PHYSICS ENROLMENTS IN AUSTRALIAN AND NEW ZEALAND UNIVERSITIES 1991-1996

PHILLIP JENNINGS, JOHN DE LAETER & GRAEME PUTT

This is the tenth 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 in 1974 [**1**] and Watson-Munro in 1974 [**2**] for physics enrolments at 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 [**3**] de Laeter and Watson-Munro 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.

We now have a consistent set of data covering the period 1968 to 1996 for Australian universities and from 1991 to 1996 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 1979-1996 for Australian universities (1991-1996 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 this 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.

This year's survey was undertaken in the midst of unprecedented anxiety about the future of physics as a result of severe budget cuts in universities. Because physics is a ▷

Assoc Prof PJ Jennings is at Murdoch University. jennings@ fizzy.murodch.edu.au

Prof JR de Laeter is Deputy Vice-Chancellor at Curtin University of Technology. rdlaete@alpha2.curtin.edu.au

Dr GD Putt is at the University of Auckland. gdp@phy.auckland.ac.nz

Numbers of Third Year Physics Students 1991-1996

Institution	1991		1992		1993		1994		1995		1996	
	M	F	M	F	M	F	M	F	M	F	M	F
Griffith University	14	2	18	2	17	3	11	3	9	3	6	1
James Cook University	6	1	4	2	1	5	3	3	4	3	4	3
Queensland Uni of Technology	18	3	20	2	12	4	20	6	16	3	8	3
Central Queensland University	21	2	10	2	16	3	17	3	21	6	16	7
University of Queensland	28		29		27		7	1	7	1	11	1
Total Queensland	**95**		**89**		**88**		**58 16 74**		**57 16 73**		**45 15 60**	
Macquarie University	7	0	22	6	16	5	35	2	19	3	21	5
University of Newcastle	7	0	4	1	4	1	10	1	10	0	10	1
University of New England	4	0	7	1	3	1	2	1	4	1	1	0
University of New South Wales	25	3	28	4	31	7	34	10	27	11	21	8
University of Sydney	41	5	39	12	40	10	28	4	31	5	21	2
Sydney Uni of Technology	10	2	16	0	22	3	19	1	16	2	17	4
University of Western Sydney	2	0	5	4	13	5	18	3	12	2	13	1
University of Wollongong	5	1	4	0	5	3	5	1	10	2	9	1
Total New South Wales	**101 11 112**		**125 28 153**		**134 35 169**		**151 23 174**		**129 26 155**		**113 22 135**	
Aust Defence Force Academy	6	0	6	0	8	1	7	1	5	0	8	2
Aust National Uni - Faculties	7		9		20		11	4	11	2	10	3
University of Canberra	0	0	1	0	1	0	2	0	2	0	1	1
Total ACT	**13**		**16**		**30**		**20 5 25**		**18 2 20**		**19 6 25**	
University of Ballarat	11	2	6	2	3	3	1	0	2	3	-	-
Deakin University	6	2	11	3	8	6	7	6	9	8	4	1
La Trobe University	18	2	18	5	22	3	10	3	9	3	10	1
Monash University	60		57	6	60	8	70	20	62	13	49	18
Royal Melb Inst of Technology	30	3	28	3	28	4	22	8	42	11	41	10
Swinburne University	40	10	47	18	45	12	13	5	12	12	17	11
University of Melbourne	46	8	56	6	44	5	29	12	24	7	21	9
Victoria University	30	0	24	4	31	4	33	5	29	9	35	9
Total Victoria	**268**		**247 47 294**		**241 45 286**		**185 59 244**		**189 66 255**		**177 59 236**	
University of Tasmania	**18 1 19**		**11 1 12**		**16 5 21**		**12 0 12**		**11 2 13**		**10 5 15**	
Flinders University	10	4	10	4	13	0	19	2	11	3	8	5
University of Adelaide	31	5	18	2	27	7	18	4	16	4	18	6
University of South Australia	6	1	6	0	6	1	3	0	14	1	15	5
Total South Australia	**47 10 57**		**34 6 40**		**46 8 54**		**40 6 46**		**41 8 49**		**41 16 57**	
Curtin University of Technology	14	2	20	2	22	2	12	3	14	4	18	3
Murdoch University	9	2	8	3	12	5	6	2	3	3	6	2
University of Western Australia	15	3	21	1	21	1	16	1	22	3	28	4
Total Western Australia	**38 7 45**		**49 6 55**		**55 8 63**		**34 6 40**		**39 10 49**		**52 9 61**	
Northern Territory University	0	0	0	0	0	0	0	0	2	0	2	0
Total Australia	**609**		**659**		**711**		**500 115 615**		**486 130 616**		**459 132 591**	
Massey University	7	1	8	1	3	1	4	1	6	1	8	0
University of Auckland	37	4	41	4	58	6	16	4	24	2	44	4
University of Canterbury	36	4	28	4	20	2	17	5	17	2	27	3
University of Otago	12	2	9	2	7	4	18	5	15	2	10	2
University of Waikato	15	1	15	0	11	2	17	2	16	1	13	1
Victoria University	8	1	11	1	16	2	14	3	14	1	20	2
Total New Zealand	**115 13 128**		**112 12 124**		**115 17 132**		**86 20 106**		**92 9 101**		**122 12 134**	

relatively expensive discipline amongst the sciences it has suffered more than most and its future is uncertain in many universities. In fact several Australian universities (Deakin, Ballarat, Southern Queensland) have discontinued their physics programmes and several others are currently facing difficult decisions.

This data was obtained from the Heads of the various physics departments in Australia and New Zealand. We have tried to ensure that the data is 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. Also, the picture is not a static one and this data was collected during April and May of 1996. The numbers relating to 1994 and 1995 may be subject to slightly larger error than for 1996.

Third Year Enrolments

Table 1 contains the data on third year physics enrolments for the period 1991-1996. 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 de Laeter, Jennings and Putt [9] due to retrospective corrections notified by Departmental Heads during the course of this survey. In **Figure 4** we have plotted these enrolments over the period of 1968 to 1996.

The total number of Australian third year students has declined over the past three years, from a peak of 711 in 1993 to 591 in 1996. Over the same period the New Zealand numbers have remained relatively stable.

Over the longer term it is clear that growth has occurred from around 400 third year students in 1968 to around 600 in 1996. 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 of three so physics has clearly failed to share in most of the growth which has occurred in the tertiary education sector.

A closer examination of **Table 1** reveals that there was a sharp decline in third year physics numbers in all States and New Zealand in the mid-nineties. This could be a demographic trend.

Third year physics enrolments in Queensland have declined steadily since 1991 while other States and New Zealand have fluctuated. The participation rate in physics is about the same for New Zealand (~32 per million people) and all Australian States (~37 per million) except NSW and Queensland, where it is significantly lower (~ 25 per million). This is not a counting error. The participation rate in Queensland in the late eighties and early nineties was close to the Australian average but it 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 is slightly over 20% at third year level in Australia in 1996 compared with 15% in 1991. 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 10%) 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.

Fourth Year Enrolments

The data for fourth year enrolments for 1991-1996 are presented in **Table 2** and the trends in these enrolments from 1968 to 1996 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, may be as a result of marginally better employment prospects for Australian pass graduates.

The retention rate from third to fourth year appears to vary considerably between the States, with Victoria having the lowest (25%) and Queensland the highest (50%). The ACT has more fourth year students than third years, probably due to interstate migration of students wishing to study in the Research School of Physical Sciences and Engineering. The reasons for this variation are related to the range of fourth year options available. large diploma courses in NSW and Queensland seem to account for their high retention rates.

The proportion of females undertaking fourth year studies appears to be increasing, from 16% in 1991 to 25% in 1996, which is similar to the trend in third year numbers. A similar pattern is observed in New Zealand although females represent only 10% of the third year students there.

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 to 1996.

After fifteen years of steady growth the postgraduate numbers in Australian universities have declined and stabilised since 1993. In contrast, the New Zealand numbers have continued to rise steadily over the past six years. The reasons for this contrasting behaviour is probably related to the introduction of fees for higher education in Australia in 1990 and the restrictions on postgraduate scholarships, especially for overseas students. It is now very difficult for overseas students from developing countries to undertake higher degrees in ▷

Numbers of Fourth Year Physics Students 1991-1996

Institution	1991 M	1991 F	1992 M	1992 F	1993 M	1993 F	1994 M	1994 F	1995 M	1995 F	1996 M	1996 F
Griffith University	5	1	5	1	6	1	4	0	4	1	3	1
James Cook University	0	1	1	0	2	0	0	2	3	2	4	1
Queensland Uni of Technology	0	0	0	0	0	0	0	0	2	0	5	0
Central Queensland University	1	0	4	1	0	0	13	2	15	4	15	1
University of Queensland	7	1	12	3	12	0	19	1	9	1	8	1
	13	**3**	**22**	**5**	**20**	**1**	**36**	**5**	**33**	**8**	**33**	**4**
Total Queensland	**16**		**27**		**21**		**41**		**41**		**39**	
Macquarie University	3	1	1	0	7	2	3	2	4	1	8	0
University of Newcastle	3	0	1	0	3	0	3	1	1	0	4	0
University of New England	1	0	3	0	5	0	2	1	1	0	3	1
University of New South Wales	11	4	10	4	11	1	10	2	13	4	13	7
University of Sydney	17	2	19	2	18	3	12	6	16	2	14	3
Sydney Uni of Technology	6	2	1	2	2	1	3	2	3	0	2	1
University of Western Sydney	0	0	0	0	2	1	1	0	8	1	0	2
University of Wollongong	3	2	5	1	5	1	2	2	1	1	7	2
	44	**11**	**40**	**9**	**53**	**9**	**36**	**16**	**47**	**9**	**51**	**16**
Total New South Wales	**55**		**49**		**62**		**52**		**56**		**67**	
Aust Defence Force Academy	1	0	0	0	0	0	0	1	4	0	2	0
Aust National Uni - Faculties	9	2	7	1	7	2	16	3	8	5	19	4
University of Canberra	5	1	4	1	6	0	5	0	5	0	4	0
	15	**3**	**11**	**2**	**13**	**2**	**21**	**4**	**17**	**5**	**25**	**4**
Total ACT	**18**		**13**		**15**		**25**		**22**		**29**	
La Trobe University	2	1	3	0	7	1	5	0	1	1	6	2
Monash University	8	3	9	3	9	2	10	4	12	7	10	6
Royal Melb Inst of Technology	0	0	7	1	10	0	6	2	6	1	8	2
Swinburne University	7	3	13	6	16	11	4	2	5	2	4	1
University of Melbourne	8	3	16	4	22	0	23	2	15	9	12	5
Victoria University	0	0	0	0	5	0	2	1	2	0	2	0
	25	**10**	**48**	**14**	**69**	**14**	**50**	**11**	**41**	**20**	**42**	**16**
Total Victoria	**35**		**62**		**83**		**61**		**61**		**58**	
	10	**5**	**5**	**0**	**5**	**2**	**7**	**0**	**5**	**0**	**5**	**2**
University of Tasmania	**15**		**5**		**7**		**7**		**5**		**7**	
Flinders University	8	1	4	0	3	0	4	0	8	1	4	4
University of Adelaide	11	1	12	1	13	2	11	5	13	3	11	2
University of South Australia	0	0	1	2	2	1	3	1	0	0	7	0
	19	**2**	**17**	**3**	**18**	**3**	**18**	**6**	**21**	**4**	**22**	**6**
Total South Australia	**21**		**20**		**21**		**24**		**25**		**28**	
Curtin University of Technology	13	0	21	3	21	4	10	0	9	2	11	1
Murdoch University	6	0	9	5	11	5	1	4	2	3	5	6
University of Western Australia	8	0	5	2	10	1	11	1	10	0	10	3
	27	**0**	**35**	**10**	**42**	**10**	**22**	**5**	**21**	**5**	**26**	**10**
Total Western Australia	**27**		**45**		**52**		**27**		**26**		**36**	
Northern Territory University	**0**		**0**		**0**		**0**		**0**		**0**	
	153	**34**	**178**	**43**	**220**	**41**	**190**	**47**	**185**	**51**	**206**	**58**
Total Australia	**187**		**221**		**261**		**237**		**236**		**264**	
Massey University	4	1	4	1	4	1	1	0	2	1	2	1
University of Auckland	6	2	5	0	15	0	9	1	15	3	20	5
University of Canterbury	17	3	17	3	11	2	7	4	13	1	11	2
University of Otago	9	1	16	4	13	5	8	3	9	1	9	1
University of Waikato	8	1	6	0	12	0	13	2	5	0	6	1
Victoria University	5	0	4	0	4	1	5	1	6	2	3	0
	49	**8**	**52**	**8**	**59**	**9**	**43**	**11**	**50**	**8**	**51**	**10**
Total New Zealand	**57**		**60**		**68**		**54**		**58**		**61**	

Numbers of Postgraduate Physics Students 1991-1996

Institution	1991		1992		1993		1994		1995		1996	
	M	F	M	F	M	F	M	F	M	F	M	F
Griffith University	7	0	8	0	8	0	11	0	13	0	12	0
James Cook University	9	2	17	2	22	2	21	2	15	2	15	2
Queensland Uni of Technology	33	22	32	24	36	27	45	11	51	14	43	11
Central Queensland University	1	0	0	0	1	0	2	1	2	1	2	1
University of Queensland	39	2	37	3	40	5	34	5	32	6	37	7
	89	**26**	**94**	**29**	**107**	**34**	**113**	**19**	**113**	**23**	**109**	**21**
Total Queensland	**115**		**123**		**141**		**132**		**136**		**130**	
Macquarie University	42	12	44	17	40	10	31	5	31	7	35	8
University of Newcastle	9	1	15	1	13	1	21	3	21	2	18	2
University of New England	9	1	7	1	8	1	11	1	10	1	7	1
University of New South Wales	45	9	50	13	57	18	53	17	45	19	46	18
University of Sydney	56	8	62	10	67	15	63	11	64	12	68	20
Sydney Uni of Technology	14	3	19	4	19	4	19	5	19	6	18	5
University of Western Sydney	2	0	4	1	6	1	10	2	12	2	15	2
University of Wollongong	11	2	14	2	12	1	14	2	16	4	17	5
	188	**36**	**215**	**49**	**222**	**51**	**222**	**46**	**218**	**53**	**224**	**61**
Total New South Wales	**224**		**264**		**273**		**268**		**271**		**285**	
Aust Defence Force Academy	8	1	7	1	8	1	9	2	11	0	12	0
Aust National Uni - Faculties	12	1	12	2	12	2	9	0	7	0	7	2
ANU - Res Schl of Phys Sciences	68	7	77	10	97	12	88	9	87	16	78	21
	88	**9**	**96**	**13**	**117**	**15**	**106**	**11**	**105**	**16**	**97**	**23**
Total ACT	**97**		**109**		**132**		**117**		**121**		**120**	
La Trobe University	20	3	20	4	18	3	13	3	24	5	21	5
Monash University	54	2	56	3	56	4	39	6	43	6	47	6
Royal Melb Inst of Technology	25	8	23	8	23	9	26	10	26	5	26	3
Swinburne University	15	2	24	2	40	5	22	4	24	5	19	6
University of Melbourne	78	6	71	6	73	11	67	10	79	7	75	13
Victoria University	3	0	8	1	12	1	15	1	16	2	19	2
	195	**21**	**202**	**24**	**222**	**33**	**182**	**34**	**212**	**30**	**207**	**35**
Total Victoria	**216**		**226**		**255**		**216**		**242**		**242**	
	12	**1**	**11**	**1**	**11**	**2**	**13**	**1**	**8**	**1**	**10**	**1**
University of Tasmania	**13**		**12**		**13**		**14**		**9**		**11**	
Flinders University	24	7	27	7	26	6	23	3	13	1	13	1
University of Adelaide	36	3	39	3	48	6	53	11	47	10	47	12
University of South Australia	8	2	10	3	14	4	11	3	18	4	19	2
	68	**12**	**76**	**13**	**88**	**16**	**87**	**17**	**78**	**15**	**79**	**15**
Total South Australia	**80**		**89**		**104**		**104**		**93**		**94**	
Curtin University of Technology	33	2	48	6	51	7	30	5	31	4	27	4
Murdoch University	10	1	9	2	10	2	12	5	9	4	12	4
University of Western Australia	26	4	27	4	26	5	28	8	23	6	31	3
	69	**7**	**84**	**12**	**87**	**14**	**70**	**18**	**63**	**14**	**70**	**11**
Total Western Australia	**76**		**96**		**101**		**88**		**77**		**81**	
	2	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**0**	**3**	**0**
Northern Territory University	**3**		**2**		**2**		**3**		**1**		**3**	
	711	**113**	**779**	**142**	**855**	**166**	**795**	**147**	**798**	**152**	**787**	**179**
Total Australia	**824**		**921**		**1021**		**942**		**950**		**966**	
Massey University	5	0	7	1	8	1	11	0	8	0	7	1
University of Auckland	21	2	31	2	38	5	26	4	21	4	35	10
University of Canterbury	17	5	23	5	23	2	30	3	33	2	42	2
University of Otago	22	3	19	1	16	3	31	5	28	7	38	6
University of Waikato	21	1	18	1	22	1	25	2	27	4	17	2
Victoria University	6	2	7	2	8	2	10	0	9	1	11	3
	92	**13**	**105**	**12**	**115**	**14**	**133**	**14**	**126**	**18**	**150**	**24**
Total New Zealand	**105**		**117**		**129**		**147**		**144**		**174**	

Australia unless they are sponsored by an international aid agency.

The participation rate in higher degree studies in physics is similar in 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.

The proportion of females undertaking higher degree studies in physics continues to increase steadily, from 12% in 1991 to 18% in 1996. A similar trend is occurring in New Zealand.

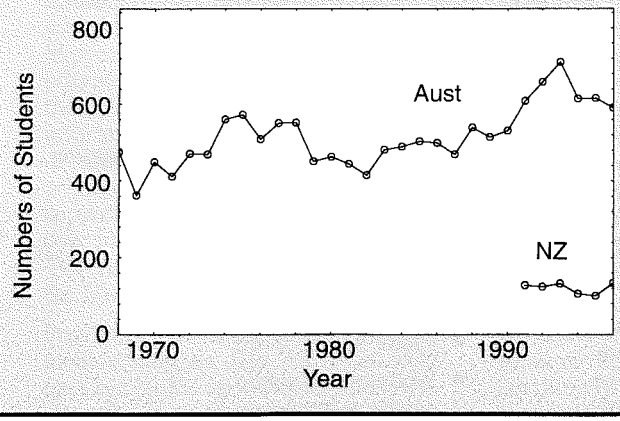
Conclusions

The results of this survey show that physics is experiencing very difficult times in Australia and New Zealand. There has been very little growth in enrolments over the past three years, except for postgraduate students in New Zealand. Similar fluctuations have occurred in the past, particularly in the late seventies where third and fourth year numbers declined and remained down for nearly a decade.

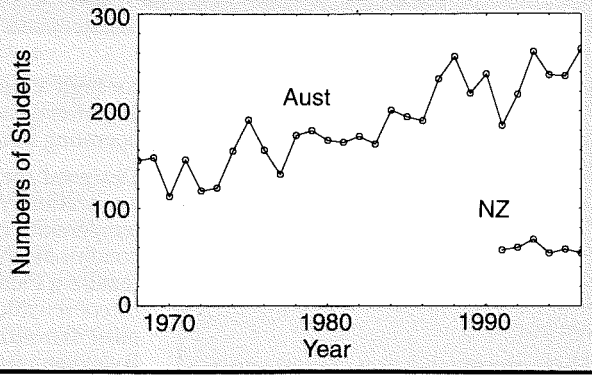
The reasons for this decline are not clear and would require a detailed analysis of high school enrolments and demographic patterns. However, the effects of the decline will place further pressure on physics departments as funding is now generally directly tied to enrolments in most institutions.

These difficulties are compounded by a decline in postgraduate physics enrolments in Australian Universities since 1993. This decline is probably a result of Government policy on fees and overseas students. This pattern has not occurred in New Zealand where Government policies are different. In Australia the decline in postgraduate enrolments combined with declines in undergraduate numbers will place physics departments under financial pressure. Some departments have already closed down and others are exploring various options, including amalgamation or a scaling down of activities. There are few signs of relief from this gloomy outlook. The only promising developments which could alleviate these problems are the increasing retention rates from third year to fourth year and the increasing participation rate by females in physics. These trends may point to strategies which could be employed to moderate the impact of the new funding arrangements for Australian universities.

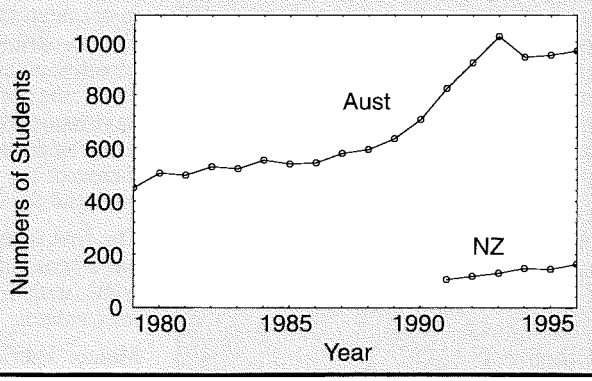
Numbers of Third Year Physics Students (1968-1996)



Numbers of Fourth Year Physics Students (1968-1996)



Numbers of Postgraduate Physics Students (1979-1996)



It is also important to note that despite the fluctuating enrolments in physics in the short-term, the long-term trends still show modest growth. The profession is not in decline but the effects of Government policy have had a damaging effect on the morale of all physics departments.

References

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 Lyn Simpson of Murdoch University who distributed the questionnaires and prepared the manuscript for publication.

Acknowledgements

1 JR de Laeter, *Aust Phys* **11** (1974) 200
2 CN Watson-Munro, *Aust Phys* **11** (1974) 33
3 JR de Laeter & CN Watson-Munro, *Aust Phys* **12** (1975) 137
4 JR de Laeter & CN Watson-Munro, *Aust Phys* **16** (1979) 22
5 JR de Laeter & PJ Jennings, *Aust Phys* **19** (1982) 37
6 PJ Jennings & JR de Laeter, *Aust Phys* **21** (1984) 257
7 JR de Laeter & PJ Jennings, *Aust Phys* **24** (1987) 279
8 PJ Jennings & JR de Laeter, *ANZ Phys* **28** (1991) 80
9 JR de Laeter & PJ Jennings & G Putt, *ANZ Phys* **30** (1993) 245 ANZP