Enrolment Trends in Physics in Australian Tertiary Educational Institutions (1980–1984)

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This is the fifth survey in a series on enrolment trends in Australian tertiary education institutions. Previous surveys have covered the periods 1963-1973 (de Laeter, 1974; Watson-Munro, 1974), 1965-1975 (de Laeter and Watson-Munro, 1975), 1974-1978 (de Laeter and Watson-Munro, 1979) and 1977-1981 (de Laeter and Jennings, 1982).

This survey contains information from the thirty institutions, including twenty universities and ten CAEs, whose degrees are accepted by the AIP as a professional qualification in physics. There are only two significant changes since our last survey. These are the inclusion of data from the Royal Military College, Duntroon and the change of name of Caulfield Institute of Technology to Chisholm Institute of Technology.

The survey includes data on third year physics enrolments, fourth year physics enrolments, postgraduate enrolments and final year radiography enrolments. All of these data were obtained directly from the heads of the various physics departments. In some cases there may be minor inaccuracies present because of the difficulty of uniquely identifying physics students in some institutions. However, despite these difficulties, a consistent approach has been used over all five surveys.

THIRD YEAR ENROLMENTS

Table 1 contains the data for third year physics enrolments over the period 1980-1984. Institutions are grouped by States and type so that comparisons may be made between sectors and States. In Figure 1 we have plotted the third year enrolments by sector over the seventeen year period 1968-1984.

The data show a generally static pattern of enrolments over the seventeen year period. There are pronounced dips in the early seventies and early eighties and a distinct peak in the mid-seventies but the total enrolments over the seventeen year period fall within the range of 475 $\pm$ 100.

The University sector shows signs of a steady decline from a mean of approximately 400 students in the late sixties to a mean of about 320 students in the early eighties. The CAE sector shows a steady increase from a mean of about 50 students in the late sixties to a mean of about 125 students in the early eighties. Superimposed on these underlying trends are annual fluctuations of up to 100 students.

An interesting feature of all curves in Figure 1 is the presence of the double-peaked structure in the mid-seventies and the dip in the early eighties. The most recent data show signs of a possible recovery but it is still too soon to predict a return to the enrolment patterns of the mid-seventies. The reasons for these features are not apparent. The analysis of the data by sector shows similar patterns in both sectors, thus indicating that the trends may be due to National or State factors such as employment prospects or changes to the education system.

The trends in Figure 1 closely resemble those in the National participation rates in higher education, as reported by the Tertiary Education Commission in its

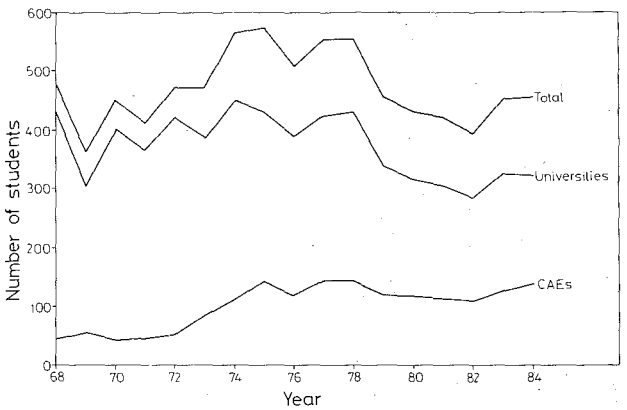

Figure 1: *Enrolments in Third Year Physics at Australian Universities and Colleges of Advanced Education, 1968-1984.*

1984 Report. During the period 1975 to 1981 there was a twenty percent decline inthe total participation rate in higher education in Australia and this decline was more pronounced amongst males than amongst females. Since 1981 there has been a strong recovery in participation rates similar to that in Figure 1.

A close study of the data by State reveals that the dip in 1969 was due to the introduction of the Wyndham scheme in N.S.W. The sharp rise in the enrolments in the mid-seventies also correlates closely with increased physics enrolments in N.S.W. following the demise of the Wyndham scheme. Victoria and South Australia also show a substantial increase in enrolments in the mid-seventies followed by a decline. De Laeter et al (1980) have noted a decline in secondary science enrolments in these States due to changes in the secondary school curriculum and student preferences.

Thus it appears that the fluctuations in the curves in Figure 1 can be explained in terms of a basically steady pattern of enrolments overall which correlates with an adequate supply of jobs for physicists (Prescott, 1984). Superimposed on this pattern is a steady drift from universities to the more vocationally-oriented courses at CAEs. There are also substantial fluctuations in enrolments in those States where there have been major changes to the secondary school curriculum in physics.

It is of interest to note from the data in Table 1 that Victoria, despite its smaller population, produces about thirty percent more physicists than N.S.W. and that South Australia, which has a similar population to W.A., also produces about twenty-five percent more physicists. These differences are also reflected in AIP membership patterns (de Laeter and Jennings, 1982) and this suggests that employment prospects may be a factor in determining the overall level of physics enrolments in each State.

There is some cause for concern about the large numbers of institutions which have very small enrolments in third year. Class sizes may be even lower than Table 1 indicates because of the presence of appreciable numbers of part-time students, particularly in the CAEs. This situation may improve as a result of

TABLE 1
NUMBERS OF THIRD YEAR PHYSICS STUDENTS

	1980	1981	1982	1983	1984
Griffith University	14	10	12	15	15
James Cook University	7	2	3	8	2
University of Queensland	17	19	13	13	19
Queensland Institute of Technology	5	13	10	14	11
Capricornia Institute of Advanced Education	17	15	11	14	12
Darling Downs Institute of Advanced Education	5	4	1	4	8
Total QUEENSLAND	65	63	50	68	67
Macquarie University	7	16	12	6	13
University of Newcastle	7	7	4	7	5
University of New England	7	4	3	4	6
University of New South Wales	25	27	16	15	25
University of Sydney	36	33	47	48	38
University of Wollongong	5	5	1	5	4
New South Wales Institute of Technology	7	7	7	10	13
Total NEW SOUTH WALES	94	99	90	95	104
Australian National University	6	9	8	15	13
Royal Military College	5	0	5	8	3
Canberra College of Advanced Education	17	15	15	13	17
Total AUSTRALIAN CAPITAL TERRITORY	28	24	28	36	33
Deakin University	8	6	0	4	2
Latrobe University	12	12	18	19	15
University of Melbourne	50	46	42	39	36
Monash University	14	22	15	27	26
Ballarat College of Advanced Education	12	5	9	6	4
Chisholm Institute of Technology	16	19	19	22	24
Royal Melbourne Institute of Technology	23	27	21	21	13
Total VICTORIA	135	137	124	138	120
University of Tasmania	18	13	12	9	18
University of Adelaide	42	34	37	39	39
Flinders University	8	7	7	10	5
South Australian Institute of Technology	4	1	6	12	19
Total SOUTH AUSTRALIA	54	42	50	61	63
Murdoch University	9	15	14	14	13
University of Western Australia	21	19	17	22	25
Western Australian Institute of Technology	11	9	9	10	13
Total WESTERN AUSTRALIA	41	43	40	46	51
Total AUSTRALIA	430	421	394	453	456

the upturn in tertiary enrolments which is underway at present. The National Technology Strategy and the development of high technology industry could also stimulate the demand for physicists and help to produce viable class sizes at some of the smaller and newer institutions later in the decade.

FOURTH YEAR ENROLMENTS

The data for fourth year enrolments are given in Table 2 and the totals by sector are plotted in Figure 2. In this survey fourth year students include honours, postgraduate diploma and masters preliminary.

The fourth year enrolments show a similar pattern

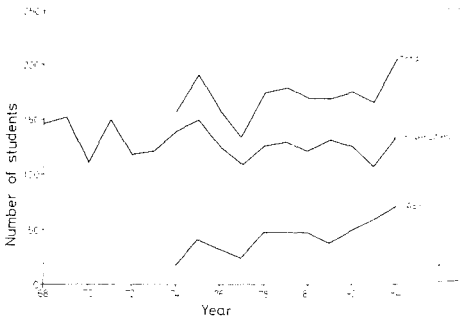

Figure 2: *Enrolments in Fourth Year Physics at Australian Universities and Colleges of Advanced Education, 1968-1984.*

to the third year figures. A decline in the University sector enrolments and a steady increase in the CAE sector enrolments is also apparent. The fluctuations are not as prominent at the fourth year level as they were for third year students.

Over the past decade the total fourth year enrolments have fluctuated by up to 40, about a mean of 175 students. University enrolments have declined from a mean of about 140 to about 125 over the past seventeen years while CAE enrolments have risen from about 35 to about 75 over the past decade.

These figures indicate that the same influences are at work in determining the numbers of students electing to stay on after their third year of study. The retention rate from third year to fourth year is about thirty-seven percent and this has remained reasonably steady over the past seventeen years. A significant trend in these data reflects the establishment of postgraduate diploma studies in CAEs.

As noted in our previous studies (de Laeter and Jennings 1982; de Laeter and Watson-Munro 1979) the fourth year enrolments in many institutions are very low. Only about one quarter of the institutions have sufficient numbers to permit efficient teaching in the traditional way. Many institutions have very small enrolments and have probably been forced to adopt

TABLE 2
NUMBERS OF FOURTH YEAR PHYSICS STUDENTS
(Honours, Graduate Diploma and Master's Preliminary)

	1980	1981	1982	1983	1984
Griffith University	3	1	2	3	2
James Cook University	2	2	1	3	5
University of Queensland	11	8	13	10	9
Queensland Institute of Technology	10	11	11	10	12
Total QUEENSLAND	26	22	27	26	28
Macquarie University	2	1	2	3	3
University of Newcastle	3	4	3	1	5
University of New England	2	6	2	1	3
University of New South Wales	6	17	17	10	15
University of Sydney	12	13	7	7	8
University of Wollongong	1	0	2	0	1
New South Wales Institute of Technology	2	1	3	10	12
Total NEW SOUTH WALES	28	42	36	32	47
Australian National University	4	6	3	7	11
Royal Military College	1	0	1	1	1
Total AUSTRALIAN CAPITAL TERRITORY	5	6	4	8	12
Deakin University	2	1	1	0	0
Latrobe University	5	4	5	2	2
University of Melbourne	19	8	11	7	14
Monash University	19	8	11	7	14
Ballarat College of Advanced Education	1	0	0	0	0
Swinburne Institute of Technology	1	2	19	14	23
Total VICTORIA	54	40	51	45	55
University of Tasmania	8	6	5	6	3
University of Adelaide	10	5	16	13	18
Flinders University	6	4	4	2	5
South Australian Institute of Technology	4	4	0	0	0
Total SOUTH AUSTRALIA	20	13	20	15	23
Murdoch University	1	2	6	2	3
University of Western Australia	7	13	10	7	11
Western Australian Institute of Technology	21	26	17	25	24
Total WESTERN AUSTRALIA	29	41	33	34	38
Total AUSTRALIA	170	170	190	166	206

alternative teaching strategies to conserve their staff resources.

It should also be noted that no distinction has been drawn between full-time and part-time enrolments at fourth year level. In the CAEs, many Graduate Diploma students study part-time over several years and consequently the class sizes and graduation rates may be much smaller than Table 2 would appear to indicate.

POSTGRADUATE ENROLMENTS

The data on postgraduate enrolments are given in Table 3 and the numbers over the past six years are plotted in Figure 3. The data include Master degree and Ph.D. students. They are plotted only over the period 1979-1984 as these data were not collected in the first three surveys.

Table 3 shows an interesting pattern of enrolments by State. At the post-graduate level, N.S.W. has emerged as the leading State in line with overall population trends. Victoria, which trains more third year and fourth year students, appears to have a lower retention rate for postgraduate work than N.S.W. The A.C.T. has a high level of postgraduate enrolments due mainly to the presence of the Research School of Physical Sciences at the A.N.U. The smaller States (S.A., W.A. and Qld.) have similar numbers of postgraduate students, while

TABLE 3
NUMBERS OF POSTGRADUATE PHYSICS STUDENTS
(Master's and Ph.D. Students)

	1980	1981	1982	1983	1984
Griffith University	4	4	4	4	7
James Cook University	1	2	3	5	5
University of Queensland	17	15	17	18	24
Queensland Institute of Technology	16	15	14	20	23
Total QUEENSLAND	38	36	38	47	59
Macquarie University	32	33	19	14	17
University of Newcastle	6	7	7	5	4
University of New England	4	5	8	8	7
University of New South Wales	69	67	80	73	82
University of Sydney	26	26	31	29	35
University of Wollongong	10	9	9	8	6
New South Wales Institute of Technology	7	6	5	4	6
Total NEW SOUTH WALES	154	153	159	141	157
Australian National University	8	6	6	5	5
Australian National University (RSPS)	50	51	66	62	67
Royal Military College	7	7	6	3	2
Total AUSTRALIAN CAPITAL TERRITORY	65	64	78	70	74
Deakin University	1	1	0	0	0
Latrobe University	21	22	18	17	18
University of Melbourne	44	50	49	49	57
Monash University	29	28	31	33	28
Chisholm Institute of Technology	4	7	5	4	5
Royal Melbourne Institute of Technology	15	13	16	16	12
Swinburne Institute of Technology	1	2	3	3	2
Total VICTORIA	115	123	122	122	122
University of Tasmania	30	24	22	26	24
University of Adelaide	23	20	29	30	29
Flinders University	13	14	15	19	20
South Australian Institute of Technology	5	5	6	5	8
Total SOUTH AUSTRALIA	41	39	50	54	57
Murdoch University	3	4	8	7	8
University of Western Australia	23	24	22	26	24
Western Australian Institute of Technology	22	21	26	24	23
Total WESTERN AUSTRALIA	48	49	56	57	55
Total AUSTRALIA	491	488	525	513	548

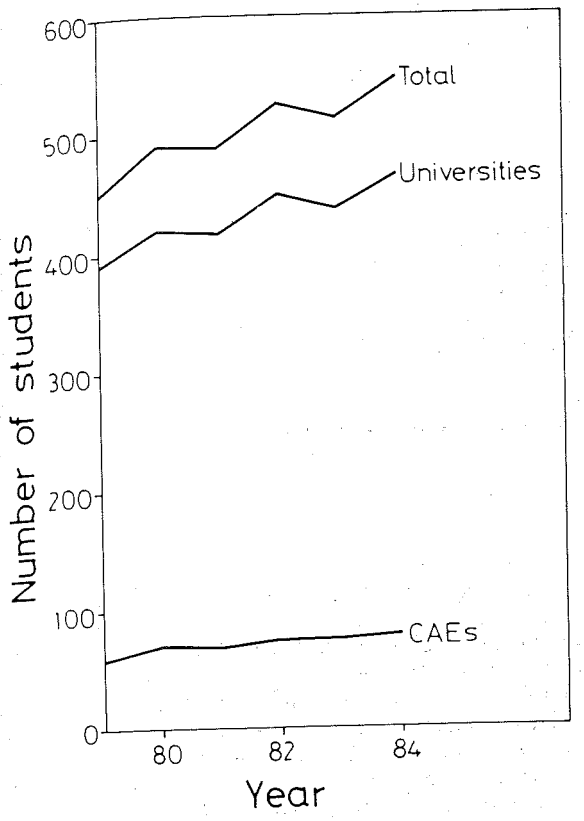

Figure 3: *Postgraduate enrolments in Physics at Australian Universities and Colleges of Advanced Education, 1979-1984.*

Tasmania has a remarkable high number considering its population base.

The enrolments by sector are plotted in Figure 3. These show a steady upward trend with an annual growth rate of about three percent in each sector. Since the fourth year numbers are relatively static, this growth must be coming from either improved retention rates or an influx of overseas students. It seems more likely to the authors that the former is the case as Australian students now tend to remain in Australia for postgraduate studies, perhaps because of the wider range of choice available and the increasing cost of overseas study.

Assuming a mean enrolment period of five years for a Ph.D. and three years for a Master's degree and also assuming, based on local experience, that sixty percent of the postgraduate students will complete their degree, it appears that we are producing about fifty Ph.D. and fifty Master's degree graduates in physics each year in Australia.

This analysis indicates that about fifty percent of the fourth year students stay on for higher degree studies (when allowance is made for overseas students).

Another inference that can be drawn from the data is that about ten percent of first year physics majors will eventually undertake a postgraduate degree. This is again based on local data which indicate that about fifty percent of first year physics students who intend to major in physics eventually graduate in physics. Of these, about forty percent stay on for fourth year studies and about fifty percent of these stay on for higher degree studies.

FINAL YEAR RADIOGRAPHY ENROLMENTS

Table 4 and Figure 4 show the enrolment patterns in final year radiography. There are only six CAEs involved in this area, which includes diagnostic and therapeutic radiography and nuclear medicine.

The curve in Figure 4 shows a steady rise in enrolments from around a mean of 90 in the early seventies to around 150 in the early eighties. Superimposed on this curve is a large peak during the years 1977-1980. This peak is due primarily to a sudden increase and subsequent decline in enrolments at RMIT. Apart from this feature the enrolment pattern shows steady growth of about four percent per annum and a reasonably equal distribution of students amongst institutions.

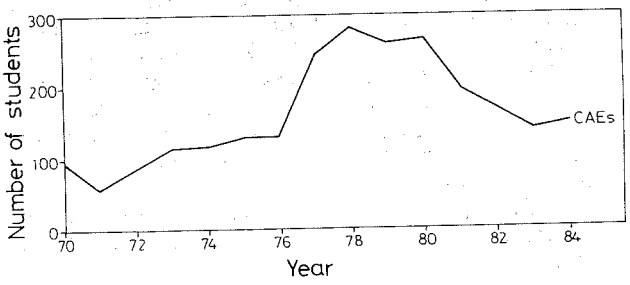

Figure 4: *Enrolments in final-year radiography in Colleges of Advanced Education, 1970-1984.*

CONCLUSIONS

The main conclusions to emerge from this study are:

(1) national undergraduate physics enrolments have remained reasonably stable over the past seventeen years apart from local fluctuations, probably reflecting changes in the secondary education system.

(2) there has been a steady increase in enrolments in the CAE sector and a corresponding decline in enrolments in the University sector, at the third year and fourth year levels.

(3) postgraduate enrolments in both sectors have continued to increase over the past five years.

TABLE 4
NUMBERS OF FINAL YEAR RADIOGRAPHY STUDENTS IN CAEs*

	1980	1981	1982	1983	1984
Queensland Institute of Technology	43	40	39	34	37
Newcastle College of Advanced Education	13	8	8	9	8
Riverina College of Advanced Education	28	23	18	25	23
Royal Melbourne Institute of Technology	142	85	64	46	38
South Australian Institute of Technology	23	23	24	13	27
Western Australian Institute of Technology	17	15	14	14	15
Total AUSTRALIA	266	194	167	141	148

* The term "radiography" includes Diagnostic and Therapeutic Radiographers and Nuclear Medicine students.

(4) radiography enrolments nationally have shown a steady growth over the past fifteen years apart from a large fluctuation due to local factors in Victoria.

ACKNOWLEDGEMENTS

The authors are indebted to our colleagues in the various tertiary institutions who have kindly supplied us with the data on which this article is based.

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Canberra – In Brief

- The terms of reference for the Commission of the Future announced in the Federal Budget, have been released by the Minister for Science and Technology, Mr Barry Jones. Its main aim will be raise community awareness and understanding of the social and economic impacts of technological change. Its terms of reference will also include stimulation of discussion and debate on the implications of such developments — and related social and economic change — for personal choices in education, career, leisure and related matters. This Commission will not be an advisory body for the Government. Instead it will stimulate public interest by publications, media contributions and direct contact with all sorts of community groups.
- The Minister for Science and Technology, Mr Jones, has announced that a review of the effectiveness of the Industrial Research and Development Incentives Scheme is being undertaken by his Department. The review will help the Government to determine whether its present policy of support through this scheme is the most effective way to encourage industrial R&D, or whether changes should be made. The review will be undertaken by the consultancy firm of Price Waterhouse Associates.
- A senior officer of the Department of Science and Technology, Dr John Bell, has been appointed to the OECD as the Head of the Science and Technology Policy Division. In his new position, Dr Bell will oversee a Secretariat which produces studies and policy papers for the OECD Committee for Science and Technology policy.
- A $32 million dollar radio telescope which will eventually link major telescopes across Australia was recently inaugurated by the Minister for Science and Technology, Mr Jones. The telescope, to be known as the The Australia Telescope, will be built at Culgoora in northern New South Wales. It will comprise a six kilometre array of six fully steerable and moveable twenty-two metre antennae at Culgoora, a new fixed antenna at Siding Spring (also in northern New South Wales) and will incorporate the already established sixty-four metre radio telescope at Parkes, central New South Wales.
- The Prime Minister, Mr. Hawke made the following statement in the Australian Labor Party's Policy Speech at the Sydney Opera House on 13 November 1984:

The New Technology Challenge

National reconstruction and the enhancement of sustained growth will require heavy investment in education, training and retraining, and a redirection of our education effort to ensure that it prepares our young people better for productive and creative lives in a complex and rapidly changing modern world.

This concern for the quality and relevance of education has caused the Government to initiate inquiries into tertiary education through the Commonwealth Tertiary Education Commission, under its chairman, Hugh Hudson, and into secondary and primary education under the Vice-Chancellor of the Australian National University, Professor Peter Karmel. These reports will provide the Government with a basis for ensuring that the substantially increased resources which we will make available to education at all levels are used in the most effective way in the years ahead.

To succeed in building a dynamic, prosperous and secure Australia it is essential that we have available and apply the world's best technology. The strengthening of technical and applied scientific education is essential to this end. Our pure scientific research effort has been at the forefront of the world, and we will continue to maintain the very large Australian Government effort in scientific research through our Universities and C.S.I.R.O. But we have to recognise that our application of new technology to many areas of industry has lagged behind.

Sustained high growth in Australia will require greater and more systematic application of the best technology to all our industry.

In recognition of this weakness in our national research and development effort, we have promoted a greatly increased flow of funds to enterprises applying new technology through the Management Investment Companies.

Research Concession

To further encourage this effort, we intend to allow 150 percent of genuine expenditure within Australia on research and development to be deducted against income for taxation purposes. This will mean that the effective cost of research and development to the investor will be only thirty-one percent of expenditure. We expect this initiative to expand substantially the research and development effort within Australian business, and assist also in the revitalisation of the established research communities. All research and development expenditure will qualify, unless it is within projects which already receive assistance under R & D Grant Schemes.

AIP Science Policy Committee