the
australian
physicist

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References—are to be cited in the text thus:

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NOTES AND NEWS

Biological Memory

Most physicists these days either dabble or specialize in computing techniques. The analogy between these and many functions of the brain fascinates everybody from the cartoonist to the physiologist. Report No. 16 of The Australian Academy of Science (March 1973) contains papers presented at a Symposium on Biological Memory and these are well worth reading to gain an inkling of the state of progress and of ignorance in this complex subject. "Darwin, himself, was worried when he reflected that the brain that conceived the idea of evolution was itself the product of evolutionary processes. Since the brain presumably evolved on the basis of the selective value of the thoughts it produced, the validity of its ideas on evolution should perhaps be viewed with suspicion."

OECD to Study Australian Science

The Minister for Science, the Hon. W.L. Morrison, has asked for a wide ranging examination of Australia's scientific and technological activities to be carried out by an expert panel appointed by the OECD.

Mr. Morrison said that Australian scientists and technologists had made notable contributions in the past to national goals and a number of achievements have been promised in their fields. The Australian Government will continue to support the efforts of our scientists and technologists, but the Government wishes to see more of their effort being turned in the future toward social and environmental problems.

"It is timely that Australia make a critical appraisal of the desirable broad aims of its scientific and technological efforts over the next decade or two. The OECD had already assisted other countries to make this kind of study, and its experience will prove valuable to us."

At present approximately one percent of the GNP, or $405 million, is spent annually on research in Australia. With over 5,000 professional employees in scientific research the way in which we use science should be analysed and a co-ordinated plan developed for the wise use of our intellectual resources."

"The Government will not be replying solely on the advice of these overseas experts in developing its policies", Mr. Morrison added. "Interested groups in Australia will be given adequate opportunities to make known their views. However, an impartial scrutiny by independent experts of our present situation and possible future needs will be of considerable value."

Student Award

A continuing supply of reports on physics activities in Australia is needed to enable the Australian Physicist to serve its proper function. A special award of $20.00 will therefore be made for the best student contribution which is published by June 1974.

Students have seldom written for the Australian Physicist in the past but this can hardly be because of a shortage of worthwhile things to say. Reports of interesting lectures, seminars, conferences, projects or proposals and news or views relating to the role of physics and physicists offer plenty of scope for worthwhile contributions.

The award will be based on the interest to physicists in Australia and the effectiveness with which a topic is presented. Contributions should be annotated "for consideration for student award" and be submitted through an Associate-Editor.

ARGC Grants

The Government will provide $6.5 million for ARGC grants in 1974. This is $0.7 million more than the funds allocated during 1973. The sum includes provision for initiatives in fields of special contemporary significance. These include $297,000 for research in marine science, $121,000 for multi-disciplinary research, and $340,000 for upper atmosphere research.

A total of 959 projects will be supported during 1974 compared to 894 during 1973. 281 of the total are new projects. As in previous years, most of the research will be undertaken in universities. Work to be undertaken outside universities includes 19 projects in Colleges of Advanced Education, 10 in medical research institutes, 10 in museums and 2 in private firms.
1972 SURVEY OF PHYSICISTS

G.W. Cox, T.M. Sabine
AIP Employment Survey Sub-Committee

INTRODUCTION

This survey attempted to get statistical information from all qualified physicists who currently reside in Australia, as well as AIP members who are resident overseas. All members were reached by direct mailing; other physicists were reached by asking the employers involved in the employer section of the survey to pass questionnaire forms on to their physicists employed.

After including duplicates and responses which did not fall within the scope of the survey, the number of usable replies to the questionnaire was 1107. It is difficult to estimate the coverage of the physicist population in the community that this represents, and to what extent the coverage varied among different employee groups.

In a previous survey conducted under the auspices of the Department of Labour and National Service, and assisted by the Australian Institute of Physics (Argy, F. (1971) Aust. Phys., 7, 3), it was estimated that in March 1968 there were 3500 qualified physicists in Australia. If we use this figure, together with the observation of a 5 per cent growth rate per year obtained from the employer section of this survey, the physicist population in March 1972 should be about 4400.

Thus the questionnaire return represents a 25 per cent sample of the physicist population (compared with 60 per cent in the 1968 survey). It is difficult to estimate the uniformity of sampling among different employee groups; however, it is fairly clear that school teachers are under-represented, and it is also likely that physicists in industry are also under-represented in our sample.

We think that these deficiencies in our sample are due to difficulties in contacting the two groups. In the case of school teachers assistance was promised by Education Departments but the information simply never appeared despite repeated requests. In the case of private industry we assume that many physicists have left the area of physics and are either not known as physicists in the organisation or have retained little interest in the Institute.

RESULTS

The following paragraphs present some of the results of the survey.

Distribution by Age

This distribution (table 1) shows much less bias toward younger ages than shown in the Argv report (48.6 per cent under 30). We think that this trend is real and that the age distribution of physicists has settled down in 1972 to that of the total labour force (37.4 per cent under 30).

Table 1

<table>
<thead>
<tr>
<th>Age</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>399</td>
<td>36</td>
</tr>
<tr>
<td>30-39</td>
<td>337</td>
<td>30</td>
</tr>
<tr>
<td>40-49</td>
<td>221</td>
<td>20</td>
</tr>
<tr>
<td>50-59</td>
<td>112</td>
<td>10</td>
</tr>
<tr>
<td>60+</td>
<td>27</td>
<td>4</td>
</tr>
</tbody>
</table>

Distribution by Sex

49 out of 1104 or 4.5 per cent of physicists are women. We think this figure is very much lower than would be found in a general survey of physical sciences. The correlation between age and sex showed a slight tendency for the lowest number of women in the 30-39 age group. The numbers are too small for further deductions to be made.

Place of First Degree

A striking feature of this table (table 2) is the very high contribution of Melbourne University to the physics population. This reflects the strength of the

Table 2

<table>
<thead>
<tr>
<th>Place</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Universities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University of Melbourne</td>
<td>249</td>
<td>22.5</td>
</tr>
<tr>
<td>University of Sydney</td>
<td>137</td>
<td>12.4</td>
</tr>
<tr>
<td>University of Adelaide</td>
<td>108</td>
<td>9.8</td>
</tr>
<tr>
<td>University of Queensland</td>
<td>99</td>
<td>8.9</td>
</tr>
<tr>
<td>University of Western Australia</td>
<td>74</td>
<td>6.7</td>
</tr>
<tr>
<td>University of New South Wales</td>
<td>60</td>
<td>5.4</td>
</tr>
<tr>
<td>Monash University</td>
<td>25</td>
<td>2.3</td>
</tr>
<tr>
<td>University of Tasmania</td>
<td>18</td>
<td>1.6</td>
</tr>
<tr>
<td>Other Australian Universities</td>
<td>44</td>
<td>4.0</td>
</tr>
<tr>
<td>Overseas Universities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.K.</td>
<td>126</td>
<td>11.4</td>
</tr>
<tr>
<td>U.S.</td>
<td>17</td>
<td>1.5</td>
</tr>
<tr>
<td>Other</td>
<td>60</td>
<td>5.4</td>
</tr>
<tr>
<td>Institutes and Colleges</td>
<td>65</td>
<td>5.9</td>
</tr>
</tbody>
</table>
Melbourne school in the pre-war period. This is emphasised by the correlation between age and place of first degree, shown in Table 3. By far the major contribution from overseas is from English Universities. This we would expect.

<table>
<thead>
<tr>
<th>Age</th>
<th>Mel.</th>
<th>Syd.</th>
<th>Ade.</th>
<th>Q.</th>
<th>WA</th>
<th>UN</th>
<th>SW</th>
<th>Mon.</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>65</td>
<td>42</td>
<td>39</td>
<td>33</td>
<td>15</td>
<td>35</td>
<td>24</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>30-39</td>
<td>77</td>
<td>38</td>
<td>28</td>
<td>42</td>
<td>31</td>
<td>22</td>
<td>1</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>58</td>
<td>32</td>
<td>30</td>
<td>17</td>
<td>16</td>
<td>2</td>
<td>0</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>50-59</td>
<td>40</td>
<td>21</td>
<td>7</td>
<td>5</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>60+</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>245</td>
<td>137</td>
<td>107</td>
<td>98</td>
<td>74</td>
<td>60</td>
<td>25</td>
<td>124</td>
<td></td>
</tr>
</tbody>
</table>

Table 3

Correlation between Place of First Degree and Age

Higher Degrees

<table>
<thead>
<tr>
<th>Degree</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS</td>
<td>37</td>
<td>3.3</td>
</tr>
<tr>
<td>PhD or other Doctorate</td>
<td>350</td>
<td>32</td>
</tr>
<tr>
<td>Master's Degree</td>
<td>168</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 4 shows the distribution of physicists in the sample with higher degrees.

<table>
<thead>
<tr>
<th>Employment</th>
<th>20-29</th>
<th>30-39</th>
<th>40-49</th>
<th>50-59</th>
<th>60+</th>
<th>Total</th>
<th>Mean Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSIRO</td>
<td>17</td>
<td>12</td>
<td>40</td>
<td>29</td>
<td>50</td>
<td>37</td>
<td>26</td>
</tr>
<tr>
<td>Commonwealth</td>
<td>55</td>
<td>33</td>
<td>49</td>
<td>29</td>
<td>42</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>State</td>
<td>89</td>
<td>49</td>
<td>51</td>
<td>28</td>
<td>22</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>University</td>
<td>64</td>
<td>23</td>
<td>111</td>
<td>39</td>
<td>69</td>
<td>24</td>
<td>36</td>
</tr>
<tr>
<td>College</td>
<td>31</td>
<td>36</td>
<td>32</td>
<td>37</td>
<td>16</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>School</td>
<td>20</td>
<td>49</td>
<td>16</td>
<td>39</td>
<td>4</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Industry</td>
<td>38</td>
<td>42</td>
<td>29</td>
<td>32</td>
<td>15</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Student</td>
<td>70</td>
<td>93</td>
<td>5</td>
<td>7</td>
<td>15</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Unemployed</td>
<td>14</td>
<td>42</td>
<td>4</td>
<td>12</td>
<td>3</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>398</td>
<td>36</td>
<td>337</td>
<td>31</td>
<td>221</td>
<td>20</td>
<td>112</td>
</tr>
</tbody>
</table>

Table 5

Correlation Between Age and Employment

The percentages given are the proportions in each age group.

"Table 5 reflects the lack of mobility among Australian Physicists. In the Commonwealth Government sector, CSIRO has a significantly higher mean age. The relative youth of university physicists is explainable by the rapid increase in the numbers of universities in the early sixties.

The Australian Physicist, November, 1973
Employment

Table 6
Distribution by Employment

<table>
<thead>
<tr>
<th>Employer</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSIRO</td>
<td>136</td>
<td>12.3</td>
</tr>
<tr>
<td>Commonwealth</td>
<td>172</td>
<td>15.5</td>
</tr>
<tr>
<td>Government</td>
<td>183</td>
<td>16.5</td>
</tr>
<tr>
<td>University</td>
<td>286</td>
<td>25.8</td>
</tr>
<tr>
<td>College</td>
<td>87</td>
<td>7.9</td>
</tr>
<tr>
<td>School</td>
<td>41</td>
<td>3.7</td>
</tr>
<tr>
<td>Industry</td>
<td>91</td>
<td>8.2</td>
</tr>
<tr>
<td>Student</td>
<td>75</td>
<td>6.8</td>
</tr>
<tr>
<td>Unemployed/retired</td>
<td>35</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Table 6 shows the balance of employment between universities and the Commonwealth Government. The number in industry, while larger than that found by Argy, is still small.

Type of Work Done

Table 7
Type of Work Done

<table>
<thead>
<tr>
<th>Type of Work</th>
<th>Percent of Time (Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management and Administration</td>
<td>18</td>
</tr>
<tr>
<td>Research and Development</td>
<td>42</td>
</tr>
<tr>
<td>Teaching</td>
<td>27</td>
</tr>
<tr>
<td>Routine</td>
<td>7</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
</tr>
</tbody>
</table>

It is comforting to see from table 7 that physicists spend one half of their time doing research and development.

Correlation between Employer and Type of Work

Table 8
Correlation Between Employer and Type of Work

The percentages given are the proportion of time spent on each type of work.

<table>
<thead>
<tr>
<th>Type of Work</th>
<th>M and A</th>
<th>R and D</th>
<th>Teach</th>
<th>Routine</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSIRO</td>
<td>15</td>
<td>76</td>
<td>0</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Commonwealth</td>
<td>30</td>
<td>52</td>
<td>1</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>State</td>
<td>20</td>
<td>9</td>
<td>55</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>University</td>
<td>13</td>
<td>51</td>
<td>31</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>College</td>
<td>14</td>
<td>11</td>
<td>69</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>School</td>
<td>13</td>
<td>5</td>
<td>80</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Industry</td>
<td>34</td>
<td>34</td>
<td>1</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>Student</td>
<td>0</td>
<td>85</td>
<td>11</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Unemployed</td>
<td>13</td>
<td>35</td>
<td>39</td>
<td>4</td>
<td>9</td>
</tr>
</tbody>
</table>

| Total        | 18      | 43      | 28    | 7       | 5     |

A significant feature of table 8 is the disproportionate amount of time spent in management and administration by Commonwealth and State Governments and industry compared with universities and CSIRO.

It would be worthwhile examining the reasons for this in more detail, does it, for example, mean that CSIRO is significantly better managed than other Commonwealth Departments?
Table 9
Correlation of Higher Degrees with Age

Percentages are the proportion in each age group with the respective degrees.

<table>
<thead>
<tr>
<th>Age</th>
<th>DSc No.</th>
<th>PhD No.</th>
<th>MSc No.</th>
<th>Total with Higher Degrees</th>
<th>Total, All Qual.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>0 0</td>
<td>79 20</td>
<td>41 10</td>
<td>120 30%</td>
<td>399</td>
</tr>
<tr>
<td>30-39</td>
<td>1 0</td>
<td>154 46</td>
<td>51 15</td>
<td>206 61%</td>
<td>337</td>
</tr>
<tr>
<td>40-49</td>
<td>16 7</td>
<td>78 35</td>
<td>40 18</td>
<td>134 60%</td>
<td>221</td>
</tr>
<tr>
<td>50-59</td>
<td>14 12</td>
<td>31 28</td>
<td>28 25</td>
<td>73 65%</td>
<td>112</td>
</tr>
<tr>
<td>60+</td>
<td>6 16</td>
<td>7 19</td>
<td>7 19</td>
<td>20 54%</td>
<td>27</td>
</tr>
<tr>
<td>Total</td>
<td>37 18</td>
<td>349 38</td>
<td>167 18</td>
<td></td>
<td>1096</td>
</tr>
</tbody>
</table>

Table 9 shows that the high number of PhD’s in the 30-39 age group reflects the fact that PhD programmes were first introduced in Australia in the early fifties.

Table 10
Correlation Between Employment and Highest Degree

The percentages given represent the number of each qualification as a proportion of the total number in each employer class.

<table>
<thead>
<tr>
<th>Employment</th>
<th>DSc No.%</th>
<th>PhD No.%</th>
<th>MSc No.%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSIRO</td>
<td>18 13</td>
<td>52 38</td>
<td>20 15</td>
</tr>
<tr>
<td>Commonwealth</td>
<td>2 1</td>
<td>45 26</td>
<td>33 19</td>
</tr>
<tr>
<td>State</td>
<td>2 1</td>
<td>8 4</td>
<td>18 10</td>
</tr>
<tr>
<td>University</td>
<td>11 4</td>
<td>194 68</td>
<td>31 11</td>
</tr>
<tr>
<td>College</td>
<td>1 1</td>
<td>23 26</td>
<td>18 21</td>
</tr>
<tr>
<td>School</td>
<td>2 5</td>
<td>9 22</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>1 1</td>
<td>17 19</td>
<td>12 13</td>
</tr>
<tr>
<td>Student</td>
<td>4 5</td>
<td>16 21</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>2 6</td>
<td>5 14</td>
<td>11 31</td>
</tr>
<tr>
<td>Total</td>
<td>37 13</td>
<td>350 31.6</td>
<td>168 15.2</td>
</tr>
</tbody>
</table>

Correlation Between Employment and Highest Degree

Table 10 shows that physicists in universities and CSIRO are significantly better qualified academically than physicists in other organisations. This reflects both the opportunity for university staff to obtain higher degrees and the requirement that research scientists in CSIRO must have a PhD degree. The long term nature of work in CSIRO is reflected in the relatively high number of DSc holders.

Field of Speciality

Information obtained on field of speciality both during training and during current employment is summarised in table 11. Part 1 of the table shows fields where more people were trained than are currently employed; part 2 shows fields where there is no significant difference, and part 3 shows fields where more people are currently employed than were trained. The table shows that the distribution of courses available does not correspond to the requirements of the employment market.

Table 11
Field of Speciality

<table>
<thead>
<tr>
<th>Field</th>
<th>No. Trained</th>
<th>No. Working</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 1 - Over-trained fields</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear Physics</td>
<td>101</td>
<td>54</td>
</tr>
<tr>
<td>Theoretical Physics</td>
<td>46</td>
<td>29</td>
</tr>
<tr>
<td>Space Physics, Cosmic Rays</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Chemical Physics</td>
<td>27</td>
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INDUSTRY AND THE ENVIRONMENT

INDUSTRY AND THE ENVIRONMENT

Report No. 6 of the Science and Industry Forum of the Australian Academy of Science (April 1973) presents the text of four lectures from a forum meeting in October 1972. H.C. Coombs listed the ecologist’s prescription for the problems facing the contemporary world as:
(a) halt the growth of world population;
(b) limit the use of scarce resources and ideally use them only to the degree and in ways that would enable perpetual recycling;
(c) use resources only in ways which do not threaten the survival of other living species;
(d) control the emission of waste products to a level within the capacity of the environment to absorb without damage.

From the point of view of an economist these require a price structure which will not only allow present communities to win a living for themselves but also to ensure the welfare of future generations. Men have always accepted responsibility for people and institutions beyond the range of their own lives, but how far can this be extended? Coombs believes that for the economic system to deal effectively with the ecological problem will involve a revolution in the mind of man and in the values which he seeks. A rational approach would be:
(1) for the Government to make it clear that it proposed to charge ‘scarcity loyalties’ for access to scarce resources;
(2) to impose charges or taxes on the creation of disutilities and the damage or destruction of existing amenities graduated according to their approach to acceptable margins of tolerance;
(3) to require all major projects, public or private, to submit an independent ‘ecological impact’ report before authority to proceed is granted;
(4) to halt, pending further study and research, all developments which threaten potentially fragile eco-systems.

F.J. Jenner (ANU) reinforced the view that we will need an immense redirected scientific and technological effort to tide us over a period of readjustment from our present commitment to a materials-based growth ethic, until we can develop new philosophies for civilized living.

Between these two papers were two on some of the current activity in industrial projects such as Bass Strait oil and gas, and the industrial development of Western Port. In the latter case, “planning and study is well in advance of the events it will control and before any significant environmental degradation has occurred” This could, therefore, serve as a blueprint for tackling problem (d) above, but it does not tackle the other three much more difficult problems.
MECHANICS OF FLIGHT AS PART OF AN INTRODUCTORY PHYSICS COURSE

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Introduction
The study of mechanics is a basic part of nearly all first year physics courses at University level, and in elementary mechanics, more than in most other branches of physics, the presentation usually consists of a large selection of carefully chosen examples illustrating the application of the relatively small number of physical principles involved.

To many students the mechanics part of the course is dull. We do our best with the examples, and linear and rotational air-tracks have revolutionized the laboratory part of the course, but still much of the exposition fails to excite the interest of students.

In an attempt to improve this situation we have developed a presentation of related applications of physical principles based upon the theory of flight (or elementary aerodynamics). This is a subject involving a large range of mechanical principles which can be fairly easily dissected out, it is of considerable interest to young people, it is of obvious practical relevance, and useful laboratory experiments can be devised. Even biologists appreciate its application to the flight of birds and the structure of their wings.

This article describes briefly the way in which we are using this subject, not to be taught in its own right but as an illustrative vehicle for a mechanics course. It also describes the fundamental laboratory experiment which we have developed and our plans for further variety.

Theory of Flight
Because all our first year students have had a reasonable prior exposure to elementary physics, it is possible to introduce a discussion of Bernoulli's theorem for fluid flow before the course is too far advanced and to introduce the concept of dynamic pressure, \( \frac{1}{2} \rho v^2 \). The usual discussion of the Venturi and the Pitot tube then leads naturally to consideration of the force acting on a moving aerofoil. As shown in figure 1, this force \( \mathbf{F} \) can be resolved into two components: the lift \( L \) acting perpendicular to the airstream velocity \( v \) and the drag \( D \) acting parallel to it. From quite general considerations we can then define coefficients of lift and drag, \( C_L \) and \( C_D \), by

\[
L = \frac{1}{2} \rho v^2 C_L A \tag{1}
\]

\[
D = \frac{1}{2} \rho v^2 C_D A \tag{2}
\]

where \( A \) is the area of the aerofoil.

It is clear that both lift and drag depend upon the angle of attack \( \alpha \), shown in the figure, and the experiment to be described later allows this dependence to be examined, in addition to verification of the form of equations (1) and (2). In particular the most efficient attack angle (that giving maximum lift-to-drag ratio) can be found and the phenomenon of stall, when lift decreases sharply with increasing attack angle, can be demonstrated.

A simple discussion of the propeller—a twisted aerofoil—and the jet as thrust producers is useful at this stage as it allows illustration of the relation between force and momentum change, as well as setting the stage for the next part of the development.

An aircraft can now be considered as a simple body acted on by thrust and drag (both parallel to the direction of motion but in opposite senses), by lift produced by the wings acting perpendicular to the direction of motion, and by weight acting vertically downwards. This is an excellent system for illustrating a variety of mechanical problems and is far more interesting than blocks of wood sliding on rough planes or cyclists racing around banked tracks.

Simple level flight, climbing and diving situations provide useful examples and, of particular interest, we find that, if the thrust is set equal to zero, the angle of descent \( \theta \) is given simply by

\[
\tan \theta = \frac{C_L}{C_D} \tag{3}
\]

This leads to useful discussion of aircraft behaviour and of relative design features of heavy aircraft and of sailplanes, particularly if the original discussion of drag includes the notion of induced drag and its dependence on the aspect ratio of the wing.

Enlarging the glide problem to include the effects of a wind upon glide path relative to the ground is now simple and a wide selection of problems including wind-shear is possible.

Finally a discussion of an aircraft in a banked turn illustrates the essential features of circular motion and

Figure 1
The resultant force \( \mathbf{F} \) acting on an aerofoil in motion resolved into a lift component \( L \) perpendicular to the airstream velocity \( v \) and a drag component \( D \) parallel to it. \( \alpha \) is the angle of attack.

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the ‘g’ forces produced by acceleration. It is not generally realised that the rudder is of very little effect in making a turn and that its real purpose is to compensate for minor unbalances in other forces. Almost the entire turning force comes from the centrally directed component of the lift produced by banked wings. Discussion of the problem is therefore simple and we find, for a turn of radius $R$,

$$\tan \theta = \frac{v^2}{Rg}$$  \hspace{1cm} (4)

where $\theta$ is the bank angle. Useful examples can be devised about optimum speeds for race circuits around pylons and similar problems.

The discussion can now easily be extended to calculate the load supported by the wings

$$L = W \sec \theta$$  \hspace{1cm} (5)

where $W$ is the aircraft weight, and the $g$ loading on the pilot,

$$g' = g \sec \theta$$  \hspace{1cm} (6)

The aerofoils are rotated by a variable-speed electric motor, freely mounted so that the thrust produced by the lift force and the torque produced by the drag are both taken up in a helical spring as shown in figure 2. The motor speed is measured by means of a simple electric tachometer.

After calibration of the reaction spring by means of a spring balance attached to the aerofoils, the apparatus is used to verify equations (1) and (2) and to determine $C_L$ and $C_D$ as functions of angle of attack. A more advanced experiment, carried out only by those interested, allows similar measurements to be made on wings of different aspect ratio and on wings fitted with flaps, slats and slots.

As examples of the sort of results obtainable with the equipment, figure 3 shows the measured dependence of $L$ and $D$ on $v^2$, of $C_L$ and $C_D$ on $\alpha$ and of $C_L/C_D$ on $\alpha$ for an aerofoil with an aspect ratio (span/chord) of 3 and a fineness ratio (chord/thickness) of 6. Part of the scatter of points in the curve for $C_L$ seems to represent a real departure from the simple curve drawn but this is best ignored and treated as the normal student error involved in a rather complex experiment. The measured lift coefficient is a little large and the stall behaviour is not very clearly apparent, probably because of the rather low Reynold’s number achieved ($R \approx 3000$), but the measurements demonstrate the general behaviour quite convincingly.

The actual equipment was designed around an ordinary sewing-machine motor and more details of the

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**Figure 2**

*Construction of the experimental equipment. Calibrated scales read the forces exerted by the reaction spring.*

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**A Laboratory Experiment**

A small wind-tunnel for a laboratory experiment is clearly out of the question if hundreds of students working in groups of two must be accommodated. We have therefore devised an experiment in which two matched aerofoils are mounted on the ends of light rods and rotated about an axle. The airspeed varies about 30 per cent from the inner to the outer end of the aerofoil but this is not of any importance. The slight fan-effect can also be neglected and the aerofoils treated as though moving through still air.
construction are shown in figure 2. The speed control supplied with the motor can be used, with the help of a screw clamp, but a small variable transformer is more convenient. Two-stage gearing provides a 10:1 speed reduction to the drive shaft. Simple mechanical indicators are used for the two reaction forces and the only really critical point in the whole assembly is the quality of the bearings supporting the motor. Combined bearings each consisting of a ½-inch (2 cm) shaft of hardened steel (with a clearance hole for the motor drive shaft) supported by a recirculating-ball bearing inset into a ball race have been found to give adequately smooth motion in both directions.

To add further interest to the presentation, we are producing a short 16 mm film giving a pilot's-eye view of a banked turn, a stall and several other manoeuvres.

A class experiment with powered model aircraft under radio control would have obvious student appeal, but is probably out of the question for most departments!

References

I have not been able to find any books at a level really suitable for this course. The references listed do, however, provide useful background material. To supplement standard physics texts we have therefore prepared a booklet which can be used for this part of the course, whether it is taught as an entity or, as I prefer, used primarily as a source of illustrative applications.

Acknowledgements

I am greatly indebted to Ken Dixon, Carl Merten and John Chapman for the contributions they have made to the design and construction of the experimental equipment.

References


BOOK REVIEWS

A COURSE IN CONTINUUM MECHANICS,

 Reviewed by W. B. Fraser, Department of Applied Mathematics, University of Sydney, Sydney.

In volumes I and II of this work the general theory of continuum mechanics is set up. Volumes III and IV contain applications of this theory to fluid mechanics, and elastic and plastic solids, respectively. They are not entirely self contained, as reference is made throughout to the first two volumes. One particularly good feature of these two volumes on applications is the way in which the engineering theories of hydraulics and strength of materials are presented and related to the more general theory.

In the first chapter of volume III the description of the integral relations of fluid mechanics and the applications, particularly to pumps and gas engines, is excellent. The other two chapters of this volume contain a detailed treatment of potential flows, and a more introductory treatment of turbulence, boundary layer theory, and vortex motion.

Volume IV starts with a fairly conventional treatment of linear elasticity and variational methods. This is followed by a chapter on plasticity theory and finally a chapter devoted to plane elastostatic problems and a brief account of crack theory.

Each volume contains a summary table of contents for all four volumes and volume IV has an overall subject index.

I feel that most readers of these volumes will already have some familiarity with the usual material contained in undergraduate courses on elasticity and fluid mechanics, and I was disappointed that the author did not adopt a more advanced treatment. However, the book is an excellent reference text and should be of great interest to those who are already familiar with the subject.

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not include more advanced applications (e.g. finite strain elasticity) of the very general theory developed in volume 1 with the help of generalized tensors. However, the work must be strongly recommended for the unified and often original manner in which the variety of topics that comprise continuum mechanics are treated.


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

This book is primarily designed as a text for senior undergraduate and graduate students—and was specifically written by the author to provide a one-quarter introduction to field theory for students not planning to become theorists.

The treatment, which is mathematically orientated, begins with a succinct summary of Quantum Mechanics; and throughout the whole volume, provides an extensive collection of problems on which the student can practice. The detailed solutions to these exercises are supplied in an appendix.

The topics covered contain certain subjects not normally mentioned in this type of text. Notable examples of this are a section on Cerenkov radiation and the Glauber development of coherent states by building in uncertainty to the number of photons in a field. The many applications are drawn from solids (i.e. phonons), Liquids (i.e. Superfluids), gases (i.e. quantum gases) and plasmas (i.e. Landau damping).

Generally speaking, the treatment is not sufficient to provide a complete understanding, and even non-specialists would need to supplement the book with other material. To this end, a useful reference list with explanatory notes (a welcome innovation) is supplied in an appendix.

One feels the lack of any experimental discussion. This is particularly noticeable in certain sections, such as those describing parity non-conservation and the Lamb shift, where the ensuing mathematics is fashioned by the result of the experiment.

In summary, the book is well suited for a students' course and the applications are widespread. However, the text would need to be supplemented to provide a complete treatment.


Reviewed by G. J. Troup, Physics Department, Monash University, Clayton, Victoria.

The appearance of this work in translation is to be welcomed, since it has been referred to in the Russian Scientific journals by many workers in non-linear optics. It is clearly written, and has perhaps a better introduction to the field than the book by Bloembergen, to which it is a most useful supplement. It treats the Nonlinear Susceptibility of Weakly Absorbing Media, Theory of Waves in a Nonlinear Dispersive Medium, Distortion of Unmodulated Electromagnetic Waves in such media, Wave Modulation in such media, Generation of Optical Harmonics, Parametric Effects in Optics, and gives a summary of Experimental Nonlinear Optics up to the end of 1963 (The Russian edition was published in 1964). On the debit side are the small print, and the lack of an index—serious defects in a work of this kind. Nevertheless, it is fair value for its cost to any worker in this advanced field.


Reviewed by M. J. Kenny, A.A.E.C.R.E., Lucas Heights, NSW.

This book is a useful introductory text for non-physicists involved in incidental use of radioisotopes and radiation detectors. The topics are presented in summary form and mathematical treatment is kept to a minimum. Technical workers should have no difficulty in understanding the book. The final chapter lists a number of texts relevant to radiation detection for further reading. However, radiation detection is dealt with superficially. In particular, the treatment of neutron detection is more than elementary. It is therefore necessary to consult other books, e.g. those listed in Chapter 5, to obtain the necessary insight into practical use of detectors.


Reviewed by L. W. Davies, Amalgamated Wireless (Australasia) Limited, North Ryde, N.S.W.

All of the 58 papers presented in this volume were read at the (First) International Conference on Ion Implantation in Semiconductors, held in California in May, 1970. The papers have already appeared in the journal Radiation Effects, and this is therefore in the nature of a reprint volume.

Most of the papers are concerned with the physics of ion implantation in elemental or compound semiconductors. However, six contributions relate to the application of ion implantation to silicon integrated circuits, including an excellent 13-page review of ion-implanted MOS technology by H. G. Dill et al. The volume provides a useful survey of semiconductor ion implantations, as they were some 3 years ago.


Proceedings of Conference held at Vanderbilt University, August 1969.

Although not a recent conference this volume contains some excellent papers on Acquisition and Analysis of Spectra (e.g. Ge(Li) and Si(Li) detectors); Multi-parameter Systems; and Studies of Short-Lived States.
San Francisco 1972.
Reviewed by Bruce H. J. McKellar, School of Physics, University of Melbourne.
This is another of the now large series of volumes honouring various prominent physicists. In my mind it stands out from most of these because it reflects the incredible variety of Professor Wheeler's contributions to physics and as a summary of the state of theoretical physics in 1970, it forms a useful addition to any physics library. In fact I envisage that it may well be as useful a book as the Bohr Festschrift (the only such book that has ever been reprinted). The contributions range from super heavy nuclei to mesic atoms, from classical electrodynamics and plasma physics to quantum electrodynamics and from gravitational theory and experiment to speculations of new descriptions of space time. It is unfair to the distinguished contributors to pick out any particular contribution for special mention but to this reviewer the most fascinating papers were by Feynman describing a new way he has developed for writing Feynman diagram expressions which proves to be extremely useful for dealing with quantization of complicated theories and by Thorne reviewing the spectacular theoretical developments in recent years in the description of gravitational collapse. All of the papers are significant contributions to their particular subjects and for this reason I feel this book deserves a place in any physics library.

ATOMIC MASSES AND FUNDAMENTAL CONSTANTS 4. J.H. Sanders, A.H. Wapstra (Editors)
Reviewed by J.C. Macfarlane, National Standards Laboratory, Chippendale, N.S.W.

The 4th International Conference on Atomic Masses and Fundamental Constants was held at Teddington U.K., in September 1971. This volume contains reprints of some 63 research and review papers which were presented there. The papers are grouped under the following headings:— Particle Energies; Beta and Gamma Energies; Mass Spectroscopy; Coulomb Energies; Mass Formulse and Mass Calculations; Velocity of Light; Wavelength Comparisons; Fine Structure Constant; 2e/h; Rydberg Constant; Magnetic Moments; Miscellaneous Constants. There is in addition an all-embracing paper entitled A Re-evaluation of the Fundamental Constants, by E.R. Cohen and B.N. Taylor, and a Conference Summary by E.R. Cohen.

A subjective list may be given of papers which the reviewer found particularly significant:— Recent Precision Mass Measurements at Princeton, L.G. Smith; Progress with a Determination of the Speed of Light, (various NPL workers); Review of Spectroscopic Data for Determining the Fine Structure Constant, K.R. Lea; various 2e/h measurements; papers on the magnetic moment and gyromagnetic ratio of the proton, by B.W. Petley, K. Morris, P. Vigoureux, P.T. Olsen, R.L. Driscoll; Lattice Spacing and Avogadro's Number, M. Hart and I.G. Morgan; and the review paper by Cohen and Taylor, although this merely summarizes progress made since the 1969 re-evaluation was completed.

The Conference took place about 18 months after the a.c. Josephson Effect had reached pre-eminence in precise measurements of 2e/h, and about a year before the speed of light had been successfully re-determined by means of frequency measurements on stabilized lasers. It is regrettable that the Proceedings do not contain a contribution by K. Evenson or his colleagues at NBS Boulder, who were among the first to achieve the measurement of the frequency of a methane stabilized laser. The Proceedings are therefore somewhat overshadowed by both earlier and later publications, but nevertheless contain useful contributions as indicated above which in some cases are not published elsewhere.

A volume of this specialized character will appeal to only a small proportion of physicists, but should be regarded as essential reference material for the research library.

Reviewed by M.C.E. Petersen, Australian Atomic Energy Research Establishment, Lucas Heights.

This is the second text in the Wiley Monographs on Chemical Physics. The author is a research group leader in the Health Physics Division at the Oak Ridge National Laboratory and is engaged in studies of the interaction of ions and electrons with gases at low energies using swarm techniques. The contents of the book reflect this more than is implied by its title.

Chapter one reviews the Bohr-Bethe treatments of the slowing of charged particles in matter. Then follows an account of the Spencer-Fano work and subsequent developments on the spectrum of electrons produced in matter following the absorption of an energetic primary electron. The chapter closes with a review of the three main interaction processes of X and gamma rays with matter. The second chapter provides one of the most complete lists of the average energy required to form an ion pair in various gases and gas mixtures. The discussion includes the complications which arise when impurities are present and the role of superexcited states.

The strength of the book lies in Chapters 3 to 7 inclusive. The first of these chapters deals with photon induced processes in atoms and molecules and dispersion of electronic excitation energy in these systems. The next two chapters are devoted to elastic and inelastic low
energy electron scattering. Chapters 6 and 7 are given to negative ions and detachment of electrons from negative ions and the electron affinity of atoms and molecules. While the theoretical content of these chapters is brief, the physical description of processes and experimental techniques for observing them is good, although the bias is towards swarm studies. These chapters provide a quite extensive collection of data in both graphical and tabular form of experimental results.

Chapter 8 contains a brief description in some 15 pages of the interaction of heavy charged and neutral particles with atomic and molecular systems in the keV to several hundred keV energy range. This seems a pity in view of attention the field has been receiving in recent years.

The final chapter moves to a discussion of some problems in the macro-molecules which are the building blocks of animate matter. However, it would appear that this field is wide open for extensive work in the future.


Reviewed by B.A. McInnes, School of Physics, University of Sydney.

This excellent book compiles twelve batteries of diagnostic tests, containing 396 questions in all, which have been pre-tested on a group of over 500 students taking an introductory course in Electricity and Magnetism at Monash University. The questions are designed to be used by the student to test for his own purposes his mastery of the subject. The questions are of multiple choice type, and the answer section gives not only the correct answer but reasons for that answer together, in many cases, with a cross reference to a number of standard introductory texts.

The book thus fits in with the current trend to emphasize the key role of the students' activity in the learning-teaching process. The availability of early feedback to him on his grasp of a subject is surely a vital contribution to keeping alive his interest in that subject.

Rachinger and his colleagues should be complimented both on the work they have done at Monash in the field of diagnostic testing and on their making the fruits of their working available, in an attractive format, for use elsewhere.

UNDERWATER SOUND, V.M. Albers (Ed.), Dowden, Hutchinson, & Ross, Inc. 1972 469 pp. $20.00

Reviewed by A.W.L. Carter, RAN Research Laboratory, Garden Island, N.S.W.

Professor Albers is well known as the author or editor of several books on acoustics, and as associate editor (Underwater Acoustics) of the Journal of the Acoustical Society of America. The book under review is a compilation of papers by others, chosen by Prof.

Albers to form one volume of the BENCHMARK series "devoted to the reproduction of seminal articles in various branches of acoustics". Prof. Albers, credentials for selecting the papers are above reproach, but the book has several weaknesses which arise from attempting to cover too wide a field in one volume.

The scope of the book can be seen from the following (simplified) section headings: propagation, velocity of sound, ambient noise, flow noise, scattering, transducers and calibration, finite amplitude effects, cavitation. The choice of sections is adequate but the coverage within sections is not. For example, one important paper in the book explains an anomalous attenuation effect in sea water as due to relaxation in dissolved magnesium sulphate. But neither this paper, nor others in the propagation section, describe the other mechanisms or the experimental results which show that there is an anomaly in a certain frequency range to be explained. The casual reader will simply not understand the significance of such articles.

Similarly in the ambient noise section there is little on ship noise, or the directivity or variation in depth of ambient noise. Knudsen's 1948 paper is the only significant paper on bio-acoustic noise. Marine geophysicists will be disappointed by the papers on scattering from the sea floor, and marine biologist will find nothing directly related to biological scattering. The transducer section does not adequately cover the difficulties of low frequency transducer design and calibration, and nowhere in the cavitation section is the important phenomenon of propeller cavitation mentioned.

The foregoing comments illustrate the difficulty of applying a 'seminal article' approach to underwater physics — the field is too large. Inevitably the book under review does not give a reasonably complete or up-to-date picture of the subject. The book would have been very much better if each section had had an introductory review article (with bibliography) outlining the development of the subject and summarising the present state of the art. Prof. Albers was eminently qualified to have supplemented the book in this way.

As it stands, the book will be mostly used by workers with considerable knowledge in the field for the convenience of quick access to many standard references. At twenty dollars a copy the book warrants a place in specialist libraries, but is not a good buy for most individual workers.


Reviewed by A.J. Mortlock, National University, Canberra.

This book is the first volume of a three volume series on point defects in solids. The two volumes yet to be published are on Defects in Semiconductors and Defects in Metals respectively. The present volume is broken up
RADIATION HAZARDS

Stop That Noise

During hearings of the House of Representatives Committee on Aircraft Noise, it became obvious that there were inadequate standards for the measurement of noise. Research aimed at rectifying that situation has been commenced at the Division of Applied Physics, NSL. The first priority is the development of facilities for calibrating noise meters and other instruments for measuring sound pressure.

Meanwhile, J.L. Goldberg (in Search, September 1973) continues the discussion on the question “Can the production version of the Concorde SST ever meet its approach noise specification?” He points out that the perceived noise scale of measurement ignores all frequency components below 50 Hz — better described as vibrations. These components should not be ignored. A second paper by Bo Lundberg (Sweden) in the same issue of Search pursues all the arguments against SST’s.

The Linear Hypothesis — Fact or Fancy

The Fourth AINSE Radiation Biology Conference, held at Lucas Heights on 15-16 October 1973, heard two papers on theoretical and experimental evidence on the linearity between dose of ionizing radiation and harmful effects. J.G. Clouston (AEC) pointed out that when the end effect occurs sometime after the primary event the overall probability is a composite of biochemical and physical as well as geometrical and temporal factors. The validity of a linear relationship between dose and effect will depend upon whether the primary injury is the cause and whether it is repairable or not. Quantitative comparison requires systematic information on dose-rate dependence and recovery behaviour which is lacking.

In a review of experimental information, G.M. Watson (AAEC) concluded that all that can be said with confidence is: “that, for carcinogenesis, the linear hypothesis does not hold universally... For mutagenesis... the linear hypothesis is not completely tenable, and these findings are in keeping with what we know of repair phenomena”.

Too Much Sunshine?

Another paper to the AINSE Radiation Biology Conference, presented by D.F. Robertson (University of Queensland), reviewed the impact of high-flying aircraft on earth-bound living tissues. In considering the effects of ultraviolet radiation (below 320 nm) there is once again a marked absence of experimental information although a Climatic Impact Assessment Program in the USA is to make an initial published assessment by the end of 1974 of the probable distributed state of the stratosphere and the anticipated meteorological, biological and economic consequences of any change produced by aircraft exhausts and other influences. Data already collected in Australia and the USA indicate that the most reliable predictions relate to the incidence of skin cancer. Even the most pessimistic estimates are lower than what is already accepted without much concern by most of the Australian population.

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This was the theme of the 45th ANZAAS Congress held at the University of Western Australia from 13–17 August, 1973. With a final enrolment in excess of 5000, this was the largest ANZAAS Congress ever held, and probably the largest conference ever organized in Australia.

Over 170 delegates enrolled for the Physics Section, making it by far the largest Physics Section since the record 1969 ANZAAS Congress in Adelaide. The Section Committee organized a number of Intersectional Symposia with the Chemistry, Geology, Engineering and Anthropology Sections. Some of these Symposia severely overtaxed the available lecture room accommodation, and many delegates were unable to obtain seating even in the large A.D. Ross lecture theatre.

The Physics Dinner was organized by the WA Branch of the Australian Institute of Physics and was attended by approximately 100 delegates and their wives. Bob Lawrance, Head of the Department of Physics in the University of the South Pacific, Fiji, gave us a very entertaining after-dinner speech entitled “Physics in the South Seas,” in which he recounted some of his experiences in setting up a Physics Department in Fiji.

Presidential Address

Professor J.H. Carver, President of the Physics Section, gave his Presidential address on “The Origin of Atmospheric Oxygen.” The earth’s paleoatmosphere was formed by the release of gases from the interior of the earth, and may have included such compounds as water vapour, carbon dioxide, methane and ammonia. The bombardment of the paleoatmosphere by the sun’s ultraviolet radiation is crucial to our understanding of the evolution of our present atmosphere.

Professor Carver emphasised the necessity of combining rocket and satellite observations of the ultraviolet spectrum of the sun, with high resolution laboratory measurements of the absorption cross sections of those gases which constitute or have constituted the atmosphere. He then discussed some of the results obtained by the Physics Department at the University of Adelaide using rocket flights from Woomera to determine the height distribution and concentration of oxygen and ozone in the upper atmosphere. The Department has recently constructed a six metre vacuum monochromator to measure the absorption of solar ultraviolet radiation by atmospheric gases, in the hope that data measured with this instrument will resolve some of the difficulties associated with our understanding of the origin of atmospheric oxygen.

Congress Symposia

The morning sessions were devoted to Sectional and Intersectional Symposia, whilst the afternoon sessions were major Congress Symposia organized in the same style as the 1972 Sydney Congress. Three Congress Symposia were offered each afternoon. They covered such diverse topics as “Economic Growth: magnificent obsession?” to “The Australian Aboriginal: the widening gap.” A special evening symposium was entitled “The Ord River Ecology.” One of the pleasing features of this ANZAAS was the number of politicians who participated in these Symposia. The Hon. W.G. Haydon, Dr Moss Cass, Hon. A.J. Grassby, Hon. Tom Uren, Sir Charles Court, Mr Race Matthews, Hon. K.E. Beasley and the Hon. A.D. Taylor all being participants.

The Physics Section was responsible for one of the Congress Symposia – “The Implications of Nuclear Explosives”. The speakers were Sir Ernest Titterton, Director of the Research School of Physical Sciences, ANU; Dr Brian O’Brien, Director of Environmental Protection in WA, and Dean Hazelwood, the Anglican Dean of Perth. Although the peaceful uses of nuclear explosives came within the ambit of the title, it was perhaps inevitable that the recent French and Chinese nuclear tests should be the centre of interest. Radioactive fallout, resulting from one of the French atmospheric tests, was detected in Perth on the day of this Symposium, and many questions were directed at Professor Titterton, who presented the relative importance of fallout from these tests with respect to natural sources of radioactivity.

Sectional Symposia

The largest Sectional Symposia was undoubtedly “Physics in Medicine” organised by John Black, Head of the Department of Medical Physics at Sir Charles Gairdner Hospital. Sixteen papers were presented covering three main topics – Physics in Nuclear Medicine, Electronics Instrumentation and Developments in Medical Physics and Computing in Medicine. One of the most interesting papers was given by J. Agzarian (Prince Henry and Prince of Wales Hospitals, NSW) on the development of a multi-access interface system which enables the totally disabled to manipulate their environment. The system enables the user to activate a microswitch placed under the chin, which can then operate a computer typewriter, a memory bank, an audio visual display and a sub-control unit containing power outlets. The application of the Mossbauer Effect measuring velocities of about 0.5 mm s⁻¹ in the ears of experimental animals was described by G.K. Yates (University of WA). These measurements have confirmed that the basilar membrane acts as a low-pass filter propagating travelling waves whose amplitudes peak and then decay at different positions along the membrane, depending on frequency.

Another Symposium which created great interest was “Environmental Physics,” although the limited number of submitted papers is perhaps a commentary on the fact that Australian physicists have not as yet become involved with environmental problems to the extent that one would expect. A.J. Dyer (CSIRO), gave an excellent account of the scientific aspects of establishing a global baseline station and of Australia’s involvement in this
field. R. Lawrence (University of the South Pacific) also gave two interesting papers on research he had carried out in Fiji. One was the simulation of the mass water movements in Laucala Bay using an electrolytic tank model, and the subsequent measurements of the currents to confirm the accuracy of the model. The second paper was concerned with the measurement of lightning strokes at Suva using a gap counter, and a statistical analysis of the results which were collected over a two year period.

B. Maund (ANU), D.R. Dowling (Ballarat Institute of Advanced Education) and E. von Perger (Education Department of WA), were contributors in a symposium entitled "Physics and Philosophy," in which such topics as the "Theory of Relativity," "Einstein's Social and Political Ideas" and "Why some great Physicists turn Philosophers", were debated (both during and after the Symposium). Inter-Sectional Symposia

An ANZAAS Congress is an ideal opportunity for physicists to meet on common ground with scientists from other disciplines. The Physics Section Committee decided to organize a number of International Symposia representing the wide ranging interests of Australian Physicists and indicative of the fact that physics has an active role to play in many diverse areas of science. Perhaps the most unusual symposium was "Scientific Techniques in Archaeology" which was organized by David Hutchinson, at one time a Lecturer in Physics at the University of WA, but now Curator of History at the WA Museum. It is of interest to note that of the 8 papers presented, 3 were by physicists. J. Green (WA Museum) spoke on "Underwater Photogrammetric Techniques"; AJ Mortlock (ANU) on "Thermoluminescent Dating" and J.R. de Laeter (WAIST) reviewed "Techniques for analysing Ancient Coins." Other papers covered the work of the WA Conservation Laboratory in preserving artefacts from the historic wrecks off the Western Australian Coast (C. Pearson, WA Museum), Pollen analysis as a tool for Australian Archaeology (D. Churchill, Royal Botanic Gardens, Melbourne) and 3 papers concerned with radiocarbon and obsidian hydration rate dating.

One of the largest Symposia was entitled "Solid State Physics and Solid State Electronics" which was jointly organised by J.B. Swan (Physics, University of WA), and A.J. Nassibian (Electrical Engineering, University of WA). Altogether 12 papers were presented covering conventional solid state physics topics to papers involved with materials science and semiconductor technology.

The most popular International Symposium organized by the Physics Section was undoubtedly "Large Scale Solar Energy Developments in Australia." Professor D.J. Allen-Williams (Mechanical Engineering, University of WA), gave a comprehensive survey of the present situation and pointed out the advantages of solar energy as an energy source. Professor D.W. George (Mechanical Engineering, University of Sydney), examined the alternative systems for electricity production such as high temperature thermal, photovoltaic conversion and biological methods of solar energy conversion for gaseous and liquid fuel production. The discussion following the symposium was quite spirited, and a strong body of opinion urged that Australia should make a contribution to this exciting prospect for solving the energy crisis.

Another Symposium entitled "X-Ray Fluorescence and Related Methods of Analysis" was organized by J. Graham (CSIRO). Two excellent review papers were given by K. Norris (CSIRO) and S.J.B. Reed (ANU) on "Physical Methods of Analysis" and "Electron Microprobe Analysis" respectively. It is of interest to note that of the 7 papers presented, all but one were given by scientists whose initial education was in Physics.

The final International Symposium was organized jointly by the Physics and Geology sections, Hugh Doyle (University of WA), being the Convenor. The theme was "Seismicity and Structure," and the topics centred around earthquakes, particularly those in South Western Australia.

Conclusion

Overall the 45th ANZAAS Congress was extremely successful, although the large numbers did cause some administrative problems. However, this was more than counterbalanced by the excellent participation in all phases of the Congress, particularly by physics teachers and tertiary physics students who were prominent in many of the symposia discussion sessions.

FOURTEENTH SCHOOL SCIENCE EXHIBITION

This exhibition which was held at Macquarie University on 22nd September included a number of projects with a physical flavour. Possibly the most interesting was an investigation entitled "Why do my Bathroom Scales Register Less when on the Carpet than when on a hard Floor?", which took out the major award in the Junior Section. The investigator, Mr. Roger Wetherall of Maitland made the observation initiating this study himself, namely that if he weighed himself on a carpeted floor his weight was apparently six pounds less than when he used the same set of scales on the bathroom tiles. This led to a remarkably thorough investigation of possible causes, identification of the cause, and confirmation by artificial production of the effect on a hard floor. The effect arises from distortion of the framework of the scales.

Another worker, Christopher O'Reilly of Goulburn, was awarded $50 for development of a scientific instrument, namely a camera for star photography consisting of a box Brownie on a motor driven mount. Some creditable twenty minute exposures had been produced with this device. Mr. O'Reilly commented wryly on the rigours of experimental astronomy.
including the misting of lenses on cold winter nights and attacks by mosquitos in the summer.

Other endeavours included "On What Surfaces does Friction Occur Least?", "Field Strength and Distribution of Electrostatic and Electromagnetic Fields", "Flatness in Soft Drinks", "Can you Influence the Tossing of a Coin Honestly?"

 Altogether 49 projects and their originators were on display on this Saturday, making an interesting and stimulating exhibition with which the A.I.P. N.S.W. Branch was pleased to be associated.

NEWS

Radioisotopes Course

The nineteenth in the series of radioisotope techniques courses for graduates will be held beginning March 4, 1974 by the Australian School of Nuclear Technology at Lucas Heights. Further details may be obtained from The Principal, Australian School of Nuclear Technology, Private Mail Bag, Sutherland, N.S.W. 2232.

Solar Energy Workshop

A workshop to discuss conversion of solar energy into useful forms is to be held at the University of Sydney on February 19-22, 1974. Application for places should be made before December 1, 1973, to C.N. Watson-Munro, School of Physics, University of Sydney, 2006.

C.S.I.R.O. Budget Increases

Among special provisions in the money allocated by the Federal Budget, which increased funds for the running of CSIRO by 15.9 million dollars (a 17 percent increase) in 1973-74, were the setting aside of 4.1 million dollars for the new Cyber 76 central computer, allocations of 180 000 dollars for a new laboratory wing at the Radiophysics Division at Epping, and 136 000 dollars for laboratory and machine stop extensions for the Atmosphere Physics Division at Aspendale. In addition to these some 667 000 dollars have been provided for initiation of new projects, including research on solar energy and atmospheric pollutants.

People-Oriented Research

With a staff of 6600 and a budget of $73 million, the CSIRO in 1972/3 has responded to requests by the Government to orient more research towards problems of the environment and the management of Australia's resources. More emphasis is also being given to social science in projects such as the land use study in Eurobodalla Shire (NSW) and the problems and needs of people living in remote communities in northern Australia.

The 25th Annual Report of CSIRO and statements by the Minister for Science (W.L. Morrison) indicate these and other policy changes. Solar energy research will in future be coordinated within CSIRO by a central group. New policies in the area of patenting and licensing of CSIRO inventions will emphasize participation by Australian industry. The Annual Report urges that more research be done in industrial laboratories, either under contract to the Government or with their own funds.

Erratum.

'Some Advanced Programs for Programmable Desk Calculators'

I am obliged to Emeritus Prof. G. Bosson for drawing my attention to an error in my paper in the August, 1973 issue. The rule for choosing the sign of the starting value in iterative solution of a cubic equation is the reverse of that stated. The pair of equations that follows equation (4) should read:

\[ y_0 = (-p)^{\frac{1}{3}} \quad \text{or} \quad y_0 = +(-p)^{\frac{1}{3}} \]

The listed program is correct — C.J. Milner.

Reviewed by K. J. Auburn, Wollongong University College, Wollongong, NSW.

"In taking the quantum mechanical point of view one supposes that there are certain types of particles in nature and that, for each type, a field theory exists much like that of E. & M. In fact the photon is such a particle". This quotation from the introduction to the final chapter of this publication appears to be the raison d'être for yet another book on Classical E & M. The material of this chapter (60 pp.), which describes the theories for the two component neutrino, the electron-positron and the photon would be profitable reading for any honours physics undergraduate in an Australian university. It is the only chapter which has an original flavour. The ten preceding chapters are probably only a suitable text (as opposed to reference book) for students of the two authors. It is unlikely that they would represent a choice of material to the liking of other lecturers.

The book is described in the preface as a textbook on the principles of electricity and magnetism written for beginning graduate students in physics. The authors would have served Australian students better by producing a short monograph on their own special interest as described in the final chapter to supplement one of the classical texts on electricity and magnetism. Nevertheless this publication could be a useful addition to a departmental library.


Reviewed by W. A. Miller, School of General Studies, Sydney Technical College.

This is the first of a three volume text designed to be used in a three semester college course in classical and modern physics. Volume one covers Introduction to Physics, Mathematics and Mechanics, volume two Thermodynamics and Electromagnetism, and volume three Relativity and Quantum Mechanics.

This volume is comparable, both in the standard reached, and the material covered to the well known text by Halliday and Resnick. It differs from their book however by giving in the first chapter a brief overview of physics. The next five chapters deal with concepts (from mass, length and time to energy and charge), elementary particles, the conservation laws, mathematics (most of kinematics is in this chapter) and vectors. The next chapter starts with Newton’s laws and the remainder of the volume follows the usual sequence.

The students will probably find this book easier than Halliday and Resnick as they are led more gently than is usual into the mathematical description of physical phenomena. In most sections there are worked examples, and each chapter is summarised. This is followed by a large number of questions, exercises and problems for the student to attempt. Most exercises and problems are used to develop the work covered in the chapter. SI units are used, with the addition of Kilocalories, the astronomical unit and the electron volt.

If you use Halliday and Resnick have a look at this book it may suit you better.


This book is written for students but it is also an excellent handbook for the occasional electronist. The text is concise, illustrations are clear and the index is comprehensive. The subject is covered from the principles of semiconductor devices to the use of modern linear integrated circuits with worked examples of circuit design.


A paperback edition of the Third Edition of this familiar book, which was first published in 1946, is now available.

A small number of minor corrections, revisions and references have been made and added. These include a revision of the discussion of Schrödinger’s equation in 23.07, and references to Isotropic Tensors in note 3.031a in the Addenda.
DIVISION OF CHEMICAL PHYSICS
CLAYTON, VIC.

GENERAL: The Division of Chemical Physics is located in modern laboratory premises adjacent to Monash University, at Clayton, Victoria. The Division has facilities for research in the fields of optical spectroscopy; mass spectroscopy; electron diffraction and electron microscopy; X-ray diffraction; solid state chemistry, including NMR and ESR investigations and theoretical chemistry. In addition the Division has well-equipped instrument laboratories for the design and construction of mechanical, optical and electronic equipment.

POSITION NUMBER 582/91
EXPERIMENTAL OFFICER
FIELD: X-RAY DIFFRACTION
DUTIES: To participate in research on the diffraction of X-rays involving single crystals, in particular the accurate measurement of diffracted X-ray intensities and the application of these results to the detailed analysis of the bonds in ionic compounds and organic molecules.
QUALIFICATIONS: Degree or equivalent qualification in physics or chemistry with experience in X-ray crystallography.
SALARY: The appointment will be made within the salary ranges of Experimental Officer Class 2 or Class 3: $5,397–$12,364 p.a.

POSITION NUMBER 582/92
SCIENTIFIC SERVICES OFFICER
FIELD: PUBLICATIONS AND LIAISON
DUTIES: To edit and process publications submitted to journals, conferences, etc.; to prepare and edit annual and other reports and general accounts of the Division's research activities; and to assist in liaison and public relations activities.
QUALIFICATIONS: A degree or equivalent qualification in physics or chemistry, with previous experience in scientific editing.
SALARY: The appointment will be made within the salary ranges of Scientific Services Officer Class 2 or Class 3: $5,397–$12,364 p.a. Appointment at a higher level may be considered for an outstanding applicant.

TENURE
These positions are available for an indefinite period and Australian Government Superannuation privileges are available.

APPLICATIONS
Applications stating full personal and professional details, the names of at least two referees, and quoting the appropriate reference number, should reach:
The Chief, Division of Chemical Physics, CSIRO, P.O. Box 160, CLAYTON, VIC. 3168 by 14th December, 1973

NATURAL ASSOCIATION OF TESTING AUTHORITIES
Australia

NATA will shortly appoint a Senior Technical Officer
to direct the work of a group of graduate chemists, engineers, metallurgists and physicists responsible for assessment and registration of laboratories working in all fields of testing and all States of Australia.

The Senior Technical Officer must have:
(a) A degree in Science, Engineering or Metallurgy, preferably from an Australian University, or other qualifications required for admission to an Australian professional institute.
(b) Sound practical experience in testing laboratory operations, covering not less than five years.
(c) Experience in staff supervision, and in laboratory or other management.

Ability to communicate with people on an easy yet professional basis is essential.

The appointee will be located in Sydney. A considerable amount of interstate travel will be required.

The salary for the position will be negotiated, but will be not less than $10,000 p.a.
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Applications should be addressed to:
The Registrar, National Association of Testing Authorities, Australia, 688 Pacific Highway, CHATSWOOD, N.S.W. 2067 Ph. No. 41 8631