Enrolment Trends in Physics in Australian Tertiary Institutions for the Period 1977-1981

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INTRODUCTION

This is the fourth in a series of articles providing descriptive and statistical information on the number of physics students in Australian tertiary institutions for the period 1977-1981. Previous reviews covered the periods 1963-1973. (de Laeter, 1974; Watson-Munro, 1974), 1965-1975 (de Laeter and Watson-Munro, 1975) and 1974-78 (de Laeter and Watson-Munro, 1979).

Stern (1981), has recently updated corresponding data for chemistry students, and has shown that the number of students taking chemistry at third year level in Australian tertiary institutions has been approximately constant each year over the past thirteen years. Similar data also exist for biology (Stern and Burchett, 1979) and for geology (Berkman, 1980), whilst a review on the overall supply of scientists in Australia has also been published (Stern, 1980).

De Laeter et al. (1980), analysed physics enrolment trends at the secondary level throughout Australia. Their data indicate that over the past decade a small decrease in enrolments has occurred in Victoria and South Australia, with small increases in New South Wales and Western Australia, whilst in Queensland and Tasmania, the numbers have remained essentially constant. Thus, although the proportion of students studying physics at Year 12 level has declined significantly over the period to 1979, the total number of physics students in Australia at this level has remained relatively constant.

On the basis of the trends in the enrolment statistics at secondary level together with evidence from employment surveys (e.g. Jennings and Zadnik, 1980; Prescott, 1980; A.I.P. 1981), there seems to be no *a priori* reasons why the number of students entering tertiary physics courses will alter significantly in the foreseeable future, unless a concentrated effort is made to increase recruitment amongst secondary school students.

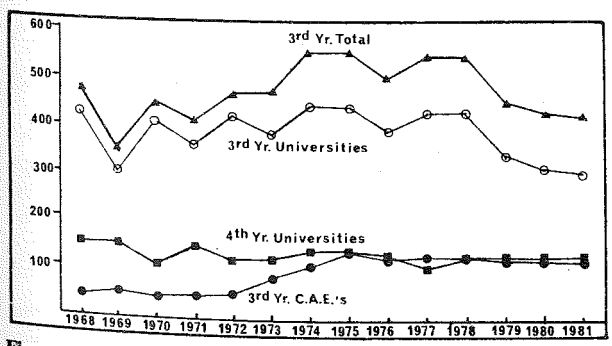

Figure 1: *Physics student numbers in Australian Tertiary Institutions*

RESULTS AND DISCUSSION

Table 1 lists the number of third year physics students in Australian universities and CAE's. No new universities or CAE's have been established during the period 1979-1981. Gordon Institute of Technology is no longer on the list of CAE's, as it was reconstituted as Deakin University in 1977. There are now 29 institutions providing programmes for entry to the profession of physics — 19 universities and 10 CAE's. Only those institutions whose courses are acceptable as providing the academic requirement for graduate membership of the Australian Institute of Physics have been listed. However it should be noted that a number of other CAE's do provide physics courses, mainly for those who wish to enter the teaching profession, and several of these courses may be accredited in the near future. It is therefore important to note that there is a group of students, other than those mainstream physics students listed in Table 1, trained in physics, and who may, in the future, occupy teaching positions in physics at the secondary level.

The number of third year students has decreased significantly over the five year period, from 553 in 1977-1978 to 421 in 1980-81. The bulk of this decline has occurred in the university sector, particularly in South Australia, Tasmania and Victoria. Figure 1 demonstrates the trends in third year physics student enrolments in universities and CAE's with reference to the Australian totals from 1965-1981. The graph highlights the significant decrease in the university sector which has occurred since 1979. The decline in South Australia and Victoria may be associated with the decrease in secondary school enrolments noted by de Laeter et al. (1980).

Table 2 gives the average number of physics students at third year level over the period 1977-1981 for both universities and CAE's for each of the States. Also listed in Table 2 is the A.I.P. membership for each State as at 16th June 1981.

Table 3 lists the numbers in fourth year physics in the various tertiary institutions. It is to be noted that the totals in universities comprise both honours and M.Sc. qualifying students. In the CAE's the numbers include students studying for a Graduate Diploma award as well as those in the first stage of a Master's programme. No attempt has been made to distinguish between full-time and part-time students for it is likely that many of the students in CAE's are part-time students, whereas most of the students in universities are probably full-time students. The numbers listed for Canberra College of Advanced Education have not been included in the totals, since

these students are studying for a Graduate Diploma in Electronics.

De Laeter and Watson-Munro (1979), drew attention to the fact that many institutions were attempting to offer graduate courses with very small student intakes. Although this is still the case, it is pleasing to note that the total number of enrolments in fourth year physics courses has increased significantly over the five year period 1977-1981. Most of this increase has come from the CAE sector and due undoubtedly, to the fact that many of the CAE's have been able to offer graduate programmes only recently and that there may well be a back-log of students who desire to continue graduate studies on a part-time basis. It will be of interest to see if this increase in enrolments continues in the CAE sector in the future. Certainly, with the reduced levels of funding for tertiary education in the 1982-1984 triennium, the viability of many graduate programmes must be suspect. In 1981 for example, the 27 institutions listed in Table 3 had an average enrolment of seven fourth-year students. In the same year, nine of the institutions had only two students or less and in most of these institutions this enrolment pattern has not altered greatly over the past five years.

Thus, although the present numbers in fourth year physics courses are encouraging, it is likely that the impact of the smaller third year physics enrolments and the attractive employment prospects for graduate physicists may cause a deterioration in this situation over the next few years. This, in turn, will affect the viability of the research effort of many physics departments and perhaps the long-term research capability of the Australian physics community.

To assist in assessing this situation, Table 4 has been compiled in order to show the number of Masters and Ph.D. students enrolled in the universities, and the number of Masters students enrolled in the CAE's. Although the information

Table 1: Numbers of Students in Third Year Physics Courses

	1977	1978	1979	1980	1981
Griffith University	22	16	13	14	10
James Cook University	2	0	2	7	2
Queensland University	9	14	17	17	19
Queensland Institute of Technology	13	10	5	5	13
Capricornia Institute of Advanced Education	4	18	17	17	15
Darling Downs Institute of Advanced Education	6	4	7	5	4
TOTAL QUEENSLAND:	56	62	61	65	63
Macquarie University	14	14	13	7	16
Newcastle University	9	10	7	7	7
New England University	5	8	7	7	4
New South Wales University	25	56	16	25	27
Sydney University	45	51	40	36	33
Wollongong University	5	3	5	5	5
New South Wales Institute of Technology	4	5	2	7	7
TOTAL NSW:	107	147	90	94	99
Australian National University	13	11	9	6	9
Canberra College of Advanced Education	15	16	11	17	15
TOTAL ACT:	28	27	20	23	24
Deakin University	5	8	14	8	6
Latrobe University	28	23	12	12	12
Melbourne University	53	77	63	50	46
Monash University	43	28	30	14	22
Ballarat College of Advanced Education	11	12	5	12	5
Caulfield Institute of Technology	10	12	21	16	19
Royal Melbourne Institute of Technology	39	28	31	23	27
TOTAL VICTORIA:	189	188	176	135	137
Tasmania University	45	38	16	18	13
Adelaide University	60	38	26	42	34
Flinders University	17	14	13	8	7
South Australian Institute of Technology	7	2	5	4	1
TOTAL SOUTH AUSTRALIA:	84	54	44	54	42
Murdoch University	—	4	11	9	15
Western Australia University	26	17	23	21	19
Western Australian Institute of Technology	18	17	14	11	9
TOTAL WESTERN AUSTRALIA:	44	38	48	41	43
TOTAL AUSTRALIA:	553	554	455	430	421

presented only covers the period 1979-1981, it can be seen that the numbers are almost constant over the three year period, and in the light of the healthy situation which presently pertains to fourth year numbers together with the relatively long period of enrolment for students in higher degree programmes, it is unlikely that any significant variation will occur in the immediate future. In the longer term, the proposed imposition of fees for graduate studies may significantly reduce the number of research students.

Assuming that there are about 180 Honours and Graduate Diploma graduates per year and that the average length of a higher degree is 5 years, it follows that about 90 students (or 45% of the fourth year class) will go on to higher degree studies in physics. This is consistent with the results of the survey of Dallimore et al. (1979), who concluded that about 45% of third year physics students intended to proceed to honours and/or higher degree studies. This will be useful in subsequently assessing the impact of fees on graduate enrolments in physics.

One of the areas for which many CAE physics

Table 2: The Average Third Year Population of Physics Students by State in Australia from 1977-1981

	Victoria	N.S.W.	S.A.	Queensland	W.A.	Tasmania	A.C.T	Australia
University	111	102	52	33	29	26	10	363
C.A.E.	54	5	4	29	14	—	15	120
TOTAL	165	107	56	62	43	26	25	483
AIP MEMBERSHIP	550	521	194	145	169	42	136	1757

Table 3: Numbers in Fourth Year Physics Courses

	1977	1978	1979	1980	1981
Griffith University	—	10	12	3	1
James Cook University	1	1	—	2	2
Queensland University	10	1	10	11	8
Queensland Institute of Technology	7	6	13	10	11
TOTAL QUEENSLAND:	18	18	35	26	22
Macquarie University	6	2	2	2	1
Newcastle University	4	3	3	3	4
New England University	3	2	3	2	6
New South Wales University	10	9	6	6	17
Sydney University	3	10	11	12	13
Wollongong University	1	—	0	1	0
New South Wales Institute of Technology	2	4	2	2	1
TOTAL NEW SOUTH WALES:	29	30	27	28	42
Australian National University	12	6	9	4	6
Canberra College of Advanced Eduction	20*	32*	23*	31*	37*
Deakin University	—	3	0	2	1
Latrobe University	4	7	10	5	4
Melbourne University	18	19	19	26	25
Monash University	13	18	12	19	8
Ballarat College of Advanced Education	—	1	1	1	—
Caulfield Institute of Technology	—	—	4	4	7
Royal Melbourne Institute of Technology	2	7	8	15	13
Swinburne Institute of Technology	4	—	—	1	2
TOTAL VICTORIA:	41	55	54	73	60
Tasmania University	4	7	3	8	6
Adelaide University	7	11	14	10	5
Flinders University	3	3	3	6	4
South Australian Institute of Technology	—	2	4	4	4
TOTAL SOUTH AUSTRALIA:	10	16	21	20	13
Murdoch University	—	—	2	1	2
Western Australia University	11	15	12	7	13
Western Australian Institute of Technology	12	20	29	21	26
TOTAL WESTERN AUSTRALIA:	23	35	43	29	41
TOTAL AUSTRALIA:	137	167	192	188	190

*These figures are not included in the Australian totals.

departments are responsible, is the training of radiography students. The term "radiography" embraces diagnostic and therapeutic radiography as well as nuclear medicine. In contrast to a previous five year period 1974-1978, in which the number of radiography students increase by a factor of two (de Laeter and Watson-Munro, 1979), the present statistics indicate that the number have dropped from 247 to 191 over the period 1977 to 1981.

The bulk of the decrease has occurred, in fact, at the Royal Melbourne Institute of Technology, which in the past has trained over half the total Australian radiography output by a variety of internal and external tuition modes. The evolving situation is that the training of radiographers is now diversified over a larger number of institutions, and the output is now more closely tuned to the employment potential than in the past. The South Australian situation requires some comment because the numbers at the South Australian Institute of Technology have dropped from a maximum of 62 in 1978 to 19 students in 1980. This decline was in part caused by the com-

Table 4: Numbers of Postgraduate Physics Students

	1979	1980	1981
Griffith University	3	4	4
James Cook University	3	1	2
Queensland University	16*	17	15
Queensland Institute of Technology	17	16	15
TOTAL QUEENSLAND:	39	38	36
Macquarie University	34	32	33
Newcastle University	7	6	7
New England University	3	4	5
New South Wales University	25	27	29
Sydney University	21	26	26
Wollongong University	11	10	9
New South Wales Institute of Technology	7	7	6
TOTAL N.S.W.:	108	112	115
Australian National University (Faculty)	5	8	6
Research School of Physical Sciences	50	50	51
TOTAL A.C.T.:	55	58	57
Deakin University	0	1	1
Latrobe University	24	21	22
Melbourne University	41	44	50
Monash University	33	29	28
Royal Melbourne Institute of Technology	8	15	13
Swinburne Institute of Technology	—	1	2
TOTAL VICTORIA:	106	111	116
Tasmania University	30	30	24
Adelaide University	23	23	20
Flinders University	8	13	14
South Australian Institute of Technology	5	5	5
TOTAL SOUTH AUSTRALIA:	36	41	39
Murdoch University	1	3	4
Western Australia University	21	23	24
Western Australian Institute of Technology	23	22	21
TOTAL WESTERN AUSTRALIA:	45	48	49
TOTAL AUSTRALIA:	419	438	436

*Estimated Value

Table 5: Number of Final year Radiography Students in CAE's

Institution	1977	1978	1979	1980	1981
Queensland Institute of Technology	44	40	42	43	40
Newcastle College of Advanced Education	—	—	—	13	8
Riverina College of Advanced Education	—	—	—	28	23
Royal Melbourne Institute of Technology	141	158	157	71	82
South Australian Institute of Technology	47	62	36	19	22
Western Australian Institute of Technology	15	22	25	17	16
TOTAL AUSTRALIA:	247	282	260	191	191

mencement of a second course at the Sturt College of Advanced Education which created a situation wherein the State could not economically sustain two radiography courses. A recent decision has been made to phase out the Sturt programme, and thus the South Australian Institute of Technology numbers will increase, but presumably not to the same extent as in 1978. It also appears likely that a three year Diploma course will be the standard programme of studies of the college sector in the future.

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Eye and Brain Research

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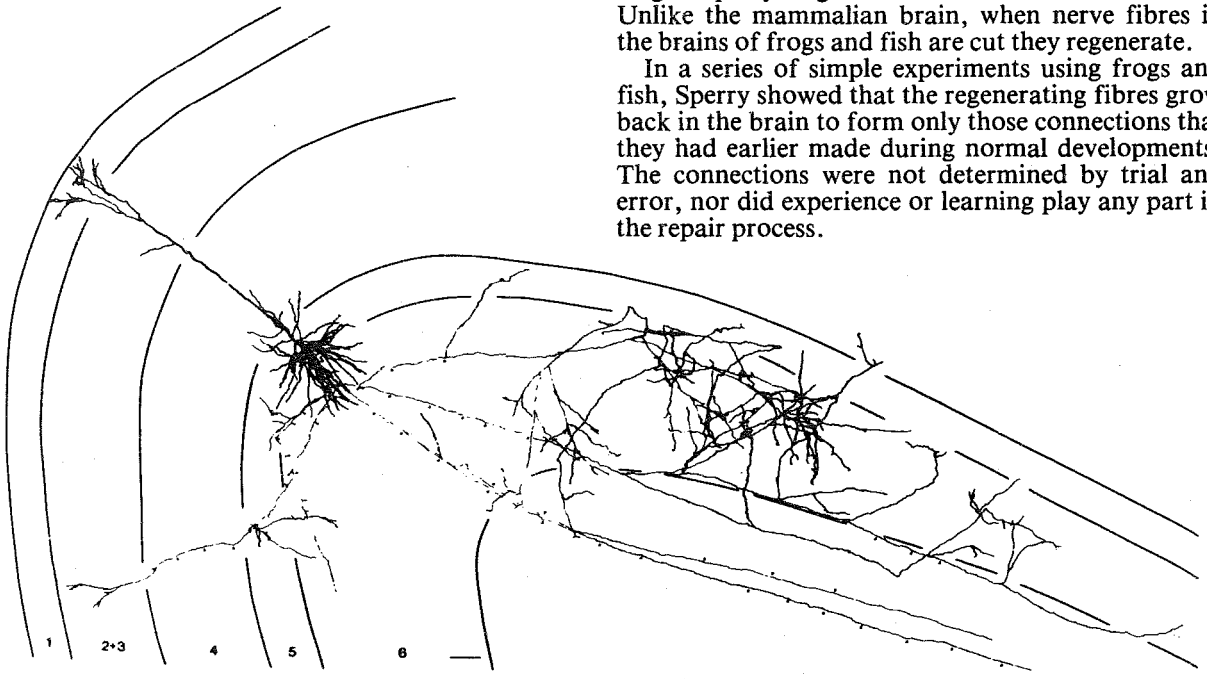
The recent announcement that three American scientists have shared this year's Nobel Prize for Physiology and Medicine has particular significance for the Australian National University. The awards were made to Dr Roger Sperry of the California Institute of Technology and to Dr David Hubel and Dr Torsten Wiesel of the Harvard Medical School. The inspiration of the work of these three scientists in the field of eye and brain research, beginning 25 years or more ago, has played a large part in the developments within Australia that have given it the prominent place it now holds in these fields. In particular, two Departments in the Institute of Advanced Studies have close links with these American scientists. In the Research School of Biological Sciences, the Department of Behavioural Biology maintains strong ties with Sperry's laboratory and much of the Department's research is a direct outcome of the work that he pioneered. And, many of the lines of research currently being pursued in the Department of Physiology in the John Curtin School of Medical Research (JCSMR) owe much to the work of Hubel and Wiesel.

The human brain consists of some hundred thousand million or more nerve cells each of which received some thousands of distinct inputs and itself connects to a large number of other nerve cells. These intricate interconnections are by no means haphazard but highly ordered. The problem of how these nervous connections are made during embryonic and postnatal development was almost untouched until Roger Sperry began his studies in the late 1930s. Unlike the mammalian brain, when nerve fibres in the brains of frogs and fish are cut they regenerate.

In a series of simple experiments using frogs and fish, Sperry showed that the regenerating fibres grow back in the brain to form only those connections that they had earlier made during normal developments. The connections were not determined by trial and error, nor did experience or learning play any part in the repair process.



This drawing, from Gilbert and Wiesel, **Nature 280** *120-125 (1979), shows a single nerve cell and its processes in the visual cortex in isolation from the thousands of cells that closely neighbour it. Only this cell was stained because the dye was injected into the cell body via the same glass micropipette used for the intracellular recording of the cell processes. The ramifications of these processes in the drawing give some ideas of the vast interconnections that are made between nerve cells. The short scale line at the bottom centre is a tenth of a millimetre. The numbers are the separate layers of nerve cells in the cerebral cortex.*