



1998 – 99

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RESEARCH AND EXPERIMENTAL DEVELOPMENT

**GOVERNMENT AND PRIVATE
NON-PROFIT ORGANISATIONS** AUSTRALIA

EMBARGO: 11.30AM (CANBERRA TIME) MON 24 JULY 2000

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- For further information about these and related statistics, contact the National Information Service on 1300 135 070 or Derek Byars on Canberra 02 6252 5627.

NOTES

RESEARCH AND DEVELOPMENT (R&D) GUIDELINES

Australian Bureau of Statistics (ABS) surveys of R&D are conducted in accordance with standard guidelines promulgated by the Organisation for Economic Co-operation and Development (OECD).



ABBREVIATIONS

ABS	Australian Bureau of Statistics
FOR	Field of research
GDP	Gross Domestic Product
GOVERD	Government expenditure on R&D
OECD	Organisation for Economic Co-operation and Development
R&D	Research and experimental development
SEO	Socio-economic objective
TKH	Technical know-how
TOA	Type of R&D activity

Dennis Trewin
Australian Statistician

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EXPENDITURE ON R&D

Expenditure on R&D carried out by Government organisations (GOVERD) in Australia in 1998–99 was estimated to be \$2,072m at current prices. This represented a marginal decrease over the two years since 1996–97. In volume terms, R&D expenditure decreased by 4% compared with 1996–97.

GOVERD represented 0.35% of Gross Domestic Product (GDP), down from 0.39% in 1996–97.

Expenditure on R&D carried out by Private non-profit organisations in Australia in 1998–99 was estimated to be \$184m at current prices. This represented an increase of 6% compared with 1996–97. In volume terms, R&D expenditure increased by 1% compared with 1996–97.

HUMAN RESOURCES
DEVOTED TO R&D

Human resources devoted to R&D in Australia by Government organisations in 1998–99 was estimated to be 18,946 person years. This was 2% lower than in 1996–97.

Human resources devoted to R&D in Australia by Private non-profit organisations in 1998–99 was estimated to be 2,068 person years, down 5% on 1996–97.

PURPOSE OF RESEARCH

Most expenditure on R&D by Government organisations was directed towards Economic development (\$1,139m or 55%). Expenditure on the Environment increased from \$412m or 20% in 1996-97 to \$429m or 21% in 1998-99.

Private non-profit organisations continued to mainly direct their R&D towards Health (\$156m or 85%).

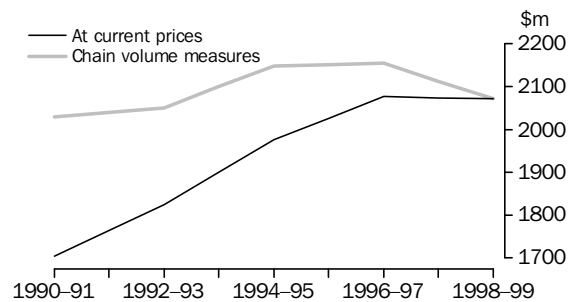
CHAPTER 2

GOVERNMENT R&D

EXPENDITURE ON R&D

GOVERD has decreased marginally since 1996–97. R&D expenditure by Commonwealth government organisations fell by \$72m or 6%, while State government organisations increased their R&D expenditure by \$66m or 8%.

EXPENDITURE ON R&D



EXPENDITURE ON R&D

	1990-91	1992-93	1994-95	1996-97	1998-99
	\$m	\$m	\$m	\$m	\$m
AT CURRENT PRICES					
Commonwealth	1 034.0	1 155.4	r1 193.3	r1 264.2	1 192.6
State	670.0	668.5	r782.8	r812.7	879.0
Total	1 704.0	1 823.9	r1 976.0	r2 076.9	2 071.6
CHAIN VOLUME MEASURES					
Commonwealth	1 233.1	1 298.9	1 297.7	1 312.6	1 192.6
State	796.6	752.2	850.3	842.2	879.0
Total	2 029.8	2 051.1	2 147.8	2 154.7	2 071.6

r revised

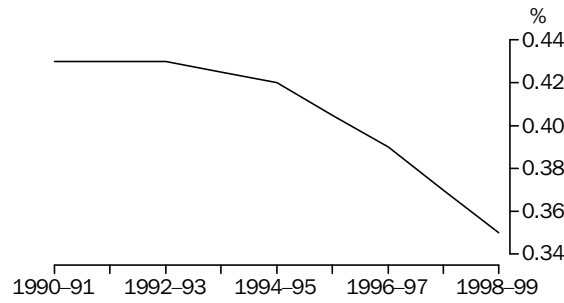
GOVERD AS A PERCENTAGE OF GDP

GOVERD as a percentage of GDP was 0.43% in 1990–91 and 1992–93 before falling to 0.42% in 1994–95 and 0.39% in 1996–97. It has now fallen to 0.35% in 1998–99.

GOVERNMENT AS A
PERCENTAGE OF GDP

continued

GOVERNMENT AS A PERCENTAGE OF GDP



Although the GOVERNMENT/GDP ratio has fallen, Australia still has a high ratio when compared with other Organisation for Economic Co-operation and Development (OECD) countries for which comparable data are available.

GOVERNMENT/GDP RATIOS OF OECD COUNTRIES

	1996-97	1998-99
	%	%
France	0.47	0.43
Finland	0.41	0.38
Australia	0.39	0.35
Germany	0.35	0.34
Czech Republic	0.33	0.33
Denmark	0.30	0.29
United Kingdom	0.28	na
Japan	0.27	na
Poland	0.24	0.24
Canada	0.25	0.22
United States of America	0.23	0.22
Italy	0.20	0.22
Hungary	0.19	0.21
Spain	0.16	0.15
Ireland	0.12	0.10

na not available

HUMAN RESOURCES
DEVOTED TO R&D

Human resources devoted to research by Government organisations steadily increased over the years to peak in 1992-93 at 19,804 person years, before falling 2% to 19,309 person years in 1994-95 at which level it remained until falling to 18,946 in 1998-99.

HUMAN RESOURCES
DEVOTED TO R&D *continued*

HUMAN RESOURCES DEVOTED TO R&D

	1990-91	1992-93	1994-95	1996-97	1998-99
	person years	person years	person years	person years	person years
Commonwealth	10 670	11 019	r10 660	r10 343	9 449
State	8 990	8 785	r8 649	r9 045	9 497
Total	19 660	19 804	r19 309	r19 388	18 946

r revised

TYPE OF EXPENDITURE

Labour costs continued to be the main component of Government R&D expenditure (52%), up from 49% in 1996-97. Capital expenditure dropped from 13% in 1996-97 to 8% in 1998-99.

PURPOSE OF RESEARCH

Socio-economic objectives (SEO's) on which most Government R&D expenditure occurred were: Economic development (\$1,139m), Environment (\$429m) and Society (\$238m). Within Economic development, the main objectives were Plant production and primary products (\$353m), Animal production and primary products (\$237m) and Manufacturing (\$237m).

FIELD OF RESEARCH
(FOR)

The FOR's in which most Government R&D expenditure occurred were: Agricultural sciences (\$664m); Biological Sciences (\$255m) and Earth Sciences (\$207m).

TYPE OF ACTIVITY

Applied research was 56% of Government R&D expenditure, down from 59% in 1996-97. Pure basic and Strategic basic research remained steady at 5% and 24% respectively with Experimental development increasing from 12% in 1996-97 to 16% in 1998-99.

SOURCE OF FUNDS FOR
R&D

Most of the funding for Government R&D came from the government sector itself: 73% from within the organisation performing the R&D (own funds), 7% from other Commonwealth organisations and 2% from other State government organisations, totalling \$1,706m. The next major sources of funds were from joint government/business (\$137m, or 7%) and private businesses (\$121m, or 6%).

STATE COMPARISONS

The leading States in terms of location of Government R&D expenditure were New South Wales at \$484m and Victoria at \$477m, each accounting for 23% of total expenditure. Next in order were Queensland(17%), South Australia(13%), the Australian Capital Territory(10%) and Western Australia(8%). The ranking was similar to 1996-97 although New South Wales has replaced Victoria as the leading location for R&D and South Australia is now ranked above the Australian Capital Territory.

The R&D expenditure by Commonwealth government organisations was mainly located in Victoria (26%), New South Wales (20%), the Australian Capital Territory (16%) and South Australia (15%).

Of the \$879m State government R&D, most was carried out in New South Wales (28%), Queensland(26%) and Victoria(18%).

TYPE OF R&D STAFF

Total human resource effort devoted to R&D by Government organisations has decreased slightly since 1996–97. While the research effort of technicians increased by 6% or 393 person years to 7,034, that of Researchers and Other supporting staff decreased by 3% and 16% respectively.

Researchers accounted for 47% of the total research effort in 1996–97 and 1998–99.

2.1

RESOURCES DEVOTED TO R&D

	TOTAL		COMMONWEALTH		STATE	
	1996-97	1998-99	1996-97	1998-99	1996-97	1998-99
Type of R&D expenditure (\$'000)						
Land and buildings	159 996	57 615	111 156	28 455	48 840	29 160
Other capital expenditure	113 510	102 774	76 474	72 487	37 036	30 287
Labour costs(a)	1 013 136	1 075 774	614 680	639 233	398 456	436 541
Other current expenditure	790 276	835 446	461 876	452 439	328 400	383 007
Type of R&D activity (\$'000)						
Pure basic research	100 043	96 909	51 102	64 689	48 941	32 220
Strategic basic research	488 687	497 387	391 433	369 120	97 255	128 267
Applied research	1 226 756	1 156 196	673 050	565 838	553 706	590 358
Experimental development	261 431	321 118	148 601	192 968	112 830	128 150
Source of funds (\$'000)						
Own funds	1 586 408	1 507 754	1 027 802	921 825	558 607	585 930
Commonwealth government	139 639	148 863	79 131	71 786	60 508	77 077
State and local government	41 027	48 965	9 100	24 846	31 927	24 119
Private businesses	109 463	120 658	71 800	71 413	37 663	49 245
Government owned businesses	9 307	9 051	4 836	—	4 471	9 051
Joint government/business(b)	130 245	136 908	48 094	44 027	82 151	92 881
Universities	8 126	7 301	1 646	116	6 480	7 185
Private non-profit and other						
Australian	37 373	61 170	11 843	32 467	25 530	28 703
Overseas	15 330	30 939	9 935	26 135	5 395	4 804
Location of expenditure (\$'000)						
NSW	460 318	484 133	226 137	234 318	234 181	249 815
Vic.	472 544	476 905	311 018	314 595	161 526	162 310
Qld	315 126	343 925	112 212	111 637	202 915	232 289
SA	245 087	267 697	172 758	177 519	72 330	90 178
WA	159 202	156 702	63 700	64 263	95 502	92 439
Tas.	91 626	88 593	76 205	77 051	15 421	11 542
NT	37 781	47 881	12 828	14 604	24 952	33 277
ACT	283 546	197 105	280 518	193 040	3 028	4 065
Other(c)	11 687	8 668	8 810	5 588	2 878	3 080
Total R&D expenditure (\$'000)	2 076 918	2 071 609	1 264 186	1 192 615	812 732	878 995
Human resources devoted to R&D (person years)						
Researchers	9 130	8 860	4 503	3 939	4 627	4 922
Technicians	6 641	7 034	3 272	3 525	3 369	3 510
Other supporting staff	3 617	3 051	2 569	1 985	1 049	1 066
Total	19 388	18 946	10 343	9 449	9 045	9 497

— nil or rounded to zero (including null cells)

(a) Includes wages and salaries, payroll tax, payments to contract staff on the payroll, fringe benefits tax, workers compensation insurance, overtime earnings, shift allowances, penalty rates, bonuses, commission payments, holiday pay, long service leave payments, sick pay, employer contributions to superannuation and pension schemes.

(b) Includes funds provided by government levies.

(c) Includes Australian External Territories and overseas.

2.2**EXPENDITURE, by Socio-economic Objective, by Type of Expenditure**

<i>Socio-economic objective</i>	<i>Total</i>	<i>Land and buildings</i>	<i>Other capital expenditure</i>	<i>Labour costs(a)</i>	<i>Other current expenditure</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
Defence					
	205 051	146	18 518	126 854	59 532
Economic development					
Plant — production and primary products	352 803	10 042	11 870	167 068	163 823
Animal — production and primary products	237 411	8 762	8 423	114 285	105 942
Mineral resources (excl. energy)	59 416	1 545	3 681	29 080	25 111
Energy resources	59 259	869	2 680	23 076	32 635
Energy supply	16 001	494	1 784	8 776	4 947
Manufacturing	236 711	8 953	13 546	124 964	89 248
Construction	38 424	884	3 158	21 905	12 477
Transport	18 627	3 298	195	10 773	4 361
Information and communication services	69 065	2 419	3 407	36 916	26 323
Commercial services	13 092	298	1 479	6 311	5 004
Economic framework	38 557	619	1 533	22 513	13 892
<i>Total economic development</i>	1 139 366	38 183	51 754	565 665	483 763
Society					
Health	197 242	4 568	9 400	112 772	70 502
Education and training	8 333	222	172	6 105	1 834
Social development and community services	32 199	193	997	21 153	9 857
<i>Total society</i>	237 774	4 982	10 569	140 030	82 193
Environment					
Environmental knowledge	291 552	8 249	13 736	141 385	128 183
Environmental aspects of economic development	58 274	3 152	3 308	30 752	21 062
Environmental management and other aspects	78 920	1 321	2 681	38 546	36 372
<i>Total environment</i>	428 745	12 722	19 724	210 682	185 617
Advancement of knowledge					
Natural sciences, technologies and engineering	57 872	1 422	2 114	31 081	23 256
Social sciences and humanities	2 802	160	94	1 462	1 086
<i>Total advancement of knowledge</i>	60 674	1 581	2 208	32 543	24 341
TOTAL	2 071 609	57 615	102 774	1 075 774	835 446

(a) Includes wages and salaries, payroll tax, payments to contract staff on the payroll, fringe benefits tax, workers compensation insurance, overtime earnings, shift allowances, penalty rates, bonuses, commission payments, holiday pay, long service leave payments, sick pay, employer contributions to superannuation and pension schemes.

2.3

EXPENDITURE, by Field of Research, by Type of Expenditure

<i>Field of research</i>	<i>Total</i>	<i>Land and buildings</i>	<i>Other capital expenditure</i>	<i>Labour costs(a)</i>	<i>Other current expenditure</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
Natural sciences, technologies and engineering					
Mathematical sciences	20 285	416	759	12 395	6 716
Physical sciences	88 821	1 866	6 285	49 508	31 161
Chemical sciences	87 336	2 021	7 217	48 134	29 964
Earth sciences	207 356	5 169	8 800	90 199	103 189
Information, computers and communication technologies	117 061	2 488	9 666	66 706	38 201
Applied sciences and technologies	187 968	4 016	14 793	103 897	65 262
General engineering	180 503	7 190	13 448	101 893	57 973
Biological sciences	255 177	8 503	10 653	125 563	110 457
Agricultural sciences	663 826	19 447	21 880	321 741	300 758
Medical and health sciences	188 966	5 670	7 595	108 905	66 796
<i>Total natural sciences, technologies and engineering</i>	1 997 298	56 788	101 096	1 028 938	810 476
Social sciences and humanities					
Social sciences	71 563	758	1 611	45 406	23 789
Humanities	2 749	69	67	1 430	1 181
<i>Total social sciences and humanities</i>	74 312	827	1 679	46 836	24 970
TOTAL	2 071 609	57 615	102 774	1 075 774	835 446

(a) Includes wages and salaries, payroll tax, payments to contract staff on the payroll, fringe benefits tax, workers compensation insurance, overtime earnings, shift allowances, penalty rates, bonuses, commission payments, holiday pay, long service leave payments, sick pay, employer contributions to superannuation and pension schemes.

2.4 EXPENDITURE, by Socio-economic Objective, by Type of Activity(a)

<i>Socio-economic objective</i>	<i>Total</i>	<i>Pure basic research</i>	<i>Strategic basic research</i>	<i>Applied research</i>	<i>Experimental development</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
Defence	205 051	20 356	60 893	61 902	61 900
Economic development					
Plant — production and primary products	352 803	3 639	37 224	261 401	50 539
Animal — production and primary products	237 411	3 889	31 656	174 838	27 028
Mineral resources (excl. energy)	59 416	2 303	15 020	37 877	4 216
Energy resources	59 259	3 472	16 416	35 294	4 077
Energy supply	16 001	254	6 051	7 255	2 442
Manufacturing	236 711	4 832	64 547	117 586	49 746
Construction	38 424	59	8 438	20 001	9 925
Transport	18 627	91	1 068	14 628	2 840
Information and communication services	69 065	1 673	11 010	41 317	15 065
Commercial services	13 092	181	2 568	7 947	2 396
Economic framework	38 557	1 015	4 084	24 553	8 906
<i>Total economic development</i>	<i>1 139 366</i>	<i>21 407</i>	<i>198 082</i>	<i>742 697</i>	<i>177 180</i>
Society					
Health	197 242	18 137	54 272	104 219	20 614
Education and training	8 333	934	4 192	2 294	913
Social development and community services	32 199	406	8 340	18 119	5 334
<i>Total society</i>	<i>237 774</i>	<i>19 477</i>	<i>66 804</i>	<i>124 632</i>	<i>26 861</i>
Environment					
Environmental knowledge	291 552	10 438	127 369	135 788	17 957
Environmental aspects of economic development	58 274	1 907	16 286	29 410	10 672
Environmental management and other aspects	78 920	569	17 382	39 647	21 321
<i>Total environment</i>	<i>428 745</i>	<i>12 914</i>	<i>161 037</i>	<i>204 845</i>	<i>49 950</i>
Advancement of knowledge					
Natural sciences, technologies and engineering	57 872	20 824	10 166	21 804	5 079
Social sciences and humanities	2 802	1 932	405	317	148
<i>Total advancement of knowledge</i>	<i>60 674</i>	<i>22 756</i>	<i>10 571</i>	<i>22 120</i>	<i>5 227</i>
TOTAL	2 071 609	96 909	497 387	1 156 196	321 118

(a) See paragraph 8 of the Explanatory Notes.

2.5**EXPENDITURE, by Field of Research, by Type of Activity(a)**

<i>Field of research</i>	<i>Total</i>	<i>Pure basic research</i>	<i>Strategic basic research</i>	<i>Applied research</i>	<i>Experimental development</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
Natural sciences, technologies and engineering					
Mathematical sciences	20 285	173	3 949	9 498	6 665
Physical sciences	88 821	19 303	18 293	27 285	23 940
Chemical sciences	87 336	2 439	28 982	39 174	16 741
Earth sciences	207 356	7 301	80 478	106 351	13 226
Information, computers and communication technologies	117 061	6 012	25 248	51 886	33 915
Applied sciences and technologies	187 968	9 347	47 408	85 591	45 621
General engineering	180 503	8 683	47 719	87 917	36 184
Biological sciences	255 177	16 079	86 385	129 248	23 466
Agricultural sciences	663 826	7 549	78 156	481 994	96 127
Medical and health sciences	188 966	16 159	56 754	97 575	18 478
<i>Total natural sciences, technologies and engineering</i>	1 997 298	93 044	473 372	1 116 517	314 365
Social sciences and humanities					
Social sciences	71 563	2 597	23 753	38 734	6 479
Humanities	2 749	1 268	262	944	274
<i>Total social sciences and humanities</i>	74 312	3 865	24 015	39 678	6 753
TOTAL	2 071 609	96 909	497 387	1 156 196	321 118

(a) See paragraph 8 of the Explanatory Notes.

2.6 SOURCE OF FUNDS, by Socio-economic Objective

Socio-economic objective	Total	OWN FUNDS			State and local government	Private businesses
		Commonwealth	State	Commonwealth government		
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Defence	205 051	204 002	—	257	44	398
Economic development						
Plant — production and primary products	352 803	54 288	186 370	15 399	11 018	21 338
Animal — production and primary products	237 411	57 614	106 914	17 006	5 133	10 425
Mineral resources (excl. energy)	59 416	34 849	4 189	7 190	963	6 567
Energy resources	59 259	47 528	1 061	2 886	1 095	3 261
Energy supply	16 001	10 761	55	1 248	524	1 612
Manufacturing	236 711	146 397	18 325	10 855	3 983	24 486
Construction	38 424	21 950	9 356	1 047	830	3 725
Transport	18 627	3 903	13 885	112	95	241
Information and communication services	69 065	38 904	10 252	5 930	1 564	4 769
Commercial services	13 092	9 997	693	407	186	787
Economic framework	38 557	31 670	1 334	2 388	306	1 498
<i>Total economic development</i>	<i>1 139 366</i>	<i>457 859</i>	<i>352 433</i>	<i>64 467</i>	<i>25 696</i>	<i>78 709</i>
Society						
Health	197 242	18 120	80 022	30 939	8 242	20 672
Education and training	8 333	1 486	5 345	752	343	184
Social development and community services	32 199	19 070	6 806	3 902	1 354	236
<i>Total society</i>	<i>237 774</i>	<i>38 677</i>	<i>92 173</i>	<i>35 593</i>	<i>9 940</i>	<i>21 092</i>
Environment						
Environmental knowledge	291 552	157 929	60 483	27 687	9 092	12 265
Environmental aspects of economic development	58 274	26 973	14 110	2 932	1 619	3 456
Environmental management and other aspects	78 920	19 662	38 397	11 011	1 541	2 045
<i>Total environment</i>	<i>428 745</i>	<i>204 564</i>	<i>112 989</i>	<i>41 630</i>	<i>12 251</i>	<i>17 766</i>
Advancement of knowledge						
Natural sciences, technologies and engineering	57 872	16 710	25 917	6 816	875	2 651
Social sciences and humanities	2 802	13	2 418	99	160	42
<i>Total advancement of knowledge</i>	<i>60 674</i>	<i>16 723</i>	<i>28 335</i>	<i>6 916</i>	<i>1 035</i>	<i>2 693</i>
TOTAL	2 071 609	921 825	585 930	148 863	48 965	120 658

— nil or rounded to zero (including null cells)

2.6**SOURCE OF FUNDS, by Socio-economic Objective *continued***

<i>Socio-economic objective</i>	<i>Government owned businesses</i>	<i>Joint government/business(a)</i>	<i>Universities</i>	<i>Private non-profit and other Australian</i>	<i>Overseas</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
Defence	—	29	—	95	226
Economic development					
Plant — production and primary products	1 510	57 575	197	3 332	1 776
Animal — production and primary products	2 396	32 596	126	3 187	2 015
Mineral resources (excl. energy)	—	254	16	3 600	1 788
Energy resources	—	196	16	994	2 223
Energy supply	—	104	—	898	800
Manufacturing	282	16 570	141	10 138	5 534
Construction	—	401	1	286	830
Transport	113	97	—	119	63
Information and communication services	—	3 537	—	2 354	1 757
Commercial services	—	282	1	255	485
Economic framework	20	143	—	448	749
<i>Total economic development</i>	4 321	111 754	498	25 611	18 020
Society					
Health	2 362	1 796	6 222	24 732	4 135
Education and training	70	40	2	59	52
Social development and community services	150	407	45	177	52
<i>Total society</i>	2 581	2 242	6 269	24 968	4 239
Environment					
Environmental knowledge	927	10 927	329	5 802	6 111
Environmental aspects of economic development	78	5 558	18	2 177	1 352
Environmental management and other aspects	398	4 306	117	975	468
<i>Total environment</i>	1 403	20 791	465	8 955	7 932
Advancement of knowledge					
Natural sciences, technologies and engineering	687	2 092	70	1 531	523
Social sciences and humanities	59	—	—	12	—
<i>Total advancement of knowledge</i>	746	2 092	70	1 543	523
TOTAL	9 051	136 908	7 301	61 170	30 939

— nil or rounded to zero (including null cells)

(a) Includes funds provided by government levies.

2.7 SOURCE OF FUNDS, by Field of Research

<i>Field of research</i>	<i>Total</i>	OWN FUNDS			<i>Commonwealth government</i>	<i>State and local government</i>	<i>Private businesses</i>
		<i>Commonwealth</i>	<i>State</i>				
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	
Natural sciences, technologies and engineering							
Mathematical sciences	20 285	15 690	1 470	502	756	984	
Physical sciences	88 821	73 501	616	4 995	952	4 343	
Chemical sciences	87 336	66 333	2 416	2 914	1 355	6 998	
Earth sciences	207 356	130 391	31 278	17 210	4 996	8 467	
Information, computers and communication technologies	117 061	88 093	9 917	5 859	1 879	5 060	
Applied sciences and technologies	187 968	143 718	10 296	3 924	1 265	11 819	
General engineering	180 503	115 488	25 750	5 836	2 302	15 986	
Biological sciences	255 177	105 777	79 577	22 470	5 829	12 195	
Agricultural sciences	663 826	124 293	330 020	46 380	18 418	32 725	
Medical and health sciences	188 966	15 233	78 259	30 070	8 383	21 267	
<i>Total natural sciences, technologies and engineering</i>	<i>1 997 298</i>	<i>878 516</i>	<i>569 598</i>	<i>140 160</i>	<i>46 135</i>	<i>119 845</i>	
Social sciences and humanities							
Social sciences	71 563	42 908	14 391	8 455	2 815	744	
Humanities	2 749	400	1 940	249	15	69	
<i>Total social sciences and humanities</i>	<i>74 312</i>	<i>43 308</i>	<i>16 331</i>	<i>8 703</i>	<i>2 830</i>	<i>813</i>	
TOTAL	2 071 609	921 825	585 930	148 863	48 965	120 658	

2.7SOURCE OF FUNDS, by Field of Research *continued*

<i>Field of research</i>	<i>Government owned businesses</i>	<i>Joint government/ business(a)</i>	<i>Universities</i>	<i>Private non-profit and other Australian</i>	<i>Overseas</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
Natural sciences, technologies and engineering					
Mathematical sciences	—	148	—	611	123
Physical sciences	—	1 262	13	1 367	1 772
Chemical sciences	25	2 349	183	2 791	1 972
Earth sciences	606	5 908	68	3 043	5 390
Information, computers and communication technologies	274	1 605	1	2 520	1 853
Applied sciences and technologies	48	9 886	25	3 956	3 031
General engineering	118	2 280	91	7 744	4 909
Biological sciences	728	15 931	736	7 605	4 330
Agricultural sciences	4 675	94 621	219	8 143	4 333
Medical and health sciences	2 430	1 437	5 921	23 076	2 889
<i>Total natural sciences, technologies and engineering</i>	8 903	135 428	7 255	60 857	30 601
Social sciences and humanities					
Social sciences	114	1 478	46	291	322
Humanities	34	3	—	22	17
<i>Total social sciences and humanities</i>	148	1 481	46	313	338
TOTAL	9 051	136 908	7 301	61 170	30 939

— nil or rounded to zero (including null cells)

(a) Includes funds provided by government levies.

2.8 LOCATION OF EXPENDITURE, by Socio-economic Objective

	Aust.	NSW	Vic.	Qld	SA	WA	Tas.
<i>Socio-economic objective</i>	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Defence	205 051	7 612	61 113	48	125 496	1 437	5 138
Economic development							
Plant — production and primary products	352 803	99 925	52 270	87 769	23 102	36 617	7 754
Animal — production and primary products	237 411	51 589	61 719	59 957	18 964	18 769	7 438
Mineral resources (excl. energy)	59 416	12 411	17 781	14 642	1 456	10 911	394
Energy resources	59 259	18 886	9 055	5 312	8 310	12 460	1 985
Energy supply	16 001	9 626	3 677	452	613	117	10
Manufacturing	236 711	63 638	113 212	19 233	17 458	8 724	925
Construction	38 424	8 048	18 375	8 888	446	230	163
Transport	18 627	9 351	1 460	546	4 078	566	84
Information and communication services	69 065	23 493	6 278	15 250	3 171	6 488	424
Commercial services	13 092	8 335	3 193	345	48	83	423
Economic framework	38 557	15 876	6 951	1 003	308	386	68
<i>Total economic development</i>	1 139 366	321 178	293 972	213 398	77 955	95 351	19 668
Society							
Health	197 242	56 308	40 943	36 830	30 625	9 670	3 213
Education and training	8 333	2 193	384	3 696	70	290	584
Social development and community services	32 199	5 160	5 284	2 950	2 551	1 174	874
<i>Total society</i>	237 774	63 661	46 610	43 476	33 246	11 134	4 671
Environment							
Environmental knowledge	291 552	38 183	53 962	43 909	20 208	22 360	46 607
Environmental aspects of economic development	58 274	11 442	7 768	13 361	5 736	5 180	4 303
Environmental management and other aspects	78 920	13 316	9 667	15 975	1 303	18 837	5 902
<i>Total environment</i>	428 745	62 941	71 397	73 245	27 248	46 377	56 812
Advancement of knowledge							
Natural sciences, technologies and engineering	57 872	27 784	3 801	13 638	3 351	2 336	2 299
Social sciences and humanities	2 802	957	12	120	401	67	7
<i>Total advancement of knowledge</i>	60 674	28 741	3 813	13 758	3 753	2 403	2 305
TOTAL	2 071 609	484 133	476 905	343 925	267 697	156 702	88 593

2.8LOCATION OF EXPENDITURE, by Socio-economic Objective *continued*

	NT	ACT	Other(a)
<i>Socio-economic objective</i>	\$'000	\$'000	\$'000
.....			
Defence	—	4 206	—
Economic development			
Plant — production and primary products	3 317	41 196	854
Animal — production and primary products	6 381	11 780	816
Mineral resources (excl. energy)	864	780	176
Energy resources	784	1 026	1 441
Energy supply	—	1 505	—
Manufacturing	121	12 824	575
Construction	671	1 572	30
Transport	67	2 475	—
Information and communication services	67	13 809	86
Commercial services	45	586	34
Economic framework	403	13 560	2
<i>Total economic development</i>	<i>12 721</i>	<i>101 112</i>	<i>4 013</i>
Society			
Health	7 700	11 069	883
Education and training	885	191	40
Social development and community services	784	13 310	112
<i>Total society</i>	<i>9 370</i>	<i>24 570</i>	<i>1 036</i>
Environment			
Environmental knowledge	16 530	47 356	2 437
Environmental aspects of economic development	1 473	8 781	229
Environmental management and other aspects	3 203	10 438	279
<i>Total environment</i>	<i>21 206</i>	<i>66 575</i>	<i>2 945</i>
Advancement of knowledge			
Natural sciences, technologies and engineering	3 411	635	617
Social sciences and humanities	1 173	8	58
<i>Total advancement of knowledge</i>	<i>4 583</i>	<i>643</i>	<i>675</i>
TOTAL	47 881	197 105	8 668

— nil or rounded to zero (including null cells)

(a) Includes Australian external territories and overseas.

2.9

LOCATION OF EXPENDITURE, by Field of Research

<i>Field of research</i>	<i>Aust.</i>	<i>NSW</i>	<i>Vic.</i>	<i>Qld</i>	<i>SA</i>	<i>WA</i>	<i>Tas.</i>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Natural sciences, technologies and engineering							
Mathematical sciences	20 285	5 049	2 861	1 075	1 202	1 706	376
Physical sciences	88 821	42 710	18 544	555	21 238	720	1 750
Chemical sciences	87 336	21 861	36 856	5 145	13 043	3 314	1 817
Earth sciences	207 356	36 865	38 310	43 814	16 196	24 947	27 369
Information, computers and communication technologies	117 061	32 776	23 362	5 613	27 932	3 563	1 837
Applied sciences and technologies	187 968	35 635	78 173	12 524	51 988	1 389	2 323
General engineering	180 503	42 593	67 929	25 138	27 289	13 866	962
Biological sciences	255 177	39 070	46 642	53 988	10 105	16 906	22 134
Agricultural sciences	663 826	161 061	114 602	157 974	52 858	77 793	24 799
Medical and health sciences	188 966	57 710	36 022	29 974	40 819	9 368	4 128
<i>Total natural sciences, technologies and engineering</i>	<i>1 997 298</i>	<i>475 330</i>	<i>463 301</i>	<i>335 801</i>	<i>262 670</i>	<i>153 571</i>	<i>87 495</i>
Social sciences and humanities							
Social sciences	71 563	7 790	13 290	8 070	4 670	3 044	1 076
Humanities	2 749	1 013	315	54	358	87	23
<i>Total social sciences and humanities</i>	<i>74 312</i>	<i>8 803</i>	<i>13 604</i>	<i>8 125</i>	<i>5 027</i>	<i>3 131</i>	<i>1 098</i>
TOTAL	2 071 609	484 133	476 905	343 925	267 697	156 702	88 593

2.9LOCATION OF EXPENDITURE, by Field of Research *continued*

<i>Field of research</i>	<i>NT</i>	<i>ACT</i>	<i>Other(a)</i>
	\$'000	\$'000	\$'000
Natural sciences, technologies and engineering			
Mathematical sciences	149	7 867	—
Physical sciences	803	2 184	318
Chemical sciences	1 767	3 152	381
Earth sciences	4 746	12 365	2 744
Information, computers and communication technologies	49	21 828	101
Applied sciences and technologies	45	5 627	265
General engineering	681	1 954	91
Biological sciences	21 947	42 626	1 760
Agricultural sciences	8 334	63 997	2 408
Medical and health sciences	6 005	4 443	497
<i>Total natural sciences, technologies and engineering</i>	<i>44 525</i>	<i>166 042</i>	<i>8 564</i>
Social sciences and humanities			
Social sciences	2 574	30 990	60
Humanities	782	74	44
<i>Total social sciences and humanities</i>	<i>3 356</i>	<i>31 063</i>	<i>104</i>
TOTAL	47 881	197 105	8 668

— nil or rounded to zero (including null cells)

(a) Includes Australian external territories and overseas.

2.10**HUMAN RESOURCES DEVOTED TO R&D, by Socio-economic Objective**

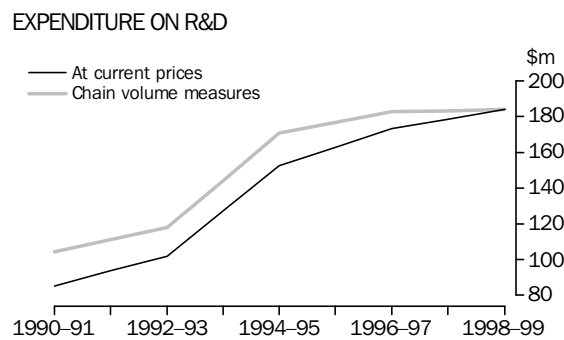
<i>Socio-economic objective</i>	TYPE OF EMPLOYEE			
	<i>Total</i>	<i>Researchers</i>	<i>Technicians</i>	<i>Other supporting staff</i>
	person years	person years	person years	person years
Defence	1 887	1 050	689	148
Economic development				
Plant — production and primary products	3 209	1 289	1 486	434
Animal — production and primary products	2 231	902	915	414
Mineral resources (excl. energy)	428	173	145	110
Energy resources	325	164	105	56
Energy supply	125	42	49	34
Manufacturing	1 906	635	823	448
Construction	273	106	112	55
Transport	108	77	17	14
Information and communication services	533	232	188	113
Commercial services	97	49	34	14
Economic framework	362	256	68	38
<i>Total economic development</i>	9 595	3 925	3 942	1 729
Society				
Health	2 925	1 716	901	308
Education and training	107	79	13	15
Social development and community services	360	259	39	62
<i>Total society</i>	3 392	2 054	953	385
Environment				
Environmental knowledge	2 160	994	737	428
Environmental aspects of economic development	549	203	235	111
Environmental management and other aspects	700	329	272	100
<i>Total environment</i>	3 409	1 526	1 244	639
Advancement of knowledge				
Natural sciences, technologies and engineering	638	287	202	149
Social sciences and humanities	25	18	5	2
<i>Total advancement of knowledge</i>	663	305	207	151
TOTAL	18 946	8 860	7 034	3 051

2.11**HUMAN RESOURCES DEVOTED TO R&D, by Field of Research**

<i>Field of research</i>	TYPE OF EMPLOYEE			
	<i>Total</i>	<i>Researchers</i>	<i>Technicians</i>	<i>Other supporting staff</i>
	person years	person years	person years	person years
Natural sciences, technologies and engineering				
Mathematical sciences	218	147	41	31
Physical sciences	758	308	282	168
Chemical sciences	711	302	271	139
Earth sciences	1 374	671	428	275
Information, computers and communication technologies	954	480	328	146
Applied sciences and technologies	1 561	690	623	249
General engineering	1 367	564	513	290
Biological sciences	2 223	966	853	404
Agricultural sciences	6 152	2 519	2 681	952
Medical and health sciences	2 829	1 635	907	287
<i>Total natural sciences, technologies and engineering</i>	<i>18 147</i>	<i>8 281</i>	<i>6 926</i>	<i>2 940</i>
Social sciences and humanities				
Social sciences	772	562	104	106
Humanities	27	17	5	5
<i>Total social sciences and humanities</i>	<i>799</i>	<i>579</i>	<i>109</i>	<i>111</i>
TOTAL	18 946	8 860	7 034	3 051

EXPENDITURE ON R&D

Private non-profit R&D has increased each year since 1990–91. Expenditure in current prices in 1998–99 was 6% higher than in 1996–97.



HUMAN RESOURCES DEVOTED TO R&D

Human resources devoted to R&D by Private non-profit organisations has fallen since 1996–97, down from 2,171 person years to 2,068 person years in 1998–99.

RESOURCES DEVOTED TO R&D

	1990-91	1992-93	1994-95	1996-97	1998-99
R&D expenditure					
At current prices (\$m)	85.4	101.9	r152.7	r173.4	183.9
Chain volume measures (\$m)	104.3	117.9	170.9	182.6	183.9
Human resources devoted to R&D (person years)	1 282	1 369	r1 666	r2 171	2 068

r revised

TYPE OF EXPENDITURE

Labour costs continued to be the main component of R&D expenditure (50%), down slightly from 52% in 1996–97. Capital expenditure accounted for 10% of research expenditure by Private non-profit organisations.

PURPOSE OF RESEARCH

In the Private non-profit sector, Health remained the leading SEO, accounting for 85% or \$156m of total expenditure. Education and training accounted for \$13m (7%), while \$8m (4%) was directed towards Advancement of knowledge.

FIELD OF RESEARCH

In the Private non-profit sector, Medical and health sciences (\$126m) and Biological sciences (\$41m) remained the leading FOR's in terms of R&D expenditure.

TYPE OF ACTIVITY

Most R&D expenditure in the Private non-profit sector was directed towards Strategic basic research (\$79m or 43%).

SOURCE OF FUNDS	The main source of funding for Private non-profit R&D expenditure was the Commonwealth government which provided \$47m (26%), while State and local government provided a further \$23m (12%). Own funding of research accounted for \$46m (25%).
STATE COMPARISONS	The leading States in terms of the location of Private non-profit R&D expenditure were Victoria at \$124m, New South Wales at \$40m and Western Australia at \$11m, accounting for 67%, 22% and 6% of total expenditure respectively.
TYPE OF R&D STAFF	The total R&D human resource effort of Private non-profit organisations in 1998–99 was estimated to be down 5% from 1996–97. Researchers accounted for 56% of the total research effort, Technicians 32% and Other supporting staff 12%.

3.1 EXPENDITURE, by Socio-economic Objective, by Type of Expenditure

<i>Socio-economic objective</i>	<i>Total</i>	<i>Land and buildings</i>	<i>Other capital expenditure</i>	<i>Labour costs(a)</i>	<i>Other current expenditure</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
Defence	—	—	—	—	—
Economic development	3 688	304	493	1 378	1 513
Society					
Health	155 608	2 903	13 396	79 485	59 824
Education and training	12 909	189	440	4 984	7 296
Social development and community services	1 889	—	3	917	970
<i>Total society</i>	170 406	3 092	13 838	85 386	68 090
Environment	2 166	10	28	1 444	685
Advancement of knowledge	7 644	78	419	3 970	3 177
TOTAL	183 904	3 483	14 778	92 178	73 465

— nil or rounded to zero (including null cells)

(a) Includes wages and salaries, payroll tax, payments to contract staff on the payroll, fringe benefits tax, workers compensation insurance, overtime earnings, shift allowances, penalty rates, bonuses, commission payments, holiday pay, long service leave payments, sick pay, employer contributions to superannuation and pension schemes.

3.2

EXPENDITURE, by Field of Research, by Type of Expenditure

<i>Field of research</i>	<i>Total</i>	<i>Land and buildings</i>	<i>Other capital expenditure</i>	<i>Labour costs(a)</i>	<i>Other current expenditure</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
Natural sciences, technologies and engineering					
Mathematical sciences	—	—	—	—	—
Physical sciences	1 014	5	35	649	325
Chemical sciences	1 214	4	57	729	424
Earth sciences	29	1	1	26	1
Information, computers and communication technologies	517	1	21	351	144
Applied sciences and technologies	113	—	—	113	—
General engineering	179	1	6	155	18
Biological sciences	41 161	730	3 144	21 352	15 935
Agricultural sciences	541	9	36	258	238
Medical and health sciences	125 905	2 632	11 258	63 459	48 556
<i>Total natural sciences, technologies and engineering</i>	<i>170 674</i>	<i>3 382</i>	<i>14 558</i>	<i>87 092</i>	<i>65 641</i>
Social sciences and humanities					
Social sciences	13 146	101	217	5 017	7 811
Humanities	84	—	3	68	13
<i>Total social sciences and humanities</i>	<i>13 230</i>	<i>101</i>	<i>220</i>	<i>5 085</i>	<i>7 824</i>
TOTAL	183 904	3 483	14 778	92 178	73 465

— nil or rounded to zero (including null cells)

(a) Includes wages and salaries, payroll tax, payments to contract staff on the payroll, fringe benefits tax, workers compensation insurance, overtime earnings, shift allowances, penalty rates, bonuses, commission payments, holiday pay, long service leave payments, sick pay, employer contributions to superannuation and pension schemes.

3.3

EXPENDITURE, by Socio-economic Objective, by Type of Activity(a)

<i>Socio-economic objective</i>	<i>Total</i>	<i>Pure basic research</i>	<i>Strategic basic research</i>	<i>Applied research</i>	<i>Experimental development</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
Defence	—	—	—	—	—
Economic development	3 688	603	1 952	718	415
Society					
Health	155 608	39 667	70 310	36 811	8 820
Education and training	12 909	426	2 217	6 389	3 877
Social development and community services	1 889	10	71	1 707	102
<i>Total society</i>	170 406	40 103	72 598	44 907	12 798
Environment	2 166	89	98	1 969	10
Advancement of knowledge	7 644	1 945	4 339	1 292	68
TOTAL	183 904	42 740	78 987	48 886	13 291

— nil or rounded to zero (including null cells)

(a) See paragraph 8 of the Explanatory Notes.

3.4 EXPENDITURE, by Field of Research, by Type of Activity(a)

<i>Field of research</i>	<i>Total</i>	<i>Pure basic research</i>	<i>Strategic basic research</i>	<i>Applied research</i>	<i>Experimental development</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
Natural sciences, technologies and engineering					
Mathematical sciences	—	—	—	—	—
Physical sciences	1 014	95	134	456	329
Chemical sciences	1 214	159	398	397	260
Earth sciences	29	—	1	27	1
Information, computers and communication technologies	517	19	33	93	372
Applied sciences and technologies	113	—	—	33	80
General engineering	179	—	—	75	104
Biological sciences	41 161	12 185	19 467	8 900	611
Agricultural sciences	541	—	163	181	198
Medical and health sciences	125 905	30 032	57 230	31 247	7 397
<i>Total natural sciences, technologies and engineering</i>	<i>170 674</i>	<i>42 489</i>	<i>77 425</i>	<i>41 408</i>	<i>9 352</i>
Social sciences and humanities					
Social sciences	13 146	251	1 483	7 474	3 939
Humanities	84	—	79	5	—
<i>Total social sciences and humanities</i>	<i>13 230</i>	<i>251</i>	<i>1 562</i>	<i>7 479</i>	<i>3 939</i>
TOTAL	183 904	42 740	78 987	48 886	13 291

— nil or rounded to zero (including null cells)

(a) See paragraph 8 of the Explanatory Notes.

3.5 SOURCE OF FUNDS, by Socio-economic Objective

<i>Socio-economic objective</i>	<i>Total</i>	<i>Own funds</i>	<i>Commonwealth government</i>	<i>State and local government</i>	<i>Private businesses</i>	<i>Government owned businesses</i>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Defence	—	—	—	—	—	—
Economic development	3 688	1 277	336	121	381	102
Society						
Health	155 608	37 187	41 372	18 778	25 013	746
Education and training	12 909	4 518	2 545	1 834	248	75
Social development and community services	1 889	206	258	1 114	82	—
<i>Total society</i>	170 406	41 911	44 174	21 726	25 343	821
Environment	2 166	167	652	175	99	111
Advancement of knowledge	7 644	2 828	2 275	844	413	49
TOTAL	183 904	46 183	47 437	22 866	26 235	1 083

— nil or rounded to zero (including null cells)

3.5SOURCE OF FUNDS, by Socio-economic Objective *continued*

<i>Socio-economic objective</i>	<i>Joint government/business(a)</i>	<i>Universities</i>	<i>Private non-profit and other Australian</i>	<i>Overseas</i>
	\$'000	\$'000	\$'000	\$'000
Defence	—	—	—	—
Economic development	np	42	120	np
Society				
Health	21	3 186	20 648	8 658
Education and training	4	11	641	3 033
Social development and community services	—	8	222	—
Total society	25	3 205	21 511	11 691
Environment	np	np	927	—
Advancement of knowledge	—	np	933	np
TOTAL	98	3 393	23 491	13 118

— nil or rounded to zero (including null cells)

np not available for publication but included in totals where applicable, unless otherwise indicated

(a) Includes funds provided by government levies.

3.6 SOURCE OF FUNDS, by Field of Research

<i>Field of research</i>	<i>Total</i>	<i>Own funds</i>	<i>Commonwealth government</i>	<i>State and local government</i>	<i>Private businesses</i>	<i>Government owned businesses</i>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Natural sciences, technologies and engineering						
Mathematical sciences	—	—	—	—	—	—
Physical sciences	1 014	—	134	38	212	16
Chemical sciences	1 214	51	335	90	156	13
Earth sciences	29	—	—	10	19	—
Information, computers and communication technologies	517	88	27	138	42	3
Applied sciences and technologies	113	—	—	—	113	—
General engineering	179	6	—	—	36	—
Biological sciences	41 161	13 031	9 278	4 274	5 946	np
Agricultural sciences	541	59	34	—	358	90
Medical and health sciences	125 905	29 463	35 168	15 351	19 011	728
<i>Total natural sciences, technologies and engineering</i>	<i>170 674</i>	<i>42 697</i>	<i>44 976</i>	<i>19 901</i>	<i>25 893</i>	<i>np</i>
Social sciences and humanities						
Social sciences	13 146	3 486	2 460	2 965	338	np
Humanities	84	—	—	—	5	—
<i>Total social sciences and humanities</i>	<i>13 230</i>	<i>3 486</i>	<i>2 460</i>	<i>2 965</i>	<i>343</i>	<i>np</i>
TOTAL	183 904	46 183	47 437	22 866	26 235	1 083

— nil or rounded to zero (including null cells)

np not available for publication but included in totals where applicable, unless otherwise indicated

3.6SOURCE OF FUNDS, by Field of Research *continued*

<i>Field of research</i>	<i>Joint government/ business(a)</i>	<i>Universities</i>	<i>Private non-profit and other Australian</i>	<i>Overseas</i>
	\$'000	\$'000	\$'000	\$'000
Natural sciences, technologies and engineering				
Mathematical sciences	—	—	—	—
Physical sciences	—	95	521	—
Chemical sciences	—	104	465	—
Earth sciences	—	—	—	—
Information, computers and communication technologies	—	19	201	—
Applied sciences and technologies	—	—	—	—
General engineering	—	—	137	—
Biological sciences	np	259	5 235	3 015
Agricultural sciences	—	—	—	—
Medical and health sciences	33	2 887	16 194	7 070
<i>Total natural sciences, technologies and engineering</i>	np	3 364	22 752	10 085
Social sciences and humanities				
Social sciences	np	29	660	3 033
Humanities	—	—	79	—
<i>Total social sciences and humanities</i>	np	29	739	3 033
TOTAL	98	3 393	23 491	13 118

— nil or rounded to zero (including null cells)

np not available for publication but included in totals where applicable, unless otherwise indicated

(a) Includes funds provided by government levies.

3.7 LOCATION OF EXPENDITURE, by Socio-economic Objective

<i>Socio-economic objective</i>	<i>Total</i>	<i>NSW</i>	<i>Vic.</i>	<i>Qld</i>	<i>SA</i>	<i>WA</i>	<i>Tas.</i>	<i>NT</i>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Defence	—	—	—	—	—	—	—	—
Economic development	3 688	1 763	166	—	104	103	np	—
Society								
Health	155 608	35 592	102 983	3 866	2 934	10 191	40	—
Education and training	12 909	36	12 798	—	25	5	—	—
Social development and community services	1 889	1 649	72	—	168	—	—	—
<i>Total society</i>	170 406	37 276	115 853	3 866	3 127	10 196	40	—
Environment	2 166	98	1 708	89	—	165	—	—
Advancement of knowledge	7 644	1 101	6 363	—	—	180	—	—
TOTAL	183 904	40 238	124 089	3 955	3 231	10 644	np	—

— nil or rounded to zero (including null cells)

np not available for publication but included in totals where applicable, unless otherwise indicated

3.7LOCATION OF EXPENDITURE, by Socio-economic Objective *continued*

<i>Socio-economic objective</i>	<i>ACT</i>	<i>Other(a)</i>
	\$000	\$000
.....		
Defence	—	—
Economic development	np	—
Society		
Health	—	2
Education and training	46	—
Social development and community services	—	—
<i>Total society</i>	46	2
Environment	106	—
Advancement of knowledge	—	—
TOTAL	np	2
.....		

— nil or rounded to zero (including null cells)

np not available for publication but included in totals
where applicable, unless otherwise indicated

(a) Includes Australian external territories and overseas.

3.8

LOCATION OF EXPENDITURE, by Field of Research

<i>Field of research</i>	<i>Total</i>	<i>NSW</i>	<i>Vic.</i>	<i>Qld</i>	<i>SA</i>	<i>WA</i>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Natural sciences, technologies and engineering						
Mathematical sciences	—	—	—	—	—	—
Physical sciences	1 014	—	1	—	—	1 014
Chemical sciences	1 214	—	416	—	—	798
Earth sciences	29	—	—	—	—	29
Information, computers and communication technologies	517	—	286	—	—	200
Applied sciences and technologies	113	—	5	—	—	108
General engineering	179	—	10	—	134	35
Biological sciences	41 161	6 353	31 903	769	—	np
Agricultural sciences	541	—	149	—	104	np
Medical and health sciences	125 905	32 013	80 116	3 183	2 966	7 589
<i>Total natural sciences, technologies and engineering</i>	<i>170 674</i>	<i>38 366</i>	<i>112 884</i>	<i>3 952</i>	<i>3 204</i>	<i>10 644</i>
Social sciences and humanities						
Social sciences	13 146	1 842	11 152	3	27	—
Humanities	84	31	53	—	—	—
<i>Total social sciences and humanities</i>	<i>13 230</i>	<i>1 873</i>	<i>11 205</i>	<i>3</i>	<i>27</i>	<i>—</i>
TOTAL	183 904	40 238	124 089	3 955	3 231	10 644

— nil or rounded to zero (including null cells)

np not available for publication but included in totals where applicable, unless otherwise indicated

3.8LOCATION OF EXPENDITURE, by Field of Research *continued*

<i>Field of research</i>	<i>Tas.</i>	<i>NT</i>	<i>ACT</i>	<i>Other(a)</i>
	\$'000	\$'000	\$'000	\$'000
Natural sciences, technologies and engineering				
Mathematical sciences	—	—	—	—
Physical sciences	—	—	—	—
Chemical sciences	—	—	—	—
Earth sciences	—	—	—	—
Information, computers and communication technologies	32	—	—	—
Applied sciences and technologies	—	—	—	—
General engineering	—	—	—	—
Biological sciences	—	—	np	—
Agricultural sciences	np	—	—	—
Medical and health sciences	7	—	30	2
<i>Total natural sciences, technologies and engineering</i>	np	—	np	2
Social sciences and humanities				
Social sciences	1	—	122	—
Humanities	—	—	—	—
<i>Total social sciences and humanities</i>	1	—	122	—
TOTAL	np	—	np	2

— nil or rounded to zero (including null cells)

np not available for publication but included in totals where applicable, unless otherwise indicated

(a) Includes Australian external territories and overseas.

3.9 HUMAN RESOURCES DEVOTED TO R&D, by Socio-economic Objective

<i>Socio-economic objective</i>	TYPE OF EMPLOYEE			
	<i>Total</i>	<i>Researchers</i>	<i>Technicians</i>	<i>Other supporting staff</i>
	person years	person years	person years	person years
Defence	—	—	—	—
Economic development	26	21	5	—
Society				
Health	1 809	996	602	211
Education and training	95	65	14	16
Social development and community services	17	10	5	2
<i>Total society</i>	1 921	1 071	622	228
Environment	34	31	1	1
Advancement of knowledge	88	44	36	8
TOTAL	2 068	1 167	664	238

— nil or rounded to zero (including null cells)

3.10**HUMAN RESOURCES DEVOTED TO R&D, by Field of Research**

<i>Field of research</i>	TYPE OF EMPLOYEE			
	<i>Total</i>	<i>Researchers</i>	<i>Technicians</i>	<i>Other supporting staff</i>
	person years	person years	person years	person years
Natural sciences, technologies and engineering				
Mathematical sciences	—	—	—	—
Physical sciences	12	8	2	2
Chemical sciences	14	9	3	2
Earth sciences	1	1	—	—
Information, computers and communication technologies	4	2	1	1
Applied sciences and technologies	2	2	1	—
General engineering	3	3	—	—
Biological sciences	482	232	195	55
Agricultural sciences	5	5	—	—
Medical and health sciences	1 455	837	449	170
<i>Total natural sciences, technologies and engineering</i>	<i>1 978</i>	<i>1 098</i>	<i>651</i>	<i>229</i>
Social sciences and humanities				
Social sciences	89	68	14	8
Humanities	1	1	—	—
<i>Total social sciences and humanities</i>	<i>90</i>	<i>68</i>	<i>14</i>	<i>8</i>
TOTAL	2 068	1 167	664	238

— nil or rounded to zero (including null cells)

CHAPTER 4

TECHNICAL KNOW-HOW

PAYMENTS FOR TECHNICAL KNOW-HOW (TKH)

Government payments for TKH in 1998–99 were estimated to be \$4.1m, with 85% being payments within Australia.

Private non-profit payments for TKH in 1998–99 were estimated to be \$0.5m, with 81% being payments within Australia.

RECEIPTS FOR TKH

Receipts for TKH by government organisations in 1998–99 were estimated to be \$20.8m, of which 81% were receipts from Australian organisations.

Receipts for TKH by the Private non-profit sector were estimated to be \$7.3m, of which 23% were receipts from Australian organisations.

4.1 PAYMENTS FOR TECHNICAL KNOW-HOW

	GOVERNMENT			Private non-profit
	Total	Commonwealth	State	
Type of TKH (\$'000)				
Patent licence fees and royalties	1 322	1 070	252	292
Other technical know-how	2 808	332	2 476	171
Location of recipient (\$'000)				
Australia	3 503	1 075	2 428	373
Africa	1	1	—	—
Asia	12	12	—	—
Canada	3	3	—	—
Europe	34	34	—	87
NZ	309	9	300	—
Oceania	—	—	—	—
UK	6	6	—	—
USA	261	261	—	3
Other countries	2	2	—	—
Total (\$'000)	4 130	1 402	2 728	463

— nil or rounded to zero (including null cells)

4.2 RECEIPTS FOR TECHNICAL KNOW-HOW

	GOVERNMENT			Private non-profit
	Total	Commonwealth	State	
Type of TKH (\$'000)				
Patent licence fees and royalties	15 340	10 290	5 050	7 037
Other technical know-how	5 475	2 226	3 249	213
Location of paying organisation (\$'000)				
Australia	16 941	10 473	6 468	1 683
Africa	32	32	—	—
Asia	995	83	912	—
Canada	45	—	45	—
Europe	1 365	895	470	2 143
NZ	52	52	—	—
Oceania	—	—	—	—
UK	239	235	4	50
USA	1 142	746	396	3 374
Other countries	4	—	4	—
Total (\$'000)	20 815	12 516	8 299	7 250

— nil or rounded to zero (including null cells)

EXPLANATORY NOTES

INTRODUCTION

1 This publication presents estimates of expenditure and human resources devoted to R&D carried out by Government and Private non-profit organisations during 1998–99.

2 Statistics are included for payments and receipts for technical know-how.

3 Comparable R&D statistics are produced for the Business and Higher Education sectors (see paragraph 24).

DATA SOURCES

4 The 1998–99 statistics presented in this publication have been compiled from data collected from Government and Private non-profit organisations in the ABS Survey of Research and Experimental Development in respect of the year ended 30 June 1999. This survey was based on a complete enumeration of Government and Private non-profit organisations identified by the ABS as likely R&D performers. The survey was conducted by mail questionnaire and a 96% response rate was obtained. The ABS believes that the non-respondents were non-R&D performers.

5 Statistics for earlier years were derived from similar surveys. A number of revisions have been made to previous statistics.

6 The Gross Domestic Product (GDP) figures used to derive Government expenditure on R&D/GDP ratios are current at the time of manuscript finalisation (*National Income, Expenditure and Product, March Quarter 2000* (Cat. no. 5206.0)), and, at current prices, are as follows: \$397,057m (1990–91); \$427,281m (1992–93); \$474,546m (1994–95); \$533,632m (1996–97); and \$594,933m (1998–99). The available Government expenditure on R&D/GDP ratios for other OECD countries are current at time of manuscript finalisation and are sourced from *Main Science and Technology Indicators, 1999-2*, OECD, Paris, 1999.

DEFINITIONS

7 R&D is defined in accordance with the OECD standard as comprising creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

8 Type of R&D activity (TOA) comprises pure basic research, strategic basic research, applied research and experimental development. Data in this classification are subjectively allocated by respondents at the time of reporting, using OECD/ABS definitions. The ABS makes every effort to ensure correct and consistent interpretation and reporting of this data and applies consistent processing methodologies. Analysts using this classification should bear the original subjectivity in mind.

9 For a more comprehensive interpretation of the definition of R&D activity, contact the ABS or refer to the OECD publication, *The Measurement of Scientific and Technological Activities (Frascati Manual 1993)*, OECD, Paris 1994.

SCOPE

10 The Government sector includes all Commonwealth, State and local government departments and authorities.

11 The Private non-profit sector includes private or semi-public incorporated organisations which are established with the intention of not making a profit.

- SCOPE *continued*
- 12** If an organisation is considered as Private non-profit but was established to serve the Business Enterprise sector then it is included in the Business Enterprise sector.
- COVERAGE
- 13** Local government organisations are excluded from this survey because it is considered that their contribution to total R&D activity would be minimal. Public sector organisations mainly engaged in higher education (e.g. universities) are included in the Higher Education sector whilst those mainly engaged in trading or financial activities are included in the Business Enterprise sector.
- SOCIO-ECONOMIC OBJECTIVE AND FIELD OF RESEARCH CLASSIFICATIONS
- 14** The statistics in this publication are classified by Socio-economic objective (SEO) and Field of research (FOR). For more information on these classifications see the *Australian Standard Research Classification, 1993* (Cat. no. 1297.0).
- 15** Respondents are asked to classify each of their R&D programs or projects to a SEO and a FOR. Two reporting possibilities exist. The first possibility allows for reporting of an obviously predominant SEO and FOR. The second allows for reporting at program level of several SEOs and FORs, where there was no obvious single predominant classification for either or both SEO and FOR. In these instances the ABS distributes the reported data to R&D projects, with relevant SEOs and FORs according to classifications and estimated percentage splits provided by respondents. Most of the data has been reported on the second basis.
- CHAIN VOLUME MEASURES
- 16** Constant price estimates have been replaced with chain volume estimates from this issue.
- 17** Chain volume measures have been introduced because they provide a better measure of growth in volume than existing constant price estimates. To understand this it is necessary to briefly explain how constant price estimates are derived.
- 18** While current price estimates of research and development expenditure reflect both price and volume changes, constant price estimates eliminate the direct effect of price changes and therefore only reflect volume changes. Although expressed in monetary terms, the constant price measures vary only with changes in the underlying quantities of inputs purchased (including labour). In effect, quantities of broadly defined categories of inputs are weighted by their prices in the base year. Because the measures relate to input quantities, they do not reflect changes in the efficiency with which labour, capital and other inputs are used.
- 19** Changes in price relativities adversely affect the usefulness of constant price estimates, particularly for periods distant from the base year, and consequently the base year used to derive constant price estimates needs to be changed from time to time. It has been ABS practice to change the base year every five years, but it has been found that better estimates of growth in volume can be obtained by rebasing every year and linking the resulting indexes to form annually reweighted chain volume measures.
- 20** The impact of the change from constant price estimates to chain volume measures largely depends on the extent of differences in growth rates between the prices and volumes of the components of particular series. In the case of research and development expenditure, the introduction of chain volume measures has had little effect on growth rates over time.
- 21** The chain volume measures appearing in this publication are annually reweighted chain Laspeyres indexes referenced to the current price values in a

CHAIN VOLUME MEASURES

continued

chosen reference year (currently 1998–99). They can be thought of as current price values re-expressed in (i.e. based on) the prices of the previous year and linked together to form continuous time series. They are formed in a multi-stage process of which the major steps are described in Section 15 of the information paper, *Introduction of Chain Volume Measures in the Australian National Accounts* (Cat. no. 5248.0).

RELIABILITY OF STATISTICS

22 The statistics in this publication should be used with caution for the following reasons:

- many respondents had to make estimates because their accounts did not separately record data on R&D activity or receipts and payments for technical know-how; and
- the OECD standard definition of R&D used in this survey differs in some respects from what respondents may regard as R&D activity.

UNPUBLISHED STATISTICS

23 Limited additional detailed R&D statistics are available at a charge from the ABS.

RELATED PUBLICATIONS

24 Users may also wish to refer to the following publications:

Research and Experimental Development, Businesses, Australia, 1998–99 (Cat. no. 8104.0)

Research and Experimental Development, Higher Education Organisations, Australia, 1998 (Cat. no. 8111.0)

Research and Experimental Development, All Sector Summary, Australia, 1998–99 (Cat. no. 8112.0) (to be released later this year)

Main Science and Technology Indicators 1999-2, OECD, Paris, 1999

The Measurement of Scientific and Technological Activities ('Frascati Manual' 1993) OECD, Paris, 1994

25 Current publications issued by the ABS are listed in the *Catalogue of Publications and Products, Australia* (Cat. no. 1101.0). The ABS also issues, on Tuesdays and Fridays, a *Release Advice* (Cat. no. 1105.0) which lists publications to be released in the next few days. The Catalogue and Release Advice are available from any ABS office.

26 Where figures have been rounded, discrepancies may occur between sums of the component items and totals.

GLOSSARY

Applied research	Original work undertaken in order to acquire new knowledge with a specific application in view. It is undertaken either to determine possible uses for the findings of basic research or to determine new methods or ways of achieving some specific and predetermined objectives.
Basic research	Experimental and theoretical work undertaken primarily to acquire new knowledge without a specific application in view. It consists of pure basic research and strategic basic research. Pure basic research is carried out without looking for long-term benefits other than the advancement of knowledge. Strategic basic research is directed into specified broad areas in the expectation of useful discoveries. It provides the broad base of knowledge for the solution of recognised practical problems.
Capital expenditure	Expenditure on the acquisition of fixed tangible assets such as land, buildings, vehicles, plant, machinery and equipment attributable to R&D activity.
Experimental development	Systematic work, using existing knowledge gained from research or practical experience for the purpose of creating new or improved products/processes.
Field of research	Field in which the R&D activity was performed. The FOR classification is primarily structured around disciplines or activities. It describes what research is being performed.
Human resources devoted to R&D	The effort of researchers, technicians and other staff directly involved with R&D activity. Overhead staff (e.g. administrative and general service employees such as personnel officers, janitors etc.) whose work indirectly supports R&D, are excluded.
Labour costs	Wages and salaries, overtime allowances, penalty rates, leave loadings, bonuses, commission payments, all paid leave, employer contributions to superannuation and pension schemes, payroll tax, fringe benefits tax, payments to contract staff on the payroll, severance, termination and redundancy payments and workers compensation insurance.
Other current expenditure	Expenditure on materials, fuels, rent and hiring, repairs and maintenance, data processing etc. and the proportion of expenditure on general services and overheads which is attributable to R&D activity.
Other supporting staff	Skilled and unskilled craftpersons, secretarial and clerical staff directly associated with R&D activity.
R&D activity	Systematic investigation or experimentation involving innovation or technical risk, the outcome of which is new knowledge, with or without a specific practical application, or new or improved products, processes, materials, devices or services. R&D activity extends to modifications to existing products/processes. R&D activity ceases and pre-production begins when work is no longer experimental.
Researchers	Those involved with the conception and/or development of new knowledge/products e.g. executives and directors involved in the planning or management of scientific and technical aspects of R&D projects, and software developers/programmers. They exclude executives and directors concerned primarily with budgets and human resources rather than project content.

Socio-economic objective	The area of expected national benefit rather than the immediate objectives of the researcher. The SEO classification defines the main areas of Australian economic and social activity to which the results of research programs are applied. It describes the purpose of the research; i.e. why the research is being performed.
Technical know-how (TKH)	Specialised technical knowledge required to successfully produce a product or implement a process, etc. (e.g. patent licences; technical data and information; scientific, technical or engineering assistance) that increases technical knowledge and understanding in an organisation. Payments are those made directly to the holders of TKH which is new to an organisation. They exclude non-monetary transfers, and costs incurred by an organisation in obtaining TKH such as overseas travel costs.
Technicians	Those performing technical tasks in support of R&D activity, normally under the direction and supervision of a researcher. These tasks include preparation of experiments, taking records, preparation of charts and graphs and coding data.
Type of R&D activity	Comprises basic research, applied research and experimental development.

FOR MORE INFORMATION...

- INTERNET** www.abs.gov.au the ABS web site is the best place to start for access to summary data from our latest publications, information about the ABS, advice about upcoming releases, our catalogue, and Australia Now—a statistical profile.
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2810900007980
ISSN 1444-6219

RRP \$21.00