

TRANSACTIONS

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A NEW ANNUITY MORTALITY TABLE AND A GRADED RATE SYSTEM FOR THE LIFE INCOME SETTLEMENT OPTIONS

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INTRODUCTION

OF THE many changes that have occurred in the life insurance field over the past quarter century, one of the most notable is the considerable growth in the annuity account. Annuity coverage, in the form of group, immediate and deferred annuities and life income settlements, has increased almost five times,¹ both in number of contracts and in amount of benefit, far outstripping the percentage increase in life coverage during that period. It may be ascribed to a variety of causes—attention focused on the need for such coverage by Federal Old-Age and Survivors Insurance, the tax incentive given to development of corporate retirement plans, the encouragement to individual insurance and annuity coverage programs from the same social security benefits and corporate retirement plans, etc. Whatever the cause, it seems apparent that there is now and will continue to be in future a growing demand for annuity coverage.

For the individual, the life insurance contract is an ideal vehicle for combining these two important risk coverages. A variety of plans, ranging from ordinary life to retirement endowment, permits varying the proportion of insurance and annuity coverage to fit the individual need, and at the same time assures the availability of annuity coverage at net rates for the policyholder's beneficiary.

It is not surprising then to find that the life income settlement options, which in the broader sense include deferred annuities with a death benefit prior to maturity and a cash value at maturity, have pre-empted the field of individual annuity coverage, leaving but a minor portion to immediate annuities. Table 1 shows the extent of this shift, as indicated by first year exposures in recent intercompany studies.²

¹ *Institute of Life Insurance Fact Book*, 1955, p. 30.

² *TASA XLVIII*, 133; *TASA XLIX*, 112; *TSA 1951 Reports*, 19; *TSA 1954 Reports*, 36.

TABLE 1
FIRST YEAR EXPOSURES

LIFE INCOME SETTLEMENTS AND DEFERRED ANNUITIES COMBINED				
ATTAINED AGES	1940-45 EXPERIENCE		1945-50 EXPERIENCE	
	Number of Contracts	Amount of Income	Number of Contracts	Amount of Income
<i>Male</i>				
Under 60.....	3,523	\$ 1,794,045	6,314	\$ 3,710,499
60-69.....	9,780	5,271,435	20,079	11,725,309
70 and over...	2,244	1,144,919	3,853	2,468,661
All.....	15,547	\$ 8,210,399	30,246	\$17,904,469
<i>Female</i>				
Under 60.....	22,377	\$ 9,781,897	27,621	\$13,237,750
60-69.....	29,741	9,614,516	40,276	15,249,465
70 and over...	4,452	1,804,077	5,956	3,150,420
All.....	56,570	\$21,200,490	73,853	\$31,637,635
<i>Both sexes</i>				
Under 60.....	25,900	\$11,575,942	33,935	\$16,948,249
60-69.....	39,521	14,885,951	60,355	26,974,774
70 and over...	6,696	2,948,996	9,809	5,619,081
All.....	72,117	\$29,410,889	104,099	\$49,542,104

INDIVIDUAL IMMEDIATE ANNUITIES

ATTAINED AGES	1941-46 EXPERIENCE		1948-53 EXPERIENCE	
	Number of Contracts	Amount of Income	Number of Contracts	Amount of Income
<i>Male</i>				
Under 60.....	4,735	\$ 1,412,794	1,617	\$ 569,790
60-69.....	6,838	2,322,349	3,544	1,450,186
70 and over...	5,730	2,379,820	3,258	1,683,032
All.....	17,303	\$ 6,114,963	8,419	\$ 3,703,008
<i>Female</i>				
Under 60.....	12,366	\$ 2,864,284	3,306	\$ 1,194,724
60-69.....	18,526	4,107,566	7,219	2,242,625
70 and over...	12,917	3,492,380	5,903	2,196,860
All.....	43,809	\$10,464,230	16,428	\$ 5,634,209
<i>Both sexes</i>				
Under 60.....	17,101	\$ 4,277,078	4,923	\$ 1,764,514
60-69.....	25,364	6,429,915	10,763	3,692,811
70 and over...	18,647	5,872,200	9,161	3,879,892
All.....	61,112	\$16,579,193	24,847	\$ 9,337,217

These figures are of course only indicative of the general trend, and the individual company can better measure the extent to which it has been affected from its own data. There can be no question, however, that a fundamental change has taken place in the Ordinary individual policy field. The life option provisions have become an indispensable part of that contract, and the net single premiums stipulated for the life options will have an increasingly important bearing on insurance costs.

When the life options were introduced at the beginning of this century, it was assumed they would be little more than a talking point for the agent. Apparently the low net single premium rates then used were not adopted in disregard of sound actuarial principle, but rather because of underestimating both the extent of use of the life options and the extent of the antiselection that would be exercised under them.

As stated in a 1924 discussion³ of the subject, "selections by the beneficiary will probably always be a minor factor as compared with selection by the insured before death. For that reason the element of selection will probably never be as intense as it is in connection with immediate annuities." And further, "some feel that these annuity settlements are so seldom selected that it does not make much difference what table is used." As late as 1934, 18 of the 25 then largest companies based their life option rates on the American Experience Table, and made no rate differential for sex.

The first report on mortality under the life options,⁴ which was published only 20 years ago in 1936, was undoubtedly hastened by the considerable increase in settlements that began with the depression in 1930. It showed, as did the 1941 report of the Joint Committee⁵ on the mortality under the life options, that mortality rates were considerably lighter than anticipated. Comparison in Table 2 of the mortality ratios taken from later reports of the Joint Committee shows that those for the life options are generally lower than for immediate annuities, and that there has been continuing and persistent decrease in the mortality rates of both groups.

The 1936 mortality report triggered fairly drastic increases in life option single premiums throughout the industry, and most companies have made two or three subsequent increases, in the main the result of adopting more conservative mortality assumptions and to a lesser degree lower interest assumptions. For the 25 largest U.S. companies, the last increase in life option single premium rates was made on an average of 8 years ago, and present rates are generally based on mortality and interest assumptions identical with or roughly equivalent to those being used for immediate annuities. Where that is the case, it means that the policy-

³ *RAIA* XIII, 103.

⁴ *TASA* XXXVII, 207.

⁵ *TASA* XLII, 172.

TABLE 2
COMPARISON OF EXPERIENCES UNDER IMMEDIATE ANNUITIES AND LIFE INCOME SETTLEMENT OPTIONS
BY NUMBER OF CONTRACTS
MORTALITY RATIOS ON 1937 STANDARD ANNUITY TABLE

NONREFUND IMMEDIATE ANNUITIES VS. PAYEE-ELECTED LIFE INCOME SETTLEMENTS															
ATTAINED AGES	MALE					FEMALE					BOTH SEXES COMBINED				
	Imm. Ann. 1941-46 (1)	Life Opt. 1940-45 (2)	Imm. Ann. 1946-48 (3)	Life Opt. 1945-50 (4)	Imm. Ann. 1948-53 (5)	Imm. Ann. 1941-46 (1)	Life Opt. 1940-45 (2)	Imm. Ann. 1946-48 (3)	Life Opt. 1945-50 (4)	Imm. Ann. 1948-53 (5)	Imm. Ann. 1941-46 (1)	Life Opt. 1940-45 (2)	Imm. Ann. 1946-48 (3)	Life Opt. 1945-50 (4)	Imm. Ann. 1948-53 (5)
DURATIONS 1-5															
Under 60...	133%	83%	*	66%	*	59%	72%	69%	61%	*	80%	74%	58%	62%	56%
60-69.....	81	87	101%	82	75%	66	63	56	63	53%	70	73	69	72	60
70-79.....	91	87	88	75	79	79	80	76	74	64	83	83	80	75	70
80 and over	110	131	68	103	67	108	110	90	90	70	109	121	80	96	69
All...	94%	89%	83%	80%	74%	78%	70%	72%	66%	62%	84%	77%	76%	72%	67%
ALL DURATIONS															
Under 60...	103%	86%	101%	71%	74%	61%	73%	83%	66%	58%	75%	75%	90%	67%	64%
60-69.....	96	87	101	83	73	75	66	69	66	66	81	74	79	72	68
70-79.....	98	91	98	93	98	95	86	92	87	90	96	88	94	89	92
80 and over	113	125	109	98	95	130	120	126	121	116	124	122	121	112	110
All...	102%	92%	103%	87%	93%	99%	76%	100%	77%	99%	100%	82%	101%	81%	97%

TABLE 2—Continued

IMMEDIATE ANNUITIES VS. LIFE INCOME SETTLEMENTS															
ATTAINED AGES	MALE					FEMALE					BOTH SEXES COMBINED				
	Imm. Ann. 1941-46 (1)	Life Opt. 1940-45 (2)	Imm. Ann. 1946-48 (3)	Life Opt. 1945-50 (4)	Imm. Ann. 1948-53 (5)	Imm. Ann. 1941-46 (1)	Life Opt. 1940-45 (2)	Imm. Ann. 1946-48 (3)	Life Opt. 1945-50 (4)	Imm. Ann. 1948-53 (5)	Imm. Ann. 1941-46 (1)	Life Opt. 1940-45 (2)	Imm. Ann. 1946-48 (3)	Life Opt. 1945-50 (4)	Imm. Ann. 1948-53 (5)
DURATIONS 1-5															
Under 60...	113%	100%	66%	72%	93%	66%	73%	73%	61%	48%	82%	76%	70%	63%	66%
60-69.....	97	85	97	83	92	71	69	67	64	71	80	74	78	72	79
70-79.....	97	90	91	77	92	89	92	82	82	74	92	91	85	80	81
80 and over	108	129	103	113	86	121	117	120	103	96	116	122	113	106	91
All...	101%	90%	94%	81%	90%	88%	76%	84%	69%	77%	92%	80%	88%	73%	82%
ALL DURATIONS															
Under 60...	109%	102%	95%	86%	92%	77%	75%	77%	66%	73%	88%	78%	83%	69%	81%
60-69.....	105	87	101	84	94	77	75	78	69	76	86	78	85	73	82
70-79.....	103	94	105	93	105	98	98	97	94	94	100	97	99	93	97
80 and over	116	125	111	99	101	132	136	129	128	123	126	133	123	120	116
All...	107%	95%	106%	89%	101%	102%	87%	103%	82%	103%	104%	89%	104%	84%	103%

* Less than 25 contracts terminated by death.

NOTE.—Figures in italics indicate less than 100 but not less than 25 contracts terminated by death.

- (1) Intercompany immediate annuity experience between 1941 and 1946 anniversaries; *TASA XLVIII*, 133.
 (2) Intercompany life option settlement experience between 1940 and 1945 anniversaries; *TASA XLIX*, 112.

(3) Intercompany immediate annuity experience between 1946 and 1948 anniversaries; *TSA 1*, 606.

(4) Intercompany life option settlement experience between 1945 and 1950 anniversaries; *TSA 1951 Reports*, 19.

(5) Intercompany immediate annuity experience between 1948 and 1953 anniversaries; *TSA 1954 Reports*, 36.

holder or his beneficiary has a contract right to purchase a life annuity at such future time as the policy matures by death, endowment or surrender, at premium rates comparable to those now currently charged for immediate annuities, less loading.

Failure to allow for future decrease in mortality rates over the period between policy issue and settlement, which may run to 50 years or more and has averaged around 25 years under recent Northwestern Mutual Life option settlements, "can involve and on occasion has resulted in large losses," as pointed out by Jenkins and Lew.⁶ Losses must, of course, be covered out of current or past surplus gains that would otherwise be available for dividends and contingency reserves. If they are charged against general surplus, the earlier series policies with the more favorable option rates will profit at the expense of the later series policies.

This inequity can be corrected under participating contracts by assessing the loss against the particular policy series from which it arose. However, such adjustment is at best crude, and does nothing to correct the inequity as between the two groups within each policy series—those who use the options and those who do not. Further, it should be recognized that to the extent use of the life options is increased and the proportion of policies under which they are elected becomes larger, both the charge against insurance gains and the distortion of equity as between users and nonusers of the life options will be correspondingly increased.

To put the life options in currently issued policies on a self-sustaining basis and avoid their becoming a lien against insurance gains requires that adequate allowance be made for future decrease in mortality rates. Under the flat rate system now generally used, with a single scale of rates to apply for all years of entry, the mortality assumption must be geared to the period of exposure for the average case. Starting with a mortality table based on current experience with a margin of safety for fluctuations, and adjusting it for the change in mortality expected over the average period between policy issue and settlement, a single scale of rates can be developed such that the expected loss from settlements that are made a longer-than-average time after issue will be balanced by gain from early settlements. This approach is described in detail in Mr. Harry Walker's paper, *TSA VI*, 85.

As pointed out by Mr. Hoskins⁷ in discussion of Mr. Walker's paper, the obvious flaw in this approach is that if net single premiums are fixed at a high enough level so that the "profit" from early settlements will offset the losses on later settlements, the life option net rates would probably equal or exceed the gross single premium rates currently quoted for non-

⁶ *TSA I*, 369.

⁷ *Ibid.*, 546.

participating immediate annuities. This redundancy would be not only difficult to explain to the layman, but could tend to defeat its purpose, in that it would discourage life option settlements at early policy durations and hence reduce the anticipated gain from such settlements.

Regardless of the level at which any static scale of life option rates is established, however, such rates will be inequitable as between individual beneficiaries of the same sex and age who settle at different times, since the benefit value will vary with the mortality level, while the net single premium remains stationary. The spread in value of a given amount of income for beneficiaries of the same age and sex can be considerable over the 50 years or more between dates of the first and last settlement from a single year's issues.

The foregoing points up the fact that the flat rate system presently used is in itself a prime source of distortion of equity in the life option rates. To obtain rates that are both self-sustaining and equitable requires not only that adequate allowance be made for future improvement in mortality, but also that net single premiums be correlated with such mortality change so that they will approximate expected benefit values for each age and sex throughout the possible settlement period.

The practical problem to which this paper is directed is the development of a system that is detailed enough to do substantial equity, yet is simple enough so that it can be readily understood by the policyholder. A new mortality table and mortality projection basis are also offered for use with the graded rate system, although they are not an essential part thereof.

Grateful acknowledgment is due the Committee on Mortality under Ordinary Insurances and Annuities for making available the data on the 1948-53 Individual Immediate Annuity experience, and to my associates, William T. Chambers and Clair A. Lewis, for their able assistance.

MORTALITY TABLE

The principal item of interest in the Joint Committee's report on the mortality experienced under individual immediate annuities between 1948 and 1953 anniversaries⁸ is the extent of the improvement in mortality at ages 80 and over, where, as shown in Table 3, mortality ratios on the Annuity Table for 1949 fell below 100% at a number of points.

With a current average entry age for life option settlements and individual annuities of around 60 for females and 65 for males, and the definite probability that these average ages will increase as longevity increases, the mortality rates assumed for the higher ages can have a considerable

⁸ TSA 1954 Reports, 36.

• TABLE 3

COMPARISON OF 1941-46 EXPERIENCE WITH 1948-53 EXPERIENCE
UNDER INDIVIDUAL IMMEDIATE ANNUITIES AT ATTAINED AGES 80 AND OVER
BY NUMBER OF CONTRACTS

ATTAINED AGES	1941-46 EXPERIENCE		1948-53 EXPERIENCE		
	Actual Deaths	Mortality Ratio Based on 1937 Stand- ard Annuity Table	Actual Deaths	Mortality Ratio Based on	
				1937 Stand- ard Annuity Table	Annuity Table for 1949
NONREFUND—MALE					
80-84.....	802	108%	1,091	90%	89%
85-89.....	488	122	675	103	93
90 and over.....	187	123	368	111	90
80 and over.....	1,477	114%	2,134	97%	91%
NONREFUND—FEMALE					
80-84.....	1,816	127%	3,058	109%	100%
85-89.....	1,017	140	1,954	123	97
90 and over.....	297	148	972	142	95
80 and over.....	3,130	133%	5,984	118%	98%
REFUND AND NONREFUND COMBINED—MALE					
80-84.....	2,208	113%	3,046	100%	98%
85-89.....	1,252	134	1,869	105	94
90 and over.....	398	115	833	102	84
80 and over.....	3,858	119%	5,748	102%	95%
REFUND AND NONREFUND COMBINED—FEMALE					
80-84.....	4,630	127%	8,086	115%	106%
85-89.....	2,774	148	5,239	130	102
90 and over.....	815	143	2,621	148	98
80 and over.....	8,219	135%	15,946	124%	103%

effect on premiums and should hence be more conservative than those in the Annuity Table for 1949. A new annuity mortality table that will provide a cushion against mortality fluctuations throughout seems indicated for use under all forms of life annuities.

The intercompany 1948-53 immediate annuity experience is not only the most recent large-scale experience available on which to base a new table, but with over 22,000 deaths at ages 80 and up it furnishes much more extensive information than has hitherto been available on annuitant mortality here at the extreme upper ages. The experience by number of contracts, rather than by amounts of annual income, was used as the basis of the Proposed 1955 American Annuity Table. The experience rates under the former not only were more stable, but also were generally lower than those by amounts.

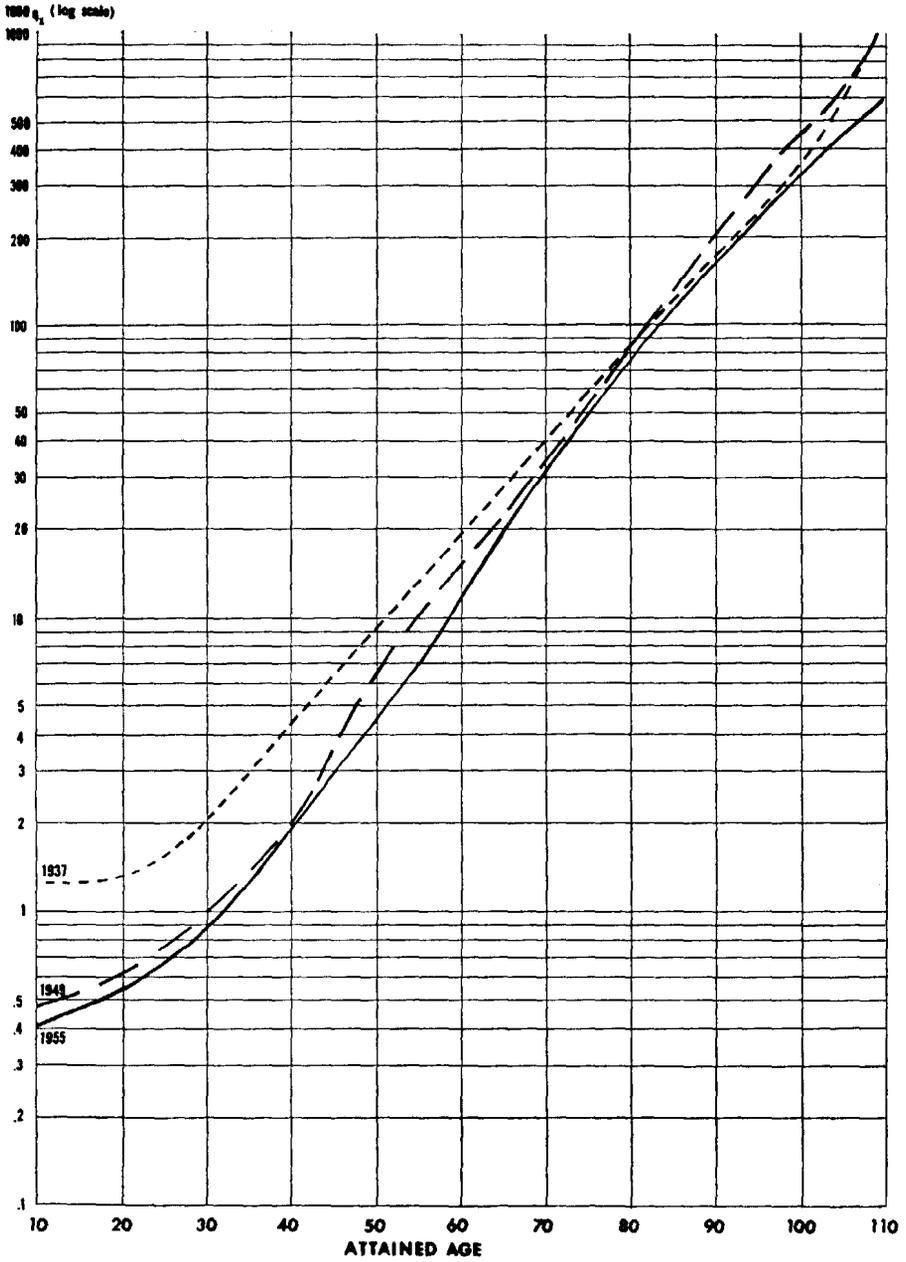
Rough graded experience rates were developed for both sexes for ages 60 and over from the nonrefund annuity experience, excluding the first two contract years. Since some extension in the limiting age beyond 110 as used for both the 1937 Standard Annuity Table and the Annuity Table for 1949 seemed indicated by the recent improvement in mortality at the higher ages, it was arbitrarily increased 5 years to age 115.

After some study of these experience rates and of the derived annuity values, the question whether to develop separate tables for each sex or a dual reference table with constant age adjustment for sex was resolved in favor of the latter. The desirability, if not necessity, of using a single table under a graded rate system is obvious, to keep the multiplicity of values at a minimum. Using the male table as a base, with 5 year setback in age for females, the effect is to understate the mortality rates for females at the older ages and overstate those at the younger ages. The result in terms of annuity net single premiums is to overstate female values by a percentage that increases with increase in age.

The female experience table on which the comparative values in Tables 6 and 7 are based was constructed for the purpose by combining the graded female nonrefund annuity experience rates for ages 60 and above with the Annuity Table for 1949 female rates for ages below 60; these were smoothed graphically, and adjusted so as to give a table roughly equivalent in conservatism to the Proposed 1955 American Annuity Table for males.

The overstatement in value of the single life annuity option with 10 year certain period, which is the type used in the large majority of life option settlements, increases from 0.1% at age 20 to 1% at age 55 and reaches a maximum of 6.1% at age 80. In view of the higher rate of decrease in the mortality for the U.S. white female population in recent

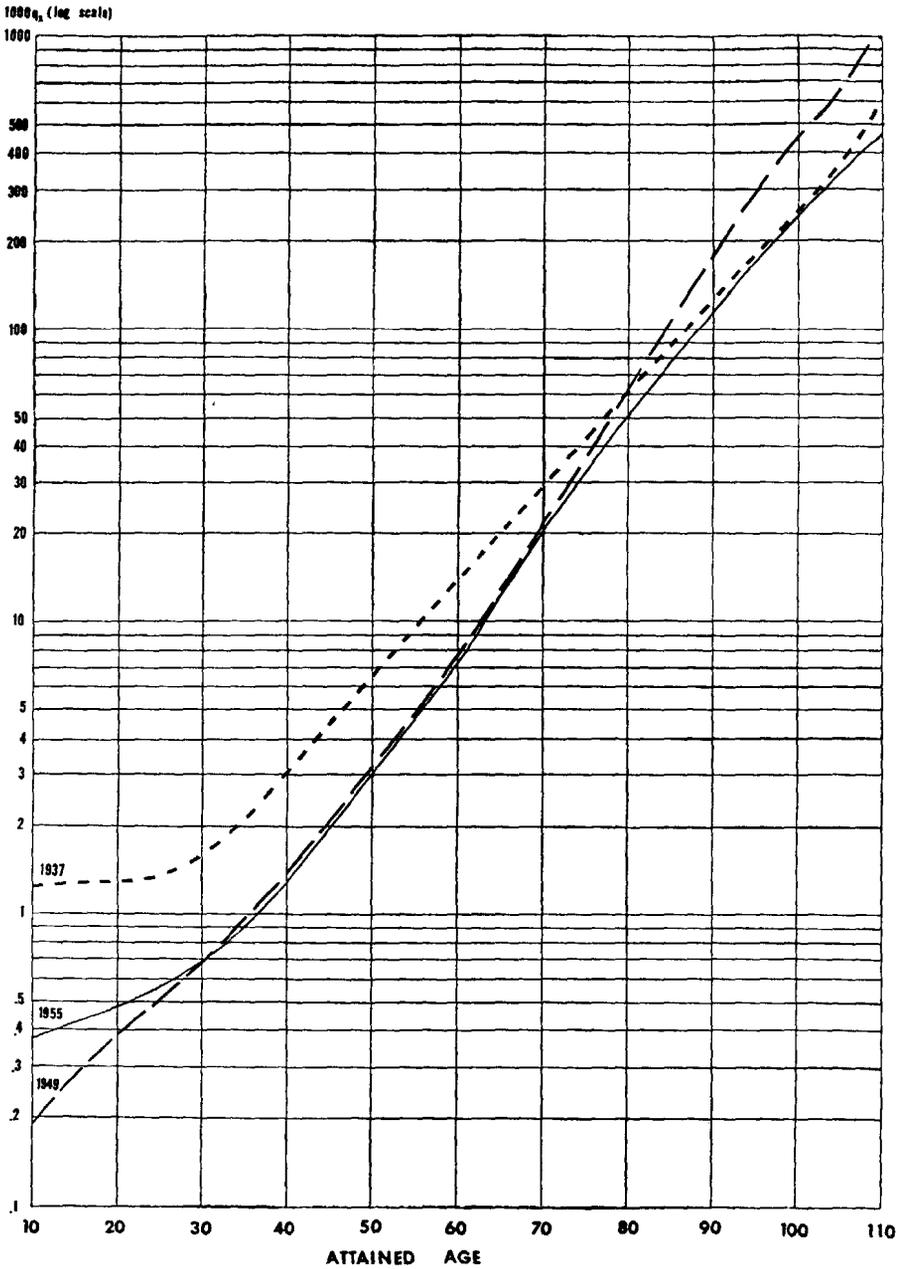
CHART I



COMPARISON OF MORTALITY RATES—MALES

- 1937 Standard Annuity Table
- - - - - Annuity Table for 1949
- Proposed 1955 American Annuity Table

CHART II



COMPARISON OF MORTALITY RATES—FEMALES

- 1937 Standard Annuity Table
- . - . - . Annuity Table for 1949
- Proposed 1955 American Annuity Table

years, and the probable increase in proportion of payee-elected settlements of death claims (over 95% of which are on female lives), this added safety margin for fluctuation in female mortality does not seem unreasonable.

TABLE 4
COMPARISON OF MORTALITY RATES
PROPOSED 1955 AMERICAN ANNUITY TABLE,
ANNUITY TABLE FOR 1949 ULTIMATE,
AND 1937 STANDARD ANNUITY TABLE

AGE x	MALES			FEMALES		
	Proposed 1955 American Annuity Table	Annuity Table for 1949 Ulti- mate	1937 Stand- ard Annuity Table	Proposed 1955 American Annuity Table	Annuity Table for 1949 Ulti- mate	1937 Stand- ard Annuity Table
	1,000 q_x					
10....	.420	.483	1.257	.370	.191	1.234
20....	.553	.624	1.331	.475	.376	1.262
30....	.893	1.004	2.065	.679	.677	1.561
40....	1.925	2.025	4.356	1.273	1.355	2.981
50....	4.550	6.557	9.288	2.975	3.109	6.362
60....	12.027	15.662	19.753	7.073	7.504	13.554
70....	32.367	35.092	41.758	20.192	20.964	28.751
80....	76.847	85.503	87.161	50.417	61.415	60.464
90....	169.202	208.485	177.138	114.977	176.161	124.837
100....	342.402	463.415	362.122	243.947	449.400	248.059

After considerable experimentation, Makeham's formula was selected as the most suitable for graduation of the male rates for ages 60 and over, using the following constants for $\text{colog}_{10} p_x = A + Bc^x$:

1,000 A	-1.93615
1,000 B	0.054435
$\log_{10} c$	0.03534351

The rates above age 109 as derived by formula were modified so as to give an orderly transition to the rate of unity at age 114.

Lacking any up-to-date group annuity mortality data on which to base rates at ages under 60, the male rates in the Annuity Table for 1949 for ages 10 to 40 were taken as a starting point, and the above formula for $\text{colog}_{10} p_x$ was used with A modified as follows:

$$\begin{array}{l}
 \text{Ages} \qquad \qquad 1,000A \text{ for Age } x \\
 5-35 \qquad -1.93615 + 1.5526 - .0304(x - 35) - .0005(x - 35)^2 \\
 35-50 \qquad -1.93615 + .7321 - .08665(x - 50) - .00264(x - 50)^2 \\
 \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad -0.000034(x - 50)^3 \\
 50-60 \qquad -1.93615 + .013298(x - 60)^2 + .0005977(x - 60)^3
 \end{array}$$

As a check on the reasonableness of these rates below age 50, they were compared with the 1948-53 mortality experience of the Northwestern Mutual under medically examined Ordinary insurance, excluding war deaths, by number of policies (Table 5).

Joint life annuities for two lives at equal ages, and a table of uniform seniority, are given in the last section of the paper.

TABLE 5
 AGGREGATE EXPERIENCE ON ORDINARY INSURANCE
 BETWEEN ANNIVERSARIES IN 1948 AND 1953
 EXCLUDING WAR DEATHS

Attained Age Group	Ratios of Actual to Expected on Proposed 1955 American Annuity Table	Attained Age Group	Ratios of Actual to Expected on Proposed 1955 American Annuity Table
13-17.....	157%	33-37.....	93%
18-22.....	170	38-42.....	103
23-27.....	124	43-47.....	112
28-32.....	98	48-52.....	129

GRADED RATES

The twin objectives of the proposed graded rate system are understandability and equity. Optimum realization of either objective requires, in the author's opinion, that life option rates be correlated as closely as possible with the anticipated future decrease in mortality, which for all practical purposes may be considered to be continuous. A discontinuous gradation such as a step-rate system, with rates changing periodically by substantial amounts, would not only distort equities but because of its arbitrariness might well impair policyholders' acceptance and understanding. Accordingly, rates in the system described herein are varied yearly, *i.e.*, are based on the year of settlement as well as the sex and age.

It is equally as important that the policy rate table take a minimum of space, yet permit calculation of exact rates for any age, sex and year of settlement by simple arithmetic, without interpolation or rounding. This is accomplished by stating the rates in terms of the net single premium value of \$10 monthly income for any particular year of settlement that is

TABLE 6

COMPARISON OF ANNUITY VALUES—FEMALES
IMMEDIATE NONREFUND ANNUITIES, 2½% INTEREST

Age	Proposed 1955 American Annuity Table	Female Experience Table	Ratio of Value on Proposed 1955 American Annuity Table to Value on Female Experience Table
15.....	31.453	31.444	100.0%
20.....	30.403	30.369	100.1
25.....	29.223	29.167	100.2
30.....	27.900	27.826	100.3
35.....	26.420	26.332	100.3
40.....	24.778	24.676	100.4
45.....	22.972	22.852	100.5
50.....	21.010	20.861	100.7
55.....	18.900	18.709	101.0
60.....	16.653	16.409	101.5
65.....	14.330	14.005	102.3
70.....	12.048	11.569	104.1
75.....	9.883	9.197	107.5
80.....	7.890	7.005	112.6
85.....	6.117	5.122	119.4

TABLE 7

COMPARISON OF ANNUITY VALUES—FEMALES
LIFE INCOME SETTLEMENT OPTIONS WITH 10 YEAR
CERTAIN PERIOD, 2½% INTEREST
SINGLE LIFE, FIRST PAYMENT IMMEDIATE

Age	Proposed 1955 American Annuity Table	Female Experience Table	Ratio of Value on Proposed 1955 American Annuity Table to Value on Female Experience Table
15.....	32.470	32.455	100.0%
20.....	31.423	31.385	100.1
25.....	30.247	30.188	100.2
30.....	28.930	28.855	100.3
35.....	27.462	27.373	100.3
40.....	25.840	25.736	100.4
45.....	24.067	23.942	100.5
50.....	22.154	21.998	100.7
55.....	20.121	19.921	101.0
60.....	18.012	17.748	101.5
65.....	15.927	15.561	102.3
70.....	13.993	13.487	103.8
75.....	12.311	11.690	105.3
80.....	10.958	10.330	106.1
85.....	9.986	9.479	105.3

TABLE 8

INTERCOMPANY EXPERIENCE UNDER INDIVIDUAL IMMEDIATE ANNUITIES
 BETWEEN 1948 AND 1953 ANNIVERSARIES, ISSUES OF 1931 TO 1952
 MORTALITY RATIOS ON (1) PROPOSED 1955 AMERICAN ANNUITY TABLE
 (2) ANNUITY TABLE FOR 1949
 (3) 1937 STANDARD ANNUITY TABLE

ATTAINED AGES	BY NUMBER OF CONTRACTS									BY AMOUNTS OF ANNUAL INCOME														
	Contract Years						All Contract Years			Contract Years						All Contract Years								
	1-2		3-5		6 and Over					1-2		3-5		6 and Over										
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)						
MALE—NONREFUND																								
Under 60....	*	*	*	150%	108%	80%	145%	103%	78%	139%	99%	74%	*	*	*	226%	162%	124%	135%	95%	73%	149%	106%	81%
60-69.....	90%	87%	71%	108	96	78	100	89	72	102	90	73	127%	112%	91%	146	130	105	115	101	82	122	108	88
70-79.....	82	76	68	102	94	85	122	113	102	117	108	98	55	51	46	109	101	91	138	127	116	127	117	107
80-89.....	78	68	70	77	67	70	106	92	96	102	89	93	85	74	77	90	79	82	99	86	90	98	85	89
90 and over..	*	*	*	*	*	*	116	93	112	112	89	108	*	*	*	*	*	*	140	111	135	136	108	132
All Ages	83%	74%	68%	93%	83%	78%	113%	99%	97%	109%	96%	93%	75%	68%	62%	107%	96%	90%	120%	105%	104%	115%	101%	100%
FEMALE—NONREFUND																								
Under 60....	*	*	*	103%	101%	51%	126%	121%	62%	117%	114%	58%	*	*	*	65%	62%	32%	117%	112%	58%	110%	106%	54%
60-69.....	67%	64%	41%	94	92	59	112	108	71	105	102	66	92%	90%	57%	97	95	61	112	108	70	107	104	67
70-79.....	71	65	55	87	79	67	120	108	94	116	104	90	65	59	50	89	81	69	123	110	96	116	104	90
80-89.....	50	39	43	86	66	75	133	100	115	130	98	113	53	40	46	97	74	84	138	103	120	133	100	116
90 and over..	*	*	*	134	85	124	152	95	142	152	94	142	*	*	*	52	33	48	134	84	125	132	82	124
All Ages	67%	59%	48%	89%	78%	67%	128%	103%	103%	123%	100%	99%	70%	61%	52%	91%	79%	70%	130%	103%	107%	125%	99%	101%

* Less than 10 contracts terminated by death.

Note.—Mortality ratios in italics where less than 50 but not less than 10 contracts terminated by death.

TABLE 8—Continued

ATTAINED AGES	BY NUMBER OF CONTRACTS												BY AMOUNTS OF ANNUAL INCOME											
	Contract Years									All Contract Years			Contract Years									All Contract Years		
	1-2			3-5			6 and Over						1-2			3-5			6 and Over					
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)			
MALE—REFUND																								
Under 60....	<i>185%</i>	<i>133%</i>	<i>99%</i>	<i>191%</i>	<i>138%</i>	<i>103%</i>	<i>181%</i>	<i>128%</i>	<i>96%</i>	<i>183%</i>	<i>130%</i>	<i>97%</i>	<i>340%</i>	<i>243%</i>	<i>182%</i>	<i>280%</i>	<i>200%</i>	<i>150%</i>	<i>217%</i>	<i>154%</i>	<i>115%</i>	<i>240%</i>	<i>171%</i>	<i>128%</i>
60-69.....	127	111	90	142	126	102	146	128	103	143	126	102	146	129	104	165	146	119	158	138	112	158	139	113
70-79.....	109	101	90	122	114	102	132	122	110	130	120	108	108	100	89	123	114	102	139	128	116	135	124	112
80-89.....	109	95	99	114	101	104	116	101	106	116	100	105	128	111	116	127	112	115	122	106	111	122	106	111
90 and over..	*	*	*	59	47	57	100	80	97	98	78	95	*	*	*	77	62	74	96	76	93	95	76	92
All Ages	117%	104%	92%	127%	113%	102%	126%	111%	106%	126%	111%	105%	132%	117%	104%	139%	124%	112%	133%	116%	112%	133%	117%	111%
FEMALE—REFUND																								
Under 60....	<i>59%</i>	<i>57%</i>	<i>29%</i>	<i>113%</i>	<i>110%</i>	<i>56%</i>	<i>180%</i>	<i>172%</i>	<i>88%</i>	<i>158%</i>	<i>152%</i>	<i>78%</i>	<i>66%</i>	<i>64%</i>	<i>32%</i>	<i>111%</i>	<i>107%</i>	<i>55%</i>	<i>194%</i>	<i>186%</i>	<i>95%</i>	<i>166%</i>	<i>160%</i>	<i>83%</i>
60-69.....	117	113	72	134	130	83	129	125	80	129	125	80	125	121	77	145	141	90	123	119	77	126	122	79
70-79.....	97	88	74	107	97	82	124	114	98	122	111	96	97	88	74	104	96	81	134	120	103	129	116	100
80-89.....	115	88	99	130	100	112	144	108	125	142	107	124	118	91	102	135	104	116	146	109	127	145	109	126
90 and over..	*	*	*	<i>112</i>	<i>71</i>	<i>105</i>	161	100	151	160	100	150	*	*	*	125	80	116	150	94	141	150	93	140
All Ages	104%	92%	75%	119%	105%	88%	136%	112%	109%	134%	111%	106%	108%	95%	78%	122%	107%	90%	140%	113%	111%	137%	112%	108%

* Less than 10 contracts terminated by death.

NOTE.—Mortality ratios in italics where less than 50 but not less than 10 contracts terminated by death.

TABLE 9
LIFE INCOME SETTLEMENTS
AGGREGATE EXPERIENCE OF NORTHWESTERN MUTUAL
LIFE INSURANCE COMPANY
BETWEEN 1950 AND 1955 ANNIVERSARIES

ATTAINED AGES	ACTUAL DEATHS		MORTALITY RATIOS BASED ON					
			Proposed 1955 American Annuity Table		Annuity Table for 1949		1937 Standard Annuity Table	
	Number of Contracts	Amounts of Annual Income	Number of Contracts	Amounts of Annual Income	Number of Contracts	Amounts of Annual Income	Number of Contracts	Amounts of Annual Income
MALE—PAVEE ELECTIONS								
Under 60.....	25	12,643	171%	146%	121%	104%	93%	79%
60-69.....	198	97,564	96	75	85	66	69	54
70-79.....	253	131,365	98	90	91	83	81	74
80 and over...	116	53,435	110	125	95	109	100	114
All Ages..	592	295,007	102%	90%	90%	80%	80%	70%
FEMALE—PAVEE ELECTIONS								
Under 60.....	45	21,778	126%	102%	120%	98%	61%	50%
60-69.....	168	113,367	96	108	93	104	59	66
70-79.....	294	179,307	105	106	95	96	80	81
80 and over...	224	150,486	150	163	113	124	130	141
All Ages..	731	464,938	114%	120%	101%	106%	82%	86%
MALE—ALL ELECTIONS								
Under 60.....	29	18,080	174%	186%	124%	132%	94%	100%
60-69.....	202	99,261	97	76	85	67	69	54
70-79.....	255	132,259	98	90	91	83	81	73
80 and over...	124	56,312	113	127	98	111	103	115
All Ages..	610	305,912	103%	92%	91%	82%	80%	71%
FEMALE—ALL ELECTIONS								
Under 60.....	74	39,294	140%	124%	134%	118%	68%	60%
60-69.....	217	146,772	98	106	94	102	60	65
70-79.....	367	236,233	103	103	94	93	79	78
80 and over...	310	217,736	148	153	110	114	128	133
All Ages..	968	640,035	115%	118%	101%	103%	82%	85%

TABLE 10
 PROPOSED 1955 AMERICAN ANNUITY TABLE
 ELEMENTARY FUNCTIONS AND ANNUITY VALUES

AGE x		l_x	d_x	$1,000q_x$	a_x AT 2½% INTEREST
Male	Female				
5	10	1,000.0000	.3700	.370	32.386
6	11	999.6300	.3799	.380	32.208
7	12	999.2501	.3897	.390	32.026
8	13	998.8604	.3995	.400	31.839
9	14	998.4609	.4094	.410	31.648
10	15	998.0515	.4192	.420	31.453
11	16	997.6323	.4290	.430	31.253
12	17	997.2033	.4398	.441	31.048
13	18	996.7635	.4505	.452	30.838
14	19	996.3130	.4613	.463	30.623
15	20	995.8517	.4730	.475	30.403
16	21	995.3787	.4857	.488	30.178
17	22	994.8930	.4994	.502	29.948
18	23	994.3936	.5141	.517	29.712
19	24	993.8795	.5307	.534	29.470
20	25	993.3488	.5493	.553	29.223
21	26	992.7995	.5699	.574	28.970
22	27	992.2296	.5924	.597	28.712
23	28	991.6372	.6168	.622	28.447
24	29	991.0204	.6432	.649	28.176
25	30	990.3772	.6725	.679	27.900
26	31	989.7047	.7047	.712	27.617
27	32	989.0000	.7408	.749	27.327
28	33	988.2592	.7817	.791	27.031
29	34	987.4775	.8285	.839	26.729
30	35	986.6490	.8811	.893	26.420
31	36	985.7679	.9394	.953	26.105
32	37	984.8285	1.0045	1.020	25.783
33	38	983.8240	1.0773	1.095	25.455
34	39	982.7467	1.1587	1.179	25.120
35	40	981.5880	1.2496	1.273	24.778
36	41	980.3384	1.3509	1.378	24.430
37	42	978.9875	1.4636	1.495	24.075
38	43	977.5239	1.5875	1.624	23.714
39	44	975.9364	1.7245	1.767	23.346
40	45	974.2119	1.8754	1.925	22.972
41	46	972.3365	2.0409	2.099	22.592
42	47	970.2956	2.2220	2.290	22.206
43	48	968.0736	2.4192	2.499	21.813
44	49	965.6544	2.6333	2.727	21.414
45	50	963.0211	2.8650	2.975	21.010
46	51	960.1561	3.1147	3.244	20.599
47	52	957.0414	3.3831	3.535	20.183
48	53	953.6583	3.6706	3.849	19.761
49	54	949.9877	3.9776	4.187	19.333
50	55	946.0101	4.3043	4.550	18.900
51	56	941.7058	4.6549	4.943	18.461
52	57	937.0509	5.0395	5.378	18.016
53	58	932.0114	5.4690	5.868	17.567
54	59	926.5424	5.9558	6.428	17.112
55	60	920.5866	6.5113	7.073	16.653
56	61	914.0753	7.1462	7.818	16.191
57	62	906.9291	7.8703	8.678	15.727
58	63	899.0588	8.6903	9.666	15.261
59	64	890.3685	9.6000	10.782	14.795

TABLE 10—Continued

AGE x		l_x	d_x	1,000 q_x	a_x at 2½% INTEREST
Male	Female				
60	65	880.7685	10.5930	12.027	14.330
61	66	870.1755	11.6612	13.401	13.868
62	67	858.5143	12.7927	14.901	13.407
63	68	845.7216	13.9764	16.526	12.950
64	69	831.7452	15.2093	18.286	12.497
65	70	816.5359	16.4875	20.192	12.048
66	71	800.0484	17.8059	22.256	11.604
67	72	782.2425	19.1579	24.491	11.165
68	73	763.0846	20.5354	26.911	10.731
69	74	742.5492	21.9282	29.531	10.304
70	75	720.6210	23.3243	32.367	9.883
71	76	697.2967	24.7094	35.436	9.468
72	77	672.5873	26.0668	38.756	9.062
73	78	646.5205	27.3776	42.346	8.663
74	79	619.1429	28.6205	46.226	8.272
75	80	590.5224	29.7724	50.417	7.890
76	81	560.7500	30.8082	54.941	7.516
77	82	529.9418	31.7016	59.821	7.152
78	83	498.2402	32.4260	65.081	6.797
79	84	465.8142	32.9550	70.747	6.452
80	85	432.8592	33.2639	76.847	6.117
81	86	399.5953	33.3306	83.411	5.792
82	87	366.2647	33.1363	90.471	5.477
83	88	333.1284	32.6669	98.061	5.172
84	89	300.4615	31.9141	106.217	4.878
85	90	268.5474	30.8768	114.977	4.594
86	91	237.6706	29.5615	124.380	4.321
87	92	208.1091	27.9836	134.466	4.058
88	93	180.1255	26.1676	145.274	3.806
89	94	153.9579	24.1469	156.841	3.564
90	95	129.8110	21.9643	169.202	3.333
91	96	107.8467	19.6701	182.389	3.112
92	97	88.17660	17.32062	196.431	2.901
93	98	70.85598	14.97577	211.355	2.700
94	99	55.88021	12.69520	227.186	2.510
95	100	43.18501	10.53485	243.947	2.329
96	101	32.65016	8.54321	261.659	2.157
97	102	24.10695	6.75819	280.342	1.994
98	103	17.34876	5.20489	300.015	1.841
99	104	12.14387	3.89449	320.696	1.695
100	105	8.249380	2.824604	342.402	1.558
101	106	5.424776	1.980857	365.150	1.428
102	107	3.443919	1.339533	388.956	1.306
103	108	2.104386	.870871	413.836	1.190
104	109	1.233515	.542507	439.806	1.081
105	110	.6910080	.3226185	466.881	.978
106	111	.3683895	.1823808	495.076	.881
107	112	.1860087	.0975441	524.406	.789
108	113	.08846460	.04908777	554.886	.700
109	114	.03937683	.02313590	587.551	.611
110	115	.01624093	.01014386	624.586	.520
111	116	.00609707	.00408724	670.361	.419
112	117	.00200983	.00147445	733.619	.302
113	118	.00053538	.00044535	831.839	.164
114	119	.00009003	.00009003	1000.000	

TABLE 10—Continued
 PROPOSED 1955 AMERICAN ANNUITY TABLE
 COMMUTATION COLUMNS AT 2½% INTEREST

Age x		D_x	N_x	C_x	M_x	R_x
Male	Female					
5	10	883 8543	29508.3870	.319050	164 137544	10605 072963
6	11	861 9778	28624.5327	.319597	163 818494	10440 935419
7	12	840 6344	27762.5549	.319845	163 498897	10277 116925
8	13	819 8112	26921.9205	.319891	163 179052	10113 618028
9	14	799.4960	26102.1093	.319823	162 859161	9950.438976
10	15	779 6762	25302.6133	.319491	162 539338	9787 579815
11	16	760.3403	24522.9371	.318985	162 219847	9625 040477
12	17	741 4764	23762.5968	.319040	161 900862	9462 820630
13	18	723 0726	23021.1204	.318831	161 581822	9300 919768
14	19	705.1178	22298.0478	.318512	161 262991	9139.337946
15	20	687 6013	21592.9300	.318625	160 944479	8978 074955
16	21	670.3403	20905.3287	.319200	160 625854	8817 130476
17	22	653 8388	20234.8168	.320198	160 306654	8656 504622
18	23	637 5713	19580 9780	.321584	159 986456	8496 197968
19	24	621.6992	18943.4067	.323871	159 664872	8336 211512
20	25	606 2119	18321 7075	.327046	159 341001	8176 546640
21	26	591.0992	17715 4956	.331035	159 013955	8017 205639
22	27	576 3511	17124 3964	.335711	158 682920	7858 191684
23	28	561 9581	16548 0453	.341014	158 347209	7699 508764
24	29	547 9108	15986 0872	.346936	158 006195	7541 161555
25	30	534 2001	15438 1764	.353893	157 659259	7383 155360
26	31	520 8170	14903 9763	.361793	157 305366	7225 496101
27	32	507 7523	14383 1593	.371050	156 943573	7068 190735
28	33	494 9971	13875 4070	.381987	156 572523	6911 247162
29	34	482 5420	13380 4099	.394981	156 190536	6754 674639
30	35	470 3777	12897 8679	.409813	155 795555	6598 484103
31	36	458 4953	12427 4902	.426272	155 385742	6442 688548
32	37	446 8862	11968 9949	.444695	154 959470	6287 302806
33	38	435 5418	11522 1087	.465292	154 514775	6132 343336
34	39	424 4536	11086 5669	.488243	154 049483	5977 828561
35	40	413 6128	10662 1133	.513703	153 561240	5823 779078
36	41	403 0110	10248 5005	.541801	153 047537	5670 217838
37	42	392 6396	9845 4895	.572685	152 505736	5517 170301
38	43	382 4904	9452 8499	.606014	151 933051	5364 664565
39	44	372 5553	9070 3595	.642257	151 327037	5212 731514
40	45	362 8263	8697 8042	.681421	150 684780	5061 404477
41	46	353 2955	8334 9779	.723468	150 003359	4910 719697
42	47	343 9551	7981 6824	.768454	149 279891	4760 716338
43	48	334 7975	7637 7273	.816247	148 511437	4611 436447
44	49	325 8154	7302 9298	.866815	147 695190	4462 925010
45	50	317 0019	6977 1144	.920083	146 828375	4315 229820
46	51	308 3501	6660 1125	.975876	145 908292	4168 401445
47	52	299 8535	6351 7624	1 034116	144 932416	4022 493153
48	53	291 5058	6051 9089	1 094631	143 898300	3877 560737
49	54	283 3013	5760 4031	1 157252	142 803669	3733 662437
50	55	275 2343	5477 1018	1 221759	141 646417	3590 858768
51	56	267 2995	5201 8675	1 289049	140 424658	3449 212351
52	57	259 4909	4934 5680	1 361515	139 135609	3308 787693
53	58	251 8004	4675 0771	1 441515	137 774094	3169 652084
54	59	244 2174	4423 2767	1 531537	136 332579	3031 877990
55	60	236 7293	4179 0593	1 633546	134 801042	2895 545411
56	61	229 3219	3942 3300	1 749101	133 167496	2760 744369
57	62	221 9796	3713 0081	1 879348	131 418395	2627 576873
58	63	214 6861	3491 0285	2 024542	129 539047	2496 158478
59	64	207 4253	3276 3424	2 181922	127 514505	2366 619431

TABLE 10—Continued

AGE x		D_x	N_x	C_x	M_x	R_x
Male	Female					
60	65	200.1842	3068.9171	2.348893	125.332583	2239.104926
61	66	192.9528	2868.7329	2.522688	122.983690	2113.772343
62	67	185.7239	2675.7801	2.699968	120.461002	1990.788653
63	68	178.4941	2490.0562	2.877849	117.761034	1870.327651
64	69	135.12628	2311.5621	3.055329	114.883185	1752.566617
65	70	164.0303	2140.2993	3.231318	111.827856	1637.683432
66	71	156.7982	1976.2690	3.404591	108.596538	1525.855576
67	72	149.5693	1819.4708	3.573757	105.191947	1417.259038
68	73	142.3475	1669.9015	3.737287	101.618190	1312.067091
69	74	135.1383	1527.5540	3.893430	97.880903	1210.448901
70	75	127.9488	1392.4157	4.040305	93.987473	1112.567998
71	76	120.7878	1264.4669	4.175840	89.947168	1018.580525
72	77	113.6659	1143.6791	4.297794	85.771328	928.633357
73	78	106.5958	1030.0132	4.403818	81.473534	842.862029
74	79	99.59209	923.41742	4.491458	77.069716	761.488495
75	80	92.67156	823.82533	4.558270	72.578258	684.318779
76	81	85.85301	731.15377	4.601810	68.019988	611.740521
77	82	79.15722	645.30076	4.619763	63.418178	543.259033
78	83	72.60679	566.14354	4.610075	58.798415	480.302355
79	84	66.22582	493.53675	4.571009	54.188340	421.503940
80	85	60.03955	427.31093	4.501322	49.617331	367.315600
81	86	54.07385	367.27138	4.400339	45.116009	317.698269
82	87	48.35463	313.19753	4.267988	40.715670	272.582260
83	88	42.90726	264.84290	4.104906	36.447682	231.866590
84	89	37.75584	221.93564	3.912497	32.342776	195.418908
85	90	32.92247	184.17980	3.693005	28.430279	163.076132
86	91	28.42648	151.25733	3.449453	24.737274	134.645853
87	92	24.28370	122.83085	3.185689	21.287821	109.908579
88	93	20.50572	98.54715	2.906296	18.102132	88.620758
89	94	17.09929	78.04143	2.616456	15.195836	70.518626
90	95	14.06577	60.94214	2.321911	12.579380	55.322790
91	96	11.40079	46.87637	2.028668	10.257469	42.743410
92	97	9.094058	35.475576	1.742786	8.228801	32.485941
93	98	7.129466	26.381518	1.470096	6.486015	24.257140
94	99	5.485481	19.252052	1.215829	5.015919	17.771125
95	100	4.135860	13.766571	.9843222	3.8000899	12.7552058
96	101	3.050663	9.630711	.7787645	2.8157677	8.9551159
97	102	2.197492	6.580048	.6010237	2.0370032	6.1393482
98	103	1.542871	4.382556	.4515948	1.4359795	4.1023450
99	104	1.053645	2.839685	.3296583	.9843847	2.6663655
100	105	.6982883	1.7860395	.2332637	.6547264	1.6819808
101	106	.4479932	1.0877512	.1595948	.4214627	1.0272544
102	107	.2774717	.6397580	.1052920	.2618679	.6057917
103	108	.1654121	.3622863	.06678391	.15657585	.34392379
104	109	.09459375	.19687416	.04058817	.08979194	.18734794
105	110	.05169841	.10228041	.02354830	.04920377	.09755600
106	111	.02688918	.05058200	.01298750	.02565547	.04835223
107	112	.01324584	.02369282	.00677678	.01266797	.02269676
108	113	.00614599	.01044698	.00332715	.00589119	.01002879
109	114	.00266894	.00430099	.00152989	.00256404	.00413760
110	115	.00107395	.00163205	.00065442	.00103415	.00157356
111	116	.00039334	.00055810	.00025725	.00037973	.00053941
112	117	.00012650	.00016476	.00009054	.00012248	.00015968
113	118	.00003287	.00003826	.00002668	.00003194	.00003720
114	119	.00000539	.00000539	.00000526	.00000526	.00000526

TABLE 11
COMPARISON OF ANNUITY VALUES
IMMEDIATE NONREFUND ANNUITIES, 2½% INTEREST

Age	Proposed 1955 American Annuity Table	Annuity Table for 1949	1937 Standard Annuity Table Set Back 2 Years	Ratio of Value on Proposed 1955 American Annuity Table to Value on Annuity Table for 1949	Ratio of Value on Proposed 1955 American Annuity Table to Value on 1937 Standard Annuity Table Set Back 2 Years
MALES					
15.....	30.403	29.932	29.334	101.6%	103.6%
25.....	27.900	27.317	26.768	102.1	104.2
35.....	24.778	24.057	23.588	103.0	105.0
45.....	21.010	20.112	19.905	104.5	105.6
55.....	16.653	15.837	15.887	105.2	104.8
60.....	14.330	13.676	13.832	104.8	103.6
65.....	12.048	11.496	11.806	104.8	102.0
70.....	9.883	9.351	9.855	105.7	100.3
75.....	7.890	7.323	8.029	107.7	98.3
80.....	6.117	5.492	6.371	111.4	96.0
85.....	4.594	3.923	4.911	117.1	93.5
FEMALES					
15.....	31.453	31.222	30.393	100.7%	103.5%
25.....	29.223	28.890	28.129	101.2	103.9
35.....	26.420	25.988	25.251	101.7	104.6
45.....	22.972	22.433	21.800	102.4	105.4
55.....	18.900	18.215	17.924	103.8	105.4
60.....	16.653	15.882	15.887	104.9	104.8
65.....	14.330	13.455	13.832	106.5	103.6
70.....	12.048	11.010	11.806	109.4	102.0
75.....	9.883	8.642	9.855	114.4	100.3
80.....	7.890	6.459	8.029	122.2	98.3
85.....	6.117	4.560	6.371	134.1	96.0

TABLE 12
COMPARISON OF ANNUITY VALUES
LIFE INCOME SETTLEMENT OPTIONS WITH
10 YEAR CERTAIN PERIOD, 2½% INTEREST
SINGLE LIFE, FIRST PAYMENT IMMEDIATE

Age	Proposed 1955 American Annuity Table	Annuity Table for 1949	1937 Standard Annuity Table Set Back 2 Years	Ratio of Value on Proposed 1955 American Annuity Table to Value on Annuity Table for 1949	Ratio of Value on Proposed 1955 American Annuity Table to Value on 1937 Stand- ard Annuity Table Set Back 2 Years
MALES					
15.....	31.423	30.955	30.383	101.5%	103.4%
25.....	28.930	28.351	27.831	102.0	103.9
35.....	25.840	25.124	24.709	102.8	104.6
45.....	22.154	21.306	21.160	104.0	104.7
55.....	18.012	17.327	17.419	104.0	103.4
60.....	15.927	15.386	15.595	103.5	102.1
65.....	13.993	13.533	13.886	103.4	100.8
70.....	12.311	11.881	12.366	103.6	99.6
75.....	10.958	10.557	11.104	103.8	98.7
80.....	9.986	9.655	10.149	103.4	98.4
85.....	9.389	9.177	9.515	102.3	98.7
FEMALES					
15.....	32.470	32.235	31.442	100.7%	103.3%
25.....	30.247	29.913	29.182	101.1	103.6
35.....	27.462	27.032	26.335	101.6	104.3
45.....	24.067	23.531	22.976	102.3	104.7
55.....	20.121	19.447	19.294	103.5	104.3
60.....	18.012	17.256	17.419	104.4	103.4
65.....	15.927	15.071	15.595	105.7	102.1
70.....	13.993	13.023	13.886	107.4	100.8
75.....	12.311	11.282	12.366	109.1	99.6
80.....	10.958	10.012	11.104	109.4	98.7
85.....	9.986	9.293	10.149	107.5	98.4

chosen as the "anchor point," with yearly adjustment amounts which are to be added to or subtracted from the stated net single premiums to give the values for other years of settlement. For example, if 1965 were taken as the base year, the formula and rate table for the single life option might be given as shown in the following table.

LIFE INCOME WITH INSTALLMENTS CERTAIN

The amount of policy proceeds required to provide monthly installments of \$10 is the amount in Column (i) where settlement is effected during the year 1965; where settlement is effected prior to 1965, it is the amount in Column (i) minus the amount of the Yearly Adjustment multiplied by the difference between 1965 and the year of settlement; where settlement is effected subsequent to 1965, it is the amount in Column (i) plus the amount of the Yearly Adjustment multiplied by the difference between the year of settlement and 1965.

Age of Beneficiary		With Payments Certain for				Installment Refund	
		10 years		20 years			
Male	Female	(i)	Yearly Adjust-ment	(i)	Yearly Adjust-ment	(i)	Yearly Adjust-ment
	10*	\$3,974	\$2.00	\$3,981	\$1.95	\$3,993	\$1.90
	11	3,953	2.05	3,960	2.00	3,972	1.95
	12	3,932	2.10	3,939	2.05	3,951	2.00
	13	3,910	2.15	3,917	2.10	3,930	2.05
	14	3,888	2.20	3,895	2.15	3,908	2.10
10*	15	3,865	2.25	3,872	2.20	3,886	2.15
	16	3,842	2.30	3,849	2.25	3,863	2.20
	17	3,818	2.35	3,825	2.30	3,840	2.25
	18	3,794	2.40	3,801	2.35	3,816	2.30
	19	3,769	2.45	3,776	2.40	3,791	2.35
	20	3,743	2.50	3,751	2.45	3,767	2.40
	21	3,717	2.55	3,725	2.50	3,741	2.45
	22	3,690	2.60	3,699	2.55	3,716	2.50
	23	3,663	2.65	3,672	2.60	3,689	2.55
	24	3,635	2.70	3,644	2.65	3,662	2.60
	25	3,606	2.75	3,616	2.70	3,635	2.65
	26	3,577	2.80	3,587	2.75	3,607	2.70
	27	3,547	2.85	3,558	2.80	3,578	2.75
	28	3,517	2.90	3,528	2.85	3,549	2.80
	29	3,486	2.95	3,497	2.90	3,519	2.85
	30	3,454	3.00	3,466	2.95	3,489	2.90
	31	3,421	3.05	3,434	3.00	3,458	2.95
	32	3,388	3.12	3,401	3.07	3,426	3.00
	33	3,353	3.20	3,368	3.15	3,394	3.05
	34	3,317	3.30	3,333	3.25	3,362	3.10
	35	3,281	3.40	3,298	3.35	3,328	3.15
	36	3,244	3.50	3,262	3.43	3,294	3.22
	37	3,206	3.60	3,226	3.50	3,259	3.30
	38	3,167	3.70	3,190	3.55	3,223	3.40
	39	3,128	3.80	3,153	3.60	3,186	3.50
	40	3,087	3.90	3,116	3.65	3,149	3.58
	41	3,046	4.00	3,078	3.70	3,112	3.65
	42	3,005	4.10	3,040	3.75	3,074	3.70
	43	2,963	4.18	3,001	3.80	3,036	3.75
	44	2,920	4.25	2,962	3.85	2,997	3.80
	45	2,878	4.30	2,922	3.90	2,958	3.85
	46	2,834	4.35	2,881	3.95	2,918	3.90
	47	2,790	4.40	2,841	4.00	2,878	3.95
	48	2,746	4.45	2,800	4.03	2,837	4.00
	49	2,700	4.50	2,759	4.05	2,795	4.05

* 10 years and under.

LIFE INCOME WITH INSTALLMENTS CERTAIN—Continued

The amount of policy proceeds required to provide monthly installments of \$10 is the amount in Column (i) where settlement is effected during the year 1965; where settlement is effected prior to 1965, it is the amount in Column (i) minus the amount of the Yearly Adjustment multiplied by the difference between 1965 and the year of settlement; where settlement is effected subsequent to 1965, it is the amount in Column (i) plus the amount of the Yearly Adjustment multiplied by the difference between the year of settlement and 1965.

Age of Beneficiary		With Payments Certain for				Installment Refund	
		10 years		20 years			
Male	Female	(i)	Yearly Adjust-ment	(i)	Yearly Adjust-ment	(i)	Yearly Adjust-ment
45	50	\$2,654	\$4.55	\$2,719	\$4.05	\$2,754	\$4.10
46	51	2,607	4.60	2,678	4.05	2,711	4.15
47	52	2,559	4.65	2,637	4.05	2,668	4.20
48	53	2,511	4.70	2,597	4.05	2,625	4.25
49	54	2,463	4.75	2,556	4.05	2,581	4.30
50	55	2,414	4.80	2,516	4.03	2,537	4.35
51	56	2,364	4.85	2,477	4.00	2,492	4.40
52	57	2,314	4.90	2,438	3.95	2,446	4.45
53	58	2,263	4.95	2,400	3.88	2,400	4.50
54	59	2,213	4.98	2,363	3.80	2,355	4.55
55	60	2,162	5.00	2,327	3.70	2,309	4.60
56	61	2,112	5.00	2,292	3.60	2,263	4.63
57	62	2,062	5.00	2,257	3.50	2,217	4.65
58	63	2,011	5.00	2,224	3.40	2,170	4.65
59	64	1,961	4.98	2,192	3.30	2,124	4.65
60	65	1,912	4.95	2,162	3.18	2,078	4.65
61	66	1,863	4.90	2,133	3.05	2,031	4.65
62	67	1,815	4.85	2,106	2.90	1,985	4.65
63	68	1,768	4.78	2,081	2.75	1,937	4.65
64	69	1,722	4.70	2,057	2.58	1,891	4.65
65	70	1,678	4.60	2,036	2.40	1,844	4.65
66	71	1,634	4.50	2,017	2.20	1,798	4.65
67	72	1,591	4.40	1,999	2.02	1,752	4.65
68	73	1,550	4.28	1,983	1.85	1,704	4.65
69	74	1,511	4.15	1,968	1.70	1,659	4.65
70	75	1,473	4.00	1,955	1.55	1,614	4.63
71	76	1,437	3.85	1,943	1.40	1,568	4.60
72	77	1,402	3.70	1,933	1.25	1,524	4.55
73	78	1,368	3.55	1,925	1.10	1,480	4.50
74	79	1,337	3.40	1,918	.95	1,436	4.45
75	80†	1,307	3.25	1,913	.80	1,393	4.40
76		1,279	3.08	1,909	.65	1,349	4.35
77		1,253	2.90	1,906	.52	1,308	4.30
78		1,229	2.70	1,903	.40	1,265	4.25
79		1,208	2.50	1,901	.30	1,224	4.20
80†		1,189	2.30	1,900	.20	1,182	4.15

† 80 years and over.

Using the policy table to give, for example, the rate for settlement in 1980 under the 10 year certain life option with a female beneficiary aged 60, the policy proceeds required to provide \$10 a month would be:

$$\$2,162 + \$5.00 (1980 - 1965) = \$2,237 .$$

Similarly, for a female beneficiary aged 40 in 1959, the net single premium would be:

$$\$3,087 - \$3.90 (1965 - 1959) = \$3,063.60 .$$

The values in this table, intended solely for illustration, are based on the Proposed 1955 American Annuity Table and $2\frac{1}{2}\%$ interest, assuming a one-tenth year setback in age per calendar year elapsed from 1955. The average yearly increases in net single premiums between the years 1975 and 2000, after smoothing and minor adjustment to assure consistency, were taken as the yearly adjustments. Net single premiums for 1965 were then found by extrapolation from the premiums for the year 1975, using these smoothed yearly adjustment factors.

The use of 1965 as the base year or anchor point in the table is of no real significance in the system. Normally it would be taken a few years subsequent to current date, so as to avoid the possible misunderstanding that might arise if the basic life option rates in Column (i) were stated for a year prior to the policy issue year.

Because of its built-in adjustment, a graded rate scale based on reasonably conservative mortality and interest assumptions should be expected to apply unchanged for upward of 15 years, or double the average duration of flat rate scales. Since life option settlements tend to concentrate in the ten year period 20 to 30 years following the policy issue date, the rates that are of primary importance in a graded scale currently adopted for use over a 15 year period are those that will apply for settlement effected 20 to 45 years in the future. The adjustment factors to be used in the graded scale should accordingly be based on the average yearly increase between the rates that are estimated to be appropriate for settlements to be made 20 years hence and 45 years hence. Net single premiums for whatever base year has been chosen can then be determined by extrapolation from the 20th year rates, using the assumed yearly adjustment factors.

Some smoothing or correction of the adjustment factors may be necessary to prevent inconsistencies in rates from developing between the various options, particularly at the points where the refund period under the installment refund option approximately equals the payment certain period of the period certain options.

Variations from the straight line projection may be introduced as a transition device to go from a scale of rates based on one mortality table to a scale based on another table, by using two sets of yearly adjustment factors, one set to apply prior to and the other subsequent to the base year. It is questionable, however, whether such added refinement would justify the sacrifice in simplicity.

Other adjustments that have been used with flat rate systems, such as an age set back or forward to distinguish between settlements for particular types of beneficiaries or elections, can be applied with equal facility under this graded rate system.

The only serious complication introduced by the use of graded rates, other than the larger reference tables that would be necessary for field and home office use, is in the retirement income type contracts which provide for a retirement income at maturity of a set percentage such as 1% of the face amount of insurance. With life option rates varying by year of settlement, the retirement income maturity value for a given sex and maturity age not only would vary with age at issue, but also should change each calendar year, *i.e.*, vary with the year of issue.

The variation in maturity value by age at issue obviously poses no problem, particularly where business machines are used to calculate premiums and nonforfeiture values, but changing the maturity values and consequently premiums and nonforfeiture values for each year of issue would be unduly expensive to administer. This can be avoided by continuing the initial year's maturity values unchanged for a period of 4 or 5 years, and deducting the small deficiency in life option net single premium from the final year's dividend.

MORTALITY PROJECTION

The recent decrease in annuitant mortality shown in the 1954 Committee Report⁹ is, as would be expected, fairly consistent with the decrease in the U.S. population mortality for white males and females. As shown in Table 13, there has been a fairly steady improvement for all age groups and both sexes, with average yearly rates of decrease over the period 1940 to 1952 of 1% or more except for the male age groups 55-64 and 65-74.

In light of the comprehensive treatment in Messrs. Jenkins and Lew's paper¹⁰ of the probability and possible extent of the decrease in future mortality according to cause of death, it is of interest to note the source of this improvement in population mortality at the higher ages, as shown

⁹ TSA 1954 Reports, 36.

¹⁰ TSA I, 369.

in Table 14. Decrease in the death rate from cardiovascular-renal disease accounts for roughly 40% of the total reduction, influenza and pneumonia for 25%, and "other causes" for 25%; the cancer death rate has remained relatively stationary.

Although the over-all rate of decrease at these ages is somewhat higher than had previously been experienced, the data by cause of death do not

TABLE 13*
U.S. WHITE POPULATION DEATH RATES† PER 1,000

Year†	Ages 45-54	Ages 55-64	Ages 65-74	Ages 75-84	Ages 85 and over
MALES					
1940.....	11.3	24.7	52.9	119.1	242.4
1941.....	11.2	24.7	52.3	116.9	237.4
1942.....	11.2	24.6	51.7	115.8	236.0
1943.....	11.0	24.6	51.0	114.6	234.0
1944.....	10.9	24.6	50.4	113.6	234.0
1945.....	10.6	24.1	48.8	109.3	227.3
1946.....	10.5	24.1	48.4	107.9	229.2
1947.....	10.4	23.9	48.3	106.9	231.4
1948.....	10.3	23.8	48.4	106.6	228.9
1949.....	10.0	23.4	48.3	105.6	224.4
1950.....	9.9	23.1	48.3	105.2	218.3
1951.....	9.8	23.0	48.3	105.0	211.9
1952.....	9.7	23.0	48.1	105.1	205.8
FEMALES					
1940.....	7.5	16.7	40.6	102.3	225.2
1941.....	7.2	16.1	39.6	99.4	219.6
1942.....	7.1	15.9	38.9	97.9	217.6
1943.....	6.9	15.7	38.3	96.8	217.4
1944.....	6.8	15.4	37.5	95.8	217.2
1945.....	6.5	14.9	36.0	91.9	211.3
1946.....	6.3	14.5	35.1	90.2	211.5
1947.....	6.0	14.1	34.4	88.8	212.1
1948.....	5.8	13.7	33.7	87.4	208.7
1949.....	5.6	13.3	32.9	85.7	202.6
1950.....	5.5	12.9	32.3	84.8	196.4
1951.....	5.4	12.7	31.7	84.3	192.2
1952.....	5.2	12.4	31.2	84.1	189.7

AVERAGE YEARLY RATES OF DECREASE, 1940-52, GEOMETRIC BASIS

Males.....	1.3%	0.6%	0.8%	1.0%	1.4%
Females....	3.0	2.5	2.2	1.6	1.4

* Derived from data given in Bureau of the Census publications.

† Average of annual rates for 3 year period shown for central year of period.

TABLE 14*
DECREASE IN MORTALITY OF U.S. WHITE POPULATION
BY CAUSE OF DEATH—1940 TO 1952
ATTAINED AGES 75 AND OVER

	AGES 75-79			AGES 80-84			AGES 85-89			AGES 90 AND OVER		
	1952 Death Rates per 100,000	Amount of Decrease in Death Rate 1940-1952	Decrease as Percent- age of Total Death Rate	1952 Death Rates per 100,000	Amount of Decrease in Death Rate 1940-1952	Decrease as Percent- age of Total Death Rate	1952 Death Rates per 100,000	Amount of Decrease in Death Rate 1940-1952	Decrease as Percent- age of Total Death Rate	1952 Death Rates per 100,000	Amount of Decrease in Death Rate 1940-1952	Decrease as Percent- age of Total Death Rate
MALE												
Cardiovascular-renal.....	6,063	612	5.9%	9,301	1,277	8.1%	13,103	2,338	10.2%	18,548	2,825	8.5%
Cancer.....	1,299	-22	-0.2	1,582	-109	-0.7	1,777	-178	-0.8	1,578	-84	-0.4
Influenza and Pneumonia..	238	330	3.2	438	583	3.7	723	1,076	4.7	1,360	1,850	5.6
Accidents.....	266	108	1.0	418	231	1.5	665	364	1.6	1,208	381	1.1
Diabetes.....	143	97	0.9	152	85	0.5	165	73	0.3	123	72	0.2
Other causes.....	972	299	2.9	1,330	524	3.3	1,821	1,079	4.7	3,066	2,364	7.1
All causes.....	8,981	1,424	13.7%	13,221	2,591	16.4%	18,254	4,752	20.7%	25,883	7,408	22.3%
FEMALE												
Cardiovascular-renal.....	4,830	828	9.5%	8,070	1,216	8.8%	12,192	1,901	9.0%	19,259	1,009	3.2%
Cancer.....	973	65	0.7	1,145	50	0.4	1,322	32	0.2	1,382	-16	-0.1
Influenza and Pneumonia..	175	323	3.7	351	623	4.5	634	1,052	5.0	1,286	1,803	5.7
Accidents.....	220	189	2.2	455	335	2.4	825	625	3.0	1,603	725	2.3
Diabetes.....	181	144	1.7	197	121	0.9	176	93	0.4	102	27	0.1
Other causes.....	508	270	3.1	748	504	3.6	1,156	1,007	4.8	2,320	2,074	6.6
All causes.....	6,887	1,819	20.9%	10,966	2,849	20.6%	16,305	4,710	22.4%	25,952	5,622	17.8%

* Derived from data given in Bureau of the Census publications.

indicate that the anticipated improvement in mortality that must inevitably result from the extensive medical research on heart disease and cancer has as yet been realized. In the author's opinion, it would be unsound to assume for projection purposes that the future rate of decrease at ages 80 and over would be much less than the rates assumed for ages under 80.

An excellent statement of the rationale in selection of a scale of mortality decrease rates was given by Mr. Wilmer A. Jenkins in 1946:

Equally unproductive would be argument as to whether or not the yearly mortality decrease should be a constant percentage at all ages. At some times in the past, it is true, changes have been far from that, but the very diversity of changes that have occurred suggests that an assumption of a simple percentage change may be as good an assumption as any other reasonable one. The objective of any scheme of projecting mortality rates far into the future is to produce premiums and reserves which, as far as is known, are safe yet not redundant as a whole, and which, as far as is known, are as likely to result in as complete equity at the various ages as would calculations based on any other equally justifiable assumption. Opinions as to the future trends of mortality will naturally differ, but it is quite likely that several opinions will yield actual annuity premiums, reserves, etc., that are much the same.¹¹

Certainly the more recent immediate annuity experience would point to use of a fairly level percentage decrease at all ages.

A device that gives reasonably level rates of decrease under the Proposed 1955 American Annuity Table for ages 40 and above, as shown in Table 15, is a constant setback in age per calendar year. The assumption of 1/10 year age setback per calendar year is roughly comparable in conservatism to the Projection Scale A rates suggested by Messrs. Jenkins and Lew,¹² and the 1/8 year age setback per calendar year corresponds to their Projection Scale B rates. So far as the effect on annuity premiums is concerned, the principal difference between the two sets of tables lies in the rate of decrease assumed at the higher ages; as demonstrated by Messrs. Jenkins and Lew in their paper,¹² the rates of decrease assumed for ages 40 and under are of no real significance.

This approach, originally suggested by Mr. Duncan C. Fraser¹³ in 1924 and further developed by Mr. Jenkins in his 1946 paper,¹⁴ offers a considerable advantage in the convenience of being able to derive values for any age and calendar year from the mortality table for the base year. If the age setback is one-tenth year per calendar year elapsed from the base year, nine additional sets of the elementary functions for the fractional

¹¹ *TASA XLVII*, 265.

¹³ *JIA LV*, 160.

¹² *TSA I*, 369.

¹⁴ *TASA XLVII*, 265.

ages $x + n/10$, $n = 1$ to 9, taken together with the basic table will permit derivation of values for any age and calendar year based on either the "year of issue" or "year of exposure" hypothesis. Similarly, where an age setback of one-eighth year is used, seven additional sets of the elementary functions for fractional ages $x + n/8$, $n = 1$ to 7, are all that would be needed.

TABLE 15
 AVERAGE YEARLY RATES OF DECREASE IN MORTALITY
 (Geometric Basis)

MALE AGE	PROPOSED 1955 AMERICAN ANNUITY TABLE		ANNUITY TABLE FOR 1949	
	One-Tenth Year Age Setback per Calendar Year	One-Eighth Year Age Setback per Calendar Year	Projection Scale A	Projection Scale B
20.....	.35%	.44%	2.8%	1.25%
25.....	.45	.56	2.6	1.25
30.....	.62	.78	2.4	1.25
35.....	.76	.95	2.2	1.25
40.....	.85	1.06	2.0	1.25
45.....	.87	1.08	1.8	1.25
50.....	.83	1.03	1.6	1.25
55.....	.95	1.19	1.4	1.225
60.....	1.09	1.36	1.2	1.20
65.....	.99	1.23	1.0	1.10
70.....	.91	1.14	.8	.95
75.....	.86	1.08	.6	.75
80.....	.82	1.03	.4	.50
85.....	.79	.99	.2	.25
90.....	.76	.94	.0	.0

Nonrefund immediate annuity and life income settlement option values are given on the Proposed 1955 American Annuity Table projected with one-tenth year age setback per calendar year elapsed from 1955, and on the Annuity Table for 1949 with projection according to Scale B, in Tables 16 to 19. Using the apt terminology coined by Mr. Jenkins to distinguish between the two projection bases, the mortality rates on which these values are based are according to the "year of exposure" hypothesis, which is that the mortality rate at a given attained age is a function of and varies with the calendar year of exposure. For comparison, values are also given on the Proposed 1955 American Annuity Table without projection, *i.e.*, on the "year of issue" hypothesis, with mortality rates adjusted for decrease in mortality only up to the year of issue of the annuity.

TABLE 16
COMPARISON OF ANNUITY VALUES
IMMEDIATE NONREFUND ANNUITIES, 2½% INTEREST
1955 YEAR OF ISSUE

AGE	PROPOSED 1955 AMERICAN ANNUITY TABLE WITH PROJECTION*	PROPOSED 1955 AMERICAN ANNUITY TABLE WITHOUT PROJECTION	ANNUITY TABLE FOR 1949 PRO- JECTED ON SCALE B †	RATIO OF VALUE ON PROPOSED 1955 AMERICAN ANNUITY TABLE WITH PROJECTION TO VALUE ON	
				Proposed 1955 American Annuity Table without Projection	Annuity Table for 1949 Pro- jected on Scale B †
MALES					
35.....	25.835	24.778	25.140	104.3%	102.8%
40.....	23.981	22.972	23.185	104.4	103.4
45.....	21.947	21.010	21.057	104.5	104.2
50.....	19.746	18.900	18.829	104.5	104.9
55.....	17.384	16.653	16.550	104.4	105.0
60.....	14.933	14.330	14.250	104.2	104.8
65.....	12.524	12.048	11.944	104.0	104.9
70.....	10.240	9.883	9.641	103.6	106.2
75.....	8.146	7.890	7.491	103.2	108.7
80.....	6.290	6.117	5.574	102.8	112.8
85.....	4.704	4.594	3.947	102.4	119.2
FEMALES					
35.....	27.506	26.420	26.794	104.1%	102.7%
40.....	25.835	24.778	25.072	104.3	103.0
45.....	23.981	22.972	23.151	104.4	103.6
50.....	21.947	21.010	21.057	104.5	104.2
55.....	19.746	18.900	18.798	104.5	105.0
60.....	17.384	16.653	16.358	104.4	106.3
65.....	14.933	14.330	13.832	104.2	108.0
70.....	12.524	12.048	11.274	104.0	111.1
75.....	10.240	9.883	8.798	103.6	116.4
80.....	8.146	7.890	6.537	103.2	126.1
85.....	6.290	6.117	4.583	102.8	137.2

* One-tenth year age setback per calendar year.

† See TSA I, 417.

TABLE 17
 COMPARISON OF ANNUITY VALUES
 LIFE INCOME SETTLEMENT OPTIONS WITH 10 YEAR CERTAIN PERIOD,
 2½% INTEREST
 1955 YEAR OF SETTLEMENT
 SINGLE LIFE, FIRST PAYMENT IMMEDIATE

AGE	PROPOSED 1955 AMERICAN ANNUITY TABLE WITH PRO- JECTION*	PROPOSED 1955 AMERICAN ANNUITY TABLE WITHOUT PROJECTION	ANNUITY TABLE FOR 1949 PROJECTED ON SCALE B †	RATIO OF VALUE ON PROPOSED 1955 AMERICAN ANNUITY TABLE WITH PROJECTION TO VALUE ON	
				Proposed 1955 American Annuity Table with- out Projection	Annuity Table for 1949 Pro- jected on Scale B †
MALES					
35.....	26.895	25.840	26.229	104.1%	102.5%
40.....	25.072	24.067	24.320	104.2	103.1
45.....	23.088	22.154	22.265	104.2	103.7
50.....	20.961	20.121	20.158	104.2	104.0
55.....	18.732	18.012	18.020	104.0	104.0
60.....	16.513	15.927	15.909	103.7	103.8
65.....	14.446	13.993	13.898	103.2	103.9
70.....	12.638	12.311	12.071	102.7	104.7
75.....	11.176	10.958	10.631	102.0	105.1
80.....	10.114	9.986	9.674	101.3	104.5
85.....	9.452	9.389	9.177	100.7	103.0
FEMALES					
35.....	28.546	27.462	27.870	103.9%	102.4%
40.....	26.895	25.840	26.146	104.1	102.9
45.....	25.072	24.067	24.284	104.2	103.2
50.....	23.088	22.154	22.221	104.2	103.9
55.....	20.961	20.121	20.030	104.2	104.6
60.....	18.732	18.012	17.722	104.0	105.7
65.....	16.513	15.927	15.403	103.7	107.2
70.....	14.446	13.993	13.218	103.2	109.2
75.....	12.638	12.311	11.372	102.7	111.1
80.....	11.176	10.958	10.032	102.0	111.4
85.....	10.114	9.986	9.293	101.3	108.8

* One-tenth year age setback per calendar year.

† See TSA I, 417.

TABLE 18
 COMPARISON OF ANNUITY VALUES
 IMMEDIATE NONREFUND ANNUITIES, 2½% INTEREST
 1980 YEAR OF ISSUE

AGE	PROPOSED 1955 AMERICAN ANNUITY TABLE WITH PROJECTION*	PROPOSED 1955 AMERICAN ANNUITY TABLE SET BACK 2½ YEARS WITHOUT PROJECTION	ANNUITY TABLE FOR 1949 PROJECTED ON SCALE B†	RATIO OF VALUE ON PROPOSED 1955 AMERICAN ANNUITY TABLE WITH PROJECTION TO VALUE ON	
				Proposed 1955 American Annuity Table Set Back 2½ Years with- out Projection	Annuity Table for 1949 Projected on Scale B†
MALES					
35.....	26.693	25.621	26.193	104.2%	101.9%
40.....	24.931	23.897	24.306	104.3	102.6
45.....	22.986	22.012	22.222	104.4	103.4
50.....	20.867	19.975	20.000	104.5	104.3
55.....	18.583	17.795	17.684	104.4	105.1
60.....	16.162	15.498	15.285	104.3	105.7
65.....	13.716	13.183	12.812	104.0	107.1
70.....	11.362	10.953	10.341	103.7	109.9
75.....	9.165	8.869	7.978	103.3	114.9
80.....	7.186	6.982	5.843	102.9	123.0
85.....	5.462	5.334	4.041	102.4	135.2
FEMALES					
35.....	28.273	27.181	27.560	104.0%	102.6%
40.....	26.693	25.621	25.873	104.2	103.2
45.....	24.931	23.897	23.993	104.3	103.9
50.....	22.986	22.012	21.914	104.4	104.9
55.....	20.867	19.975	19.636	104.5	106.3
60.....	18.583	17.795	17.168	104.4	108.2
65.....	16.162	15.498	14.552	104.3	111.1
70.....	13.716	13.183	11.868	104.0	115.6
75.....	11.362	10.953	9.230	103.7	123.1
80.....	9.165	8.869	6.781	103.3	135.2
85.....	7.186	6.982	4.669	102.9	153.9

* One-tenth year age setback per calendar year.

† See TSA I, 417.

TABLE 19
 COMPARISON OF ANNUITY VALUES
 LIFE INCOME SETTLEMENT OPTIONS WITH 10 YEAR CERTAIN PERIOD,
 2½% INTEREST
 1980 YEAR OF SETTLEMENT
 SINGLE LIFE, FIRST PAYMENT IMMEDIATE

AGE	PROPOSED 1955 AMERICAN ANNUITY TABLE WITH PROJECTION*	PROPOSED 1955 AMERICAN ANNUITY TABLE SET BACK 2½ YEARS WITHOUT PROJECTION	ANNUITY TABLE FOR 1949 PROJECTED ON SCALE B†	RATIO OF VALUE ON PROPOSED 1955 AMERICAN ANNUITY TABLE WITH PROJECTION TO VALUE ON	
				Proposed 1955 American Annuity Table Set Back 2½ Years with- out Projection	Annuity Table for 1949 Projected on Scale B†
MALES					
35.....	27.742	26.671	26.983	104.0%	102.8%
40.....	26.005	24.973	25.134	104.1	103.5
45.....	24.099	23.129	23.139	104.2	104.1
50.....	22.041	21.153	21.046	104.2	104.7
55.....	19.854	19.074	18.887	104.1	105.1
60.....	17.612	16.962	16.678	103.8	105.6
65.....	15.453	14.939	14.507	103.4	106.5
70.....	13.504	13.121	12.499	102.9	108.0
75.....	11.858	11.595	10.852	102.3	109.3
80.....	10.594	10.430	9.732	101.6	108.9
85.....	9.736	9.649	9.186	100.9	106.0
FEMALES					
35.....	29.307	28.216	28.356	103.9%	103.4%
40.....	27.742	26.671	26.729	104.0	103.8
45.....	26.005	24.973	24.872	104.1	104.6
50.....	24.099	23.129	22.825	104.2	105.6
55.....	22.041	21.153	20.653	104.2	106.7
60.....	19.854	19.074	18.326	104.1	108.3
65.....	17.612	16.962	15.930	103.8	110.6
70.....	15.453	14.939	13.609	103.4	113.5
75.....	13.504	13.121	11.575	102.9	116.7
80.....	11.858	11.595	10.102	102.3	117.4
85.....	10.594	10.430	9.302	101.6	113.9

* One-tenth year age setback per calendar year.

† See TSA I, 417.

JOINT LIFE ANNUITY VALUES

The law of uniform seniority can of course be applied under the Proposed 1955 American Annuity Table for ages 60 and above, where Makeham's formula was used, to give the equal ages to be substituted for two different ages in obtaining joint life annuity values. However, in testing its application where one or both lives were under age 60, it was found that although the errors in value were within acceptable limits, the values were at some points inconsistent. Where the difference in ages was 30 years or more and the younger life was age 35 or under, joint annuity values for the equal ages were in some cases larger than the value of the single life annuity at the older age.

The age adjustments were accordingly modified so as to give consistent values, as given in Table 21 for use with the joint life annuity values in Table 20.

TABLE 20

JOINT LIFE ANNUITIES FOR TWO LIVES AT EQUAL AGES ON THE
 PROPOSED 1955 AMERICAN ANNUITY TABLE AT 2½% INTEREST

AGE <i>x</i>		<i>a_{xx}</i>	AGE <i>x</i>		<i>a_{xx}</i>	AGE <i>x</i>		<i>a_{xx}</i>
Male	Female		Male	Female		Male	Female	
5	10	30.774	40	45	20.016	75	80	5.118
6	11	30.566	41	46	19.595	76	81	4.818
7	12	30.354	42	47	19.170	77	82	4.529
8	13	30.137	43	48	18.739	78	83	4.252
9	14	29.916	44	49	18.304	79	84	3.986
10	15	29.689	45	50	17.864	80	85	3.732
11	16	29.456	46	51	17.420	81	86	3.488
12	17	29.219	47	52	16.972	82	87	3.256
13	18	28.976	48	53	16.520	83	88	3.034
14	19	28.727	49	54	16.064	84	89	2.823
15	20	28.472	50	55	15.605	85	90	2.622
16	21	28.212	51	56	15.141	86	91	2.432
17	22	27.945	52	57	14.675	87	92	2.251
18	23	27.673	53	58	14.205	88	93	2.080
19	24	27.394	54	59	13.732	89	94	1.918
20	25	27.109	55	60	13.258	90	95	1.765
21	26	26.817	56	61	12.784	91	96	1.622
22	27	26.519	57	62	12.311	92	97	1.487
23	28	26.215	58	63	11.840	93	98	1.360
24	29	25.904	59	64	11.374	94	99	1.241
25	30	25.586	60	65	10.914	95	100	1.130
26	31	25.261	61	66	10.461	96	101	1.026
27	32	24.930	62	67	10.016	97	102	.929
28	33	24.591	63	68	9.579	98	103	.839
29	34	24.246	64	69	9.152	99	104	.755
30	35	23.894	65	70	8.733	100	105	.677
31	36	23.535	66	71	8.324	101	106	.605
32	37	23.169	67	72	7.925	102	107	.537
33	38	22.797	68	73	7.536	103	108	.475
34	39	22.418	69	74	7.158	104	109	.418
35	40	22.033	70	75	6.790	105	110	.365
36	41	21.641	71	76	6.433	106	111	.316
37	42	21.244	72	77	6.087	107	112	.271
38	43	20.840	73	78	5.753	108	113	.230
39	44	20.431	74	79	5.430	109	114	.191
						110	115	.153
						111	116	.114
						112	117	.071
						113	118	.028
						114	119	.000

TABLE 21
 AGE ADJUSTMENTS TO GIVE EQUAL AGES
 FOR JOINT LIFE ANNUITIES ON THE
 PROPOSED 1955 AMERICAN ANNUITY TABLE

Years Difference in Age*	Addition to Younger Age in Years	Years Difference in Age*	Addition to Younger Age in Years
1	.510	31	24.300
2	1.043	32	25.262
3	1.597	33	26.224
4	2.171	34	27.186
5	2.765	35	28.148
6	3.379	36	29.110
7	4.013	37	30.071
8	4.667	38	31.032
9	5.341	39	31.993
10	6.034	40	32.954
11	6.747	41	33.915
12	7.480	42	34.876
13	8.232	43	35.837
14	9.003	44	36.798
15	9.793	45	37.760
16	10.602	46	38.722
17	11.429	47	39.684
18	12.273	48	40.646
19	13.133	49	41.608
20	14.008	50	42.570
21	14.897	51	43.532
22	15.799	52	44.494
23	16.713	53	45.456
24	17.638	54	46.418
25	18.572	55	47.380
26	19.514	56	48.342
27	20.463	57	49.304
28	21.418	58	50.266
29	22.377	59	51.228
30	23.338	60	52.190

* For one male and one female, the age of the female is taken as the actual attained age minus 5.

TABLE 22

TEST OF PROPOSED AGE ADJUSTMENTS FOR JOINT LIFE ANNUITIES ON THE
PROPOSED 1955 AMERICAN ANNUITY TABLE AT 2½% INTEREST

YOUNGER LIFE AGE x	OLDER LIFE AGE y	EXACT VALUE a_{xy}	APPROXIMATE VALUE a_{wv}	ERROR	
				Value of $a_{xy} - a_{wv}$	Percentage of a_{xy}
Male or Female 15 20	25 30	26.786	26.807	-.021	-0.1%
	35 40	24.202	24.243	-.041	-0.2
	45 50	20.702	20.702	.000	0.0
	55 60	16.510	16.541	-.031	-0.2
	65 70	11.967	12.043	-.076	-0.6
	75 80	7.856	7.851	.005	0.1
25 30	35 40	23.559	23.522	.037	0.2
	45 50	20.364	20.428	-.064	-0.3
	55 60	16.361	16.366	-.005	-0.0
	65 70	11.908	11.862	.046	0.4
	75 80	7.836	7.703	.133	1.7
	85 90	4.578	4.476	.102	2.2
35 40	45 50	19.570	19.580	-.010	-0.1
	55 60	15.983	16.060	-.077	-0.5
	65 70	11.752	11.682	.070	0.6
	75 80	7.780	7.554	.226	2.9
	85 90	4.561	4.371	.190	4.2
45 50	55 60	15.060	15.125	-.065	-0.4
	65 70	11.349	11.370	-.021	-0.2
	75 80	7.635	7.408	.227	3.0
	85 90	4.514	4.265	.249	5.5
55 60	65 70	10.425	10.445	-.020	-0.2
	75 80	7.264	7.155	.109	1.5
	85 90	4.393	4.162	.231	5.3
65 70	75 80	6.437	6.421	.016	0.2
	85 90	4.070	3.984	.086	2.1
75 80	85 90	3.491	3.480	.011	0.3