, 2% may be expected under extremely favourable assumptions. With this, a tokamak reactor of 30MW power might be built for more than 1000 million dollars. For economic tokamaks, $\beta$-values of 10% are necessary, but up to now no way has been found or theoretically predicted for reaching this value.

In Moscow in December 1978, Velikhov, the successor of Artsimovich, considered the four tokamaks of 500 million dollars value each, presently being built in Princeton, Japan, Europe and Moscow. He said that the next type of tokamak will cost 2000 million dollars and he cannot justify the request of this sum from one country, but proposes with others an international project, e.g. by the IAEA in Vienna.

The plasma physics which can be learnt from the extensive tokamak research is very valuable. Even if this way does not give a solution for fusion energy, it can help to develop other magnetic field configurations which are now new or which will be discovered in the future. One of these concepts is the surmac⁴ where no internal magnetic fields exist in the plasma. Another is
wall confinement in which magnetic fields prevent thermal conduction to walls of several thousand atmospheres pressure based on classical transport processes. A highlight of the new proposals, in contrast to the older concepts which use stationary magnetic fields, is the use of MHz rotary magnetic fields in the spheromak which has a spherical plasma configuration. These very promising configurations demonstrate how it may pay to look for basically new schemes of magnetic confinement.

3. INERTIAL CONFINEMENT BY LASER COMPRESSION OF PLASMA

The inertial confinement of plasmas produced by very fast irradiation of solid fuel pellets has advanced technologically during the last few years. The traditional direction uses lasers for irradiation, while electron beams (using a new effect of guiding the beam energies) and ion beams in excess of 100 MeV are studied for the same purpose. While it can certainly be assumed that 2 MJ, 2 MeV electron beam pulses of 50 nsec duration will irradiate pellets within the next four years, the anomalous interaction processes with plasma, on which the compression of the pellets is based, are not sufficiently understood. What helps is the fact that there is much less penetration of the electrons at high current densities than at low currents. An explanation found by using a collective model may also be derived from the Fokker-Planck treatments, if their very poor approximations of small perturbation are corrected.

The problems for inertial confinement by lasers are not less complex. First, some highlights in the development of laser fusion should be kept in mind. One stimulating result for the use of laser irradiation onto materials for nuclear fusion was that of Linj (1962) where the immediate generation of keV ions was observed. Though the ion acceleration process was not directly connected with thermonuclear conditions, the observation stimulated the idea of laser fusion. The first publication of a scientific discussion of laser fusion was due to Basov and Krokhin (1963) followed by further authors. The report of first experiments of laser generated fusion neutrons was in 1968 with picosecond neodymium glass laser pulses where the threshold of neutron detection was just exceeded. Quantitative numbers of neutrons were reported in August 1969 by M. Lubin and in September 1969 by F. Floux. The essential point of this experiment was the steep increase of the laser pulse within about one nsec where any prepulse had to be suppressed to less than 10⁻⁹ times the intensity of the main pulse.

Following this knowledge, Skilizko et al. constructed the nine beam KALMAR system with which up to 10¹⁰ fusion neutrons were produced from deuterated targets (1973). A very strong stimulation for further work came from the disclosure by E. Teller in 1972 reporting on the many unpublished work of J. Nuckolls and others. In this work the use of the laser irradiation for a strong compression and heating of the fusion pellet was evaluated by numerical calculations to find conditions for exothermal reactions for reasonable fusion power reactors. The next important experimental step was the use of DT gas filled glass balls with spherical laser irradiation to demonstrate the laser compression of the pellet by pinhole x-ray pictures. While the peripheral parts of the plasma were emitting x-rays from the direct laser interaction, no fusion neutrons were produced in this region, as only glass plasma was generated there. Obscure neutron production in the outer plasma part could then be excluded. The x-rays from the center were from the compressed plasma which appeared about 100 psec later and corresponded to the generated genuine CTR (controlled thermonuclear) fusion neutrons. The compression of plasma up to 70-times that of the solid state has now been reached. The initial density was as much below the solid state Table 1: Laser-fusion projects, gained and projected results, compiled by Nishikawa with some modifications and additions according to information January 1979.

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<td>Shiva (LLL)</td>
<td>26</td>
<td>10</td>
<td>10¹¹</td>
<td>100</td>
<td>test run, ND</td>
</tr>
<tr>
<td>TBS (LASL)</td>
<td>0.8</td>
<td>0.8</td>
<td>10⁹</td>
<td>0.04</td>
<td>CO₂</td>
</tr>
<tr>
<td>Helios (LASL)</td>
<td>21</td>
<td>10.7</td>
<td>10⁶</td>
<td>7</td>
<td>CO₂ just started</td>
</tr>
<tr>
<td>KMS-I</td>
<td>0.8</td>
<td>0.2</td>
<td>10⁹</td>
<td></td>
<td>Nd, cryogenic and solid-layered target</td>
</tr>
<tr>
<td>Zeta (Rochester)</td>
<td>1</td>
<td>0.2</td>
<td>10⁷</td>
<td></td>
<td>Nd</td>
</tr>
<tr>
<td>Camelia (Limeil)</td>
<td>1</td>
<td>1</td>
<td>10⁷</td>
<td></td>
<td>Nd, preliminary</td>
</tr>
<tr>
<td>Gekko IV (Osaka)</td>
<td>4</td>
<td>0.4</td>
<td>10⁷</td>
<td>0.4</td>
<td>Nd, DD fuel</td>
</tr>
<tr>
<td>Lekko II (Osaka)</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>CO₂</td>
</tr>
<tr>
<td>1980-1985 (expected)</td>
<td>300</td>
<td>500</td>
<td>5 x 10¹⁸</td>
<td>200x300</td>
<td>Nd</td>
</tr>
<tr>
<td>Nova (LLL)</td>
<td>200</td>
<td>100</td>
<td>10¹⁰</td>
<td>100</td>
<td>CO₂</td>
</tr>
<tr>
<td>Antares (LASL)</td>
<td>4</td>
<td>1</td>
<td>10¹⁰</td>
<td>30</td>
<td>λ = 0.35μm</td>
</tr>
<tr>
<td>KMS-II</td>
<td>30</td>
<td>3</td>
<td>10¹⁴</td>
<td>10x10⁴</td>
<td>Nd</td>
</tr>
<tr>
<td>Omega (Rochester)</td>
<td>20</td>
<td>20</td>
<td>10¹³x10¹⁴</td>
<td>10x10⁴</td>
<td>CO₂</td>
</tr>
</tbody>
</table>

The Australian Physicist, July 1979  95
density as that of a high pressure gas. The number of genuine CTR neutrons (10^4 in 1974) has been increased to 10^5 neutrons per shot in 1975 with the irradiation of 10 keV laser pulses of the SHIVA laser system. The development of the 10 keV CO laser system^24 HELIOS produced more than 10^6 fusion neutrons, while the use of very short pulses from neodymium glass lasers (30 ps pulses) seems to be very favourable when compared with the other cases mentioned with longer pulses. M. Lubin^25 reported about 10^7 neutrons from DT filled glass balloons with an input laser energy of 100 J only. Similar excellent results with short pulses were known at the end of 1976. The small ARGUS laser was producing at least the number of fusion neutrons for deuterium target conditions per unit input laser energy as were obtained from the Princeton Tokamak experiment per unit input neutral beam energy. It has to be emphasized that the laser compression experiments were producing genuine CTR neutrons, while the tokamak experiment^27 had a second high ion energy distribution maximum which showed that no thermal equilibrium was present, therefore, no genuine CTR neutrons were produced in the tokamak.

Optimism for reaching the laser fusion reactor was expressed by Hofstadter when he underlined that the genuine CTR neutrons produced in 1974 had by the end of 1976 increased by a factor 10^4 up to the value 3 x 10^19, and another factor of 10^7 can be expected during the next four years this reading would mean the scientific break-even point for laser fusion. The comparison of results in 1976 with that in 1978 and some projections for the next years can be seen from Table 1 the main part of which was given by Nishikawa.

Though the laser fusion has a better ranking than the tokamaks in the Derby of counting genuine fusion neutrons per input energy, the problems do not look less complicated. This is especially so since the shorter laser pulses now favoured involve highly nonlinear processes within the laser-plasma interaction.

REFERENCES
6. H. Tuczek, Colloq. 16th March, 1979, University NSW.
22. J. D. Lindl et al. ibid.
SIR,

D. C. Sams and I. C. Falconer have concluded in their Nuclear Energy - Attitudes Survey that ‘from the lack of comments on this point we assume that the majority of respondents in favour of mining would not object strongly to the return of spent fuel’.

This particular matter was widely discussed among physicists in Western Australia a year or two ago. One of the points of agreement among those who held widely differing views on the general issue was that spent fuel should not be returned.

The principal reason was that agreement by Australia to accept spent fuel would reduce the urgency of research on better methods of disposal of nuclear wastes.

I am very doubtful of the correctness of Sams and Falconer’s assumption.

E. N. Maslen,
Department of Physics,
The University of Western Australia.

SIR,

In response to the Australian Physicist (AP) of May 1979 concerning the Career Pamphlet to be edited, I would like to contribute the following comments. (A few points below have already been commented on earlier by some AP writers):

1. I have had over thirty interviews by various employers before I got my present job.

2. Interviewers from private industries such as large mining companies do not understand the flexibilities of the post-grad. graduates as indicated by the following conversation:

   I said, “I do not intend to continue doing exactly what I have been doing during my Ph.D. training. I would be most interested to widen my research experiences in other fields of applied science including applied maths.”

   The interviewer said, “You people all seem to be fed up with what you have been doing after spending a few years in specialized research and wanting to do something useful instead.”

   This indicates that they only know that post-grad research is specialized, but which they erroneously think is hence narrow and not directly useful or useable.

   I would like to stress the point that such specialized research always demands sound mastery of general experimental techniques and mathematical methods like statistical inference, optimization, linear algebra and its numerical applications; and most valuable of all, the ability to approach unseen problems.

   In support of this point of view, I would like to present a preprint of my paper in the Diamond Jubilee Conference of the Australian Institute of Engineering, entitled “Groundwater Modelling in Water Resources Planning for The Swan Coastal Plain”. I have adapted myself in this job within a month, after which I have had three to four projects going on at the same time. This paper represents about half man-year of work.

   I enclose herewith also a list of my publications by which I hope to indicate the diversity of my work rather than quality. At the moment I am moving into the field of stochastic hydrology.

   My publications are as follows:


F. H. Yung

SIR,

I am touched by your editorial appeal for humour in physics - a very scarce commodity. It so happens that I have just been introduced to a little piece of pure physics which is both funny and vulgar in compliance with today’s standards. It comes from the skipper of a Japanese ship.

The inside lining of a packet of cigarettes is dual in character, consisting of a sheet of paper bonded to one of aluminium foil. Smooth out such a sheet from an empty packet. It is a rectangle. Across the smaller dimension cut two strips about 20mm wide. Fold these in two, end to end, one with the paper side out and the other with the foil side out. Open them slightly and stand them a little way apart on a smooth surface. (A stainless steel bar top is excellent and probably immediately available at the time.) You now have two standing inverted V’s. You say to the assembled company “These represent two good and faithful wives. Which of them has a headache?” Light a match and slip the flame briefly into the two V’s in turn, the paper-side-out one first.

Pure physics. I do not know how much Japanese research went into this discovery.

Dr. H. H. Macey,
Western Australia.

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The Department of Physics was created in 1968, three years after the Queensland Institute of Technology developed from the Central Technical College. From 1965 to 1968 physics teaching was carried out by the Department of General Studies.

The department has a very important service role in providing units in physics for physical science departments and for building science. In addition, it organises the Bachelor of Applied Science (Physics), Master of Applied Science (Medical Physics), and Associate Diploma courses in Applied Physics and in Diagnostic and Therapeutic radiography. It is also possible to undertake a program leading to a Master of Applied Science by Research. Major facilities incorporated within the department include a radioisotope suite, medical radiography rooms, medical physics laboratories, X-ray and NAA laboratories housing a Philips PW1140 X-ray generator with diffraction and fluorescence facility and Kaman-Nuclear neutron generator respectively. Electronic and mechanical workshops provide support for the Department's laboratory programs.

**Master of Applied Science (Medical Physics)**

The Master of Applied Science (Medical Physics) is a degree offered to students who have completed an acceptable tertiary course to pass degree level. The course extends over two years by full time study, four years part time study, or a mix of full time and part time study. Course work is broad in scope, with an emphasis on activities of current professional importance. It is recognised that medical physics is a dynamic specialty with changing requirements; the content of the program is kept under review to enable changes to be made as required.

In general the topics covered in the course may be considered as falling into the following groups:

(a) Basic topics, e.g. radiation physics, anatomy and physiology, electronics, concepts in biochemistry, computing and data processing.

(b) Specialised topics, e.g. biochemistry, ionizing radiation dosimetry, clinical applications of ionizing radiation, physical measurement of biological parameters, radiation safety, principles of biochemical measurement, case studies and project perspectives, a project, and medical applications of wave physics.

(c) General topics, e.g. genetics, radiobiology, administration and budgeting.

Professionals working in the field are involved in giving lecture/demonstrations relating to specialized equipment and techniques. Efforts are also made to arrange for students to spend periods with hospitals or health departments to gain familiarity with procedures and an appreciation of problems of the medical physicist.

Examples of projects recently undertaken include - "Measurements of ore dust in a uranium mill and their significance in estimates of radiation doses to internal organs of workers"; "Modification of existing M-mode echocardiography system to a sector scanning system"; "A microprocessor application in non invasive cardiology"; "Development of an 8080 base microcomputer system for the real time analysis of blood flow data"; "Design and construction of a multi-rate biofreezer"; "Measurement of pressure distribution created by supports designed to prevent the formation of decubitus ulcers".

The course is arranged such that a student can undertake the formal lecture part of the program in one calendar year. This enables flexibility on the part of both employers and students so that country as well as metropolitan students may be accommodated.

**Master of Applied Science by Research**

The Masters degree by research is administered jointly by the Academic Boards of the Schools of Applied Science and Health Science through a Graduate Studies Standing Committee.

In order to gain entry to a program leading to the Master of Applied Science by Research, an applicant must possess a recognized and appropriate bachelor's degree in science or its equivalent. The expected duration of the program is two years for a full time student and four years for a part time student.

All projects undertaken must be sponsored by either outside agencies (e.g. industry, government authorities), professional organisations or the Institute itself. This provision is an attempt to have students entering into programs of research deemed relevant to the aims of the Institute and the community.

Projects currently being undertaken by students sponsored by the Physics Department include "Design, Development and Clinical Trial of a Novel Arteriography System" and "Measurement of Ages of Sediments using Polonium-210 Fallout".

**Bachelor of Applied Science (Physics)**

The Bachelor of Applied Science (Physics) course is offered as a three year full time course. In addition, some facility is offered to enable students to undertake parts of the course through part time study. The course is accepted by the Australian Institute of Physics as meeting the academic requirements for admission to corporate membership.

The course has been designed to provide students with a sound knowledge of physics and its applications. The emphasis is on the experimental and applied aspects of physics, suitably supported by units in electronics, computing and mathematics, and consequently graduates are well able to cope with problems of an applied nature. The availability of electives enables the student to consider some aspect of applied science (e.g. applied acoustics, astronomy) or to broaden his experience by undertaking other than science units (e.g. management units).

In the second and third years of the courses, projects
are undertaken which give students the opportunity to apply and develop their knowledge of theory and practice, show initiative and demonstrate their scientific approach to the problem. A feature of projects undertaken is that they may frequently form a segment of or are related to a current research program of the Department. Students present both a formal written report and a seminar to staff and senior students. Example of projects undertaken include "Design, construction and testing of a sun follower"; "Investigation of drag reduction in a mixed polymer fibre system"; "A computer study of computer assisted tomography"; "Determination of stress by X-ray diffraction"; "Acoustic detection of biliary calculi"; "Alpha-particle detection techniques and alpha spectroscopy".

Initially the majority of graduates entered the teaching profession, but in more recent times they have been moving to other areas of employment, e.g., medical physics, equipment sales, electronic development, meteorology and industrial physics.

Associate Diploma in Applied Physics

The Associate Diploma in Applied Physics (Physical Techniques and Instrumentation) is a two year full time or four year part time course and is designed to produce graduates with a broad technical background directed toward instrumentation design and use. Such a graduate has a role intermediate between that of the graduate scientist and the trade based technical assistant.

Material covered includes basic physics, chemistry, mathematics, photographic techniques, instrumentation, materials science, process control, workshop practice, vacuum techniques, computing and non-technical subjects (management methods etc.) It is anticipated that this course will become more popular in future, as the community appreciates its usefulness.

Radiography Courses (Diagnostic and Therapeutic Radiography)

The radiography courses are vocational courses at associate diploma level although accreditation at diploma level is currently being sought. The courses are designed to prepare students for immediate employment as diagnostic or therapeutic radiographers on graduation, and also to cope with future developments in the area.

The physics input to these courses involve basic physics (in radiation, mechanics, heat, optics, electronics, electricity and magnetism, properties of matter), radiographic equipment, ultrasonics, radiobiology and protection, radiographic processing etc.

In the past technological developments in radiography have been associated mainly with the X-ray generator and ancillary equipment and have not influenced the practice of radiography unduly; Some drastic changes have recently occurred (e.g., computer assisted tomography) and others are likely. Developments concerning imaging techniques, applications of information theory and increasing emphasis on scientifically based quality control will become of increasing concern to radiographers. The education programs will thus continue to require significant "physics" input requiring varying degrees of sophistication.

Applied Research

The department's applied research activity has gathered momentum over the past few years. The areas of specific interest may be described under the broad headings of "medical physics" and "materials science".

Examples of programs currently being undertaken, either completely internally, or in conjunction with other institutions are:

- Development of an NAA system to undertake in vivo measurement of tissue concentrations of cadmium. The development of a portable system has been undertaken internally and clinical trials will be made in collaboration with the Department of Radiology, University of Queensland.
- Development of an ultrasonic computerised tomography system. This program is being undertaken in conjunction with the Department of Surgery, University of Queensland. The aim is to develop a computerized system to produce two dimensional tomographic images using ultrasound.
- Remote voltage calibration of diagnostic X-ray machines. This will enable the peak operating potentials of diagnostic machines to be determined without expert personnel and expensive equipment being on site. Field trials will be made in collaboration with the State Health Department.
- The estimation of the past and present soil erosion rates on the Darling Downs. The program is being undertaken in conjunction with Griffith University and utilizes caesium-137 and lead-210, to enable an estimate to be made of the areal variation in soil erosion in an upland catchment of the Darling Downs.
- Damage in quartz produced by fast neutron irradiation. This study is hoped to lead to a possible development of a dosimeter suitable for use with neutrons. (Wong, Ellis and Norton 1978).
- Investigation of drag reduction. Large scale test apparatus is being used to assess drag reduction in turbulent flows. A model of flow behaviour will be developed.
- Study of cerebellum calcification — ultrastructure and histochemistry. This program was undertaken in conjunction with the School of Health Science, Queensland Institute of Technology and external agencies. (Saal et al 1978).
- Studies of silica concentration in airborne dusts in mining operations. This program is undertaken in conjunction with the Queensland State Mines Department.
- Study of crystal field effects in titanium from the temperature dependence of integrated X-ray diffraction intensities.

The above examples, while illustrative of the nature of the activities being undertaken, are also indicative of the interaction of the Department with other institutions or parts of the community. A number of the activities have attracted substantial research grants or assistance.

Other Activities

Continuing education activities have always been of
interest to the department. Short courses in electronics have been presented since 1971 (Davies 1974). In more recent times short courses have been offered in experimental physics, principles and practices of noise measurement, medical ultrasonics and fundamentals in science.

The department played a significant role in the development of a course entitled “Electronics for Schools (ELFS)”. This development arose from the enthusiasm of teachers undertaking an electronics short course given, by the Department, specifically for teachers.

Industrial consultancy has provided a valuable means of community interaction. Such activity ranges from technical advice, analysis of specific materials to activities relating to meeting legislative requirements (e.g. noise measurement).

Final Comment

The Physics Department of the Queensland Institute of Technology has a well developed range of activities involving a high level of interaction with the community. Graduates from courses have been very well accepted and have proved through their performance that such acceptance is justified. In order to maintain this interaction, advisory committees largely composed of persons from outside the Institute meet to discuss courses, suggest desirable changes and generally consider and review any associated problems.

References:


New Head of Antarctic Division

Mr. Clarence McCue, head of the Ionospheric Prediction Service, has been appointed Acting Director of the Antarctic Division of the Department of Science and the Environment.

He will take over responsibility for the Antarctic Division at a time when its structure and programs are being reviewed in response to the Government's desire to strengthen Australia's Antarctic activities.

The Antarctic Division maintains Australia's Antarctic stations, organises the Australian National Antarctic Research Expeditions and conducts research programs. It is based in Melbourne, but will move to Tasmania when its new headquarters are completed at Kingston, near Hobart, in 1981.

Since 1967, Mr. McCue has been head of the Department's Ionospheric Prediction Service which helps to maintain long-distance radio communications by issuing predictions of ionospheric conditions and solar flares which affect ionospheric radio systems. IPS is based in Sydney.

Mr. McCue was previously a Senior Research Scientist and Principal Research Scientist with the former Weapons Research Establishment (1960-67). Before that he was Lecturer in Physics at the Royal Military College, Duntroon (1958-60); Scientific Officer and Higher Scientific Officer, Weapons Research Station, U.K. (1951-53); and Scientific Officer, Ionospheric Prediction Service (1949-51).

New Dean,
Faculty of Military Studies, Duntroon

Professor G. Wilson, appointed Dean of the Faculty of Military Studies, Duntroon from 1st November, 1978 has been Professor of Physics at Duntroon since 1971. He previously spent ten years on the academic staff of Monash University. He has specialized in the field of hyperfine interactions.

Professor Wilson is well known for his work in the development of a low temperature cryostat which produces temperatures as low as 0.004 K. One by-product of this research has been to assist towards the development of a gamma-ray laser. Professor Wilson has been actively involved in the plans for Casey University - the Australian Defence Force Academy. (Uniken, No. 20, 1978)

New Dating System Developed

Associate Professor Jack Kelly, of the School of Physics at the University of New South Wales, has developed a method of dating ancient pottery that has been able to detect errors of earlier datings by as much as 800 years. Professor Kelly has also developed what has been widely accepted by the scientific community as the world's best thermoluminescence dating oven. Professor Kelly may be contacted on 662-2093.

Long-range Radio Communications Experiment

Australia and the USA will carry out a joint experiment in very long-range radio communication using the ionosphere as a transmission duct. The experiment will be led by a team from the Department of Defence Electronics Research Laboratory (DERL), Salisbury, S.A. and the Stanford Research Institute, California.

The normal method of HF communication uses the ionosphere to reflect radio waves back to earth, thus permitting transmission beyond the horizon. In the proposed experiment HF radio waves will be injected into the ionosphere and will be confined there as they travel toward a receiving station. At a point near the receiver the ionosphere will be disturbed artificially to deflect the waves down to the receiver. [Engineers Australia, March 23, 1979]

Wide Range Monochromator

A new monochromator (a ½ m unit) with a range of from 180 mm to 20 microns, depending on the grating chosen, is now available from John Morris Australia Pty. Ltd. who market this McKee-Pedersen Instrument. Its range of from the ultraviolet into the infra-red is its main feature and a full range of associated accessories is available.

Computer X-ray Machine is Country's First

A computer X-ray machine which will carry out standard X-ray examinations helped by a computer and diagnose the results in 30 seconds, will be installed in Westmead Hospital, Sydney, in June this year.

The only other machine of this type in the world was recently installed in an American hospital.

The machine, called a whole body scanner, has more than 700 electronic detectors linked to a computer programmed to instantly reconstuct in high detail, three dimensional pictures for diagnosis of any part of the body. The machine contains a bromide camera designed to cut the cost of processing X-ray film from 60 cents an exposure to 7 cents. [Engineers Australia, March 9, 1979]

Scanning Surfaces with X-rays

By adapting conventional X-ray fluorescence analysis equipment, Dr. Gerry Newman of the CSIRO Division of Mineral Physics has devised a surface scanning technique offering resolutions down to a few tenths of microns.

Possible applications include precise measurements on very low density regions of photographic images, mapping variations in the concentration of elements in mineral specimens and measuring thickness variations of surface coatings.

Further information is available from: CSIRO Division of Mineral Physics, P.O. Box 136, North Ryde, NSW, 2113
ERT—Energy Resources & Technology

A copy of this new Australian monthly journal devoted to all aspects of energy and related topics has been received. It is to be the adopted official journal of the Australian Institute of Energy but will not necessarily reflect the views of that Institute.

It is intended that the journal will be up to date in news coverage and carry high technology articles which will be of interest to the qualified membership of the Australian Institute of Physics. Readers who are interested in obtaining a copy should write to: ERT F.O. Box 315, Mona Vale, N.S.W. 2103.

Chief to Head
Two CSIRO Divisions

Chief of the CSIRO Division of Mineral Engineering, Dr D. F. (Kelly) Kelsall, has also been made Chief of the Organisation’s Division of Applied Geomechanics.

The two Divisions, which are part of CSIRO’s Institute of Earth Resources, created within the restructured framework of the Organisation last December, will maintain their separate identities. Both are based in Melbourne, although the Division of Applied Geomechanics also has laboratories in Adelaide, Cobar and Mackay.

Dr Kelsall is recognised internationally for his work in the field of mineral processing. He joined CSIRO in 1959 after a distinguished career in Britain, attained his Ph.D in 1969 and was appointed Chief of the then Division of Chemical Engineering — now the Division of Mineral Engineering — in 1974.

Dr Kelsall’s achievements in the field of mineral processing research have been recognised internationally as recipient of the Richards Award in 1977. This is awarded annually by the American Institute of Mining, Metallurgical and Petroleum Engineers for work involving mineral processing.

New Chief for CSIRO Division of Building Research

An Australian scientist who is regarded as an international authority on concrete construction has been appointed Chief of CSIRO’s Division of Building Research.

The Division is part of CSIRO’s Institute of Industrial Technology, created within the restructured framework of the Organisation last December.

He is Dr F. A. (Lex) Blakey, who has been Acting Chief of the Melbourne-based Division since the retirement in May 1978 of Dr R. W. R. Muncey.

Dr Blakey joined the Division of Building Research in 1949, following post graduate study at Cambridge University which led to his Ph.D in 1949. He had earlier graduated from the University of Western Australia as a Bachelor of Engineering.

He was appointed an Assistant Chief of the Division in 1968, and in 1974 spent two years on secondment to the then Federal Department of Housing and Construction, during the establishment of its building technology and sociology division.

In 1971 he was made a Fellow of the Australian Institute of Building.

Membership of CSIRO Advisory Council

The appointment of twenty-two members of the reconstituted CSIRO Advisory Council was recently announced by Senator Webster, The Chairman is Mr. Victor G. Burley and the Council will be a major source of independent advice to the Executive of the CSIRO. The members appointed include the Chairman of the six CSIRO State Committees which are soon to be established.

The State Committees aim to provide grass roots contacts with industry, centres of education and the community generally. The six State Chairmen are:

Mr. Alexander Boden, company director and science writer, NSW;

Mr. Laurence Brodie-Hall, director of mining companies, W.A.;

Mr. Kenneth E. Gibson, Managing Director and Deputy Chairman A.C.F. and Shirley's Fertilizers Limited (retired), Queensland;

Mr. John Harris, Managing Director, Adelaide and Wallaroo Fertilizers Ltd., S.A.;

Mr. Jan Kohn, Executive Director, ICI Australia Limited, Victoria;

Professor Peter Scott, Professor of Geography, University of Tasmania, Tasmania.

Three-Colour CRT Display Makes Reading of High Information Density Displays Easier

This new three-colour CRT display unit from Hewlett-Packard helps solve the problem of reading high speed, high density information displays. Called the Hewlett-Packard Model 1338A Tricolour Display, the unit is a high resolution, high speed electrostatic display. It is useful in any application where data must be interpreted rapidly, such as in air traffic control and process control. Because data can be colour coded to identify different results, the display is useful in instrumentation, flight simulation and computer-aided design systems.

Nominations for Medals

Nominations for the 1980 Pawsey and Gottschalk Medals close on 30 September 1979. The purpose of the Pawsey Medal is to recognise outstanding research in experimental physics and the Gottschalk Medal recognises distinguished research in the medical or biological sciences. Candidates must be under the age of 36 years at the closing date for nominations, and their research must have been carried out mainly in Australia. Nominations are confidential and should be addressed to: The Executive Secretary, Australian Academy of Science.
Measurement of the Temperature of the Sky

At the CSIRO Division of Mechanical Engineering in Melbourne, solar engineers have devised a simple and extremely sensitive instrument that accurately measures sky temperature. The information is necessary in order to further research into the development of solar-powered systems.

The atmosphere radiates and absorbs thermal energy, but because of its properties it does this selectively, depending on the wavelength of the radiation. As a consequence, the effective temperature of the sky for radiation exchange is usually below that of the air. This cold sky temperature results in frosts on clear nights, even though the air temperature is above freezing. The sky temperature ranges from $9^\circ$ to $20^\circ$ C below ambient under such conditions.

The sensor operates by accurately monitoring incoming solar and thermal radiation and outgoing thermal radiation. An operator can derive the sky temperature from an equation linking the measurements with three experimentally derived physical constants.

Information is available from: CSIRO Division of Mechanical Engineering, P.O. Box 26, Highett, Victoria, 3190.

Compact Portable 100MHz Storage Oscilloscope

Philips has produced a new 100 MHz PM3266 storage oscilloscope which uses a transfer charge tube system to provide high writing speeds up to 1000 div/US with display over the whole screen. Storage time at maximum speed varies from 15s to one hour, depending on intensity. Autoerase and variable persistence facilities are also provided and much effort has been put into ensuring that the controls are as simple as possible. Further information is available from Philips Test and Measuring Instruments, 27 Paul St., North Ryde, NSW.

CONFERENCES

Physiological Measurement Symposium
The Australian Sports Medicine Association and the Society of Medical and Biological Engineering are jointly sponsoring a Symposium to be held in Brisbane from 15-16 November, 1979. Sessions will include the following fields of interest: Muscle Physiology; Stress Testing; Transducers; Clinical recording, analysis and display; Biotelemetry; Cryotherapy; Electrotherapy; Ultrasonic Diathermy; Biofeedback; Standards and Safety.

Information is available from Mr. J. F. Whiting, C/- Department of Physics, Queensland Institute of Technology, P.O. Box 2434, GPO, Brisbane, 4001.

Australasian Engineering Education Conference
Brisbane, September 17-19, 1980. The Conference will be directed towards an analysis of the changes occurring in society and engineering practice, the impact of future developments in the Pacific and South East Asian region and the influence that such changes will have on engineering education.


10th International Congress on Acoustics

19th Conference on Physical Sciences and Engineering in Medicine and Biology
Sponsored by Australian College of Physical Scientists. 13th—17th August, 1979, Sydney University.

Dr. L. A. Geddes of Purdue University, Indiana, USA will be Guest Lecturer and will speak on topics in electrophysiology. For further details contact Dr. R. W. Gill, P.O. Box R999, Royal Exchange, 2000.

AUSTRALIAN SCHOOL OF NUCLEAR TECHNOLOGY
LUCAS HEIGHTS, N.S.W.

RADIOISOTOPE COURSE FOR NON-GRADUATES NO. 26
Will be held from 12 November to 7 December 1979

The objective of the course is to assist personnel below graduate level to gain understanding and proficiency in isotope 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 fee for the course, exclusive of accommodation, subsistence and fares, is $375.

The number of places at the course will be limited and those wishing to take the course should write to: The Principal, Australian School of Nuclear Technology, Private Mailbag, Sutherland, NSW, 2232. Telephone 531 3071, to whom all enquiries in respect of the course should be addressed.

The closing date for receipt of applications is 2 October, 1979.

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BOOK REVIEWS

Reviewed by Dr. I. M. Bassett, Senior Lecturer in Physics.

This work describes a new development in geometrical optics; something new under the sun. It has been stimulated by the search for more effective solar energy.

Nonimaging optics is concerned with the efficient transport of light from one place to another in the four dimensional space which light inhabits – that is, from one surface and range of directions to another.

The leading theoretical principle is the invariance of the brightness (power per unit normal area, per unit solid angle) in a medium of constant refractive index, along a ray. If the entrance aperture of an optical concentrating system is illuminated with uniformly bright light, in a given range of incident directions, the greatest power at the exit aperture is attained if every point is illuminated in every outward direction. The invariance of the brightness thus sets an upper limit on the attainable concentration.

Nonimaging optics exhibits some collecting systems which attain this upper limit of concentration, and others which nearly do. Their performance is superior to that of earlier concentrating systems based on image-forming ideas. Applications include reflectors for fixed solar collecting tubes, where in practice concentration by a factor of about 6 may be attained; reduction of signal to noise ratio in an infrared telescope by an effective reduction in the area of the image; optically pumped lasers; collection of Cerenkov light in high energy particle physics experiments.

The same principles which apply to the collection of light apply to the complementary problems of light emission, when for example an absorbing tube is replaced by a fluorescent tube; there are potential applications to domestic and industrial lighting.

The book results from a collaboration between Roland Winston, physicist, of the University of Chicago, the chief architect of the subject, and Walter Welford, Professor of Applied Optics, Imperial College, London. The work is a masterpiece of non-pompous exposition.

Reviewed by J. R. Shepanski, Department of Theoretical Physics, School of Physics, The University of New South Wales, Kensington NSW.

This is a collection of twenty conference papers delivered in 1977 in New Orleans by a group of physicists and mathematicians, attempting to answer the "incredibly important and difficult . . . quantum question", in response to the 1908 exhortation by Einstein (in his letter to J. Laub).

Of the twenty, two are both important and readable. The first of these is the opening address by Dirac, asking that new physical or philosophical ideas be fitted to sound (and elegant) mathematical schemes rather than the other way round. Pointing to the natural inflexibility of mathematical theories, as contrasted with the (relative) pliability of conceptual constructs, he describes his current efforts at fitting relativistic Quantum Mechanics of its renormalization difficulties as an example of this.

Another notable paper is one by Wheeler, discussing complementarity in terms of certain variants of the "double slit" thought experiment. As expected, the analysis is lucid, thorough and thought-provoking. The conclusion reached is then summarized in his final words: "no phenomenon is a phenomenon until it is an observed phenomenon". – No doubt: game, set and match to operationalism.

The main concern of the remaining papers is the setting up of an, often tentative, logical and mathematical framework to support an axiomatic formulation of Quantum Mechanics. Readers, to reap any benefit, will require some acquaintance with orthomodular structures, Boolean lattices, partially ordered sets (posets) and manuals. Gone are the days when knowledge of separable and non-separable Hilbert spaces, plus some set theory constituted an adequate preparation for dealing with fundamentals of Quantum Mechanics.

Reviewed by J. R. Shepanski, Department of Theoretical Physics, School of Physics, The University of New South Wales, Kensington NSW.

In this intellectual journey through the history of the development of physical concepts of space and time, Geroch sets out to examine some representative views within the modern framework of concepts of events, world-lines, world-surfaces etc.

In Part A (The Space-Time Viewpoint), he moves from the philosophical, Aristotelian view, on which characterization of an event is in terms of spatial coordinates and time of occurrence, identical for all observers, to the, more physical, Galilean view which allows for differences in spatial coordinate characterizations by observers in mutual relative motion, while still requiring them to assign to the event the same time. This view, however, also has to be abandoned, as it gives results at variance with observations.

In Part B (General Relativity) re-examines basic meaning of space and time and ushers in the idea of the interval. With its help, Geroch deftly guides the reader through the Space-Time Geometry view of Special Relativity and explains how gravitation "curves" the space-time. He then introduces the fundamental principles of Einstein’s theory of General Relativity. An exciting discussion of the example of a Black Hole well illustrates use of these principles.

All this is done simply, without need of mathematics other than elementary algebra and Pythagoras’ theorem. Numerous (ninety-eight) informative diagrams ably complement the text.

While this book is intended for non-science undergraduates, it should prove very valuable didactically and will find its way onto bookshelves even of some experts.

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