An Analysis of Physics Honours Students' Examination Results and Careers Undertaken—
J. H. Noon .................................................. 171

Election to Honorary Fellowship—Dr. H. R. Lang 173

Seeing out of our Motor Cars—P. J. Eccles .... 175

Book Reviews .............................................. 180

Books Received ......................................... 182

On Walkabout ........................................... 182

Notes and News ........................................ 183
You may seldom use its full performance — you will constantly exploit its versatility!

MARCONI INSTRUMENTS
SOLID-STATE
MF/HF AM SIGNAL GENERATOR
Type TF 2002

Once you are convinced that frequency, carrier level and modulation depth need not be interdependent... when you can flip the a.m. on and off without re-setting anything... when your signal generator remains tuned for hours without a tweak, yet tests are made so rapidly that stability scarcely matters... then you tend to become inventive. External shift facilities tempt you to use the TF 2002 as a sweep generator. Don’t resist the temptation. You devise a new way to measure deviation with an a.m. instrument, and a quicker way to measure bandwidth. Go ahead—the TF 2002 is intended for people like you. No other single commercially available equipment combines the wide carrier frequency range, output facilities, modulation characteristics and all-round performance and versatility of Marconi Instruments MF/HF AM Signal Generator Type TF 2002.

SPECIFICATION

* Carrier frequency 10 kc/s to 72 Mc/s in 8 ranges
* Discrimination of the order of 0.005% of carrier
* Crystal calibration 1 Mc/s, 100 kc/s and 10 kc/s, also 1 kc/s check points
* Output 0.2 µV to 2V r.m.s.
* Attenuators 140 dB in 1 dB steps
* AM up to 100% depth. Internal oscillator 20 c/s to 20 kc/s
C.S.I.R.O.

DIVISION OF CHEMICAL PHYSICS

APPOINTMENT OF SECTION LEADER, INSTRUMENT SECTION

**SALARY:**
Principal Research Scientist, £3,885-£4,485 p.a., or Senior Principal Research Scientist, £4,690-£4,840 p.a.
Salary rates for women are £201 p.a. less than the corresponding rates for men.

**LOCATION:**
Clayton, Melbourne, Victoria.

**GENERAL:**
The Division of Chemical Physics, a component of the Organisation's Chemical Research Laboratories, undertakes fundamental research in the fields of spectroscopy, crystallography and solid state chemistry.

**DUTIES:**
As leader of the Division's Instrument Section, present staff complement of twenty, the appointee will be responsible for a continuing programme of instrumentation research and development. Some projects are initiated within the Section, while others are developed in collaboration with other members of the research staff of the Division. He will also be responsible for effective operation of the present services provided by the Section. These include a design drawing office and machine, electronic, glassblowing and optical finishing shops.

**QUALIFICATIONS:**
Applicants should have a Ph.D. degree, either in Science with Physics as a major subject, or in Mechanical or Electrical Engineering, or have had postgraduate research experience of equivalent standard and duration supported by satisfactory evidence of research ability. Considerable experience and evidence of substantial contributions to the scientific instrument field will be required from the applicant.

Applications, quoting reference number 582/4, and stating full name, place, date and year of birth, nationality, marital state, present employment, details of qualifications and experience, together with the names of not more than four persons acquainted with the applicant's academic and professional standing, should reach:

The Chief,
Division of Chemical Physics,
C.S.I.R.O.,
P.O. Box 160,
CLAYTON, VIC

by 20th December, 1965.
New Wiley Books

THE PHYSICAL PRINCIPLES OF MAGNETISM
By Allan H. Morrish
University of Minnesota
680 pages, 8½” x 6”, £8.50.

An extensive treatment of the magnetic properties of matter, especially in the solid state, this book presents both microscopic and macroscopic experimental and theoretical viewpoints. Diamagnetism, paramagnetism, ferromagnetism, ferrimagnetism and antiferromagnetism are covered in an integrated manner—unifying subject matter from physics, chemistry, metallurgy and engineering.

PLASMA PHYSICS
By J. L. Delcroix
Faculte des Sciences de Paris
366 pages, 8½” x 5¼”, 60/-

Intended for research students and others entering the plasma research field, this book is distinguished from many others in the same field in that the text is firmly based on physical principles while mathematical clarification can be found in the appendices. It lays special emphasis on the relations between microscopic and macroscopic descriptions of plasma, but also describes a wide range of plasma properties.

HIGH ENERGY BEAM OPTICS
By Klaus G. Steffen
Deutsches Elektronen-Synchrotron, Hamburg
211 pages, 9” x 6”, illustrated, 95/-

InterScience Publishers

A comprehensive guide and working aid to both the basic concepts of high energy beam optics and the tools and methods for practical beam and spectrometer design work. Includes such topics as non-linear aberrations, nondegenerate and isochronous deflecting system, slotted window spectrometer, beam envelope formalism, fast analog computer method and acceptance of momentum and mass separators.

PROBLEMS FOR COMPUTER SOLUTION
By Fred J. Gourley
The Rand Corporation
and George Jaffray
Associate Professor of Mathematics
Los Angeles Valley College
401 pages, 9” x 6”, paper bound, 45/-

Presents 92 provocative problems taken from a broad range of disciplines. They are attacked from the point of view of computer solution and answer such questions as: What is the logic involved? Is this an easy problem to program for a computer? How shall we make this statistical test with a computer?

From all Booksellers
JOHN WILEY & SONS
AUSTRALASIA PTY. LTD.
102 Alexander Street, Crown’s Nest, N.S.W.

Australian Institute Of Physics

PRESIDENT:
Mr. F. J. Lehany

VICE-PRESIDENT:
Dr. A. Walsh

HONORARY REGISTRAR:
Dr. J. S. Dryden

HONORARY TREASURER:
Mr. G. A. Bell

HONORARY SECRETARY:
Mr. A. F. A. Harper

The Australian Physicist

Editor: Dr. J. L. Symonds.

C/- A.A.E.C.R.E., Private Mail Bag, Sutherland, N.S.W. Telephone: 531-0111
523-2147 (after hours)

Advertising Manager:
Mr. J. T. O’Mara
P.O. Box 37, Potts Point, N.S.W. Telephone: 35-6191

Branch Correspondents:
A.C.T.—Dr. A. J. Mortlock, N.S.W.—Mr. C. E. Curnow,
South Australia—Mr. C. G. McCue,
Victoria—Dr. C. R. Coogan,
W.A.—Dr. B. S. Crisp,
Manuscripts and correspondence relating to the editorial content of The Australian Physicist should be sent to the Editor. Copy deadline—21st of month prior to the month of issue. Advertising space instructions and/or copy should be forwarded to the Advertising Manager.

Annual Subscription:
The Australian Physicist is issued to Members, Students and Subscribers of the Australian Institute of Physics. For non-members, the subscription is £1/16/- per annum; single issues are three shillings per copy.
An Analysis of Physics Honours Students' Examination Results and Careers Undertaken

J. H. Noon

Physics Department, University of Queensland.

INTRODUCTION.

Over the last six years at the University of Queensland, there have been a number of changes in content of both undergraduate and honours courses in Physics. Students enrolling for honours physics will, from now on, be given entirely separate lectures from the ordinary pass degree students. It will thus no longer be possible to directly compare the performance of honours and pass students taking the same courses and same examinations. However, a study of past examination records over a number of years does allow such a comparison at this time. In addition, Dr. J. Crouchley has recently completed a survey of careers entered into by past honours graduates in Physics from the University of Queensland and these results are included in this article. It is hoped, therefore, that this material will be of general interest to Australian physicists.

COMPARISON OF PHYSICS III AND PHYSICS I RESULTS.

Between 1956 and 1964 a total of 292 students majoring in Physics sat for Physics III. 83% of these passed and 52% of those who passed gained a Credit or Distinction*. 59% of the students sitting for Physics III had previously gained a Credit or Distinction in Physics I.

The Physics III failure rate was highest for those who had poor grades in Physics I, being 36% for those with a Pass grade in Physics I and only 8% for those with a Credit or Distinction in Physics I. 20% of all students sitting for Physics III had previously failed one or more years.

It is also possible to compare Physics III and Physics I examination results for individual students, rather than the average results of different groups.

A sample of 181 Physics III students in the years 1960-1964 was taken for this comparison. 3% of these students increased their grades of Pass between Physics I and Physics III, 30% with a Credit or Distinction in Physics I passed with a lower grade in Physics III, and 18% with a Pass grade in Physics I failed Physics III.

COMPARISON OF PASS AND HONOURS STUDENTS.

30% of those who passed Physics III over these nine years undertook the Honours Physics course, and the majority of these sat for the Honours Examination two years after completing their undergraduate work. Between 1956 and 1962, 57 students took the Honours Examination. Of these 89% had a Credit or Distinction in Physics I and 76% had a Credit or Distinction in Physics III. These are significantly higher than the average figures for all students taking Physics III, of 59% and 52% respectively.

32% of the Honours candidates gained First Class Honours in Physics, and of these 84% had a Distinction in Physics I, but only 39% had a Distinction in Physics III. All First Class Honours students had Credits or Distinctions in Mathematics I, but only 66% had Credits or Distinctions in Mathematics II. Both these figures are higher than those for the Second Class Honours students of whom 83% had Credits or Distinctions in Mathematics I and 52% had Credits or Distinctions in Mathematics II.

EFFECT OF CHANGES IN STANDARDS OF COURSES.

(a) All Students: More information can be obtained by dividing the nine years into three separate periods. This allows an evaluation of the effect of the changes in course content and type of examinations which have occurred over the nine years.

The results are shown in Table I.
| Third Year | Number of | % Passing | % with Credit | % with Credit | % Failing |
| Classes | Phys. III | or Distinction | or Distinction | or more years | of course |
| Considered | Students | in Physics III | in Physics I | of course | in Physics I |
| 1962-1964 | 99 | 73 | 25 | 66 | 26 |
| 1960-1961 | 92 | 78 | 47 | 79 | 18 |
| 1956-1959 | 101 | 98 | 75 | 83 | 16 |

Table I: Comparison of Examination Grades over three separate periods for Physics III students.

The percentage of students gaining Credits and Distinctions has fallen both in Physics III and in Physics I, but most markedly in Physics III. The percentage of candidates passing Physics III has fallen and the total number of students sitting for the examination has decreased. Whether these two points are correlated is difficult to establish and it would be of interest to know whether this is a general trend in all Australian universities.

As reflected by the examination results, changes in the Physics syllabus over the years have not been as great at the First Year level as those at the Third Year level, where both the amount of material and the mathematical content of the course have been substantially increased. The altered standards have had their effect not only on the Pass Degree candidates, but also on the Honours candidates, as shown in the next section.

(b) Honours Students: To consider the effect of changes in course content and type of examinations on Honours students alone, they too, have been divided up into three separate groups. Since different numbers of students are involved the significance of smaller samples may be open to question, but consistent trends are clearly indicated.

The percentage of Honours candidates with Credits and Distinctions in Physics III has fallen more than the percentage with Credits and Distinctions in Physics I. Looking at First Class Honours candidates alone, the same trend is shown. Between 1956-1959 there were 50% with Distinctions in Physics III and 83% with Distinctions in Physics I. Between 1960-1962 the corresponding percentages are only 29% and 72% respectively.

The percentage of candidates gaining First Class Honours has fallen also, from 39% in 1956-1959 to 23% in 1960-1962, but it is important to emphasise that, since 1961 a new classification of Honours degrees has been instituted in the Science Faculty. Instead of only two grades of Honours, First and Second Class, there are now three grades, First, Second and Third, and Second Class awards may be Division A or Division B. A candidate awarded Second Class Honours, Division A, may have been eligible for First Class Honours under the old scheme, so no direct comparison is possible over different periods.

The amount of material and the mathematical content of the Honours course has also grown over the years. An unfortunate side effect of this increase in standards appears to be the fact that the average number of Honours students per year has stayed almost constant, in spite of the growth in university enrolments over these years. This is a disturbing state of affairs. It is hoped that the new system instituted, with a completely separate Honours course in Physics, will stimulate and encourage students, and ultimately lead to a greatly increased number of postgraduate students.

CAREERS UNDERTAKEN.

A survey of the 72 Queensland Physics Honours graduates over the period 1948-64 shows that their present (1965) occupations may be divided as indicated below:

* Students who took an M.Sc. qualifying examination have not been included in these statistics.

| Third Year | Number of Phys. III Students who passed | Number of Honours Students | % with Credit or Distinction in Physics III | % with Credit or Distinction in Physics I |
| Classes Considered | | | | |
| 1963-1964 | 47 | 17 | 47 | 71 |
| 1960-1962 | 98 | 26 | 50 | 83 |
| 1956-1959 | 98 | 31 | 75 | 85 |

Table II: Comparison of Examination Grades over three separate periods for Honours Physics students.
1. University positions in Australia .......... 21
   (teaching and research)
2. Enrolled for further study ............... 20
3. Commonwealth Departments ............... 21
4. Overseas postgraduate work .............  9
5. Secondary School teaching ...............  5
   (local and interstate)
6. Industry and research in industry .......  3
7. Foreign nationals teaching in own 
countries ..................................  2
It should be noted that items 1 and 2 and items 2 and 4 are not mutually exclusive categories. 43

of these 72 Honours graduates enrolled for Ph.D.
degrees, 29 at an Australian university and 14 at 
overseas institutions. Item 3 includes A.A.E.C.,
A.N.A.R.E., Bureau of Mineral Resources,
C.S.I.R.O., Bureau of Meteorology, P.M.G.,
R.A.A.F., and W.R.E.

Although the numbers are not as large as those 
referred to by Caro (Caro, D. E. (1964), The 
Australian Physicist 1:51), they may well be of 
interest to all Australian physicists. Similar evalua-
tions from other universities could provide further 
information.

AID THAI SCIENCE

Members clearing their bookshelves of unwanted 
sets of periodicals might consider giving them to 
a science library just being built up in Bangkok.
An associate of the Institute, Mr. F. G. Nicholls,
who played a prominent role in the formation of 
the Institute, is spending six years in Thailand to 
supervise the setting up of an Applied Science 
Research Corporation of Thailand, to advise and 
help with the many scientific problems that face 
this developing country.

Another of his tasks has been to set up a 
National Documentation Centre, to include a 
central scientific and technical library. It will 
provide, for the first time, access to presently 
published literature for people in the Universities 
of the Bangkok area. So far, however, the library 
has not been able to get pre-1965 issues, and 
would make good use of any sets of journals that 
members may wish to donate. In the case of more 
than one set reaching him, Mr. Nicholls assures 
me that he will pass them on to other needy 
libraries in the Bangkok area.

However, to avoid sending him too many repeat 
copies I suggest that members might contact me 
at the C.S.I.R.O. Division of Physics first, and let 
me know which journals they wish to contribute, 
so that it can be arranged to mail the necessary 
sets to Mr. Nicholls.—G. K. WHITE, National 
Standards Lab.

Dr. H. R. Lang

Election to Honorary Fellowship

The ceremony of presenting to the Institute of 
Physics and The Physical Society the furniture 
donated by the Australian Institute on August 18 
was made the occasion for announcing the election 
of Dr. H. R. Lang, Secretary of the Institute of 
Physics and The Physical Society, to Honorary 
Fellowship of the Australian Institute in recognition 
of his services to physics and to the Australian 
Institute of Physics. Dr. Lang thus becomes the 
Institute's fourth Honorary Fellow, joining others 
who have contributed notably to the organisation 
of physics in Australia: Prof. A. D. Boss, Dr. G. H. 
Briggs and Dr. J. S. Rogers, all office-bearers of 
the Australian Branch of the British body of which 
Dr. Lang has been Secretary for the past 33 years.

All who had cause to have dealings with the 
British body will have some appreciation of the 
credit due to Dr. Lang for his present standing and 
all who were personally involved in the develop-
ments which ultimately led to the formation of the 
Australian Institute will know that Dr. Lang was 
convinced of the desirability of this move long before 

the majority of Australian physicists had come to 
the same view and, in fact, that he did everything 
within his power to ensure the successful establish-
ment of the Australian Institute.

Dr. Lang's contributions to physics are not limited 
to the administration of one of its leading profes-
sional societies. Born in 1904, he was educated at 
Haberdashers' Aske's Hampstead School and the 
Royal College of Science where he graduated with 
honours in physics (1924). His first research 
under the late Professor Callendar on the specific 
heats of liquids gained him his Diploma of Imperial 
College and, in 1927, his Ph.D. (London). Subse-
sequently Lang took up a research Fellowship of the 
Institute of Petroleum Technologists to study the 
thermal properties of oils.

Lang's association with the British Institute of 
Physics could not be longer: he was present at the 
inaugural meeting in 1921 and was, he believes, 
the first student admitted.

In 1931, during Lord Rutherford's presidency 
of the Institute, his secretaryship suddenly became

THE AUSTRALIAN PHYSICIST, NOVEMBER, 1965  173
vacant and Dr. Lang was invited to act temporarily. He was confirmed in this position in 1932. In addition to his duties with the Institute of Physics he was senior Executive Officer of the Physical Society and of the Optical Society and as such saw through the amalgamation of the Optical Society with the Physical Society in 1932 and subsequently, in 1960, the amalgamation of the Physical Society with the Institute of Physics.

As Editor of the Journal of Scientific Instruments from 1931 he was responsible for the inauguration of the British Journal of Applied Physics and was Editor of both publications until 1960. He has represented the Institute on many bodies and is currently the Honorary Treasurer of the Parliamentary and Science Committee, which is a non-party body of parliamentarians, scientists and technologists, the object of which is to keep members of both Houses informed on scientific and technical matters.

Perhaps Lang's undeniable interest in Australian physics stems from the fact that early in his research career he was offered appointment at Melbourne University by the late Professor Laby for work with the late Professor Hercus, but was persuaded by Callendar to continue his work in London. It is intriguing to wonder whether Lang would have done more or less for Australian physics had he accepted appointment here than he has done working on our behalf in London!

Dr. Lang's first intimation of his election was when our Vice-president, Dr. Alan Walsh, read a letter from the President at the furniture presentation ceremony. In acknowledging his election, Dr. Lang indicated that it had indeed come as a complete surprise to him and said how deeply moved he was by it. He stated that he regarded it as a privilege to be able to lead a team which did its best to serve physics and physicists and in particular to have been able to help in a modest way with the establishment of the Australian Institute from the Australian Branch of the Institute and Society.
Seeing Out of our Motor Cars

P. J. Eccles

School of Physics (R.A.A.F. Academy), University of Melbourne.

1. ALLEGORY

The physicist was paying his fine. It was a lot, that five quid, but it wasn't much when you consider he ran into a cop. He didn't know that the old car was being driven by a policeman. In fact, he didn't see the car until it swelled up terrifyingly from behind his blind-spot. He didn't take to driving deliberately at other cars, but the magistrate fined him as if he had deliberately run the old Essex down.

But his irritation couldn't overcome the nagging fear that he didn't understand the real cause of the accident. That blind-spot? How could you possibly fit an old Essex behind the windscreen pillar of a modern car? With binocular vision operating, the eyes together could see the entire forward hemisphere. Real ocular blind-spots and the nose modified this a little, but there was no convincing reason why he, allegedly skilled in observation, should not have seen the old car. Peripheral vision, which evolved as a safety device to warn man of movement out of his direct line of sight, must have been working.

That was the clue. He turned and walked away with a lighter step.

2. COLLISION COURSE GEOMETRY

Let us suppose that there has been a collision between two point particles, A and B. Figure 1 shows that at any short time t prior to the collision, particle B is at an angle \( \theta \) to \( v \), the velocity of A.

Generally, therefore, if two particles are on a collision course, both the azimuth and elevation of one particle measured from the other (relative to its velocity) remain fixed. This is well known by those who investigate aircraft collisions.

Motor vehicles are not points, but the difference is unobservable by drivers, except in the terrifying short time before collision when the colliding vehicle appears to expand rapidly in solid angle. In any case, if there is a collision, there will be two points on the respective vehicles for which the above statement is true. Azimuth only is involved since elevation, measured from the road surface, is constant and usually near zero.

3. PERIPHERAL VISION AND COLLISION PREVENTION FOR THE CYCLIST

Peripheral vision, a product of the eye-brain combination, decides whether or not a dangerous object, out of the direct line of sight, is visible (observable).

Peripheral vision depends, to a large extent, on the motion of an object in these positions.

A cyclist fills his peripheral field of view with moving objects. To him, the landscape, the trees, other vehicles, signs, houses, etc., are all moving past him. His peripheral field of view is full of objects which attract attention since they are easily observed by the rods in his retina (the photosensitive peripheral retinal cells which are particularly sensitive to movement). He knows that these objects are not dangerous and he quickly accustoms himself to ignoring them completely. He looks ahead and alerts himself to movement relative to the road in his direct line of sight, such as pedestrians walking to the edge of the road, other traffic and changes in road direction.

But his most dangerous objects are in his peripheral field of view, where he is ignoring perception. What is worse, an object in his peripheral field, which will collide with him, is quite stationary in azimuth, and therefore would be most difficult to perceive even if he were concentrating on his peripheral field.

Yet he can see these objects if he has trained him-

---

Figure 1.
self to use his peripheral field in the inverse way to that in which its use has evolved. We will consider this phenomenon using lights on a telephone switchboard as analogous to peripheral sensation of movement. A light appears on the board whenever movement is detected by the peripheral rods, and otherwise there is complete darkness.

Figure 2.

Figure 2 shows how a single movement in a stationary field, around a stationary person, is easily perceived. The single light immediately attracts attention.

The much less marked difference between Figure 3(a) and 3(b) shows how a cyclist might easily ignore the one dangerous object (stationary, therefore light off) in his field of view. As a first postulate, for the case of Figure 3(b) his other senses could come to his rescue. He could hear the object in its approach and take evasive action. But, deaf cyclists may be no more accident prone than other cyclists.

Let us postulate, then, that a person can train his eye to operate in the inverse sense in the peripheral region, that his eye can be trained to reject all moving objects as of no interest and to respond immediately to a stationary object. This could happen if the person is sufficiently convinced that this one stationary object could be dangerous, and is not harmless, which is what his eye-brain combination would normally assume.

This is particularly easy to do if the objects are moving at the same angular rate. One stationary soldier in a battalion of other marchers is easy to detect.

A cyclist, with his eyes trained in this manner will assess such an object as dangerous and apply corrective measures.

4. PERIPHERAL VISION AND COLLISION PREVENTION FOR THE MOTORIST

Why has all of this space been given to the cyclist? The cyclist has a complete field of moving objects while the motorist, unless he is in a sports car with no windscreen, has surrounded himself with an array of stationary objects that are not dangerous. These are his windscreen, windscreen pillars, draught deflectors (front quarter-lights), quarter-light pillars, rear vision mirror, side win-
is full of moving objects, which are not dangerous, on which is superposed a field of stationary objects which are not dangerous, Figure 4(a).

This is a most confusing situation and the eye cannot handle it unaided.

If an object approaches the car on a collision course it will only add one point to the stationary field (Figure 4(b)). One more light will go out. The eye has no chance of perceiving this one extra stationary point in its peripheral field, added to the enormous multitude of self-inflicted stationary points due to the motorist's being inside a vehicle.

Why are there not more collisions? The answer is twofold. Motorists are aware that vehicles on collision courses can only come out of intersections, and therefore they take great care at intersections. Secondly, the experienced motorist keeps his head moving near such intersections so that the objects in his vehicle are no longer stationary with respect to his eyes and he is in an environment rather like that of the cyclist. With forward and backward head movement, the pillars, glass, labels, etc., all appear to move relative to his head but any object on a collision course with him appears stationary, see Figure 4(c). If his peripheral vision is working in an inverse manner he will be able to spot this one stationary object in his field of view, recognise that this object is dangerous and apply corrective measures without even deflecting his attention from the road ahead.

Some time ago a motoring correspondent for a Melbourne newspaper wrote an article on the correct method of driving motor vehicles. He obtained material for this by accompanying two police officers on a tour of the city and of the proving ground at Broadmeadows. He reported, among other things, that he had never been driven so safely and that the police officer perpetually moved his head. Some of this may have been forward and backward (without turning) head movement.

The above simple pictures for the motorist and cyclist are complicated somewhat if the horizon, or distant landscape, is visible. This is stationary in the field of view of the traveller and therefore contributes to the stationary field, but is not dangerous. It is a further task, for the eye to detect objects on collision courses, with the horizon as a confusing stationary background.

5. OPTICAL ILLUSIONS IN THE PERIPHERAL FIELD

The eye-brain combination can easily be mistaken. Everybody is aware of the existence of optical illusions. Usually these involve a mistaken judgement about some phenomenon in the direct line of sight. Is a certain geometrical figure a circle, another a square? These figures are placed in the direct line of sight for these judgements, and they are invariably superposed on a geometrically regular background which apparently distorts the figures.
double lines on this part of the circuit indicate that the driver must not cross over them.

An optically good (not necessarily perfect) mirror is mounted vertically, and at an angle $\phi$ to the track, but does not cross the double lines. The driver will always be on a collision course with his own image, and if he does not cross the double lines there is no chance of an accident. He would be unable to appreciate that the other car was his own image and would react in the same way as he would to any other near accident.

Good drivers, police officers, taxi drivers, driving instructors, etc., should be used and, of course, given only one run at the course. They should use their own vehicle, or one with which they are completely familiar, and a device should be fitted to the vehicle, as is done in journalists' road tests of cars, to show when the brakes are first applied. The car's speed should be 35 m.p.h. at this point.

The author predicts that for $\phi = 45^\circ$, cars with no quarter-lights and their window wound down would have their brakes applied further from the point of collision than those of other cars, window wound down or not.

The medical effect of a sudden shock to a motorist could be investigated under controlled conditions at the same time. Other experiments could be done to evaluate the effect of breaking up the peripheral field into many pieces by attaching various fittings to a test vehicle.

Recommendations, like those of Section 6, above, would be the result of such an experiment, but they would carry more weight since they would be based on sound experimental results.

8. REFLECTIONS

The query might arise, why hasn't this been investigated in the U.S.A. or in other countries? First, the work may have been done, but the author is unaware of it. If it has been done it has not been reflected in altered design of motor vehicles. Even France which produces the Citroen, Peugeot 404 and Renault R9 without quarter-lights, produces a larger range of cars with quarter-lights. In the U.S.A. the give-way rule is the same as in Australia. But traffic on the right is observed through the windscreen by a driver on the left hand side of the car. There is no overwhelming confusion caused by nearby stationary objects, as there is in Australia, and the colliding vehicle, expanding in solid angle as it approaches is more easily detectable (than it is in Australia) by peripheral vision operating in the normal way, that is, sensitive to movement. The undesirability of quarter-lights from the Australian point of view may never have occurred to U.S. designers.

In Australia, the whole nearby field is broken up by bits and pieces and no clear view is given of traffic on the right which must be seen by the motorist for the law to be obeyed. As mentioned above, the experienced motorists can combat this to some extent, but he clearly needs assistance from the motor car industry, who should re-design their vehicles so that drivers are no longer handicapped in their desire to be law-abiding.

There is no point in having good brakes, good steering, excellent lights, etc., if cars do not provide the best possible visibility in dangerous directions. Accidents can only be prevented by the driver seeing (as a prerequisite) another vehicle on a collision course so that he can then take preventive action.

---

**Book Reviews**


Reviewed by Professor H. S. Green, University of Adelaide.

Most books on optics have something to say about both (rigorous) wave optics and geometrical optics, but the reader concerned with the applications will be conscious of a sort of gulf between them. It is known that geometrical optics works quite well in most situations, but is only an approximation to which sometimes important corrections are needed. It is known also that Maxwell's equations provide, in principle, the correct solution to every problem, but that where the geometry is at all complex, the exact solution is prohibitively difficult. However, the methods by which approximate solutions of Maxwell's equations can be obtained, as tractable as, and often in substantial agreement with, those provided by geometrical optics, are not yet widely known. These methods, due in great measure to R. K. Luneburg, are explained in detail for the first time in book form by Kline and Kay. The result is a very useful work of reference.

There is just one chapter setting out the basic facts about Maxwell's equations, following which the application to geometrical optics is broached immediately. In the third chapter we are already confronted with anisotropic media, and thereafter the general methods are developed for dealing with systems of arbitrarily complex geometry. At first sight, the book looks severely mathematical, but the reader will find that this is because almost no step is omitted and that it is not unduly difficult to read. In the later chapters, where the material is less familiar, there is plenty of discussion, and the physicist who is interested in a specific application should not have too much trouble in locating and understanding what he needs.

At a time when few authors seem to afford the trouble to write a scholarly text, this book is a meritorious exception. It is well printed and bound, and will retain its value for some time to come.


Reviewed by Associate Professor F. Gutmann, Physical Chemistry Department, University of New South Wales.

These are reprint collections — nothing more and nothing less. As such, they cover the work of the Chicago Group, directed by Mulliken, between 1949 and 1964. The first mentioned collection contains 21 papers, all but three of which were originally published in the Journal of Chemical Physics. The second volume comprises 35 papers, 25 having appeared in that Journal. The 'non-JCP' papers fall into two groups: those which appeared in journals readily available everywhere, like the Journal of American Chemical Society, and those published in less widely distributed media, such as the Lowell Observatory Bulletin. The three 'non-JCP' in the first volume, and those of the second fall into this category.

Each volume features a Table of Contents which, however, fails to give page numbers. There is also a Preface, but no Index, nor a single line of editorial comment or connecting material, though the papers are arranged in a connected and non-chronological sequence; the rationale of which is explained in the Preface.

Errors are not corrected in the text, but copied with by printing the Errata Notices published in the relevant journal. It appears to this reviewer that a total of nearly £5 for reprints of six papers, which otherwise might be a bit hard to secure, may be rather on the expensive side.

The papers reprinted 'are bound together by a common approach based upon chemical systematics, as employed, e.g., by Pauling, Sklar, Bashara, Orgel and others; the philosophy of this approach is discussed in several of the papers. Their scope ranges from thermodynamics (W. Lichten, The Free Electron Theory and the Virial Theorem) to Astrophysics (J. R. Platt, On the Optical Properties of Interstellar Dust), Topology (K. H. Guenther, Topological Invariants as Generatrix of Bond Orders) and Charge Transfer Complexes (J. R. Platt, Carotene-Donor-Acceptor Complexes in Photosynthesis), though the emphasis is on molecular spectroscopy, with the free-electron theory forming a common backbone throughout.

The papers aim to show how the free-electron model, which began as an interesting way of accounting for conjugated chain and ring spectra and electrical densities, has been developed systematically . . . . The unaided nonspecialist, and the beginner a fortiori, will find the going rather hard though the specialist will appreciate the extent to which the free-electron model has been shown to fit the observed spectra; not in the least due to the effort of the Mulliken-Chicago group.

This approach is of special interest to Australian workers in this field, since it employs the free-electron model so successfully developed by N. S. Bayliss in Perth.

The material presented certainly forms a body of significant contribution to spectroscopy. The 19 contributing authors or co-authors comprise J. R. Platt (26), H. McConnell (2), H. C. Loneyt-Higgins (1), D. R. Keams (2), M. Guenther (1), N. S. Ham (9), K. H. Guenther (7), C. W. Scherr (3), H. Labhart (2), W. Lichten (1), M. A. El-Bayouni (1), L. E. Jacobs (1), H. B. Klevens (6), D. E. Mann (1), J. Petruska (3), W. J. Potts, Jr. (2), C. W. Rector (2), G. W. Schaeffer (1) and P. E. Stevenson (2); the figures in parentheses give the number of contributions.


Reviewed by R. H. Wilkinson, Physics Dept., University of Melbourne.

This little booklet has been written especially for students in secondary schools in Australia. The aim is to give a simplified theory of the functioning of semiconductors and transistors, and to give a series of experiments which show up the properties of these devices and their applications. A series of advanced experiments is also given.

The setting out of the theory is conventional in that it is descriptive and expository. The experiments consist of instructions to do certain things and to record or calculate. In this way the booklet differs from modern texts in science — it follows the fossilized English tradition of the past fifty years, and is quite innocent of the modern approach which is being developed in the new courses sponsored by the Nuffield Foundation in England or the well-known P.S.S.C. course.
This does not mean that the booklet is worthless, but it does mean that it is doubtful if pupils on their own would gain much real understanding of what is being done, while they might become quite proficient in connecting circuits and perhaps even designing them.

Summing up, the booklet will be a very useful aid to teachers (and some pupils), who wish to venture into fields somewhat off the usual school syllabus. It seems likely that semiconductors and transistors will in the future replace thermonic valves in practice, and hence on the school syllabus. This booklet will help those who wish to pioneer the teaching of these devices.


Reviewed by W. Gammell, Australian Atomic Energy Commission Research Establishment, Lucas Heights, N.S.W.

As the number of nuclear reactors in existence increases, so too does the probability of accidents. Accidents have occurred, but fortunately without serious consequences. The subject of reactor safety is relatively undeveloped and this is the first book to treat nuclear safety in its broadest sense as an integral subject and at a more than elementary level. The book is intended for a wider audience than physicists and each review, written by qualified specialists, is up-to-date, and well documented with references to the literature. The mathematical background required in reading the articles varies widely, but in no case should it prevent readers from understanding the subject.

Just under half the book is devoted to theoretical reactor physics, control instrumentation and an analytical survey of nuclear accidents that have occurred. The first two present a conventional picture and whilst competent and complete, this ground has been covered just as adequately elsewhere and can be considered no more than refresher reading. The chapter on accidents appears trite on a first reading but in fact is valuable in its assessment and in its establishment of the role nuclear reactors can play in the design and operation of reactors.

Four short chapters follow which form the basis of safety studies of a chain system — Dynamics, Criticality, Doppler Coefficients and Models for Fast Transients. These form the most successful and valuable part of the book, presenting lucid treatments of topics not generally found in other texts. Gyftopoulos's article is very successful in the insight into the approximations to the formulation of dynamics problems and their practical consequences. An introduction to the problems of non-linear systems is given. Similarly, Paxton provides material on multiplication in reactor assemblies which experienced physicists are aware of, but which is not readily available, while Neyer provides a brief introduction to the Fuchs model of energy release in supercritical accidents and the variants which have appeared since its introduction.

Finally, three articles apply various aspects of reactor physics to the safety analysis of water moderated, solid moderated and fast reactors. It is evident that the problems and solutions vary between reactor types, but enough evidence is provided to permit the reader to commence the analysis of his own reactor.

The editorial problems with a book of this nature, reviewing as it does a broad subject with many hands, are well known and the editors have attempted to forestall them. They have succeeded in that with few exceptions the book reads as an integrated subject with little overlap. The chapters do, however, vary in their demands on the reader and in their mathematical complexity.

Undoubtedly metallurgists and engineers will gain from reading some or all the book, but it appears that it will be primarily a book for physicists. The wider and deeper his reactor physics background, the greater will be the reader's appreciation and benefit from it.

As with all technical documents, the book will have a limited usefulness but in this case its usefulness will be extended for its invaluable inclusions of Gyftopoulos's article, the Fuchs model of fast transients and the Bethe-Tait model of fast reactor accidents. Rather too much space has been devoted to computer programmes and details of current reactors but it will lie as essential to those involved in safety work as is Glassstone and Edlund to the ordinary reactor physicist.

The book is thoroughly recommended to all reactor physicists.

Books Received


On Walkabout

R. O'Flyen has transferred from his position at the Electron Physics Group of the Chemistry and Physics Division at the Weapons Research Establishment, South Australia, to the Commonwealth Department of Health, Melbourne. J. Pollard has returned to the Telecommunications Group of the Chemistry and Physics Division, Weapons Research Establishment, after his tour of duty at Wilkes where he was responsible for the Inverse Measurement programme during 1964. Dr. F. J. Jacka has been appointed Director of the Mawson Institute of Antarctic Studies at the University of Adelaide. He was formerly Deputy Director of the Antarctic Division of the Department of External Affairs. Dr. E. L. Murray has been appointed Lecturer in Physics at the University of Adelaide at Bedford Park. This new University will commence undergraduate lectures in 1966. Dr. W. D. Westwood who was a Research Assistant at the Northern Electrics Company Limited in Canada has been appointed as Lecturer at the University of Adelaide at Bedford Park. So also has Dr. P. G. Storer who was formerly an Associate Research Scientist at the Courant Institute of Mathematical Sciences of New York University.

Mr. E. R. Johnson has resigned from his position as Principal Research Scientist in the Upper Atmosphere Physics Group of Weapons Research Establishment.

Dr. E. G. Bowen, Chief of the Radio-physics Division of C.S.I.R.O., has consented to deliver the Annual Einstein Memorial Lecture in South Australia on the 20th October.
N.S.W. Branch

The Life History of a Hydrogen Plasma
—Professor D. D. Millar,
The Wills Plasma Physics Department,
School of Physics,
University of Sydney

Summary

Plasma research in the School of Physics at Sydney University is confined to hydrogen plasma for pressures in the range 1 micron to 1 mm mercury. The plasmas are being investigated spectroscopically, with microwaves, lasers and piezoelectric devices. Three machines have been constructed. Supper I is a 3 foot long copper tube operated at a magnetic field of 10 kilogauss. It became operational in 1962 and is mainly used to develop diagnostic procedures and study the preparation of the plasmas. Supper II is a larger tube of stainless steel. It becomes operational in mid-1962 and is being employed for wave studies. Supper III is a miniature tube. It was completed in 1964 and is used for wave propagation and instability studies.

The plasmas are produced by the J x B technique. The gas in the tube is situated in an axial magnetic field. A high power electrical discharge is sent through the gas ionising it and producing a radial electric field and hence a rotating plasma. The plasma formation spreads down the tube by means of a hydromagnetic shock wave.

There exist three phases in the history of the plasma. Time 0 to 20 microseconds; the plasma is being formed. The discharge is then crowbarred, and from 20 to 100 microseconds there exists considerable turbulence and instability. Time 100 to 400 microseconds; there exists a stable plasma which decays as a function of time.

The first phase, 0 to 20 microseconds, exhibits some interesting effects. Both the discharge current (of the order of 10 kiloamps) and the voltage across the tube rise up to a constant value before the discharge is crowbarred. It was thought that the constant value of the voltage corresponds to the fact that neutral atoms will only be accelerated until they achieve sufficient energy for ionisation (15 electron volts) after which the energy is stabilised. The difficulty with this explanation is the fact that the time required for an isolated single ion, under the given experimental conditions, to produce another ion, is of the order of 20 microseconds, and a complete plasma has been observed to form in this time interval. The greater rate of ionisation can be explained by taking into account all interactions between particles, but this does not predict a limit to the energies of the ions as indicated by the plateau in the discharge voltage. A plot of potential versus radial distance, which is used to derive the velocity of the rotating ions as a function of distance, indicates a plateau in the velocity near the outer electrode. This velocity plateau occurs near the value predicted from the elementary considerations.

Further relevant information is available from ion density measurements (determined spectroscopically) which show that the hydromagnetic shock wave has a sharp front and that behind it the plasma is at least 95 percent ionised. Since only about 70 percent of the original neutral atoms are involved in this plasma, it seems likely that the ionised neutral atoms have been centrifuged out to the walls of the tube, and this is instrumental in producing the velocity plateau near the wall.

R. W. Harris
Assistant Secretary/Treasurer.

UNIVERSITY OF QUEENSLAND

UNIVERSITY COLLEGE OF TOWNSVILLE

The University invites applications for the position of LECTURER IN PHYSICS

in the University College of Townsville. The applicant should have an Honours Degree and preferably some teaching experience. Experience in research is preferred but is not essential. He should be capable of teaching at Part II and Part III level and of initiating or participating in research in the fields of modern physics, radio astronomy, including aerial array design, or modern optical phenomena.

The salary range for Lecturer is £2400-7x100-£3100 per annum. In addition, a northern allowance of £30 per annum will be payable.

The University provides Superannuation similar to F.S.S.U., Housing Assistance, Study Leave and Travel Grants.

Additional information and application forms will be supplied upon request to the undersigned with whom applications close on 26th November.

C. J. Connell,
Registrar.

THE AUSTRALIAN PHYSICIST, NOVEMBER, 1965 183
PHYSICIST
RADIO ISOTOPES UNIT
REQUERED BY
THE ROYAL MELBOURNE HOSPITAL

which is a general teaching hospital of 666 beds and is associated with the University of Melbourne.

DUTIES INCLUDE:
Responsible to the Medical Superintendent through Medical Head of Unit for the technical use, supervision and storage of Radioactive Substance. Assisting on the development of new techniques and the calculation involved in the use of Radioactive Substances.

QUALIFICATIONS:
The successful applicant should be at least a B.Sc. with Physics as a Major. Passes in Biological Sciences would be an advantage. Previous experience involving the use of Radioactive Substances would be an advantage, but not essential.

CONDITIONS:
A good salary is offered to the successful applicant, together with an attractive superannuation scheme, etc.

Applications close 30/11/65 and should be addressed to:
Personnel Officer,
C/- Post Office,
THE ROYAL MELBOURNE HOSPITAL.

Plane-Grating Spectrograph
PGS 2

- Satisfying the highest demands made in routine and research spectrochemical work — Embraces the full spectral range photographically to be covered — If used in conjunction with a device for double passage of light, the grating’s dispersive power is exploited twice — Interchangeable original gratings differing in line numbers and blaze properties — Wavelength scale for the first spectral order — Setting of spectral ranges and orders variable within wide limits — Stigmatic depiction — Flattened spectrum — Shutter and plate-holder automatically controlled.

NATIONAL INSTRUMENT COMPANY PTY. LTD.
A MEMBER COMPANY OF ANSETT TRANSPORT INDUSTRIES LIMITED
MELBOURNE: Melbourne Airport, 379 1528; SYDNEY: 1 Sydney St, Marrickville, 51 8931;
BRISBANE: Eagle Farm Airport, 88 2896; ADELAIDE: 265 Halifax St, 23 2246; PERTH:
414 Murray St, 21 9893

184 THE AUSTRALIAN PHYSICIST, NOVEMBER, 1965
P - the new Generation

Top-loading precision balances
with taring device
for maximum loads of 130 g to 13 kg
with maximum accuracy

They are universal: designed for use everywhere and for millions of weighing operations. That is their characteristic feature. They are simple to operate, reliable, fast and accurate; they ideally meet everyday requirements. Being of very compact design, they require little space. Top-loading precision balances enable objects of any size and shape to be freely weighed. Mettler marketed the first functional balances of this type in 1954. Ten years of experience have created the basis for tomorrow’s balances: the entirely new P series of top-loading Precision Balances.

Mettler

THE BALANCE WITH THE PERFECT AFTER-SALE SERVICE
(Ask for details of our Mettler Service Programme)
Mettler P... tomorrow's balances!

DISTRIBUTED & SERVICED IN AUSTRALIA BY
ANDREW THOM LIMITED

SCIENTIFIC & TECHNICAL EQUIPMENT
261 BROADWAY, SYDNEY, AUSTRALIA
Telephones: 68-4241, Telegrams: "ATHOMACO," Broadway, N.S.W.

Enquiries outside N.S.W. and A.C.T. should be directed through our Interstate Agents, WATSON VICTOR LTD.
PURCHASE YOUR MEASURING EQUIPMENT FROM ONE MANUFACTURER AND EASE YOUR SERVICE AND INTERCONNECTION PROBLEMS!

Cathode ray oscilloscopes: single and double beam.

Voltmeters: DC Microvolt, AC Millivolt, Volt-ohm-meters, RMS Voltmeters (mains and battery operated models).

Generators: Beat Frequency Oscillator; LF and HF RC Generators; Sine and Square Wave, Single Pulse, Double Pulse, and Modular Pulse Generators.

In electronic measuring, Philips have the widest range of equipment. Other equipment available includes Microwave Components for various bands, LCR Bridges, Transistor Testers and Analysers, Noise Level Meters.

PHILIPS
Scientific and Industrial Equipment

For further information contact: G. Ware, Sydney. 2 0223 • B. Batterham, Melbourne. 69 0141 • D. C. J. Glenn, Adelaide. 51 6051 • A. H. Barge, Brisbane. 4 2471 • C. H. Read, Hobart. 3 3038 • A. R. Leonhardt, Perth. 21 3131.

PRINTED BY THE LAND PRINTING HOUSE, 59 REGENT ST., SYDNEY