

PHYSICS ENROLMENTS IN AUSTRALIAN AND NEW ZEALAND UNIVERSITIES 1994 - 1999

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This is the eleventh of a series of triennial surveys of physics enrolments in Australian and New Zealand Universities.

This project began in 1974 with surveys by de Laeter [1] and Watson-Munro [2] for physics enrolments at Australian Colleges of Advanced Education and Universities respectively in the period 1963 to 1973. The original aim of the surveys was to collect data for planning purposes and to study the effects of Government policy on the physics profession.

In 1975 de Laeter and Watson-Munro [3] produced the first of these combined surveys for all Australian tertiary educational institutions covering the period 1965-1975. They repeated the exercise in 1979 [4]. Following the retirement of Professor Watson-Munro in 1979, Philip Jennings and John de Laeter combined to continue the surveys at triennial intervals through the eighties [5,6,7,8]. In 1993 the survey was expanded to include New Zealand universities and Graeme Putt joined the team [9,10].

We now have a consistent set of data covering the period 1968 to 1999 for Australian universities and from 1991 to 1999 for New Zealand universities. Originally, the surveys focussed on numbers of third and fourth year physics students. These were easier to identify than graduates in physics as some of them do double majors and are difficult to keep track of, while others graduate at mid-year. Although it is easier today to collect the data on physics graduates because it is required by the Federal Government, we have continued to count third and fourth years physics majors for consistency. They also represent a more realistic estimate of the enrolments in physics rather than the output of physics departments.

Beginning with the 1982 survey, we began to collect the total number of postgraduate students in physics and we now have a complete data set covering the years 1979-1999 for Australian universities (1991-1999 for New Zealand universities). Here again we chose to count the total number of postgraduate students to gain an indication of the size of the postgraduate effort. In earlier surveys we also estimated the number of pass, honours and postgraduate graduates each year.

Beginning in 1991, we also began to address gender issues because of the perceived low level of participation by females in physics. Initially there was some difficulty in obtaining these data but we now have sufficient data to draw conclusions and as time goes by, we will be able to study trends in participation rates.

The 1996 survey by Jennings, de Laeter and Putt [10] was undertaken in the midst of unprecedented anxiety about the future of physics in Australia and New Zealand due to the severe budget cuts in tertiary education. The situation has not

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improved over the intervening period of time.

Two of us presented a paper at the Thirteenth National Congress of the Australian Institute of Physics, addressing the problems faced by Australian universities in terms of static enrolments, the loss of service teaching and the reduction in public funding. Preliminary physics enrolment statistics for the years 1997 and 1998 were presented and an undertaking was given that this data, supplemented by the 1999 statistics would be published in the "Physicist" as soon as practicable.

This paper is the outcome of this undertaking. It not only provides the enrolment data for 1994-1999 in detail, but also presents, in graphical form, the data for Australian universities from 1968-1999 for third and fourth years, and for postgraduate students from 1986-1999. The New Zealand data is presented from 1991 - 1999. An attempt has also been made to report significant changes which may have occurred in the structure and offerings of Physics Departments over the past few years.

These data were obtained from the Heads of the various physics departments in Australia and New Zealand. We have tried to ensure that the data are consistent and accurate by circulating the tables to Heads for checking. However, there are certain to be minor errors due to the difficulty of uniquely identifying physics majors. We encourage physicists to correct the data as necessary.

Third Year Enrolments

Table 1 contains the data on third year physics enrolments for the period 1994 - 1999. Institutions are grouped by State together with a group for the New Zealand universities. A few of the numbers differ slightly from those in our previous survey by Jennings, de Laeter and Putt [10] due to retrospective corrections notified by Departmental Heads during the course of this survey. In Figure 1 we have plotted these enrolments over the period 1968 to 1999.

The total number of Australian Third year students has decreased slightly over the past six years. The average number of third year students was 607 over the previous three-year period 1994-1996 as compared to an average of 552 students over the 1997-1999 period. Over the same time periods, the

New Zealand Third year numbers have increased from an average of 114 from 1994 - 1996 to 131 in the past three years.

Over the longer term it is clear that growth has occurred from around 400 third year students in the late 1960's to around 550 in the late 1990's. This is a very modest growth rate and it is superimposed on a fluctuating background where variations of up to 100 students can occur from one year to the next. Over this same period the Australian University population has increased by a factor greater than three, so physics has clearly failed to share in most of the growth which has occurred in the tertiary education sector.

It should be noted that a number of universities listed in Table 1 no longer offer a physics program. In Victoria three universities are in this category - Ballarat, Deakin and Swinburne. Thus the Victorian numbers have been reduced from an average of 245 students in 1994 - 1996 to an average of 187 in 1997 - 1999, almost a 25% decline.

There has also been a significant decline in South Australia, which has partly been caused by the situation at the University of South Australia. However, USA is confident that the situation will improve in future years. Enrolments in third year physics have remained stable in Queensland and NSW and have increased in the ACT and WA, as have the New Zealand numbers. A minor artifact in the increases at third year in the latter's numbers concerns the contribution from Auckland, the most populous of NZ's six universities. The Faculty of Science altered its BSc regulations in 1996, endorsing bachelor degrees for the first time with an actual subject major. Accordingly the more stringent criterion previously used to define a third year Physics major at Auckland has been significantly relaxed from an effective 37% to 19% third year Physics loading content of its overall BSc degree.

The Australian participation rate at a third year level in physics is now approximately 29 per million people as determined by the third year statistics, which is now slightly lower than New Zealand. The participation rate in Queensland in the late eighties and early nineties was close to the Australian average but has declined significantly since then. In NSW the physics participation rate has always been lower than the Australian average and it has remained that way. The reasons for these anomalies are not known.

The female participation rate in physics has averaged 22% over the past three years at third year level in Australia as compared with 15% in 1991. The proportion of female numbers seem to be growing despite the decline in male numbers over the past few years. In New Zealand, the female numbers are significantly lower (around 16%) but have increased over the present three-year period, although with such small numbers the proportion of females fluctuates considerably. The female proportion of the enrolments is remarkably similar in all Australian States despite the large differences in the overall participation rate.

Institution	1994		1995		1996		1997		1998		1999	
	M	F	M	F	M	F	M	F	M	F	M	F
Griffith University	11	3	9	3	6	1	9	4	10	5	13	5
James Cook University	3	3	4	3	4	3	2	2	3	0	4	1
Queensland Uni of Technology	20	6	16	3	8	3	6	5	5	1	10	1
Central Queensland University	17	3	21	6	16	7	14	5	16	5	11	6
University of Queensland	7	1	7	1	11	1	9	4	13	1	9	1
Total Queensland	58	16	57	16	45	15	40	20	47	12	47	14
Macquarie University	35	2	19	3	21	5	23	2	14	4	19	5
University of Newcastle	10	1	10	0	10	1	8	1	10	2	16	1
University of New England	2	1	4	1	1	0	9	4	6	2	5	1
University of New South Wales	34	10	27	11	21	8	28	6	30	10	20	10
University of Sydney	28	4	31	5	21	2	24	6	30	8	40	5
Uni of Technology, Sydney	19	1	16	2	17	4	12	4	14	6	16	7
University of Western Sydney	18	3	12	2	13	1	13	1	8	2	14	3
University of Wollongong	5	1	10	2	9	1	12	3	9	3	4	4
Total New South Wales	151	23	129	26	113	22	129	27	121	37	134	36
Aust Defence Force Academy	7	1	5	0	8	2	9	0	9	0	19	4
Aust National Uni - Faculties	11	4	11	2	10	3	21	6	22	4	15	6
University of Canberra	2	0	2	0	1	1	1	0	2	0	2	0
Total ACT	20	5	18	2	19	6	31	6	33	4	36	10
University of Ballarat	1	0	2	3	0	0	0	0	0	0	0	0
Deakin University	7	6	9	8	4	1	0	0	0	0	0	0
La Trobe University	10	3	9	3	10	1	11	3	4	3	5	2
Monash University	70	20	62	13	49	18	50	16	44	20	50	6
Royal Melb Inst of Technology	22	8	42	11	41	10	31	7	32	7	18	5
Swinburne University	13	5	12	12	17	11	0	0	0	0	0	0
University of Melbourne	29	12	24	7	21	9	22	11	33	15	31	11
Victoria University	33	5	29	9	35	9	33	12	39	8	28	4
Total Victoria	185	59	189	66	177	59	147	49	152	53	132	28
University of Tasmania	12	0	11	2	10	5	8	1	8	1	9	2
Flinders University	19	2	11	3	8	5	13	1	14	2	14	4
University of Adelaide	18	4	16	4	18	6	4	3	19	6	16	0
University of South Australia	3	0	14	1	15	5	5	3	3	1	0	0
Total South Australia	40	6	41	8	41	16	22	7	36	9	30	4
Curtin University of Technology	12	3	14	4	18	3	12	1	15	3	15	1
Murdoch University	6	2	3	3	6	2	6	2	2	4	8	1
University of Western Australia	16	1	22	3	28	4	27	13	26	12	25	14
Total Western Australia	34	6	39	10	52	9	41	11	36	15	48	16
Northern Territory University	0	0	2	0	2	0	1	0	3	0	2	0
Total Australia	500	115	486	130	459	132	419	121	436	131	438	110
Massey University	4	1	6	1	8	0	8	4	5	2	5	3
University of Auckland	16	4	24	2	44	4	40	7	26	4	41	8
University of Canterbury	17	5	17	2	27	3	30	8	34	6	37	8
University of Otago	18	5	15	2	10	2	7	1	7	0	7	0
University of Waikato	17	2	16	1	13	1	13	1	11	4	10	1
Victoria University	14	3	14	1	20	2	19	1	18	0	14	3
Total New Zealand	86	20	92	9	122	12	117	22	101	16	114	24
	106	101	134	139	117	117	117	117	117	117	117	117

Table 1

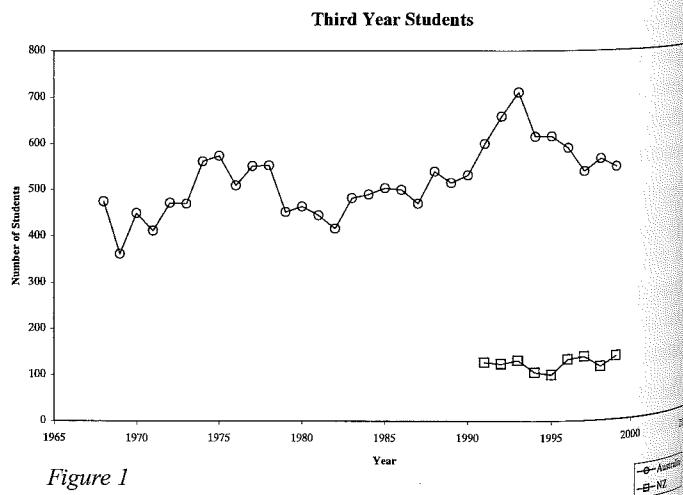


Figure 1

Fourth Year Enrolments

The data for fourth year enrolments for 1994-1999 are presented in Table 2 and the trends in these enrolments from 1968 to 1999 are plotted in Figure 2. The fourth year numbers include honours, diploma and masters preliminary students. These numbers have followed a similar fluctuating pattern to the third year enrolments. Over the thirty years, from the mid sixties to the mid nineties, the number of fourth year students in Australian universities has doubled, from about 120 to 240, while the third year numbers have only increased by 50% over this period.

This can be explained by an increase in the retention rate from third year to fourth year from 30% in 1968 to 40% in 1996. The New Zealand figures indicate a higher participation rate in fourth year (~16.5 per million) than in Australia (~14 per million). This appears to be due to a higher retention rate from third year to fourth year in New Zealand (~15% above that in Australia) over the period 1992 to 1996, which may be the result of marginally better employment prospects for Australian pass graduates.

Whilst this was the situation up to 1996, the situation over the past three years has altered drastically. The average number of 4th year students over the period 1994 - 1996 was 246 whereas in the 1997 - 1999 period, it has slumped to 177 - a decline of 28%. This is in part due to the smaller numbers in 3rd year physics in 1996, 1997 and 1998 together with a decline in retentivity from 3rd to 4th year. On the other hand, the New Zealand situation is the reverse, moving from an average of 58 over 1994 - 1996 to 68 from 1997 - 1999.

The proportion of females undertaking a 4th year in Australian universities has increased from 16% in 1991 to 25% in 1999 which correlates with the gender balance situation at third year. The proportion of females in 4th year physics courses in New Zealand is approximately 15% over the period 1997-1999, which, as expected, correlates with the female situation in 3rd year.

Postgraduate Enrolments

The data on Masters and PhD enrolments are presented in Table 3. These figures are the number of students currently enrolled for a higher degree at an Australian or New Zealand university. The trends are plotted in Figure 3 for the period 1979 - 1999.

The data in Figure 3 reveal that after 15 years of steady growth, post-graduate numbers stabilised at about 950 from 1994 - 1996. However, in a similar pattern to the 4th year enrolments, the average number of postgraduate students has declined to an average of 825 per year over the past three years, a decline of approximately 13% with respect to the previous three-year period. The New Zealand figures have continued to rise to an all-time maximum of 175 in 1999. The reasons for this contrasting behaviour are probably related to the introduction of fees for higher education in Australia in 1990 and the restrictions on postgraduate scholarships, especially for overseas stu-

Institution	1994		1995		1996		1997		1998		1999	
	M	F	M	F	M	F	M	F	M	F	M	F
Griffith University	4	0	4	1	3	1	0	1	5	1	5	1
James Cook University	0	2	3	2	4	1	0	0	0	1	2	0
Queensland Uni of Technology	0	0	2	0	5	0	3	1	2	1	1	0
Central Queensland University	13	2	15	4	15	1	7	1	6	1	3	0
University of Queensland	19	1	9	1	8	1	6	1	2	0	9	1
Total Queensland	36	5	33	8	33	4	16	4	15	4	20	2
	41		41		39		20		19		22	
Macquarie University	3	2	4	1	8	0	5	2	3	0	2	1
University of Newcastle	3	1	1	0	4	0	4	0	5	1	1	1
University of New England	2	1	1	0	3	1	0	0	2	0	0	0
University of New South Wales	10	2	13	4	13	7	8	6	13	6	9	7
University of Sydney	12	6	16	2	14	3	9	1	12	4	5	3
Uni of Technology, Sydney	3	2	3	0	2	1	5	1	4	0	1	1
University of Western Sydney	1	0	8	1	0	2	4	1	0	0	0	0
University of Wollongong	2	2	1	1	7	2	5	3	10	1	7	1
Total New South Wales	36	16	47	9	51	16	40	14	49	12	25	14
	52		56		67		54		61		39	
Aust Defence Force Academy	0	1	4	0	2	0	1	0	6	0	1	0
Aust National Uni - Facilities	6	3	8	5	9	3	4	2	5	7	9	3
University of Canberra	5	0	5	0	4	0	0	0	0	0	0	0
Total ACT	21	4	17	5	15	3	5	2	11	7	10	3
	25		22		18		7		18		13	
La Trobe University	5	0	1	1	6	2	2	0	0	0	3	2
Monash University	10	4	12	7	10	6	8	1	9	2	2	5
Royal Melb Inst of Technology	6	2	6	1	8	2	10	2	8	1	9	0
Swinburne University	4	2	5	2	4	1	0	0	0	0	0	0
University of Melbourne	23	2	15	9	12	5	9	3	10	8	14	10
Victoria University	2	1	2	0	2	0	7	1	2	1	4	0
Total Victoria	50	11	41	20	42	16	36	7	29	12	32	17
	61		61		58		43		41		49	
University of Tasmania	7	0	5	0	5	2	4	2	4	2	2	1
	7		5		7		6		6		3	
Flinders University	4	0	8	1	4	4	5	3	3	1	6	0
University of Adelaide	11	5	13	3	11	2	9	2	7	2	3	1
University of South Australia	3	1	0	0	7	0	4	2	1	2	1	1
Total South Australia	18	6	21	4	22	6	18	7	11	5	10	2
	24		25		28		25		16		12	
Curtin University of Technology	10	0	9	2	11	1	5	0	5	1	6	2
Murdoch University	1	4	2	3	5	6	4	2	2	0	2	1
University of Western Australia	11	1	10	0	10	3	16	1	8	4	10	4
Total Western Australia	22	5	21	5	26	10	29	3	15	5	18	7
	27		26		36		32		20		25	
Total Australia	190	47	185	51	206	58	148	39	134	47	117	46
	237		236		264		187		181		163	
Massey University	1	0	2	1	2	1	1	0	5	1	4	1
University of Auckland	9	1	15	3	20	5	21	2	15	4	9	4
University of Canterbury	7	4	13	1	11	2	8	1	13	5	17	3
University of Otago	8	3	9	1	9	1	17	4	9	2	8	0
University of Waikato	13	2	5	0	6	1	8	0	10	1	7	2
Victoria University	5	1	6	2	3	0	9	2	6	1	4	0
Total New Zealand	43	11	50	8	51	10	64	9	58	14	49	10
	54		58		61		73		72		59	

Table 2

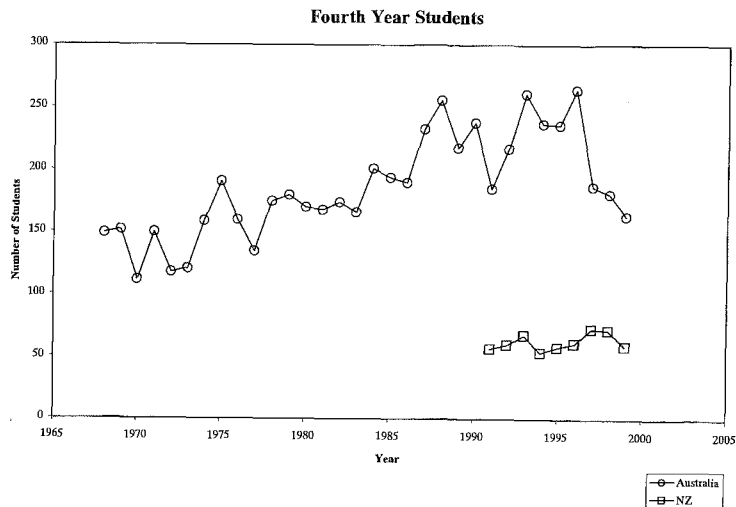


Figure 2

dents. It is now very difficult for overseas students from developing countries to undertake higher degrees in Australia unless they are sponsored by an international aid agency.

The participation rate in higher degree studies in physics is similar to all Australian States and New Zealand. The only exception is the ACT where the Research School of Physical Sciences and Engineering has a dominant role and attracts students from all States and overseas. However the number of students at ANU has declined over the period 1997 - 1999.

The proportion of females undertaking higher degree studies in physics continues to increase steadily, from 12% in 1991 to 19% in 1999. A similar trend is occurring in New Zealand with the proportion of females in postgraduate studies averaging 17% over the past three years.

Administrative Changes

In the course of conducting this survey, Heads of Departments were asked to comment on any significant changes that may have occurred to the administration of physics in their university. The following is a summary of their responses, first those from Australian HOD's then those from NZ HOD's:

- James Cook University: Physics is now in the School of Computer Science, Mathematics and Physics.
- Queensland University of Technology: Physics is now in the School of Physical Sciences (with Chemistry).
- Central Queensland University: Physics is now in the School of Engineering and Physical Systems.
- University of New England: Physics is now in the School of Physical Science and Engineering (although the Bachelor of Engineering is to be phased out).
- University of Western Sydney: a number of structural changes are taking place.
- University of Wollongong: Physics is now a Department of Engineering Physics in the Faculty of Engineering.
- University of Canberra: Physics has, for some time, been part of the School of Electronic Engineering and Applied Physics.
- La Trobe University: Physics is a Department within the School of Engineering.
- Victoria University: Physics is now in the School of Communications and Information.
- University of Tasmania: Physics is now in the School of Mathematics and Physics.
- Flinders University: Physics is now part of the School of Chemistry, Physics and Earth Sciences.
- University of South Australia: Physics has been merged with the Department of Electronic Engineering.
- Murdoch University: Physics is now part of the Department of Physics and Energy Studies.

Other comments made by Heads of Departments with respect to their courses reflect that many double degree courses have been introduced in recent years - particularly with Engineering, and these have lifted enrolments and established good cross-

Institution	1994		1995		1996		1997		1998		1999	
	M	F	M	F	M	F	M	F	M	F	M	F
Griffith University	11	0	13	0	12	0	11	0	10	0	10	0
James Cook University	21	2	15	2	15	2	17	6	16	6	17	6
Queensland Uni of Technology	45	11	51	14	43	11	36	11	34	9	31	8
Central Queensland University	2	1	2	1	2	1	7	0	4	1	2	0
University of Queensland	34	5	32	6	37	7	26	5	21	5	27	5
Total Queensland	113	19	113	23	109	21	97	22	85	21	87	19
	132		136		130		119		106		106	
Macquarie University	31	5	31	7	35	8	33	10	25	12	19	2
University of Newcastle	21	3	21	2	18	2	15	2	16	1	17	1
University of New England	11	1	10	1	7	1	4	1	5	1	5	0
University of New South Wales	53	17	45	19	46	18	59	18	61	16	51	16
University of Sydney	63	11	64	12	68	20	61	16	58	14	54	10
Uni of Technology, Sydney	19	5	19	6	18	5	19	6	18	4	14	4
University of Western Sydney	10	2	12	2	15	2	9	2	9	3	4	0
University of Wollongong	14	2	16	4	17	5	14	0	10	2	13	2
Total New South Wales	222	46	218	53	224	61	214	55	202	53	177	42
	268		271		285		259		255		219	
Aust Defence Force Academy	9	2	11	0	12	0	11	0	11	0	7	0
Aust National Uni - Faculties	9	0	7	0	7	2	12	2	12	2	14	3
ANU - Res Schl of Phys Sciences	88	9	87	16	78	21	69	20	63	21	43	21
Total ACT	106	11	105	16	97	23	92	22	86	23	64	24
	117		121		120		114		109		88	
La Trobe University	13	3	24	5	21	5	17	6	16	5	18	4
Monash University	39	6	43	8	47	6	38	7	31	9	29	9
Royal Melb Inst of Technology	26	10	26	5	26	3	32	4	35	5	34	6
Swinburne University	22	4	24	5	19	6	0	0	0	0	0	0
University of Melbourne	67	10	79	7	75	13	71	15	59	18	58	21
Victoria University	15	1	16	2	15	2	14	2	12	2	9	3
Total Victoria	182	34	212	30	203	35	172	34	153	39	148	43
	216		242		238		206		192		191	
University of Tasmania	13	1	8	1	10	1	8	0	6	0	6	0
	14		9		11		8		6		6	
Flinders University	23	3	13	1	13	1	12	2	12	2	8	3
University of Adelaide	53	11	47	10	47	12	39	9	41	11	35	11
University of South Australia	11	3	18	4	19	2	12	1	12	1	11	7
Total South Australia	87	17	78	15	79	15	63	12	65	14	54	15
	104		93		94		75		79		69	
Curtin University of Technology	30	5	31	4	27	4	21	4	31	6	38	4
Murdoch University	12	5	9	4	12	4	10	5	9	7	13	11
University of Western Australia	28	8	23	6	31	3	30	3	29	1	32	1
Total Western Australia	70	18	63	14	70	11	61	12	69	14	81	16
	88		77		81		73		83		97	
Northern Territory University	2	1	1	0	3	0	1	0	2	0	1	0
	3		1		3		1		2		1	
Total Australia	795	147	798	152	787	179	708	157	668	164	618	159
	942		950		962		865		832		777	
Massey University	11	0	8	0	7	1	10	2	11	2	14	2
University of Auckland	26	4	21	4	35	10	31	11	26	7	17	7
University of Canterbury	30	3	33	2	42	2	34	3	30	5	33	6
University of Otago	31	5	28	7	38	6	33	9	39	11	42	12
University of Waikato	25	2	27	4	17	2	27	3	20	1	25	1
Victoria University	10	0	9	1	11	3	9	2	15	2	14	2
Total New Zealand	133	14	126	18	150	24	144	30	141	28	145	30
	147		144		174		174		169		175	

Table 3
Postgraduate Students

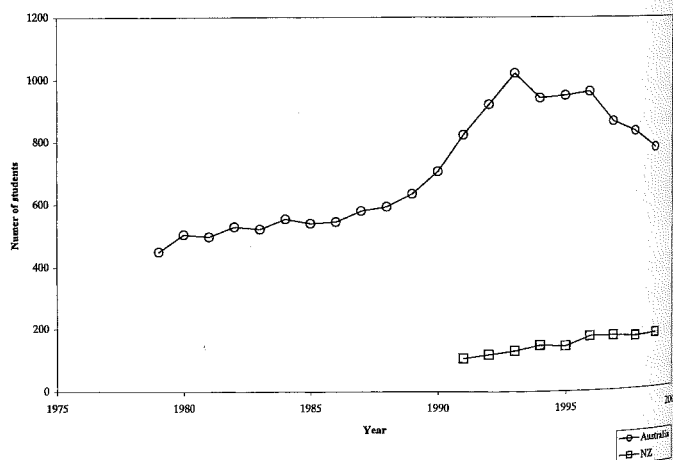


Figure 3

disciplinary relationships. Some physics courses have had to be reduced to a basic core, and in Western Australia there is a cooperative teaching program between Curtin and Murdoch Universities at the 2nd, 3rd and 4th year levels. Macquarie University has introduced a successful BSc in Astronomy and Astrophysics, and many other Departments have introduced astronomy as an elective unit. The University of Western

Australia now offers a degree in Medical Physics in tandem with their Physics major, whilst Flinders has introduced new degrees in nanotechnology and computational modelling. Many Universities have restructured their physics courses to make them more flexible and attractive to students.

New Zealand

Mergers of Physics with other departments have occurred at two of the six universities: in 1997 Victoria University of Wellington merged Physics with Chemistry into the School of Chemical and Physical Sciences and in 1998, Massey University merged Physics & Biophysics with Chemistry and Mathematics into the Institute of Fundamental Sciences.

Other comments from HOD's reflect significant structural changes in courses. Both Auckland and Canterbury are collaborating in a leading way with Engineering Schools in four year B.Tech programmes. Wellington is doing likewise with appropriate Crown Research Institutes (formerly DSIR) and Massey is contributing several electronics/electromagnetism papers to B.Tech programmes led by Computer Engineering and Consumer Technology sections. All universities have restructured their Physics courses to make them more accessible and alluring to students with funding in the tertiary sector continuing to be dominated by quantity rather than quality considerations.

Conclusions

The results of this survey show that physics is experiencing a difficult time in Australia. Third year, fourth year and post-graduate numbers have all declined in the three-year period 1997 - 1999 as compared to the previous three year period. This does not create a position of strength in times of financial stringencies where student numbers are an essential factor in determining Departmental budgets. A number of Physics Departments have, in fact, been closed down, and others have been amalgamated. The loss of Physics staff (both academic and technical) has exacerbated the situation and smaller Departments are sometimes hard pressed to cover the range of subject matter required in a good undergraduate course. Some Physics Departments have, in fact, joined forces to cover the teaching requirements of their courses.

The present study reveals a much better picture in New Zealand universities than their Australian counterparts. Third year, 4th year and postgraduate enrolments have all increased over the past three year period, and the number of third year physics students (138) now represents 25% of the total Australian third year enrolments in 1999. It is interesting to note that Physics in New Zealand is also enjoying increased participation at the secondary school level. Enrolments in Physics that have traditionally lagged those in Chemistry now exceed them. It is tempting to link gains in both gender participation (enhancement of NZ statistics for women by summing participation at all three levels of third, fourth and post-graduate levels reveals a genuine increase from 12% to 15% over the past two triennia) and overall tertiary participation to changes

that have occurred in the national school curriculum and examination style in Physics at the Universities Bursary (matriculation) level over the past half-decade. The rigour of both has been softened by demands for relevance and context in secondary science curricula much to the concern, if not chagrin, of academic staff wrestling with the deficiencies in university entry level background of contemporary students. Indeed the two larger universities at Auckland and Canterbury now have basic courses in their offerings that provide for a three-semester introductory sequence for significant numbers of students rather than the standard two-semester sequence able students still undertake. (Massey also offers a foundation course on a summer school basis but it responds to blanks in entry level rather than remedial needs). Nevertheless, the fact remains that while the secondary preparation of students had been significantly watered down, the subject has enjoyed increased popularity as an area of study at both senior secondary and all tertiary levels in New Zealand. The degree to which the two are causally linked is a matter for interesting debate in another forum. However, its mention here at least provides some food for thought to national bodies concerned with overall trends in Physics.

Another pleasing feature of this survey has been the increasing proportion of females comprising the various physics cohorts in both Australian and New Zealand universities. Although the increases have been small, they are nevertheless important for the future of physics in these two countries.

The draconian decreases in funding levels to the Australian tertiary sector which have resulted in savage staff reductions, deterioration of equipment and other facilities, and difficulties in sustaining research endeavours of international quality, are replicated to some extent in the decline in student numbers which, in turn, could trigger off further decreases in staffing etc. The Federal Government's recent Green Paper on research does not provide any comfort that the situation with respect to research will improve. Ridd and Heron [11] addressed the difficulties faced by Australian Physics Departments and related the decrease in enrolments to the decline in Secondary School physics enrolments.

This is not just a problem, which is of concern to the Physics community, but one which the Federal Government through the Prime Ministers Science, Engineering and Technology Council, should be addressing as a matter of urgency. The problem is not confined to Physics, but applies equally to Chemistry and Mathematics.

Evans [12], Dean of Research, School of Chemistry at the Australian National University has recently stated that:

"No modern society is possible in the absence of university schools somewhere in the nation, that are capable of teaching the broad, fundamental curriculum of chemistry, mathematics and physics. Tertiary education and research is in crisis across this nation."

Physics enrolments in the United States shows a similar pattern to Australia, in that the number of students graduating with a bachelor's degree in 1997 was the lowest for 40 years (Chodos, [13]. Chodos [13] argues that the lesson to be learned from the recent suspected Chinese spy case at Los Alamos National

Laboratory is that more American graduate students are required to enable the US National Laboratories to be able to recruit US nationals rather than have to rely on foreign-born scientists. Schwartz [14] has addressed some of the myths with respect to Physics Departments, students and employment in the United States. It is pertinent to remark that the US universities can at least recruit overseas students, whereas in Australia the Government policy on fees and overseas students has made this a much more difficult undertaking. This pattern has not occurred in New Zealand where Government policies are different.

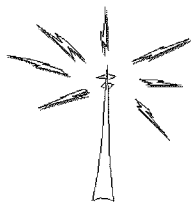
It is important to conclude that this survey has shown that, although some decreases in student numbers in physics have occurred in Australian universities, the long term trends are encouraging, whilst in New Zealand the situation with respect to physics enrolments has never been better. It is also pleasing to note that the difficulties confronting physics departments have invariably been addressed in a positive and constructive way, with some innovative solutions emerging which should serve the profession well in the future. In fact there is reason to believe that the discipline of physics will emerge from the vicissitudes of the present time stronger than before.

Acknowledgments

The authors are indebted to our colleagues in the various universities of Australia and New Zealand who have supplied us with the data and checked the tables for us. We would also like to thank Mrs Sue Shephard of Curtin University who prepared the manuscript for publication.

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