B. 1946–1949 BASIC TABLES

The last basic table prepared by the Joint Committee on Mortality for the purpose of making mortality comparisons under insurances in force during the first fifteen policy years was the 1925–1939 table, presented in *TASA* XLII, 181–187. The table covered the issues of 1925 to 1939 observed to 1940 policy anniversaries. The important improvement in mortality of recent years has been gradually causing that table to be outmoded. The Joint Committee recognized the need for a new table several years ago, but the abnormal war period did not appear to be an appropriate mortality period for that purpose. The construction of such a table was therefore deferred.

While the volume of material accumulated between 1946 and 1949 policy anniversaries is not as extensive as would perhaps have been desirable for a new table, the Committee felt that the need for a more modern table was great enough to justify the presentation of a new mortality standard at this time, based on the experience between 1946 and 1949 anniversaries among the companies which have been contributing to the Committee's regular annual studies. It will be recognized that by starting with 1946 anniversaries the war period is eliminated.

In 1942 the Joint Committee began to accumulate data with respect to the sixteenth and later policy years. It was therefore possible to compile two tables, one in select form covering the first fifteen policy years and the other in ultimate form covering the sixteenth and later years. They are presented in Tables 7 and 8, respectively. All years of issue were included in the experience for the particular policy years falling between 1946 and 1949 anniversaries. Thus each policy duration in the table representing the experience of the first fifteen years is composed of the data from three consecutive years of issue. This table is therefore of the rhomboid type, as contrasted with the triangular composition of the 1925–1939 Basic Table, where the first policy year included the data relating to 15 different years of issue, the second policy year to 14, etc., with the fifteenth policy year consisting only of the experience of the issues of 1925 between 1939 and 1940 anniversaries.

Sixteen companies contributed the standard, medically examined, insurance data which underlay the mortality rates of the first fifteen policy years in Table 7, while fifteen companies contributed the standard insurance data (not necessarily medically examined) which went into the construction of Table 8, relating to the sixteenth and later policy years. The

proportionate contributions of the different companies may be gauged from the table appearing earlier in the report showing relative proportions for the experience year between 1948 and 1949 anniversaries, which is one of the three years in the observation period covered by the tables. While "select" and "ultimate" labels are convenient for these tables and will hereafter be used in this report, the Committee would like to emphasize that the tables were derived independently from different bodies of data, and that the ultimate mortality rates are not "ultimate" in the sense that

TABLE 7

1946-1949 SELECT BASIC TABLE
GRADUATED MORTALITY RATES PER 1,000

POLICY YEAR	ISSUE AGES											
	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65 and Over
1.......	.40	.70	.65	.66	.67	.97	1.31	2.14	2.86	4.66	7.41	11.37
2.......	.50	.84	.77	.82	.91	1.39	1.99	3.16	4.45	6.84	10.54	16.13
3.......	.59	.96	.89	.97	1.14	1.78	2.74	4.27	6.29	9.52	14.33	20.50
4.......	.65	1.01	.94	1.04	1.29	2.07	3.29	5.04	7.74	11.62	16.91	23.33
5.......	.75	1.06	.98	1.12	1.49	2.43	3.96	5.95	9.42	13.92	19.92	27.53
6.......	.82	1.06	.98	1.17	1.66	2.75	4.47	6.75	10.63	15.42	22.26	31.43
7.......	.88	1.07	.98	1.23	1.81	3.00	4.77	7.43	11.37	16.42	24.51	35.90
8.......	.97	1.07	1.03	1.35	2.06	3.52	5.41	8.72	12.87	18.68	28.98	42.20
9.......	1.02	1.08	1.06	1.45	2.26	3.91	6.03	9.80	14.14	20.63	32.82	47.29
10.......	1.08	1.09	1.11	1.58	2.53	4.37	6.77	11.15	15.67	23.05	36.40	52.80
11.......	1.10	1.12	1.19	1.78	2.95	5.02	7.79	12.97	18.08	26.65	40.29	58.32
12.......	1.12	1.16	1.30	1.96	3.33	5.60	8.73	14.57	20.42	30.30	43.60	63.85
13.......	1.13	1.21	1.41	2.22	3.76	6.16	9.85	16.08	23.24	34.13	48.20	71.88
14.......	1.14	1.28	1.62	2.56	4.29	6.96	11.25	18.21	26.37	38.50	54.67	83.89
15.......	1.16	1.40	1.87	2.95	5.05	8.21	13.26	21.17	30.21	43.60	63.75	98.69

they represent the level to which the select rates will rise after the effects of selection have worn off.

The purpose of these new tables is to facilitate the analysis of future mortality trends in the material which enters into the Committee's annual reports. Companies will no doubt find the tables useful for mortality comparisons of various kinds. Any such usage should recognize the tables for what they are, a representation of the actual experience during the three years from 1946 to 1949 policy anniversaries of companies with different underwriting practices and different characteristics of their business contributing data in varying proportions at the respective durations and attained ages. Because of changes in underwriting methods which have taken place in the past and because of changes in classes of persons in-

TABLE 8

1946–1949 ULTIMATE BASIC TABLE

Attained Age	Actual Death Claims (Unit 1,000)	Crude Mortality Rates per 1,000	Graduated Mortality Rates per 1,000	Attained Age	Actual Death Claims (Unit 1,000)	Crude Mortality Rates per 1,000	Graduated Mortality Rates per 1,000
25......	$ 35	.82	1.14	60......	$33,230	20.71	21.05
26......	68	1.00	1.15	61......	34,684	22.48	23.05
27......	100	1.15	1.18	62......	36,412	24.74	25.16
28......	134	1.33	1.22	63......	36,212	26.49	27.37
29......	122	1.09	1.26	64......	38,895	31.20	29.68
30......	172	1.17	1.31	65......	36,090	33.00	32.10
31......	229	1.26	1.38	66......	34,602	34.83	34.65
32......	366	1.65	1.46	67......	34,774	37.99	37.38
33......	425	1.58	1.54	68......	32,069	38.14	40.33
34......	550	1.70	1.62	69......	34,124	44.83	43.57
35......	587	1.53	1.72	70......	30,642	45.09	47.14
36......	915	1.97	1.83	71......	31,528	52.18	51.05
37......	1,154	2.10	1.96	72......	29,102	54.60	55.34
38......	1,361	2.08	2.12	73......	27,484	60.08	59.99
39......	1,681	2.20	2.32	74......	25,383	63.70	65.03
40......	2,244	2.57	2.56	75......	22,937	68.38	70.45
41......	2,670	2.76	2.85	76......	23,897	82.39	76.27
42......	3,324	3.12	3.19	77......	20,107	82.45	82.55
43......	3,934	3.37	3.58	78......	19,609	97.54	89.38
44......	5,230	4.14	4.02	79......	15,757	97.72	96.95
45......	6,014	4.49	4.50	80......	12,406	97.34	105.45
46......	7,523	5.33	5.02	81......	10,836	107.24	115.03
47......	8,566	5.84	5.57	81......	8,910	114.60	125.67
48......	9,715	6.25	6.18	83......	8,397	137.63	137.20
49......	10,254	6.36	6.84	84......	7,995	173.57	149.31
50......	12,178	7.18	7.57	85......	5,225	162.94	161.68
51......	15,289	8.77	8.39	86......	3,692	165.89	174.20
52......	17,896	9.96	9.29	87......	3,412	195.81	186.80
53......	18,518	10.12	10.31	88......	1,929	170.41	199.42
54......	20,911	11.19	11.44	89......	1,703	223.89	212.04
55......	23,715	12.81	12.71	90......	1,156	236.79	224.66
56......	24,234	13.22	14.12	91......	784	249.82	237.28
57......	27,453	15.28	15.67	92......	491	215.17	249.90
58......	31,456	17.90	17.35	93......	395	266.70	262.52
59......	34,466	20.34	19.15	94......	286	281.56	275.14
				95......	154	273.59	287.76

sured, such as the varying proportion of women, the tables should not be regarded as representing modern mortality based on present day underwriting.

Total claims underlying the select table amounted to $415,928,000, a smaller amount than had entered into any of the previous basic tables of the Committee except the 1920–1926 table, which covered only seven durations. The average amount of claims per age-duration cell was $2,311,000. This compares with $9,832,000 in the 1925–1939 Basic Table and $4,758,000 in Joint 1939–1944 Select Table prepared by Mr. Elston.

The graduation process involved a number of steps since adjustments were deemed advisable at successive stages. The basic formula used was a Whittaker-Henderson second difference A formula, with $a = 1$. It was applied to the ratios of the crude mortality rates to the 1925–1939 Basic Table rates, first for each duration separately, and then, after an adjustment to improve the fidelity to the original data, for each age group separately. The resulting mortality rates were subsequently adjusted empirically and by regraduation in order to improve the fit, obtain greater consistency with ultimate rates at younger attained ages, and reduce the irregularities in the series. The criterion of fit was given some priority in the process because of the purpose for which the table is intended.

A test of the graduation of the select table, in the form of the ratio of actual to tabular claims, is set forth in Table 9. The actual claims in the respective subdivisions are also shown. It may be noted that in those areas where the deviations from 100% are larger than is ordinarily desirable, the volume of data, as evidenced by the amount of claims, is small. Table 10 gives in full the amount of claims entering into the calculation of the crude rates for the select table. The crude rates themselves are given in Table 11.

The claims underlying the ultimate table amounted to $958,798,000, which compares with a total of $1,029,713,000 which entered into the Joint 1939–44[16] Table (TASA XLVIII, 242). The graduation was accomplished by means of a Whittaker-Henderson third difference A formula, with $a = 3$. Adjustments at both ends of the table were considered desirable. At the upper end of the table, the original graduation produced decreasing first differences after age 87. The mortality rates were adjusted so that first differences at those ages remained constant. At the young age end, the mortality rates around age 25 appeared low relative to other observed rates. The volume of data at the young ages was small, so that

TABLE 9

TEST OF GRADUATION OF 1946–1949 SELECT BASIC TABLE
Unit 1,000

POLICY YEAR GROUP	ISSUE AGE GROUP					
	10–29	30–39	40–49	50–59	60 and Over	All
	Actual Claims					
1 and 2......	$ 6,582	$ 10,020	$ 12,602	$ 6,935	$ 1,199	$ 37,339
3– 5........	7,493	15,963	26,295	17,190	3,180	70,121
6–10........	15,643	29,767	42,926	27,804	6,207	122,347
11–15........	19,568	47,809	69,733	40,042	8,968	186,121
All......	$49,287	$103,559	$151,557	$91,971	$19,554	$415,928
	Ratios of Actual to Tabular Claims					
1 and 2......	102.8%	97.5%	100.3%	98.2%	89.0%	99.1%
3– 5........	101.5	100.7	102.0	102.0	103.5	101.7
6–10........	98.3	99.4	100.1	99.8	98.4	99.5
11–15........	98.1	101.5	99.9	98.4	102.3	99.9
All......	99.3%	100.4%	100.4%	99.5%	100.3%	100.0%

POLICY YEAR	BY POLICY YEAR ALL ISSUE AGES COMBINED		ISSUE AGE	BY ISSUE AGE ALL DURATIONS COMBINED	
	Actual Claims	Ratio of Actual to Tabular		Actual Claims	Ratio of Actual to Tabular
1..........	$ 16,758	101.4%	10–14......	$ 3,481	104.5%
2..........	20,581	97.4	15–19......	6,861	100.0
3..........	24,011	101.3	20–24......	13,600	96.8
4..........	23,142	101.6	25–29......	25,345	99.8
5..........	22,969	102.3	30–34......	40,916	99.4
6..........	22,385	98.4	35–39......	62,644	101.0
7..........	21,751	97.6	40–44......	75,271	99.9
8..........	24,737	101.4	45–49......	76,286	100.8
9..........	25,226	100.6	50–54......	57,118	99.5
10..........	28,249	99.5	55–59......	34,853	99.4
11..........	33,938	101.0	60–64......	15,591	100.0
12..........	35,762	99.9	65 and over.	3,964	101.6
13..........	37,357	98.9			
14..........	37,450	98.6			
15..........	41,614	101.1			
All......	$415,928	100.0%	All....	$415,928	100.0%

TABLE 10

1946–1949 Select Experience
Actual Death Claims
Unit 1,000

Policy Year	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65+
1....	$ 85	$412	$1,185	$1,750	$2,139	$2,589	$2,641	$2,746	$1,523	$1,175	$ 327	$185
2....	149	493	814	1,693	1,825	3,467	3,858	3,357	2,717	1,520	554	133
3....	142	470	845	1,424	2,297	3,574	4,506	4,667	3,216	1,789	869	212
4....	142	470	581	1,181	1,867	3,303	4,036	4,755	3,737	2,208	608	253
5....	180	456	578	1,024	1,886	3,036	4,589	3,741	3,696	2,545	1,042	196
6....	203	479	762	1,222	1,926	3,083	4,217	3,892	3,574	1,998	852	179
7....	259	487	979	1,246	2,233	3,019	3,787	3,588	3,117	1,820	993	223
8....	248	485	979	1,778	2,688	3,646	3,655	4,768	3,376	2,037	757	321
9....	261	438	857	1,466	2,344	3,931	4,362	4,326	3,715	2,123	1,085	318
10....	274	403	961	1,858	2,859	4,039	5,333	4,998	3,644	2,400	1,172	308
11....	331	487	1,021	1,911	3,591	5,119	6,018	6,605	4,837	2,527	1,134	359
12....	314	485	1,086	2,056	3,751	5,772	6,541	6,976	4,632	2,701	1,179	268
13....	322	481	954	2,322	3,874	5,816	7,382	6,324	5,025	3,092	1,459	305
14....	295	391	1,063	2,383	3,612	5,819	6,691	6,684	4,708	3,572	1,865	366
15....	275	425	935	2,032	4,024	6,430	7,654	8,857	5,601	3,347	1,696	338

TABLE 11

1946–1949 Select Experience
Crude Mortality Rates per 1,000

Policy Year	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65+
1.....	.36	.72	.70	.69	.72	.96	1.29	2.32	2.46	4.99	5.35	17.94
2.....	.56	.94	.64	.87	.73	1.42	2.03	2.98	4.55	6.74	9.44	13.62
3.....	.53	.99	.91	.98	1.17	1.76	2.75	4.68	6.03	8.85	16.20	22.69
4.....	.57	1.07	.96	1.18	1.29	2.10	3.03	5.56	7.99	12.14	12.51	29.26
5.....	.80	1.07	.93	1.06	1.54	2.41	4.37	5.33	9.48	16.31	24.00	24.05
6.....	.90	1.02	.92	1.09	1.56	2.70	4.83	6.42	10.77	14.76	20.73	22.61
7.....	1.09	1.01	1.04	1.06	1.85	2.88	4.94	6.84	10.95	15.49	27.39	29.48
8.....	.98	1.04	1.00	1.50	2.26	3.58	4.92	9.64	12.81	18.69	22.65	49.07
9.....	1.02	1.08	.98	1.34	2.10	4.13	6.15	9.39	15.36	20.90	34.73	52.95
10.....	1.04	.99	1.09	1.68	2.51	4.16	7.21	10.69	15.02	23.57	37.73	54.25
11.....	1.25	1.18	1.15	1.68	3.05	5.01	7.54	13.59	19.81	25.35	35.50	68.58
12.....	1.24	1.22	1.30	1.90	3.40	5.91	8.53	15.16	20.04	27.94	38.93	54.30
13.....	1.28	1.29	1.26	2.30	3.76	6.26	10.14	14.63	22.83	33.78	49.40	63.91
14.....	1.16	1.12	1.64	2.72	4.05	7.14	10.67	17.34	23.89	41.30	67.50	95.03
15.....	1.14	1.30	1.63	2.61	5.03	8.46	12.94	23.98	30.77	39.56	67.72	97.43

statistical fluctuations could account for this effect. Accordingly, the mortality rates at ages 25–29 were raised to a level equal to 47% of the rates in the U.S. 1939–1941 White Males Table, a relationship that was consistent with the ratios of the ultimate rates to the population rates in the immediately higher age range.

A test of the graduation for five and ten year age groups appears in Table 12. The individual age analysis from which those groups were de-

TABLE 12

TEST OF GRADUATION OF 1946–1949 ULTIMATE BASIC TABLE
Unit 1,000

Attained Age Group	Actual Claims	Tabular Claims	Actual minus Tabular Claims	Ratio of Actual to Tabular Claims
25–29........	$ 459	$ 493	$— 34	93.1%
30–34........	1,742	1,704	38	102.2
35–39........	5,698	5,745	— 47	99.2
40–44........	17,402	17,663	— 261	98.5
45–49........	42,072	41,916	156	100.4
50–54........	84,792	84,396	396	100.5
55–59........	141,324	140,497	827	100.6
60–64........	179,433	180,770	—1,337	99.3
65–69........	171,659	170,815	844	100.5
70–74........	144,139	145,735	—1,596	98.9
75–79........	102,307	99,484	2,823	102.8
80–84........	48,544	50,083	—1,539	96.9
85–89........	15,961	16,187	— 226	98.6
90–95........	3,266	3,243	23	100.7
All.......	$958,798	$958,731	$ 67	100.0%
25–34........	$ 2,201	$ 2,197	$ 4	100.2%
35–44........	23,100	23,408	— 308	98.7
45–54........	126,864	126,312	552	100.4
55–64........	320,757	321,267	— 510	99.8
65–74........	315,798	316,550	— 752	99.8
75–84........	150,851	149,567	1,284	100.9
85–95........	19,227	19,430	— 203	99.0
All.......	$958,798	$958,731	$ 67	100.0%

rived showed frequent changes of sign in going from one age to another, and it was also found that the accumulated differences between actual and expected deaths remained within acceptable limits.

The relationship of the select table to the ultimate is set forth in Table 13, in the form of ratios of the select mortality rates to the ultimate mortality rates for the "central" ages of the groups, as defined in the footnote

to the table. These ratios are presented because it was thought they would be of special interest, but the Committee would like to emphasize their approximate nature. The "central" ages on which the ultimate rates were based were taken from *TASA* XLVIII, 260, without further test. Moreover, allowance was not made for the probability that the increase in average age from one policy duration to the next is slightly less than a whole

TABLE 13

RATIOS OF 1946–1949 SELECT BASIC TABLE MORTALITY RATES TO
1946–1949 ULTIMATE BASIC TABLE RATES*

POLICY YEAR	ISSUE AGES											
	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65 and Over
1......	....	....	....	.555	.453	.495	.415	.388	.314	.307	.307	.309
2......	....	....	....	.667	.583	.656	.562	.516	.440	.406	.401	.406
3......	....	....	....	.758	.695	.767	.688	.631	.561	.512	.502	.478
4......	....	....	.825	.782	.741	.809	.739	.672	.621	.567	.547	.502
5......	....	....	.845	.800	.801	.853	.797	.716	.681	.620	.597	.548
6......	....	....	.824	.791	.834	.862	.810	.734	.692	.629	.618	.577
7......	....	....	.797	.788	.838	.838	.779	.728	.668	.615	.631	.608
8......	....	....	.805	.818	.869	.876	.799	.770	.685	.644	.691	.659
9......	....	.947	.797	.829	.863	.869	.804	.779	.684	.658	.724	.682
10......	....	.940	.793	.845	.866	.871	.815	.798	.692	.680	.741	.703
11......	....	.941	.804	.886	.902	.901	.847	.836	.731	.729	.757	.717
12......	....	.943	.833	.899	.907	.906	.855	.848	.758	.768	.756	.725
13......	....	.953	.855	.929	.913	.901	.869	.848	.795	.801	.771	.753
14......	1.000	.970	.926	.966	.933	.919	.894	.873	.834	.836	.807	.809
15......	1.000	1.000	1.000	1.000	.984	.979	.948	.926	.885	.874	.869	.873

* The 1946–1949 Ultimate Basic Table mortality rates were taken at the "central" attained ages for the respective age group, obtained by adding the policy duration less 1 to the "central" issue ages appearing in *TASA* XLVIII, 260.

unit because of the trend of death rates within the age group. This latter point might have special significance at the higher attained ages. The main value of Table 13 is in the general pattern that is revealed rather than in the specific ratios.

The failure of the select rates for the higher ages to merge into the ultimate by the end of fifteen policy years is a notable feature of the select table. One explanation that suggests itself is that the data entering into the tables were derived from different eras of underwriting. The select material is primarily from post-1930 underwriting while the ultimate material for the attained ages involved is largely from pre-1930 underwriting.