CENSUS OF THE COMMONWEALTH OF AUSTRALIA.

30th June, 1954.

AUSTRALIAN LIFE TABLES, 1953-1955.

Prepared by

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REPORT ON THE AUSTRALIAN LIFE TABLES, 1953–1955 BY THE COMMONWEALTH ACTUARY.

In accordance with a request by the Commonwealth Statistician I have prepared male and female Life Tables based on the results of the 1954 Census of the Commonwealth.

2. Previous national Life Tables have been as follows:—

No.	Period over which Deaths were Tabulated.	Censuses Included.
1	1881 to 1890	1881 and 1891
2	1891 to 1900	1891 and 1901
3	1901 to 1910	1901 and 1911
4	1920 to 1922	1921
5	1932 to 1934	1933
6	1946 to 1948	1947

The Tables now put forward are the seventh in the series and are entitled Australian Life Tables, 1953–1955.

It will be observed that whilst the first three Tables shown in the above summary take into account deaths over a ten-year period, i.e., the period between two censuses, the last three Tables have been based on a period of three years about a census. The reasons for this departure from earlier practice have been—

(*a*) the lengthy intervals between the 1921, 1933 and 1947 Censuses,

(*b*) the population disturbances resulting from two world wars, and

(*c*) the considerable fluctuations in birth rates and migration over the past fifty years.

In these circumstances the practice has been to limit the investigation to the years in close proximity to the census date, as one means of facilitating a satisfactory estimate of the population exposed to risk. In addition, by this means a more recent mortality experience is obtained, as the date to which the experience applies is, on the average, the date of the last census, rather than a date approximately halfway between that and the previous census.

3. For the present Tables, the reasons outlined in the previous paragraph are particularly relevant and it was, therefore, decided to follow recent practice and to base the Tables on the results of the Census of 30th June, 1954, and the deaths in the three years 1953, 1954 and 1955.

DATA.

4. The data required for the calculations was supplied by the Commonwealth Statistician. The principal statistics employed are shown in Appendix D, viz.:—

(*a*) the number of males and females living at each age last birthday, as shown by the 1954 Census;

(*b*) the number of male and female deaths at each age last birthday in the years 1953, 1954 and 1955;

(*c*) the numbers of births during the years 1947 to 1955; and

(*d*) an analysis of the number of deaths under six years of age during the years 1948 to 1955.

In addition, summaries by age last birthday of the movement of population to and from Australia during 1953 to 1955 were supplied.

5. A summary of the population, and a comparison with the corresponding figures for earlier years, is as follows:—

Population.

Year.	Males.	Females.	Total.
1901	1,977,928	1,795,873	3,773,801
1921	2,762,870	2,672,864	5,435,734
1933	3,367,111	3,262,728	6,629,839
1947	3,797,370	3,781,988	7,579,358
1954	4,546,118	4,440,412	8,986,530

At the 1954 Census, 20,735 males and 19,664 females failed to state their ages. These numbers are less than the corresponding numbers for the 1947 Census and were allocated to individual ages by the Commonwealth Statistician by a random process following an examination of the available information.

During the three years under consideration there were 136,797 male and 107,232 female deaths. Ages were not stated for only 49 male and 21 female deaths and these deaths were allocated to different ages by a proportionate method.

Migration.

6. When mortality rates are derived from the deaths in the three years about the date of a census, it is normally assumed that three times the number returned as living at a particular age at the census date provides a reasonable approximation to the total number of persons exposed to risk of death at that age during the three years.

On this occasion an examination of the data suggested that it would be advisable to adjust the numbers found in this manner for migration during 1953 to 1955, in order to obtain a better estimate of the numbers subject to the risk of death during those years. The net movement into Australia during 1953 to 1955 was—

Net Movement into Australia (all Ages).

—	Males.	Females.
1953—First six months	6,590	5,772
Second six months	13,511	17,024
1954—First six months	13,270	9,245
Second six months	24,258	21,434
1955—First six months	28,026	17,755
Second six months	28,632	22,842
Total	114,287	94,072

Adjustments were necessary in respect of—

(*a*) departures prior to the census who were subject to the risk of death from the beginning of 1953 to the date of their departure ;

(*b*) arrivals after the census who were subject to the risk of death from the date of their arrival to the end of 1955; and

(*c*) arrivals prior to the census, and departures after the census, who would otherwise be assumed to be at risk for the whole of the three years.

The adjustments necessary to correct for these under and over-statements were made at each age as follows:—

For Net Movement into Australia during—	Deduct.	Add.
1953—First six months	¼ of net movement ..	..
Second six months	¾ of net movement ..	..
1954—First six months	1¼ of net movement ..	..
Second six months	..	1¼ of net movement
1955—First six months	..	¾ of net movement
Second six months	..	¼ of net movement

Calculation of Mortality Rates.

7. *The Methods Used.*—The Life Tables prepared following the 1933 and 1947 Censuses were constructed by the method put forward by the late George King, F.I.A., in 1908. This method has been widely used in the United Kingdom and other countries. The main advantage of the method is that by grouping both the population and the deaths in quinquennial age groups to obtain quinary rates of mortality, the effects of age mis-statements and other errors which are encountered at a census, or in registrations of deaths, are minimized and reliable mortality rates are obtained. In addition, the mathematical calculations involved are simple and easily explained. Once the quinary mortality rates have been obtained the method consists of completing the intervening values by a mathematical formula which ensures their regular progression from age to age.

My examination of the present data shows that the age mis-statements which have occurred in the population at most ages have been of relatively small importance. Further, it appears that broadly similar mis-statements have occurred in the ages given for some deaths, because the unadjusted mortality rates, found by dividing the deaths at age x last birthday in the three years by the population exposed to risk of death at that age, flow in general with surprising regularity from age to age. To illustrate this feature, the unadjusted mortality rates for ages 15 to 80 are shown graphically in Appendices E and F. Investigations have shown that the corresponding rates derived from the 1947 Census data also exhibit a considerable degree of regularity at most ages.

8. Apart from the feature mentioned in the previous paragraph, there are certain technical reasons to doubt the wisdom of using King's method for calculation of mortality rates if alternative methods are available. The main reasons are—

(*a*) the practical difficulty, with King's method, of determining which age grouping should be used in calculating the quinary mortality rates;

(*b*) in arriving at the quinary mortality rates, the method involves some graduation of the population and the deaths. In view of the expectation nowadays that the numbers at successive ages may fluctuate quite substantially because of the effect of war deaths, birth rates and migration, it is doubtful whether such separate graduations can be justified; and

(*c*) the quinary mortality rates are assumed to apply to the central age of each quinquennial age group. This assumption is reasonable if the run of numbers from age to age is fairly smooth. In fact, the present age distribution is not smooth.

I have, therefore, not used King's method for the present Tables but have proceeded as described in the following paragraphs.

9. *Ages 0–5.*—The formulae adopted for the calculation of the mortality rates for these ages are detailed in Appendix G and are based on the formulae set out in Appendix D of the Report on the Australian Life Tables, 1946–1948.

It will be noted that the formula used for the calculation of $q_0^{(0\text{–}3\ \text{months})}$ differs slightly from the formula previously used, it being considered that the use of the fractions $\frac{1}{8}$ and $\frac{7}{8}$ in the denominator would result in a more accurate exposed to risk on this occasion.

The mortality rates obtained by these methods contained no adjustment to offset the effects of migration of young children and it was necessary to amend the exposed to risk at each age 0 to 5 for this purpose. The effect of this adjustment was small.

10. *Ages 6 to 106—Graduation Formula.*—For these ages, it was decided to calculate from the data the unadjusted mortality rates and to graduate those rates by a graduation formula which would produce a series of mortality rates of satisfactory smoothness and adherence to the original data.

After an investigation of a number of different methods of graduation I decided to adopt a summation method of graduation, embodying a combination of summations of varying range of the function to be graduated. The method is particularly suitable for this investigation as there is a number of summation formulae available and, as a result, it is possible to select the formula which will give the desired smoothness in the graduated values whilst not departing unnecessarily from trends shown by the data. The summation formula finally adopted was that put forward by the late John Spencer, F.I.A., and employed by him in 1903 in the graduation of the Manchester Unity Independent Order of Oddfellows Mortality Experience 1893–1897, and by the Institute of Actuaries, London, for the purposes of the Assured Lives Mortality Table 1924–1929 (Ultimate Rates). The formula may be expressed in the following form:—

$$u'_x = \frac{[5]^2\,[7]}{350}\left\{[1] + [3] + [5] - [7]\right\} u_x\,,$$

where u'_x = the graduated value,

u_x = the ungraduated value, and

$[5]\,u_x = (u_{x-2} + u_{x-1} + u_x + u_{x+1} + u_{x+2})$, &c.

11. *Ages 6 to 106—Application of Formula.*—A study of the unadjusted mortality rates for ages over 85 years indicated that it would be unwise to place too much reliance on the accuracy of these rates. Some doubts were felt as to the accuracy at these ages of the general method for determining the exposed to risk and the possibility of age mis-statements amongst the relatively small population was a factor which could not be ignored. The unadjusted mortality rates from age 86 onwards were, therefore, replaced by a series of values obtained from a mathematical formula which satisfactorily represented, in my opinion, the proper trend of mortality at those advanced ages. The functions used were—

Males .. $m_x = .20991\ (1.08156)^{x-86}$.

Females .. $m_x = .22445\ (1.07416)^{x-86} - .04772$.

Graduated values of the mortality rates were obtained by means of the graduation formula in paragraph 10 for ages 11 to 90, at which age the graduated rates merged with the values found by the above formulae.

The remaining values to be determined, i.e., for ages 6 to 10, were obtained from an examination of the unadjusted data.

Examination of the Graduation.

12. The graduated mortality rates have been tested for adherence to the original facts. The number of deaths expected at each age according to the graduated mortality rates have been calculated and compared with the number of deaths which actually occurred. The comparison is summarized for quinquennial age groups in the following table:—

Comparison of Actual and Expected Deaths.

Age Group.	Males.						Females.					
	Actual Deaths.	Expected Deaths.	Deviation.		Accumulation.		Actual Deaths.	Expected Deaths.	Deviation.		Accumulation.	
			+	−	+	−			+	−	+	−
6–10	842	842	..	..	..	..	561	560	1	..	1	..
11–15	743	781	..	38	..	38	395	395	..	..	1	..
16–20	1,473	1,435	38	..	..	..	511	496	15	..	16	..
21–25	1,746	1,758	..	12	..	12	628	625	3	..	19	..
26–30	1,885	1,882	3	..	..	9	872	883	..	11	8	..
31–35	1,999	1,985	14	..	5	..	1,223	1,213	10	..	18	..
36–40	2,529	2,565	..	36	..	31	1,780	1,803	..	23	..	5
41–45	3,760	3,732	28	..	..	3	2,524	2,507	17	..	12	..
46–50	5,588	5,575	13	..	10	..	3,434	3,424	10	..	22	..
51–55	7,922	8,016	..	94	..	84	4,579	4,564	15	..	37	..
56–60	10,986	10,949	37	..	..	47	6,367	6,475	..	108	..	71
61–65	15,535	15,408	127	..	80	..	9,443	9,353	90	..	19	..
66–70	17,812	18,050	..	238	..	158	12,033	12,162	..	129	..	110
71–75	18,341	18,167	174	..	16	..	14,560	14,399	161	..	51	..
76–80	15,434	15,471	..	37	..	21	15,214	15,326	..	112	..	61
81–85	11,568	11,538	30	..	9	..	13,615	13,558	57	..	..	4
86–90	6,396	6,237	159	..	168	..	8,278	8,283	..	5	..	9
91–95	1,830	1,981	..	151	17	..	2,993	2,980	13	..	4	..
96 and over ..	289	361	..	72	..	55	563	624	..	61	..	57
	126,678	126,733	623	678	..	55	99,573	99,630	392	449	..	57

An examination of the actual and expected deaths shows that the deviations are small and change sign frequently. As a result of this test and other tests which were made it has been concluded that the graduated rates satisfactorily represent the mortality experience of the Australian population during the years 1953 to 1955.

The Life Tables.

13. In Appendices A and B I have tabulated the Life Tables for male and female lives, showing the following functions:—

l_x = the number of persons surviving at exact age x;

d_x = the number of deaths in the year of age x to $x + 1$ among the l_x persons who enter on that year;

p_x = the probability of a person aged x living a year;

q_x = the probability of a person aged x dying within a year;

μ_x = the nominal annual rate of mortality based on the assumption that the intensity of mortality during the moment following the attainment of age x continues throughout the year of age x to $x + 1$;

$\mathring{e}_x$ = the complete expectation of life or the average number of years lived after age x by each of a group of persons aged exactly x.

The formulae adopted for the calculation of the various functions were as follows:—

$$q_x = \frac{m_x\left(1 - \frac{1}{12}\frac{q_{x-1}}{p_{x-1}}\right)}{1 + \frac{5}{12}m_x},$$

$$\mu_x = \frac{1}{12 l_x}\left[7\,(d_{x-1} + d_x) - (d_{x-2} + d_{x+1})\right],$$

$$\mathring{e}_x = \frac{1}{l_x}\sum_{t=1}^{\omega} l_{x+t} + \frac{1}{2} - \frac{1}{12}\mu_x\,.$$

Main Features of the Mortality Rates.

14. To facilitate an examination of the new mortality rates I have prepared comparisons with earlier Australian mortality rates and with the latest experience in the United Kingdom and New Zealand. These comparisons are contained in Appendix C and consist of tables showing—

(*a*) the rate of mortality (q_x) at representative ages;

(*b*) the rates of mortality for different periods;

(*c*) the number of survivors (l_x) at representative ages; and

(*d*) the complete expectation of life ($\mathring{e}_x$) at representative ages.

15. *Male Mortality.*—With the exception of ages 16 to 26 inclusive, and 69 to 73 inclusive, the 1953–55 mortality rates are less than those for 1946–48. The most significant reduction has occurred at age 0, where the mortality rate is 79 per cent. of the corresponding rate for 1946–48, and only 27 per cent. of the experience for the period 1901–1910.

The most disturbing feature of the current experience has been the increase in mortality which has occurred in the 16–26 age group. The mortality rates for the relevant quinquennial age groups for both males and females are shown in the following table. It will be seen that the increase in the male rates is the result of heavier mortality from accidents of all types, which has more than counterbalanced a decrease in the rates of mortality due to other causes.

Comparative Mortality Rates.

Age Group.	1946–48.			1953–55.		
	Accident.	Other than Accident.	All Causes.	Accident.	Other than Accident.	All Causes.
	(1)	(2)	(3)	(4)	(5)	(6)
			MALES.			
15–19	.00071	.00070	.00141	.00099	.00052	.00151
20–24	.00090	.00082	.00172	.00115	.00067	.00182
25–29	.00067	.00103	.00170	.00089	.00078	.00167
30–34	.00057	.00145	.00202	.00071	.00109	.00180
35–39	.00059	.00206	.00265	.00064	.00174	.00238
40–44	.00062	.00350	.00412	.00068	.00297	.00365
			FEMALES.			
15–19	.00012	.00057	.00069	.00015	.00043	.00058
20–24	.00012	.00096	.00108	.00013	.00054	.00067
25–29	.00008	.00142	.00150	.00010	.00072	.00082
30–34	.00008	.00170	.00178	.00008	.00103	.00111
35–39	.00010	.00229	.00239	.00011	.00162	.00173
40–44	.00012	.00317	.00329	.00012	.00242	.00254

16. At advanced ages, the experience suggests that only a slight improvement in male mortality has occurred since 1946–48.

As yet, knowledge of the true mortality rates of old age is limited because of apparent defective data. This handicap can only be overcome by detailed research into ages of population and deaths after age 90, and it might be advantageous to consider using, at future investigations, sampling techniques to establish the accuracy of these tabulations.

17. *Female Mortality.*—The comparative tables in Appendix C show that very substantial decreases in female mortality rates have occurred over the whole range of ages since the 1946–48 experience. This improvement has been considerably greater overall than that for males.

Accident mortality amongst females has never been as significant as amongst males. From the table in paragraph 15 it is apparent that the female accident mortality rate has increased very slightly but this increase has been more than offset by the reduction in the mortality rate from other causes. The disparity, in this table, between the high male accident rate and the low female accident rate is notable.

In the 1946–48 experience, female mortality from causes other than accidents was, in the age range 20 to 39 years, heavier than the corresponding male mortality. On this occasion, however, the position has been reversed.

Difficulties in the calculation of mortality rates at high ages amongst females are the same as those discussed in the previous paragraph for males. It is clear, however, that the female mortality rates at these ages have shown substantially greater improvement since 1946–48 than the male rates.

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21st April, 1958.

APPENDIX A.

A M54 — AUSTRALIAN LIFE TABLE, 1953–1955. — A M54

MALES.

Age x	l_x	d_x	p_x	q_x	μ_x	$\mathring{e}_x$	Age x	l_x	d_x	p_x	q_x	μ_x	$\mathring{e}_x$
0 ..	100,000	2,521	.97479	.02521	..	67.14	55 ..	83,132	1,165	.98598	.01402	.01340	19.00
1 ..	97,479	269	.99724	.00276	..	67.86	56 ..	81,967	1,270	.98451	.01549	.01485	18.26
2 ..	97,210	174	.99821	.00179	..	67.05	57 ..	80,697	1,375	.98296	.01704	.01639	17.54
3 ..	97,036	128	.99868	.00132	.00150	66.17	58 ..	79,322	1,480	.98134	.01866	.01800	16.84
4 ..	96,908	97	.99900	.00100	.00114	65.26	59 ..	77,842	1,586	.97963	.02037	.01969	16.15
5 ..	96,811	76	.99922	.00078	.00087	64.32	60 ..	76,256	1,694	.97779	.02221	.02150	15.47
6 ..	96,735	69	.99929	.00071	.00074	63.37	61 ..	74,562	1,804	.97580	.02420	.02345	14.81
7 ..	96,666	63	.99935	.00065	.00068	62.42	62 ..	72,758	1,918	.97364	.02636	.02557	14.17
8 ..	96,603	59	.99939	.00061	.00063	61.46	63 ..	70,840	2,035	.97128	.02872	.02790	13.54
9 ..	96,544	56	.99942	.00058	.00059	60.49	64 ..	68,805	2,154	.96870	.03130	.03044	12.93
10 ..	96,488	54	.99944	.00056	.00057	59.53	65 ..	66,651	2,274	.96588	.03412	.03321	12.33
11 ..	96,434	54	.99944	.00056	.00055	58.56	66 ..	64,377	2,397	.96276	.03724	.03628	11.74
12 ..	96,380	60	.99938	.00062	.00058	57.59	67 ..	61,980	2,520	.95934	.04066	.03966	11.18
13 ..	96,320	71	.99926	.00074	.00067	56.63	68 ..	59,460	2,644	.95554	.04446	.04343	10.63
14 ..	96,249	87	.99910	.00090	.00082	55.67	69 ..	56,816	2,762	.95138	.04862	.04759	10.10
15 ..	96,162	105	.99891	.00109	.00100	54.72	70 ..	54,054	2,873	.94685	.05315	.05216	9.59
16 ..	96,057	124	.99871	.00129	.00119	53.78	71 ..	51,181	2,970	.94197	.05803	.05713	9.11
17 ..	95,933	143	.99851	.00149	.00139	52.85	72 ..	48,211	3,049	.93676	.06324	.06250	8.63
18 ..	95,790	159	.99834	.00166	.00158	51.93	73 ..	45,162	3,103	.93130	.06870	.06820	8.17
19 ..	95,631	171	.99821	.00179	.00173	51.01	74 ..	42,059	3,132	.92554	.07446	.07422	7.74
20 ..	95,460	178	.99814	.00186	.00184	50.10	75 ..	38,927	3,136	.91945	.08055	.08062	7.33
21 ..	95,282	179	.99812	.00188	.00188	49.20	76 ..	35,791	3,115	.91296	.08704	.08743	6.92
22 ..	95,103	177	.99814	.00186	.00188	48.29	77 ..	32,676	3,074	.90593	.09407	.09480	6.54
23 ..	94,926	172	.99819	.00181	.00184	47.38	78 ..	29,602	3,013	.89822	.10178	.10293	6.17
24 ..	94,754	166	.99825	.00175	.00178	46.46	79 ..	26,589	2,931	.88975	.11025	.11190	5.81
25 ..	94,588	161	.99830	.00170	.00173	45.54	80 ..	23,658	2,829	.88042	.11958	.12189	5.47
26 ..	94,427	158	.99833	.00167	.00169	44.62	81 ..	20,829	2,702	.87030	.12970	.13298	5.14
27 ..	94,269	156	.99835	.00165	.00166	43.69	82 ..	18,127	2,548	.85941	.14059	.14505	4.84
28 ..	94,113	155	.99835	.00165	.00165	42.76	83 ..	15,579	2,370	.84787	.15213	.15809	4.55
29 ..	93,958	157	.99833	.00167	.00166	41.83	84 ..	13,209	2,170	.83572	.16428	.17210	4.28
30 ..	93,801	159	.99830	.00170	.00168	40.90	85 ..	11,039	1,953	.82308	.17692	.18694	4.01
31 ..	93,642	163	.99826	.00174	.00172	39.97	86 ..	9,086	1,728	.80987	.19013	.20266	3.77
32 ..	93,479	168	.99820	.00180	.00177	39.04	87 ..	7,358	1,501	.79605	.20395	.21938	3.54
33 ..	93,311	174	.99813	.00187	.00183	38.11	88 ..	5,857	1,280	.78152	.21848	.23717	3.33
34 ..	93,137	182	.99805	.00195	.00191	37.18	89 ..	4,577	1,070	.76618	.23382	.25621	3.12
35 ..	92,955	191	.99795	.00205	.00200	36.25	90 ..	3,507	877	.74991	.25009	.27673	2.93
36 ..	92,764	202	.99782	.00218	.00211	35.33	91 ..	2,630	703	.73258	.26742	.29908	2.74
37 ..	92,562	217	.99766	.00234	.00226	34.40	92 ..	1,927	551	.71422	.28578	.32352	2.56
38 ..	92,345	233	.99748	.00252	.00243	33.48	93 ..	1,376	420	.69490	.30510	.35023	2.40
39 ..	92,112	251	.99727	.00273	.00262	32.56	94 ..	956	311	.67462	.32538	.37849	2.24
40 ..	91,861	273	.99703	.00297	.00285	31.65	95 ..	645	224	.65337	.34663	.40956	2.10
41 ..	91,588	297	.99676	.00324	.00311	30.75	96 ..	421	155	.63120	.36880	.44299	1.95
42 ..	91,291	324	.99645	.00355	.00340	29.84	97 ..	266	104	.60813	.39187	.47682	1.82
43 ..	90,967	355	.99610	.00390	.00372	28.95	98 ..	162	67	.58422	.41578	.51440	1.70
44 ..	90,612	391	.99569	.00431	.00411	28.06	99 ..	95	42	.55955	.44045	.55614	1.57
45 ..	90,221	431	.99522	.00478	.00455	27.18	100 ..	53	25	.53423	.46577	..	..
46 ..	89,790	477	.99469	.00531	.00505	26.31	101 ..	28	14	.50837	.49163	..	..
57 ..	89,313	528	.99409	.00591	.00562	25.44	102 ..	14	7	.48215	.51785	..	..
48 ..	88,785	585	.99341	.00659	.00626	24.59	103 ..	7	4	.45576	.54424	..	..
49 ..	88,200	647	.99266	.00734	.00697	23.75	104 ..	3	2	.42944	.57056	..	..
50 ..	87,553	717	.99181	.00819	.00778	22.92	105 ..	1	1	.40343	.59657	..	..
51 ..	86,836	794	.99086	.00914	.00869	22.11							
52 ..	86,042	878	.98980	.01020	.00970	21.31							
53 ..	85,164	968	.98863	.01137	.01083	20.52							
54 ..	84,196	1,064	.98736	.01264	.01206	19.75							

APPENDIX B.

A F54 — AUSTRALIAN LIFE TABLE, 1953–1955. — A F54

FEMALES.

Age x	l_x	d_x	p_x	q_x	μ_x	$\mathring{e}_x$	Age x	l_x	d_x	p_x	q_x	μ_x	$\mathring{e}_x$
0 ..	100,000	1,989	.98011	.01989	..	72.75	55 ..	88,739	701	.99210	.00790	.00762	22.81
1 ..	98,011	241	.99754	.00246	..	73.22	56 ..	88,038	753	.99145	.00855	.00825	21.99
2 ..	97,770	128	.99869	.00131	..	72.40	57 ..	87,285	809	.99073	.00927	.00894	21.18
3 ..	97,642	89	.99909	.00091	.00102	71.49	58 ..	86,476	871	.98993	.01007	.00970	20.37
4 ..	97,553	82	.99916	.00084	.00086	70.55	59 ..	85,605	940	.98902	.01098	.01056	19.57
5 ..	97,471	66	.99932	.00068	.00076	69.61	60 ..	84,665	1,019	.98797	.01203	.01155	18.78
6 ..	97,405	55	.99944	.00056	.00062	68.66	61 ..	83,646	1,104	.98680	.01320	.01267	18.01
7 ..	97,350	46	.99953	.00047	.00051	67.70	62 ..	82,542	1,199	.98548	.01452	.01393	17.24
8 ..	97,304	40	.99959	.00041	.00044	66.73	63 ..	81,343	1,300	.98402	.01598	.01535	16.49
9 ..	97,264	36	.99963	.00037	.00039	65.76	64 ..	80,043	1,410	.98238	.01762	.01691	15.75
10 ..	97,228	34	.99965	.00035	.00036	64.78	65 ..	78,633	1,528	.98057	.01943	.01866	15.02
11 ..	97,194	34	.99965	.00035	.00035	63.80	66 ..	77,105	1,656	.97852	.02148	.02063	14.31
12 ..	97,160	36	.99963	.00037	.00036	62.83	67 ..	75,449	1,794	.97622	.02378	.02284	13.61
13 ..	97,124	39	.99960	.00040	.00038	61.85	68 ..	73,655	1,943	.97362	.02638	.02535	12.93
14 ..	97,085	43	.99956	.00044	.00042	60.87	69 ..	71,712	2,099	.97073	.02927	.02817	12.27
15 ..	97,042	47	.99952	.00048	.00046	59.90	70 ..	69,613	2,262	.96750	.03250	.03131	11.62
16 ..	96,995	50	.99948	.00052	.00050	58.93	71 ..	67,351	2,430	.96392	.03608	.03482	11.00
17 ..	96,945	54	.99944	.00056	.00054	57.96	72 ..	64,921	2,601	.95993	.04007	.03874	10.39
18 ..	96,891	57	.99941	.00059	.00057	56.99	73 ..	62,320	2,773	.95550	.04450	.04311	9.80
19 ..	96,834	60	.99938	.00062	.00060	56.03	74 ..	59,547	2,946	.95052	.04948	.04803	9.23
20 ..	96,774	62	.99936	.00064	.00063	55.06	75 ..	56,601	3,113	.94500	.05500	.05354	8.69
21 ..	96,712	64	.99934	.00066	.00065	54.10	76 ..	53,488	3,272	.93883	.06117	.05972	8.17
22 ..	96,648	66	.99932	.00068	.00067	53.13	77 ..	50,216	3,414	.93202	.06798	.06663	7.66
23 ..	96,582	67	.99931	.00069	.00069	52.17	78 ..	46,802	3,537	.92443	.07557	.07434	7.18
24 ..	96,515	69	.99929	.00071	.00070	51.20	79 ..	43,265	3,632	.91605	.08395	.08297	6.72
25 ..	96,446	71	.99926	.00074	.00072	50.24	80 ..	39,633	3,691	.90686	.09314	.09255	6.30
26 ..	96,375	74	.99923	.00077	.00075	49.28	81 ..	35,942	3,707	.89687	.10313	.10313	5.89
27 ..	96,301	77	.99920	.00080	.00078	48.31	82 ..	32,235	3,672	.88610	.11390	.11473	5.51
28 ..	96,224	82	.99915	.00085	.00082	47.35	83 ..	28,563	3,582	.87459	.12541	.12731	5.16
29 ..	96,142	87	.99910	.00090	.00088	46.39	84 ..	24,981	3,436	.86247	.13753	.14083	4.83
30 ..	96,055	92	.99904	.00096	.00093	45.43	85 ..	21,545	3,236	.84982	.15018	.15522	4.52
31 ..	95,963	99	.99897	.00103	.00099	44.48	86 ..	18,309	2,991	.83664	.16336	.17041	4.23
32 ..	95,864	106	.99889	.00111	.00107	43.52	87 ..	15,318	2,713	.82291	.17709	.18648	3.95
33 ..	95,758	115	.99880	.00120	.00115	42.57	88 ..	12,605	2,413	.80853	.19147	.20353	3.70
34 ..	95,643	124	.99870	.00130	.00125	41.62	89 ..	10,192	2,105	.79343	.20657	.22168	3.46
35 ..	95,519	135	.99859	.00141	.00135	40.67	90 ..	8,087	1,800	.77748	.22252	.24130	3.24
36 ..	95,384	147	.99846	.00154	.00148	39.73	91 ..	6,287	1,505	.76054	.23946	.26243	3.03
37 ..	95,237	160	.99832	.00168	.00161	38.79	92 ..	4,782	1,231	.74261	.25739	.28529	2.83
38 ..	95,077	173	.99818	.00182	.00175	37.85	93 ..	3,551	981	.72383	.27617	.31022	2.64
39 ..	94,904	189	.99801	.00199	.00190	36.92	94 ..	2,570	760	.70421	.29579	.33671	2.47
40 ..	94,715	206	.99783	.00217	.00208	36.00	95 ..	1,810	572	.68373	.31627	.36487	2.31
41 ..	94,509	224	.99763	.00237	.00227	35.07	96 ..	1,238	418	.66244	.33756	.39546	2.15
42 ..	94,285	244	.99741	.00259	.00248	34.15	97 ..	820	295	.64035	.35965	.42866	2.00
43 ..	94,041	267	.99716	.00284	.00271	33.24	98 ..	525	201	.61750	.38250	.46381	1.87
44 ..	93,774	293	.99688	.00312	.00298	32.34	99 ..	324	132	.59395	.40605	.50232	1.75
45 ..	93,481	319	.99659	.00341	.00327	31.44	100 ..	192	83	.56977	.43023	..	..
46 ..	93,162	348	.99626	.00374	.00357	30.54	101 ..	109	50	.54505	.45495	..	..
47 ..	92,814	380	.99591	.00409	.00392	29.65	102 ..	59	28	.51992	.48008	..	..
48 ..	92,434	413	.99553	.00447	.00429	28.77	103 ..	31	16	.49449	.50551	..	..
49 ..	92,021	448	.99513	.00487	.00468	27.90	104 ..	15	8	.46895	.53105	..	..
50 ..	91,573	485	.99470	.00530	.00509	27.03	105 ..	7	4	.44347	.55653	..	..
51 ..	91,088	524	.99425	.00575	.00554	26.18	106 ..	3	2	.41826	.58174	..	..
52 ..	90,564	565	.99376	.00624	.00601	25.32	107 ..	1	1	.39357	.60643	..	..
53 ..	89,999	607	.99325	.00675	.00651	24.48							
54 ..	89,392	653	.99270	.00730	.00704	23.64							

APPENDIX C.

COMPARATIVE TABLES.

1. Rates of Mortality (q_x) at Representative Ages.

Age. (x)	1901–10.	1920–22.	1932–34.	1946–48.	1953–55.
	(1)	(2)	(3)	(4)	(5)
Males.					
0	.09510	.07132	.04543	.03199	.02521
10	.00179	.00156	.00119	.00072	.00056
20	.00370	.00284	.00219	.00169	.00186
30	.00519	.00390	.00271	.00186	.00170
40	.00816	.00617	.00460	.00337	.00297
50	.01395	.01158	.00966	.00919	.00819
60	.02584	.02407	.02216	.02278	.02221
70	.06162	.05290	.05082	.05256	.05315
80	.13795	.13340	.12659	.12011	.11958
Females.					
0	.07953	.05568	.03642	.02519	.01989
10	.00159	.00127	.00087	.00050	.00035
20	.00329	.00252	.00183	.00091	.00064
30	.00519	.00387	.00279	.00165	.00096
40	.00718	.00524	.00402	.00284	.00217
50	.00956	.00808	.00744	.00641	.00530
60	.01920	.01571	.01466	.01360	.01203
70	.04777	.04090	.03802	.03607	.03250
80	.11333	.11230	.10106	.10027	.09314

2. Rates of Mortality for One Period as a Proportion of the Rates for the Preceding Period.

Age.	Males.				Females.			
	1920–22 / 1901–10.	1932–34 / 1920–22.	1946–48 / 1932–34.	1953–55 / 1946–48.	1920–22 / 1901–10.	1932–34 / 1920–22.	1946–48 / 1932–34.	1953–55 / 1946–48.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0	.75	.64	.70	.79	.70	.65	.69	.79
10	.87	.76	.61	.78	.80	.69	.57	.70
20	.77	.77	.77	1.10	.77	.73	.50	.70
30	.75	.69	.69	.91	.75	.72	.59	.58
40	.76	.75	.73	.88	.73	.77	.71	.76
50	.83	.83	.95	.89	.85	.92	.86	.83
60	.93	.92	1.03	.97	.82	.93	.93	.88
70	.86	.96	1.03	1.01	.86	.93	.95	.90
80	.97	.95	.95	1.00	.99	.90	.99	.93

3. Rates of Mortality for Periods since 1901–10 as a Proportion of the Rates for the Period 1901–10.

Age.	Males.				Females.			
	1920–22 / 1901–10.	1932–34 / 1901–10.	1946–48 / 1901–10.	1953–55 / 1901–10.	1920–22 / 1901–10.	1932–34 / 1901–10.	1946–48 / 1901–10.	1953–55 / 1901–10.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0	.75	.48	.34	.27	.70	.46	.32	.25
10	.87	.66	.40	.31	.80	.55	.31	.22
20	.77	.59	.46	.50	.77	.56	.28	.19
30	.75	.52	.36	.33	.75	.54	.32	.18
40	.76	.56	.41	.36	.73	.56	.40	.30
50	.83	.69	.66	.59	.85	.78	.67	.55
60	.93	.86	.88	.86	.82	.76	.71	.63
70	.86	.82	.85	.86	.86	.80	.76	.68
80	.97	.92	.87	.87	.99	.89	.88	.82

4. Number of Survivors (l_x) at Selected Ages out of 100,000 Births.

Age. (x)	Males.				Females.			
	1920–22.	1932–34.	1946–48.	1953–55.	1920–22.	1932–34.	1946–48.	1953–55.
0	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
10	89,389	93,193	95,619	96,488	91,314	94,424	96,549	97,228
20	87,697	91,797	94,562	95,460	89,906	93,341	95,953	96,774
30	84,743	89,566	92,967	93,801	87,086	91,174	94,740	96,055
40	80,813	86,539	90,823	91,861	83,279	88,175	92,758	94,715
50	74,330	81,061	85,946	87,553	78,313	83,680	89,011	91,573
60	63,386	69,950	74,251	76,256	70,150	75,565	81,257	84,665
70	44,332	50,086	52,230	54,054	54,771	59,629	65,398	69,613
80	18,614	22,223	22,785	23,658	27,170	31,539	35,401	39,633
90	2,141	2,935	3,144	3,507	4,238	5,808	6,556	8,087

5. Complete Expectation of Life ($\mathring{e}_x$) at Selected Ages.

Age. (x)	Males.				Females.			
	1920–22.	1932–34.	1946–48.	1953–55.	1920–22.	1932–34.	1946–48.	1953–55.
0	59.15	63.48	66.07	67.14	63.31	67.14	70.63	72.75
10	56.01	58.02	59.04	59.53	59.20	61.02	63.11	64.78
20	46.99	48.81	49.64	50.10	50.03	51.67	53.47	55.06
30	38.44	39.90	40.40	40.90	41.48	42.77	44.08	45.43
40	30.05	31.11	31.23	31.65	33.14	34.04	34.91	35.99
50	22.20	22.83	22.67	22.92	24.90	25.58	26.14	27.03
60	15.08	15.57	15.36	15.47	17.17	17.74	18.11	18.78
70	9.26	9.60	9.55	9.59	10.41	10.98	11.14	11.62
80	5.00	5.22	5.36	5.47	5.61	6.01	6.02	6.30

6. RATES OF MORTALITY (q_x) AT SELECTED AGES FROM 1953–55 EXPERIENCE COMPARED WITH RECENT RATES OF MORTALITY FOR THE UNITED KINGDOM AND NEW ZEALAND.

Age. (x)	Males.			Females.		
	Australia 1953–55.	United Kingdom 1950–52.	New Zealand 1950–52.	Australia 1953–55.	United Kingdom 1950–52.	New Zealand 1950–52.
	(1)	(2)	(3)	(4)	(5)	(6)
0	.02521	.03266	.02499	.01989	.02510	.01995
10	.00056	.00052	.00050	.00035	.00035	.00028
20	.00186	.00129	.00161	.00064	.00083	.00068
30	.00170	.00157	.00160	.00096	.00127	.00110
40	.00297	.00290	.00268	.00217	.00227	.00209
50	.00819	.00850	.00727	.00530	.00524	.00552
60	.02221	.02369	.01951	.01203	.01271	.01316
70	.05315	.05651	.04723	.03250	.03532	.03282
80	.11958	.13629	.11260	.09314	.10466	.09334

7. RATES OF MORTALITY FROM 1953–55 AUSTRALIAN EXPERIENCE, AS A PROPORTION OF THE RATES FOR THE UNITED KINGDOM AND NEW ZEALAND.

Age.	Males.		Females.	
	Australia 1953–55 / United Kingdom 1950–52.	Australia 1953–55 / New Zealand 1950–52.	Australia 1953–55 / United Kingdom 1950–52.	Australia 1953–55 / New Zealand 1950–52.
	(1)	(2)	(3)	(4)
0	.77	1.01	.79	1.00
10	1.08	1.12	1.00	1.25
20	1.44	1.16	.77	.94
30	1.08	1.06	.76	.87
40	1.02	1.11	.96	1.04
50	.96	1.13	1.01	.96
60	.94	1.14	.95	.91
70	.94	1.13	.92	.99
80	.88	1.06	.89	1.00

APPENDIX D.

I. POPULATION AT CENSUS, 30TH JUNE, 1954 AND DEATHS IN THREE YEARS, 1953–1955—AUSTRALIA.

MALES.

Age Last Birthday.	Population.	Deaths.	Age Last Birthday.	Population.	Deaths.
	(1)	(2)		(3)	(4)
0	99,421	7,894	55	38,869	1,699
1	98,666	830	56	39,907	1,923
2	99,833	529	57	37,690	1,944
3	98,360	379	58	39,183	2,272
4	97,402	277	59	37,499	2,381
5	94,138	210	60	38,442	2,466
6	95,078	228	61	33,197	2,475
7	104,046	189	62	35,981	2,842
8	85,165	164	63	35,445	3,172
9	83,476	132	64	35,882	3,382
10	80,032	129	65	33,962	3,664
11	70,858	126	66	29,862	3,258
12	72,777	124	67	28,074	3,598
13	66,551	133	68	26,711	3,700
14	63,857	159	69	24,531	3,569
15	63,225	201			
16	61,922	214	70	23,317	3,687
17	61,180	270	71	18,374	3,389
18	59,319	339	72	19,030	3,795
19	56,641	346	73	17,721	3,804
			74	16,519	3,819
20	56,823	304			
21	59,684	368	75	13,918	3,534
22	60,944	356	76	12,476	3,450
23	66,446	308	77	10,366	3,041
24	68,082	369	78	9,983	3,199
			79	8,361	2,960
25	69,803	345			
26	72,813	353	80	7,459	2,784
27	73,546	363	81	5,776	2,362
28	76,948	404	82	5,428	2,520
29	75,529	383	83	4,772	2,412
			84	4,537	2,312
30	75,665	382			
31	70,829	362	85	3,206	1,962
32	74,186	427	86	2,814	1,782
33	73,981	373	87	2,111	1,474
34	69,577	420	88	1,637	1,254
			89	1,257	1,065
35	62,874	417			
36	62,464	398	90	931	821
37	64,024	443	91	634	517
38	66,917	528	92	518	476
39	69,489	539	93	373	412
			94	270	258
40	70,395	621			
41	61,282	574	95	111	167
42	65,704	766	96	84	110
43	64,226	795	97	59	72
44	61,811	785	98	41	44
			99	20	23
45	60,687	840			
46	58,095	899	100 and over ..	25	40
47	56,542	987			
48	56,854	1,172			
49	54,527	1,231	Total ..	4,546,118	136,797
50	52,727	1,299			
51	44,282	1,216			
52	48,044	1,482			
53	49,953	1,744			
54	51,055	1,781			

2. POPULATION AT CENSUS, 30TH JUNE, 1954 AND DEATHS IN THREE YEARS, 1953–1955—AUSTRALIA.

FEMALES.

Age Last Birthday.	Population.	Deaths.	Age Last Birthday.	Population.	Deaths.
	(1)	(2)		(3)	(4)
0	95,331	5,937	55	39,048	987
1	94,863	708	56	41,479	1,036
2	95,087	368	57	39,705	1,146
3	94,251	249	58	43,441	1,290
4	93,203	222	59	40,449	1,423
5	90,200	175	60	44,855	1,472
6	91,117	152	61	35,982	1,477
7	98,647	138	62	39,780	1,779
8	80,856	121	63	39,651	1,935
9	80,014	75	64	38,427	2,075
10	77,375	75	65	37,176	2,177
11	68,029	78	66	33,544	2,178
12	69,622	73	67	30,976	2,308
13	64,006	69	68	30,621	2,391
14	61,073	83	69	27,855	2,517
15	61,252	92	70	28,145	2,639
16	58,954	91	71	21,298	2,444
17	58,413	104	72	22,937	2,910
18	56,291	115	73	21,870	3,047
19	54,574	102	74	21,179	3,060
20	53,801	99	75	17,804	3,099
21	54,938	109	76	16,406	3,019
22	55,743	121	77	13,922	2,912
23	61,337	122	78	13,559	3,222
24	62,368	126	79	11,047	3,082
25	63,978	150	80	10,877	2,979
26	66,257	147	81	8,112	2,661
27	66,496	170	82	7,866	2,855
28	69,840	183	83	6,943	2,827
29	69,607	182	84	6,672	2,764
30	70,567	190	85	4,750	2,508
31	67,021	201	86	4,273	2,309
32	70,743	258	87	3,216	1,855
33	69,542	242	88	2,434	1,587
34	65,732	252	89	1,945	1,357
35	61,702	270	90	1,628	1,170
36	61,849	284	91	1,091	905
37	62,774	308	92	863	761
38	64,770	353	93	609	611
39	66,260	433	94	422	433
40	69,050	402	95	248	283
41	57,126	423	96	168	210
42	62,485	502	97	122	135
43	59,516	472	98	68	101
44	56,833	531	99	46	59
45	55,750	596	100 and over ..	46	58
46	53,353	591			
47	50,943	631			
48	51,439	674			
49	48,739	739	Total ..	4,440,412	107,232
50	49,374	799			
51	40,413	686			
52	44,884	828			
53	47,708	1,027			
54	50,761	1,051			

3. BIRTHS REGISTERED IN AUSTRALIA DURING EACH QUARTER, 1947–1955.

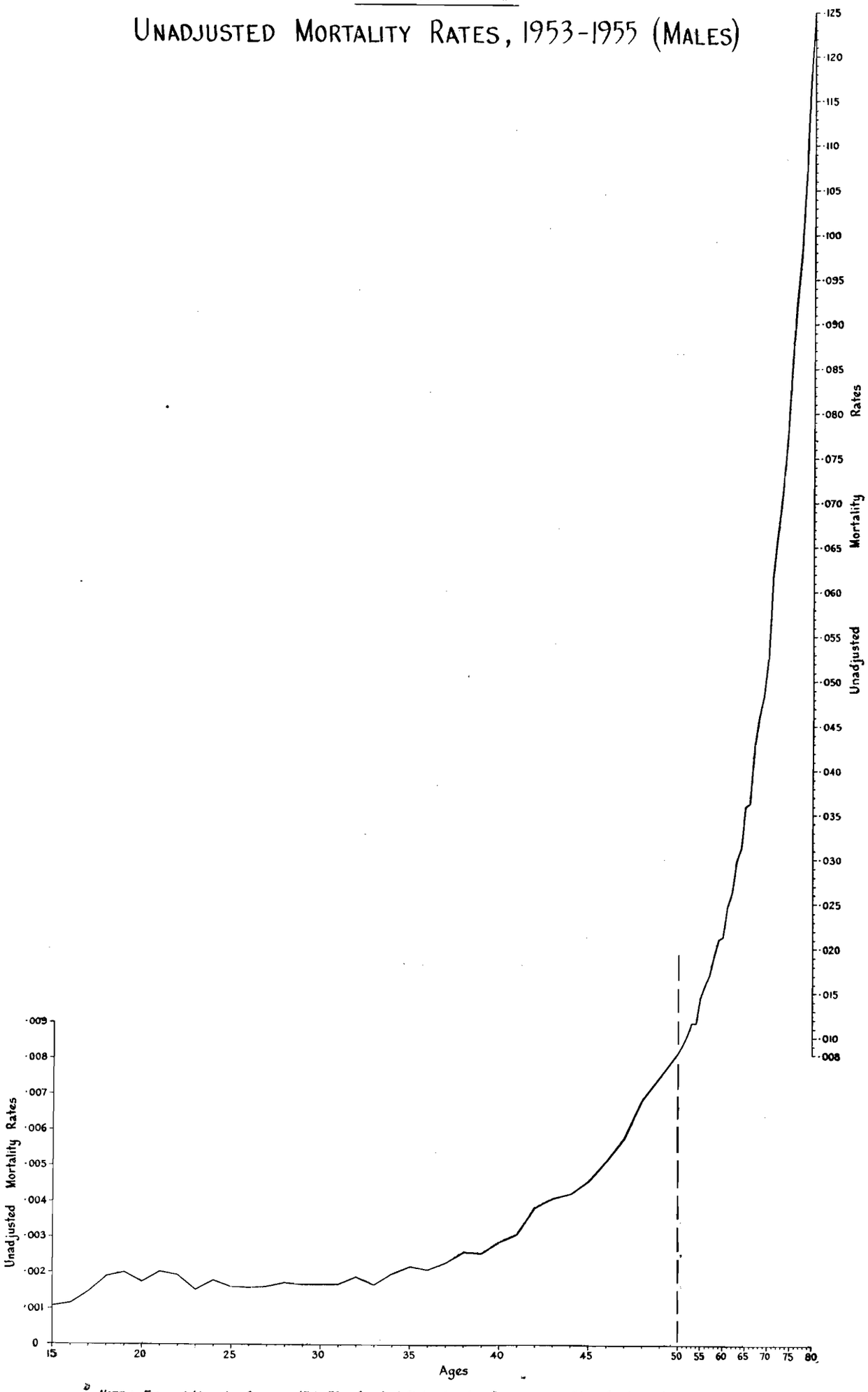
Quarter of Year.	1947.	1948.	1949.	1950.	1951.	1952.	1953.	1954.	1955.
MALES.									
First	25,005	22,462	22,430	24,374	24,686	25,799	26,326	25,453	26,235
Second	23,430	23,095	22,323	24,112	24,667	25,340	25,303	26,002	26,529
Third	23,059	22,726	24,180	24,709	25,445	25,992	25,886	25,912	27,387
Fourth	22,324	23,028	23,813	24,635	24,603	26,250	25,984	26,188	26,299
Total ..	93,818	91,311	92,746	97,830	99,401	103,381	103,499	103,555	106,450
FEMALES.									
First	23,511	21,185	21,206	23,104	23,326	24,605	25,143	24,256	25,083
Second	22,053	21,882	21,284	22,584	23,358	23,908	24,186	24,611	25,071
Third	21,985	21,629	23,225	23,724	24,236	24,904	24,631	24,860	26,327
Fourth	21,017	21,969	22,800	23,349	22,977	24,852	24,776	24,974	24,746
Total ..	88,566	86,665	88,515	92,761	93,897	98,269	98,736	98,701	101,227

4. DEATHS UNDER SIX YEARS OF AGE, REGISTERED IN AUSTRALIA, 1948–1955.

Year.	0–3 months.	3–6 months.	6–9 months.	9 months–1 year.	Total 0–1 year.	1–2 years.	2–3 years.	3–4 years.	4–5 years.	5–6 years.
MALES.										
1948	..	..	..	..	2,856	..	..	..	..	..
1949	..	..	..	..	2,624	248	..	..	..	..
1950	..	..	..	..	2,661	275	168	..	..	..
1951	..	..	..	..	2,749	315	166	123	..	..
1952	..	..	..	..	2,774	270	171	119	95	..
1953	2,143	221	168	129	2,661	268	172	125	97	78
1954	2,115	219	148	126	2,608	292	182	134	91	71
1955	2,105	250	169	101	2,625	270	175	120	89	61
FEMALES.										
1948	..	..	..	..	2,086	..	..	..	..	..
1949	..	..	..	..	1,963	220	..	..	..	..
1950	..	..	..	..	2,004	238	90	..	..	..
1951	..	..	..	..	2,129	261	150	88	..	..
1952	..	..	..	..	2,023	274	125	80	69	..
1953	1,586	183	157	126	2,052	246	132	88	77	73
1954	1,530	185	128	95	1,938	241	117	71	59	49
1955	1,496	187	142	122	1,947	221	119	90	86	53

APPENDIX E

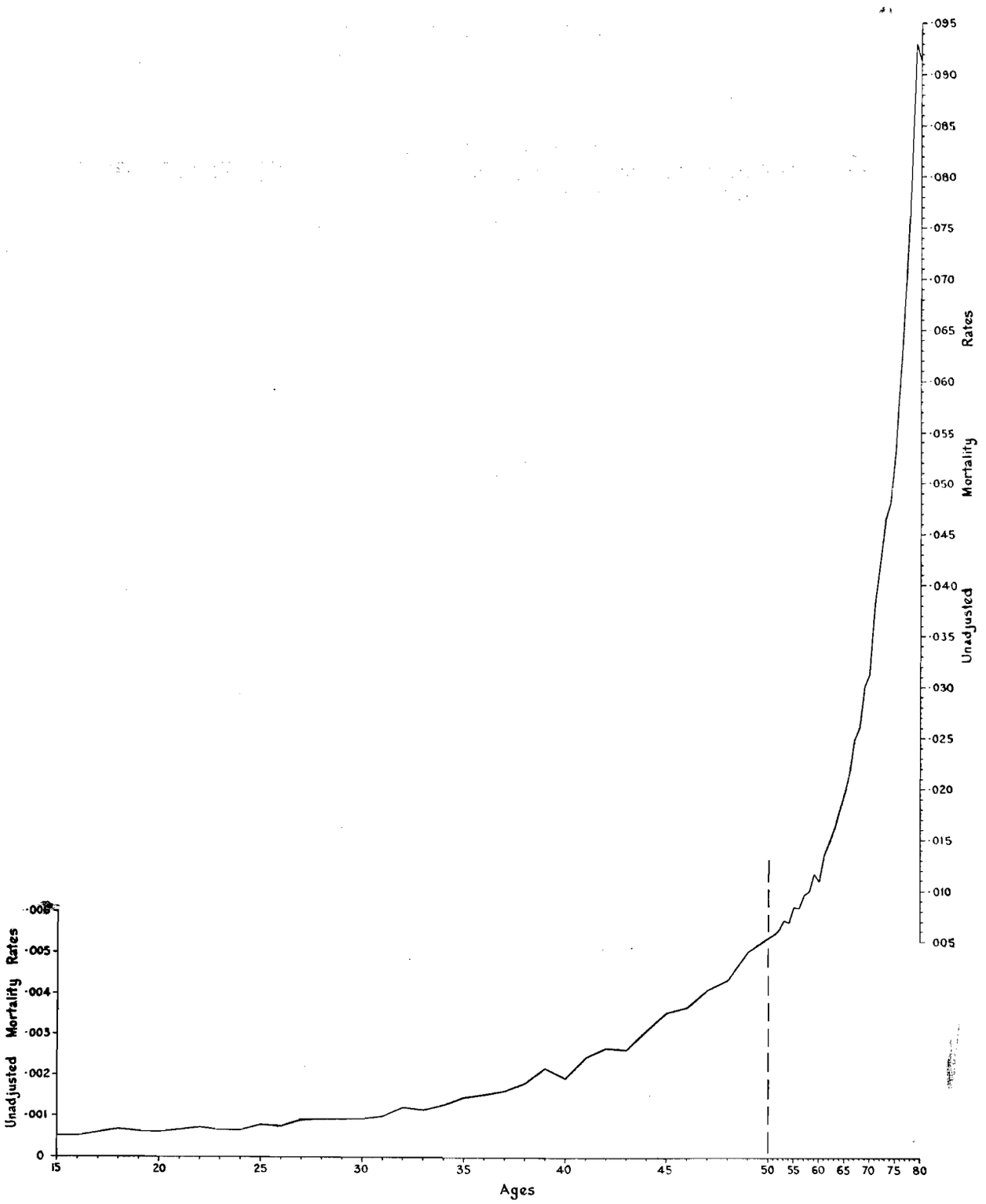
UNADJUSTED MORTALITY RATES, 1953-1955 (MALES)



NOTE : For mortality rates for ages 15 to 50 refer to left hand scale. For ages over 50 refer to right hand scale

APPENDIX F

UNADJUSTED MORTALITY RATES, 1953–1955 (FEMALES)



NOTE : For mortality rates for ages 15 to 50 refer to left hand scale. For ages over 50 refer to right hand scale.

APPENDIX G.

FORMULAE USED FOR CALCULATION OF MORTALITY RATES AT AGES 0 TO 5.

Age 0.—If the rate of mortality at age 0 is q_0 and the probability of dying in the first three months after birth is q_0(0–3 months),—

$$q_0 = q_0(\text{0–3 months}) + q_0(\text{3–6 months}) + q_0(\text{6–9 months}) + q_0(\text{9–12 months})$$

The formula used for q_0(0–3 months) is,—

$$q_0(\text{0–3 months}) = \frac{\text{Deaths in 1953, 1954 and 1955 at age 0–3 months}}{\frac{1}{8}\beta^4{}_{1952} + \beta_{1953} + \beta_{1954} + \beta^1{}_{1955} + \beta^2{}_{1955} + \beta^3{}_{1955} + \frac{7}{8}\beta^4{}_{1955}.}$$

$$q_0(\text{3–6 months}) = \frac{\text{Deaths in 1953, 1954 and 1955 at age 3-6 months.}}{\frac{1}{2}\beta^3{}_{1952} + \beta^4{}_{1952} + \beta_{1953} + \beta_{1954} + \beta^1{}_{1955} + \beta^2{}_{1955} + \frac{1}{2}\beta^3{}_{1955}.}$$

In the above formula β_{1953} is the number of births in the year 1953, $\beta^1{}_{1955}$ is the number of births in the first quarter of 1955, &c.

Ages 1–5.—

$$q_1 = \frac{\text{Deaths in 1953, 1954 and 1955 at age 1}}{\frac{1}{8}\beta^1{}_{1951} + \frac{3}{8}\beta^2{}_{1951} + \frac{5}{8}\beta^3{}_{1951} + \frac{7}{8}\beta^4{}_{1951} + \beta_{1952} + \beta_{1953} + \frac{7}{8}\beta^1{}_{1954} + \frac{5}{8}\beta^2{}_{1954} + \frac{3}{8}\beta^3{}_{1954} + \frac{1}{8}\beta^4{}_{1954}}$$

— (deaths at age 0–1 in 1952, 1953 and 1954).

For the formula for other ages *see* Report on English Life Table No. 10, Decennial Supplement of the Registrar-General (U.K.), 1931.

NOTE.—The above formulae do not include any adjustment for migration.

By Authority: A. J. ARTHUR, Commonwealth Government Printer, Canberra.