Hence the difference between the two may be regarded as very largely the consequence of the war, though of course other causes also have contributed. We may note, however, that, as shewn on the first table, the rate of increase was itself increasing. Thus, we might very fairly suppose that the rate from the end of the year 1907, which for the first year was 1.70 per cent. per annum, tended to increase uniformly 0.4 per cent. per annum. This would give for successive years 2.10, 2.50, 2.90, 3.30 per cent., which would be the increase of 1912 over 1911. Let us assume that this last rate, which is of course high, remained constant : then we should get the following figures for the successive years, viz., those shewn hereunder, and these may well have been the actual figures but for the incidence of the war if we had maintained steadily our large net immigration :—

Year.		Population as Computed.	Increase.	Year.		Population as Computed.	Increase.
			%				%
1907	..	4,161,722	..	1913	..	4,863,620	..
1908	..	4,232,471	1.70	1914	..	5,024,119	3.30
1909	..	4,321,353	2.10	1915	..	5,189,915	3.30
1910	..	4,429,387	2.50	1916	..	5,361,182	3.30
1911	..	4,557,839	2.90	1917	..	5,538,101	3.30
1912	..	4,708,248	3.30	1918	..	5,720,858	3.30
1913	..	4,863,620	3.30	1919	..	5,909,646	3.30

On 31st December, 1919, we should, on this supposition, have had a population of 5,909,646, or 662,627 more than the actual population (5,247,019). It is, therefore, abundantly clear that the population of Australia is between 240,000 and 660,000 less than it would have been but for the war.

In this connexion it may be mentioned that, with regard to the proposal to create a Capital at Canberra, the Commonwealth Statistician on the 23rd December, 1909, estimated the probable population for 1920 as 5,227,000. On the 31st March, 1920, it had reached 5,274,444, so that the increase prior to the war was somewhat larger than had then been anticipated. This, however, was due to the large net immigration which commenced in 1909, and continued till 1913 inclusive. The two results are thus in very fair agreement, since the prediction was for a point of time between ten and eleven years ahead. Of course, if the increase in the rate of advance for the years 1909 to 1913 could have continued, the loss would be still greater.

§ 18. The Influenza Epidemic of 1918-19.

In common with other countries, Australia was visited during 1918-20 by an epidemic of influenza, which was by far the most severe on record. In the following pages is given a brief analysis of its salient features. The average death rates per 100,000 of the mean population for the first three successive quinquennia of this century, for the four years 1915-18, and for 1919 are shewn hereunder :—

DEATH RATES, ALL CAUSES, PER 100,000, 1900-19.

Period.				Males.	Females.	Persons.
1900-4	..	..	..	1,322	1,052	1,194
1905-9	..	..	..	1,200	957	1,084
1910-14	..	..	..	1,189	945	1,072
1915-18	..	..	..	1,197	883	1,040
1919	..	..	..	1,466	1,098	1,288

This conspicuous increase during 1919 was largely due to deaths from influenza. Of the 65,930 deaths which were registered during that year, no less than 11,989 (7,046 males and 4,943 females) were classified as due to influenza.

The table hereunder shews for each State and the Commonwealth as a whole the deaths and death rates from influenza in 1919 :—

DEATHS AND DEATH-RATE PER 100,000 PERSONS FROM INFLUENZA, 1919.

Particulars.	N.S.W.	Vic.	Qld.	S. A.	W. A.	Tas.	N. T.	F. T.	C'wealth.
Number of deaths—									
Metropolitan areas	3,350	2,413	377	334	230	77	..	..	6,781
Remainder of State	2,630	1,148	734	206	310	163	16	1	5,208
Whole State ..	5,980	3,561	1,111	540	540	240	16	1	11,989
Death rate per 100,000 persons—									
Metropolitan areas	413	329	203	136	167	177	..	..	314
Remainder of State	228	157	137	98	167	97	333	43	174
Whole State ..	304	243	156	118	167	114	·333	43	233

A reference to Graph No. 1 (a) discloses the fact that there were marked epidemics of influenza in 1891, 1894–5, and 1899, and that the epidemic of 1918–19–20 was much more severe than any of the preceding ones. The annual death rates per million persons from influenza for the periods 1880–1893 (fourteen years), 1894–1906 (thirteen years), and 1907–18 (twelve years) were 104, 202, and 98 respectively, while the rate for 1919 was 2,331, which was 23.8 times that of the average for the twelve years 1907–18.

It appears that apart from the epidemics there is a secular fluctuation in the frequency, *i.e.*, in the degree of regularity with which the deaths for individual years vary on the positive or negative side. This oscillation is shewn on Graph 1 (see curve 1 (b)), and can be represented by the formula—

$$D = 124 + t - 100 \cos (10°t) ; \quad t = Y - 1880.$$

Where D denotes the number of deaths per annum per million of population, and Y the calendar year.

There is evidently no clearly defined and regular secular period for this disease. It is at once obvious from the graph that the last epidemic was very much more severe than previous epidemics; the differences from the oscillation curve being of the following order, viz.—

Year 1891, 570 ; year 1899, 220 ; year 1907, 68 ; and year 1919, 2,255.

Though there is no very marked correlation between the mortality-frequencies of influenza and most other diseases, it appears to be fairly definitely associated with pneumonia and heart disease, as the following table shews :—

DEATHS PER 1,000,000 FROM INFLUENZA, PNEUMONIA, AND HEART DISEASE.

—	Influenza.	Pneumonia and Broncho-pneumonia.	Heart Disease.
1880	35	527	701
1885 epidemic	77	865	820
1890	130	681	757
1891 epidemic	739	809	805
1894 epidemic	257	623	685
1895 epidemic	277	702	722
1899 epidemic	462	760	829
1900	147	670	848
1907 epidemic	219	653	922
1910	74	529	1,002
1918	170	647	798
1919 epidemic	2,331	776	1,140

The association of these three diseases was conspicuous in 1891 and 1919, and the deaths—recorded as due to influenza and to pneumonic influenza—indicate that on the whole these two causes are closely related. Thus the average number of deaths per month for 1911–17 and the number during each month of 1918 and 1919 were as follows :—

MONTHLY NUMBERS OF DEATHS FROM INFLUENZA AND PNEUMONIC INFLUENZA.

Particulars.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Ordinary influenza—													
1911–17*	14.7	9.0	10.6	14.0	18.4	27.7	34.0	52.7	59.6	42.9	33.3	17.7	334.3
1918 ..	12	5	7	12	13	26	41	52	173	275	130	102	848
1919 ..	17	30	72	81	119	293	406	242	103	54	42	37	1,496
Pneumonic influenza—													
1919 ..	62	465	280	1,845	1,491	2,129	2,339	1,074	494	202	84	28	10,493

* Annual averages.

DEATH RATES FROM INFLUENZA PER ANNUM PER MILLION PERSONS DURING EACH CALENDAR MONTH.

Period.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1907 ..	132	54	55	62	74	32	120	550	676	503	220	127	219
1908–12	47	27	32	43	67	88	143	177	184	145	109	63	94
1913–17	34	26	27	36	44	67	60	100	131	94	76	43	62
1918 ..	29	13	17	29	31	63	97	123	421	647	316	239	170
1919 ..	185	1,276	817	4,605	3,712	5,745	6,276	2,995	1,397	578	293	146	2,331

The fluctuation of annual period of ordinary influenza is shewn in the following table :—

DEATH RATES PER ANNUM PER MILLION PERSONS DURING EACH EQUALISED MONTH AND THE RATIOS OF EACH TO THEIR MEAN VALUE.

Month.	Equalised Month.	Difference from Yearly Mean.	Ratio to Average.	Month.	Equalised Month.	Difference from Yearly Mean.	Ratio to Average.
January	40.1	− 34.5	− .462	July	92.3	+ 17.6	+ .236
February	26.5	− 48.1	− .645	August	132.3	+ 57.5	+ .771
March	29.2	− 45.4	− .608	September	153.2	+ 78.6	+ 1.053
April	39.2	− 35.4	− .474	October	114.4	+ 39.8	+ .533
May	54.2	− 20.5	− .275	November ..	88.5	+ 13.9	+ .186
June	76.5	+ 1.8	+ 0.24	December ..	49.4	− 25.3	− .339

The figures in Column I. are the geometric means between the arithmetic means of the periods 1907–12 and 1913–17.

The curve equivalent to the values represented in the third column of the above table is shewn by the curve I. on graph No. 2. For Influenza the maximum of the periodic oscillation of death rate occurs in Australia about September 11, and has the value of 1.124 times the average for the year, and the minimum (by graphic determination) occurs about February 24, and has the value 0.656 of the average for the year. It has but one maximum and one minimum. For the 1919 epidemic, including both ordinary and pneumonic influenza, the following variations in the relative frequency per calendar month throughout the Commonwealth are shewn :—

DIFFERENCE IN ANNUAL DISTRIBUTION OF ORDINARY AND PNEUMONIC INFLUENZA (CALENDAR MONTHS).

Influenza.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Ordinary ..	− .463	− .646	− .611	− .479	− .282	+ .017	+ .227	+ .769	+ 1.061	+ .544	+ .195	− .332
Pneumonic	− .932	− .501	− .649	+ .964	+ .634	+ 1.460	+ 1.786	+ .308	− .440	− .777	− .901	− .951

This difference is due in part to the fact that the appearance of the disease was not simultaneous for the several States of the Commonwealth. These results indicate three maxima, viz., February, April, and July, and three minima, occurring in March, May, and December. The maximum death rates in each State occurred as follows, viz., Victoria, February, May, and July; New South Wales, April and July; Queensland, June; South Australia, May, August; Western Australia, August; and Tasmania, September.

The characteristics of the age-incidence of the epidemic are sharply differentiated from those of ordinary influenza. The deaths from influenza per 1,000,000 males and per 1,000,000 females of each age-group during the nine years 1907–15, and during the three years 1916–18, were as shewn in the table hereunder, and were very nearly identical. Graph No. 3 (Curves 1 and 2 for males, and 1′ and 2′ for females) shews the frequency. Curves 3a and 3′a illustrate the age incidence in the case of the recent epidemic, and disclose its characteristic difference from the age incidence of ordinary influenza, also given for both males and females in the table hereunder. Curves 4 (males) and 4′ (females) indicate—for comparison—the age incidence of pneumonia during the period 1907–15, and it will be noticed have the same general character as the curves of ordinary influenza.

AUSTRALIAN DEATH-RATES FOR INFLUENZA PER MILLION.

Age Group.	Deaths per Million *Males* in each Age Group.			Deaths per Million *Females* in each Age Group.		
	1907–15.	1916–18.	1919.*	1907–15.	1916–18.	1919.*
Under 1 year ..	341	240	1,531	250	186	1,286
1	82	41	903	85	49	784
2	35	31	886	38	34	829
3	34	24	659	26	28	427
4	24	12	568	11	23	577
5–9	16	18	250	21	19	340
10–14.. ..	9	12	423	15	8	347
15–19.. ..	21	31	932	18	12	772
20–24.. ..	25	40	1,862	31 ·	13	1,673
25–29.. ..	33	46	4,649	29	15	3,309
30–34.. ..	27	35	6,243	31	23	3,685
35–39.. ..	56	48	5,764	54	33	3,378
40–44.. ..	71	50	4,380	46	41	2,468
45–49.. ..	101	76	4,283	68	55	2,477
50–54.. ..	109	87	3,862	103	67	2,791
55–59.. ..	170	153	3,557	122	145	4,113
60–64.. ..	248	343	3,852	296	278	3,611
65–69.. ..	468	446	3,409	528	437	3,335
70–74.. ..	848	759	3,084	1,018	766	3,499
75–79.. ..	1,407	1,472	3,712	1,917	1,535	3,860
80–84.. ..	2,240	1,967	2,544	2,340	2,221	2,797
85–89.. ..	3,274	4,777	3,398	3,839	3,891	3,057
90–94.. ..	6,038	3,939	4,201	5,285	2,837	2,356
95–99.. ..	5,333	3,016	7,752	7,276	6,726	..
100 and over ..	..	..	..	24,096	..	..

* Ordinary and pneumonic influenza combined.

There is an extraordinary difference in the incidence of the mortality in respect to age. While in the mortality from ordinary influenza it continually increases with age for both males and females after the age of, say, 12½ is passed (see results for 1907–15 and 1916–18), in the pneumonic form it reaches a maximum—about 6,300—at age 36.4 for males and about 3,700 at age 32.6 for females.*

The masculinity of death from influenza is also peculiar. If the excess of males over females in 10,000 persons be ascertained, this number may be termed the masculinity per 10,000. Thus if the masculinity be 1,754 per 10,000, it means that the number of

* For females the results for the higher ages are irregular, being based on small numbers.

cases of males and females were in the proportions :—½ (10,000 + 1,754) males to ½ (10,000 − 1,754) females = 5,877 to 4,123.   The masculinity figures per 10,000 persons of the mortality from Influenza, Broncho-Pneumonia, Pneumonia and Heart Disease are as follow :—

MASCULINITY OF DEATHS FROM INFLUENZA, ETC.

Disease.	1907–12.	1913–19.	1918.	1919.
Influenza	575	60	967	1,754
Broncho-Pneumonia ..	1,021	938	175	739
Pneumonia	2,441	2,469	2,395	1,694
Heart Disease	1,327	1,371	981	1,047

Thus for influenza the masculinity (as defined) greatly increased in 1919 ; for broncho-pneumonia it distinctly increased over its value for 1918 though it was less than for the period 1907 to 1917 ; for pneumonia itself it conspicuously diminished ; while for heart disease it did not greatly change.

The periods at which the number of deaths from influenza became greater than the normal in each of the States were as follows :—New South Wales—September to December, 1918.   Recrudescence March, 1919, to January, 1920.   Victoria—September to November, 1918.   Recrudescence January to December, 1919.   Queensland—July, 1918, to February, 1919.   Recrudescence May to December, 1919.   South Australia—August to October, 1918.   Recrudescence April to November, 1919.   Western Australia —July, 1918, to January, 1919.   Recrudescence June, 1919, to January, 1920. Tasmania—October to December, 1918.   Recrudescence August, 1919, to February, 1920.   Commonwealth—July, 1918, to February, 1920.

The number of deaths attributable to the epidemic of influenza involves an analysis of the mortality from all diseases and of the mortality from this disease in normal circumstances.   Moreover, since certain other diseases shew an increase they may be brought into account in estimating what may possibly have been the indirect effect of the influenza.   Proceeding thus the following results are obtained for the excess deaths :—

EXCESS IN THE NUMBER OF DEATHS FROM INFLUENZA, PNEUMONIA, AND HEART DISEASE OVER NORMAL NUMBER, 1918–1919.

Disease.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Influenza ..	65	482	339	1,912	1,587	2,396	2,724	1,280	666	453	196	133	12,233
Pneumonia	31	− 3	− 1	160	68	216	166	4	11	− 3	−80	−34	535
Heart Disease	30	26	53	121	130	135	303	239	222	257	103	141	1,760
Total ..	126	505	391	2,193	1,785	2,747	3,193	1,523	899	707	219	240	14,528

Note.—Minus sign indicates that deaths were less than normal.

As the table shews, there were 14,528 deaths during 1918–19 (590 in 1918 and 13,938 in 1919) more than would have occurred normally.   This number was the death-tribute for the two years owing directly and indirectly to the epidemic of influenza, on the supposition indicated, viz., that the increase in deaths from pneumonia and heart disease were associated more or less directly therewith.

This result can be otherwise confirmed.   The death-rates for all causes of death per 100,000 of population for 1913 to 1919 were as follows :—

DEATH RATES, ALL CAUSES, 1913–19.

Year	1913.	1914.	1915.	1916.	1917.	1918.	1919.
Rate per 100,000 ..	1,078	1,051	1,066	1,104	980	1,009	1,282

Obviously the rate for 1919 is very much above the average.   If 1918 be taken as substantially normal (since the average for 1913–1917 was 1,056) and allowance be made for the fact that the population in 1919 was 1.03268 times that of 1918, the expected number of deaths in 1919 was 51,891.   The actual deaths were 65,930, or 14,039 in excess of the expected number which agrees very well with the number (13,938) given above for 1919.